



# Trucks to Meet the Future Road Freight Task

*challenges and directions*

**November 2004**

**Industry Issues Paper** prepared by

Truck Industry Council

Commercial Vehicle Industry Association of Q'ld



***"advancing the future of road transport"***

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## PREFACE

Australia is facing a climate of a growing freight task and legislative pressure for tightening of emissions, noise and safety controls on heavy vehicles. As both will escalate over the next five years and into the future, the Commercial Vehicle Industry Association of Queensland (CVIAQ) and the Truck Industry Council (TIC) jointly hosted a seminar at the Star City Hotel, Sydney, to address these vital issues.

The seminar, titled “Trucks to Meet the Future Road Freight Task”, was the first joint project under a new working agreement forged between the CVIAQ and the TIC designed to enhance the capabilities of both organisations and address what is the most significant issue facing suppliers of commercial vehicles today.

The aim of the seminar was to identify the best methods of managing future truck design requirements against a background of many competing issues such as the growing freight task, community needs, environmental and safety performance and industry viability.

Following the seminar, the TIC and CVIAQ drafted this industry issues paper to advise decision makers and the community of the environmental and safety consequences of recent decisions and to try to ensure that future decisions are made for the best interests of all concerned.

The CVIAQ and TIC are committed to ensuring the viability of the transport industry and the introduction of achievable gains in environmental and safety performance. Through this initiative, we aim to deliver the best outcome for all stakeholders.

Brett Wright  
Chief Executive Officer  
CVIAQ

Terry Pennington  
Chief Executive Officer  
TIC

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**Note relating to calculation of truck numbers**

The number of trucks that are estimated in this report are based on a relatively uncomplicated model. The model does not take account of a number of factors that might influence the result. However, it is considered that, if anything, the numbers of trucks quoted are underestimated because of factors such as:

- the average density of freight is decreasing and therefore more trucks will in future be full in volume before they meet legal mass limits, with the result that more trucks will be needed to perform the same tonne kilometres of freight;
- a number of trucks (an unknown number) cannot take advantage of increased size or weight limits for contractual and logistical reasons, meaning these trucks cannot carry additional payload;
- inefficiencies in transport that arise from different State and Territory regulations and access provisions; and
- average annual travel by trucks will not increase at the same rate as in recent history, as congestion grows and engine power plateaus.

The task of creating more complex models to accurately reflect these and other factors was beyond the scope of this issues paper.

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## EXECUTIVE SUMMARY

There are likely to be at least 15,000 more trucks in 5 years time and at least 50,000 more trucks by 2020 on Australian roads.

This position arises from:

- an expected doubling of the road freight task over the next 15 to 20 years;
- compliance with new environmental and road safety initiatives that will come at a cost to transport productivity and efficiency;
- the apparent slowing of the productivity improvements enjoyed over the last 30 years arising from regulatory change; and
- the fact that the reduction in truck numbers arising from the introduction of B-doubles cannot be repeated.

Australia's truck industry can and will meet the new environmental and road safety initiatives that are being introduced over the next few years but not without loss of productivity.

Australia has developed a highly efficient road transport fleet, which has provided significant benefits for the Australian economy and the community. Over the last 30 years, crucial productivity gains have ensured that the growing economy is serviced with a minimum number of trucks, which have also substantially improved environmental and road safety outcomes and reduced truck congestion.

The main productivity improvements have effectively stopped. Unless regulatory initiatives are taken to increase average truck payload, the benefits of the new environmental and road safety initiatives will be severely compromised. The current piecemeal approach to setting national standards has contributed to the position where benefits may be lost.

Improved environmental outcomes mainly arise when newer vehicles are used and any impediments to fleet changeovers will severely disbenefit community interests. Recent environmental and safety initiatives which have not considered truck productivity will encourage older trucks to remain in service. New regulations that do not consider fleet productivity must not be permitted.

Because of increased future freight demand, the environmental and road safety benefits of new requirements could be even greater if a holistic view is taken when determining new requirements for Australian trucks. The present approach considers changes individually and does not account for cumulative productivity losses.

The industry is willing to work cooperatively for the community benefit but that can only happen when administrative systems are in place that take account of all concerns. Greater flexibility in establishing national standards would also assist. For example, introduction of new safety initiatives could begin earlier if it were possible to trade-off requirements or if only some groups of heavy vehicles were required to be fitted. Action needs to be taken now to ensure a holistic approach to future truck regulation and to introduce a more flexible approach to national standards.

In establishing new environmental and safety initiatives, account must be taken of Australia's unique road transport environment, including greater heat, longer distances, higher gross mass but lower axle weights, when adopting overseas safety and emissions standards. Anti-lock brake systems (ABS) for Australia's unique road trains are a perfect example of where overseas standards do not work for particular segments of our road transport industry.

Steer axle masses need to be specifically addressed, as they are lower than those in place in overseas countries and do not account for our unique operating environment.

Estimates by the Bureau of Transport and Regional Economics (BTRE) of future truck numbers assume that past productivity and efficiency improvements will continue and these estimates need to be revised.

Both the Truck Industry Council (TIC) and the Commercial Vehicle Industry Association of Queensland (CVIAQ) are committed to providing safe and environmentally friendly heavy vehicles. Both organisations are also committed to providing a productive and efficient transport fleet that fully supports the Australian economy. It is expected that governments have the same objectives. Therefore, the recommendations that follow are based on what is perceived as being in the best interests of Australia's community, environmental health, road safety, and the Australian economy.

**Recommendation 1.**

That government and industry adopt the following mission statement (or a modified version with similar intent):

*The mission of government and industry is to develop a set of national standards and regulations to achieve a safe, environmentally friendly, but also productive and efficient, heavy vehicle fleet.*

**Recommendation 2.**

That the Department of Transport and Regional Services, in conjunction with key industry organisations, be asked to provide a report by July 2005 on:

- a. regulatory, policy and other barriers that prevent a holistic approach to national standards for new trucks;
- b. regulatory, policy and other barriers that prevent a flexible approach to national standards for new trucks; and
- c. recommended changes to enable a more holistic and flexible approach to the introduction of new road safety and environmental initiatives, together with any other changes that would enable a more focussed and efficient standards setting process.

**Recommendation 3.**

That the Bureau of Transport and Regional Economics, in conjunction with key industry organisations, be asked to provide revised estimates of the likely effects on truck numbers due to the expected increase in the road freight task, taking into account industry advice on the likely average payload and travel distance of articulated trucks.

**Recommendation 4.**

That the National Transport Commission, in conjunction with key industry organisations, be asked to provide a report to the Australian Transport Council no later than September 2005 on:

- a. appropriate strategies to enable the average payload of trucks to continue to increase, taking account of administrative and legal systems for approving access to local roads for high productivity vehicles and regulatory and infrastructure barriers to improving payload;
- b. appropriate strategies to ensure that no future initiatives, including environmental and road safety initiatives, are compromised by loss of truck payload and efficiency; and
- c. an appropriate increase in the legal limits for steer axles, accompanied if necessary by new requirements on tyre width, that account for new and envisaged environmental and road safety initiatives.

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## SECTION 1: INTRODUCTION

It is widely reported that the road freight task will double in the next 15 to 20 years. For example, the Bureau of Transport and Regional Economics predicts that the road freight task would increase by 118% between 2000 and 2020, a yearly increase of about 4%. With an average increase in road freight of more than 5% per annum from 1980 to 2000, such an increase is supported by history.

An increase of this magnitude will have significant effects on the number of trucks on Australian roads, leading to concerns with road safety and noise and gaseous emission levels. For example, in its *Strategic Plan 2004–2007*, Austroads states:

The efficient movement of freight is a critical aspect of a successful national economy. The road freight task is expected to double over the next fifteen years. This will impact on road infrastructure. It will increase congestion and provide a challenge to road safety.

Over the last 20 years, technological advances in truck technology, particularly engine technology, have seen vastly improved community outcomes in terms of noise and emission levels. In the same period, increases in truck *average* speeds have been achieved due to increased power, leading to significant assistance in capping freight rates and thereby leading to lower commodity prices for consumers. These emission and efficiency gains have been achieved with no loss of payload. However, new noise and gaseous emission levels presently regulated by Australian Design Rules (ADRs), together with possible new ADRs being investigated, cannot be achieved without loss of efficiency and payload. This issue is further discussed in Sections 2 and 3.

Another important aspect to be considered is the historical gain in productivity. Productivity improvements, particularly with the introduction of B-doubles, have had a marked damping effect on the number of trucks needed to carry the nation's freight. Present indications are that these productivity improvements are substantially slowing as indicated in Section 2.

Given the increasing road freight task, the twin factors of a greater freight task and reducing productivity have potentially serious consequences. There could be up to an additional 10,000 articulated trucks every 5 years simply because no action is taken to improve truck productivity or a conscious decision made that no action be taken.

This paper presents estimates of possible future truck numbers. It is pointed out that endeavours to address community concerns will be eroded without regulatory changes to improve truck productivity and efficiency.

A holistic approach to new ADRs would highlight the likely effects compared to the present approach of individual consideration of regulatory proposals that ignores the cumulative efficiency losses. A recommendation is made to begin to address this important issue.

The introduction of newer trucks needs to be fostered, not hindered. If it becomes more economic to retain older trucks, improvements in community outcomes are significantly lower because of the poorer outcomes from older technology.

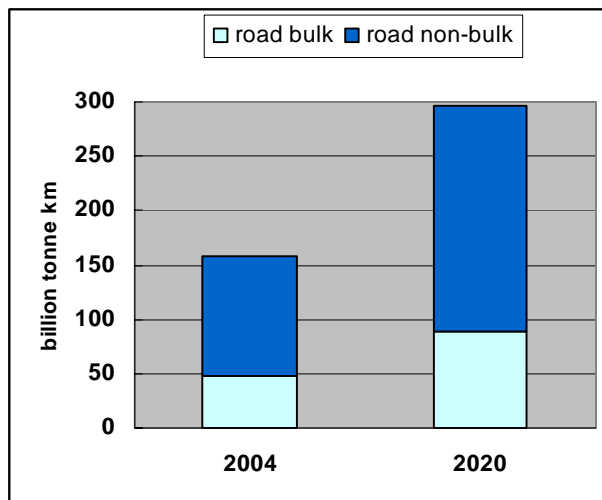
In this paper, the terms “productivity” and “efficiency” are similar but have slightly different meanings. Productivity is an improvement in the payload, either mass or volume. More tonne kilometres are achieved from a given truck with productivity improvements. Efficiency improvements, on the other hand, can arise because of changed operating characteristics, increased engine power leading to higher average truck speeds, or because of technological advances in logistical services. Not all kinds of efficiency improvements will lead to an increase in tonne kilometres of travel for a given truck but the efficiency gains discussed in this paper have that effect.

## SECTION 2: FUTURE CHALLENGES

### 2.1 The future road freight task

The Bureau of Transport and Regional Economics (BTRE) has predicted that the road freight task will more than double by the year 2020. While the “non-bulk” part of the task will have the greatest increase, so too will the “bulk” part of the task increase. Figure 1 illustrates the likely increase.

**Figure 1: Projected road freight task, 2004 –20 (billion tonne km)**



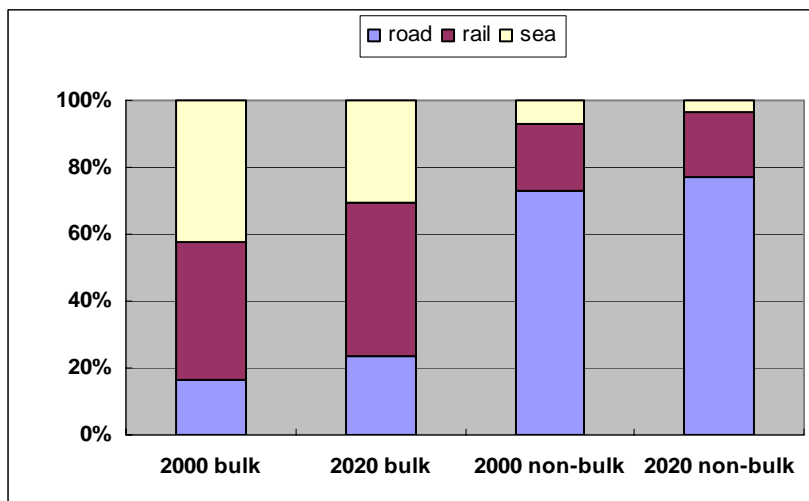
Source: derived from BTRE (2004)

Even though it is predicted that the amount of freight carried by rail will increase, a number of factors limit the likely growth of rail, including:

- the proportion of the total market that is contestable;
- the inter-capital market is less than 30% of the total non-bulk freight task; and
- rail is not suitable for short distance freight, which is by far the largest percentage of the total freight.

BTRE predictions for the modal freight proportions are given in Figure 2.

**Figure 2: Proportions of the freight task by mode**



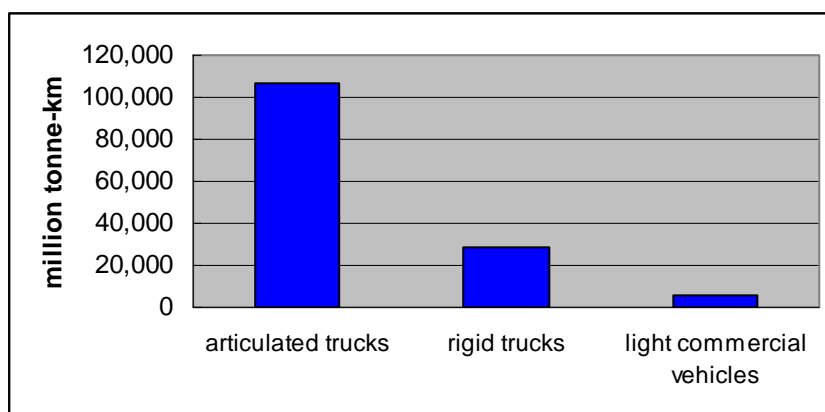
Source: derived from BTRE (2004)

## 2.2 Carrying freight by road

### 2.2.1 Types of trucks carrying freight

The best measure of the freight task is tonne kilometres of travel, which reflects not only the number of tonnes moved but also the distance they are transported. Figure 3 shows that articulated vehicles carry more than 75% of the freight task, while rigid trucks carry 20% and light commercial vehicle carry 4%.

**Figure 3: Tonne kilometres travelled by type of freight vehicle**



Source: ABS (2003)

The high proportion of tonne kilometres undertaken by articulated vehicles is in contrast to the numbers of vehicles. There are more than 1.8 million light commercial vehicles, 340,000 rigid trucks but only 61,000 articulated trucks (ABS 2003).

Only a small proportion of rigid trucks are fully loaded to legal mass limits. According to NRTC (2001), rigid trucks have an average gross mass of 6.5 tonnes (2-axle) and 14.5 tonnes (3-axle), compared to the allowable maximum of 15 tonnes and 22.5 tonnes respectively. In addition, rigid trucks are primarily used in urban areas and therefore travel relatively shorter distances, averaging only 20,000 kilometres per annum. The result is a significantly lower overall tonne kilometres of travel.

On the other hand, articulated trucks are more likely to be fully laden and unable to carry more freight because they are at the legal mass limits. Therefore, the major thrust of this paper relates to articulated trucks. However, the issues outlined apply to a range of rigid trucks and *even though the proportion affected may be less, the total numbers may be similar.*

### 2.2.2 Productivity of articulated trucks

Articulated trucks comprise:

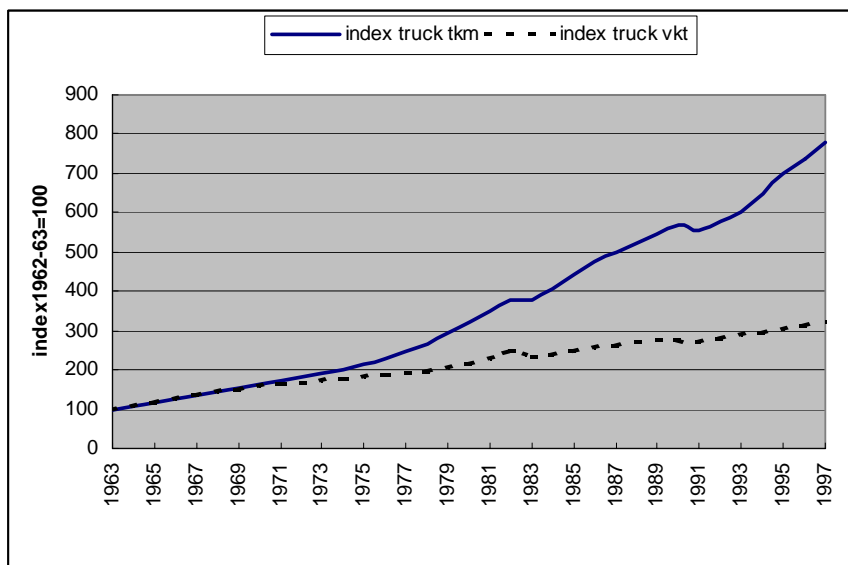
- single articulated vehicles (prime mover and semi-trailer combinations);
- B-doubles; and
- road trains.

Articulated trucks carry over three-quarters of the Australian freight task, as shown in Figure 3. It is therefore vital that the productivity and efficiency of articulated trucks be improved or the number of trucks must increase.

Over the last 30 years, the productivity and efficiency of trucks have improved significantly. As shown by Figure 4, the tonne kilometres of travel by trucks increased nearly 300% between 1974 and 1997 compared to only an 80% increase in vehicle kilometres of travel.

However, between 1991 and 2002, tonne kilometres of travel increased by 70% while vehicle kilometres of travel increased by only 37%, indicating a slowing of improvements in truck productivity and efficiency.

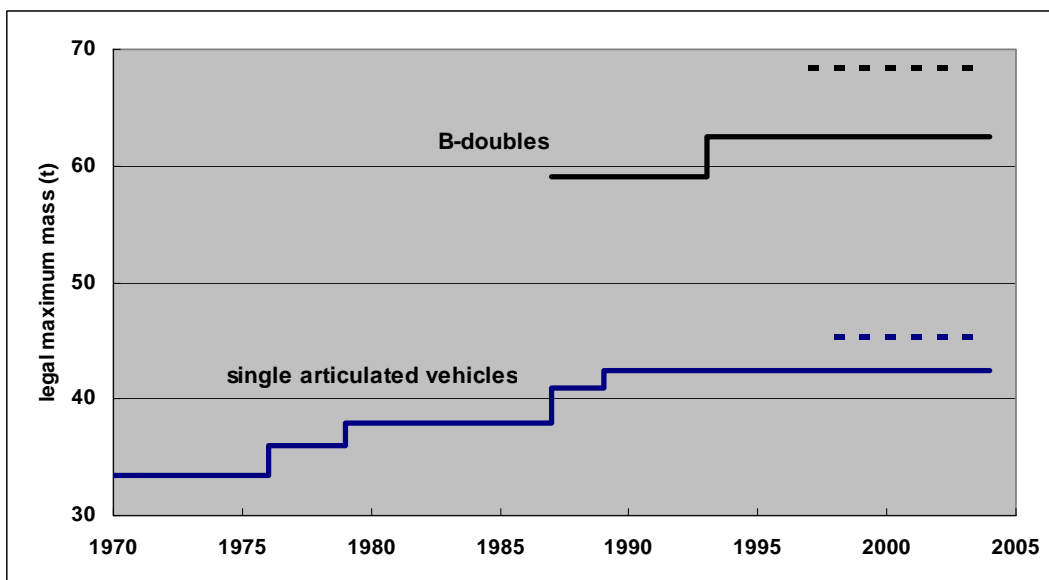
**Figure 4: Growth in tonne kilometres compared to vehicle kilometres of trucks**



Source: BTE 1999

Significant contributors to improved productivity were the increases in allowable mass limits in the 1970s and 1980s and the introduction of B-doubles. Figure 5 illustrates the changes in legal mass limits between 1970 and 2004 for single articulated vehicles and for B-doubles since their initial introduction in the 1980s.

**Figure 5: Changes in legal mass limits for single articulated vehicles and B-doubles**  
(Higher Mass Limits values shown as dashed lines)



Note: Higher Mass Limits refers to increased mass granted to trucks fitted with road friendly suspension systems.

The legal gross mass of single articulated trucks increased nearly 40% between 1976 and 1989 while the present gross mass of B-doubles is nearly double that of articulated trucks in the early 1970s. Productivity improvements gained were substantial.

Significant influences on truck efficiency over that time were:

- increases in allowable truck speed limits;
- improvements in road infrastructure;
- improvements in engine power; and
- improvements in scheduling and logistical services introduced by industry.

Even recently the trend for greater efficiency has continued. The Australian Bureau of Statistics explains this as being influenced by the growth in road trains and B-doubles. However, industry initiatives, including better scheduling of loads and use of new technology, also contributed. Use of lighter materials in manufacturing and other industry improvements have also seen payloads increase. Manufacturers and operators will continue to pursue lower vehicle unladen mass and other efficiencies to improve efficiency.

*However, apart from small gains, opportunities for increased payload are almost exhausted.*

Consider the following facts:

- in the 14-year period from 1976 to 1989, legal general mass limits were increased on 4 occasions but have not risen in the 14 years since (Higher Mass Limits are not increases in general mass limits);
- B-doubles, with significantly increased payload, were introduced during the 1990s, with the spectacular increases in numbers since 1995, but no similar new high productivity configuration is likely in the future;
- the resistance by authorities to providing Higher Mass Limits (HML) in legislation that would allow travel of higher productivity vehicles on all roads;
- the reluctance by authorities in New South Wales to allow 6-axle articulated vehicles to operate above the 42.5 tonne limit introduced in the late 1980s;
- the trend by State road agencies to require truck operators to obtain approval from local authorities for travel of B-doubles and HML vehicles on local roads;
- the general reluctance of local authorities to allow more productive vehicles on local roads, citing lack of compensatory funding for travel by vehicles with greater productivity.

The Performance Based Standards (PBS) initiative, while generally welcomed, will not be a panacea for increasing productivity. It is unlikely that more than 5% of any increase in freight will be taken up by vehicles operating under PBS, even allowing for the most optimistic forecast of acceptance of PBS by States, Territories and local government. Other productivity improvements being considered are expected to cater only for niche markets.

Clearly, increases over the last 30 years in the freight task have been accompanied by an increase in more productive and efficient trucks, leading to a slower growth in truck numbers. Such opportunities are unlikely to be available in the future, and in fact less productive trucks will result from recent new regulatory requirements as outlined in Section 3.

*Without regulatory intervention, the numbers of trucks will rise significantly with consequent implications for road safety and environmental outcomes.*

## **2.3 Trucks and the community**

### **2.3.1 Community perceptions**

Community concerns with trucks are often in the spotlight, including the concerns expressed by residents protesting for truck bans and public affairs television programs targeting speeding trucks. In a recent presentation (VicRoads 2004), the public perception of too many large, intimidating trucks on our roads was highlighted. The presentation also indicated that these trucks produced concerns in the community for road safety and the environment.

Austrroads, in its *Strategic Plan 2004–2007*, made the following observations in a section on emerging issues:

#### **Making transport safer**

Although there have been improvements in road safety and the national number of road fatalities has been trending down, there has been a slowing in the rate of improvement. Further action is required by road authorities in conjunction with other agencies to sustain improvements in road safety.

#### **Increased community concern about road transport and consequent disruption**

Achieving a balance between accessibility and living space expectations will be a challenge. There has been growing community concern about the development of road transport infrastructure, its impact on communities and the environment; the noise of heavy vehicles and vehicles emissions. These need to be addressed. Environmental impacts need to be reduced and/or ameliorated.

These concerns are recognised, with industry actively supporting many road safety and environmental initiatives to reduce truck impacts. The impacts are, in fact, decreasing but the impacts of the future road freight task may simply exacerbate community concern if no action is taken.

### **2.3.2 Road safety**

In August 2004, the Australian Transport Safety Bureau (ATSB) released a report titled *Fatal Road Crashes Involving Articulated Trucks* (ATSB 2004). Much of the material in this section is taken from that report.

Since 1991, the number of fatal crashes involving articulated vehicles has hovered around 150 to 160 per year, despite the increase in vehicle kilometres of travel of about 37% and an increase in tonne kilometres of freight of about 70%. Single vehicle crashes account for about 18% of these crashes.

A crash rate related to population is a measure of the change in the real rate of crashes. An increase in population leads to more cars competing for road space and also an increase in the demand for distribution of freight. The ATSB indicated that, based on the fatal crash rate per 100,000 of population, the crash rate of articulated trucks between 1993 and 2003 had fallen by about 25%. However, fatal crashes of articulated trucks as a proportion of all fatal crashes had increased slightly, by about 1%.

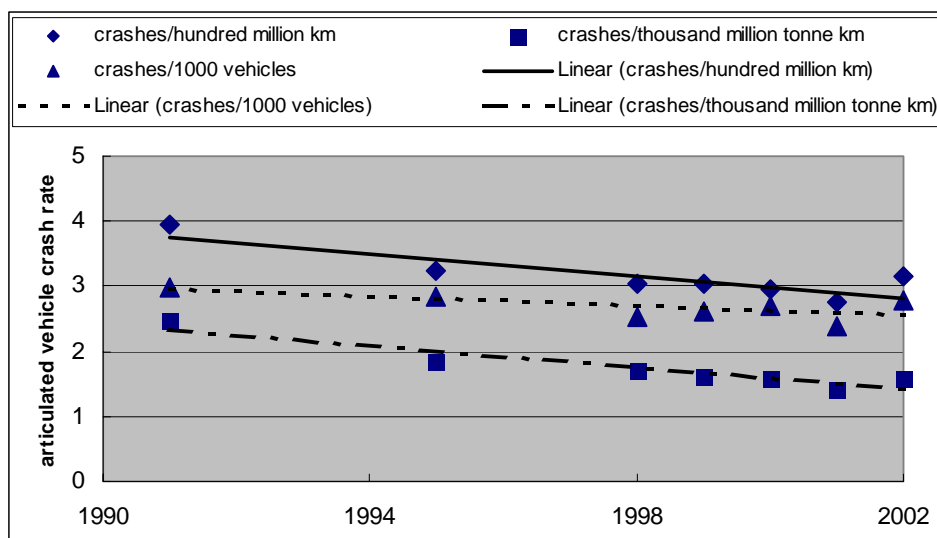
Nearly two-thirds of fatal crashes involving articulated vehicles occurred on roads with a speed limit of 100 kilometres per hour or greater. Over 80% of fatal crashes occurred in New South Wales, Victoria and Queensland.

The ATSB concluded that, over the past decade, there was an overall improved safety record for articulated vehicles. Figure 6 supports these conclusions, comparing three measures of articulated vehicle crash rates, together with trend lines, for:

- fatal crashes per 1000 vehicles;
- fatal crashes per hundred million kilometres; and
- fatal crashes per thousand million tonne kilometres.

From Figure 6, it can be seen that all crash rates are trending downwards but the reduction in the crash rate per 1000 vehicles is less than the other two measures.

**Figure 6: Articulated vehicle fatal crash rates, 1990–2002**



Source: derived from ATSB 2004

It should be noted that the rates for 2002 were influenced by a relatively high incidence of fatal crashes. There were 171 fatal articulated vehicle crashes in 2002, the highest since 1993, whereas there were only 146 in 2001 and 144 in 2003. No travel data for 2003 is yet available but the trend will again be down.

Of importance also is that, of crashes between a car and an articulated truck, the truck driver is only responsible for between 20% and 30% of the crashes whereas the car driver is responsible for the remainder, between 70% and 80% of these crash types.

The wider introduction of B-doubles in the 1990s has also seen a significant contribution to road safety. As shown by Table 1, crashes involving B-doubles are but a fraction of the crashes involving single articulated vehicles. The crash rates are a better measure of relative safety and the crash rates for B-doubles are, on average, between one-quarter and one-sixth of the rates for single articulated vehicles. Facilitation of greater use of B-doubles will obviously improve road safety outcomes.

**Table 1: Comparison of crash statistics for single articulated vehicles and B-doubles (Victoria), 1994–2003**

Year	Fatal		Serious Injury		Other Injury	
	Single artics	B-doubles	Single artics	B-doubles	Single artics	B-doubles
1994	36	0	163	0	236	1
1995	31	0	145	0	246	0
1996	33	0	131	1	274	0
1997	26	0	101	2	300	0
1998	30	0	150	0	278	3
1999	34	0	144	1	316	1
2000	31	1	141	0	276	2
2001	35	0	145	5	247	6
2002	41	0	144	3	230	5
2003	32	1	156	1	229	2
<b>Total</b>	<b>329</b>	<b>2</b>	<b>1420</b>	<b>13</b>	<b>2632</b>	<b>20</b>

Source: Bob Murphy (ISEdit) and VicRoads (2004)

*Implications for road safety of the future freight task include:*

- *that, due to the greater incidence of car drivers being responsible for crashes between cars and articulated trucks, an increase in the numbers of articulated trucks will increase the number of fatal crashes; and*
- *that, if truck productivity does not increase at the same rate as in recent years, the number of crashes involving articulated trucks will rise.*

### **2.3.3 Environmental issues**

The effects of diesel emissions are described in MVEC (2004) and Coffey Geosciences (2003). In summary:

- effects relate to duration of exposure and concentration;
- common ambient air pollutants are associated with a wide range of non-cancer health effects from transient decreases in lung function to increases in mortality;
- effects include acute toxic, chronic health and nuisance effects; and
- different groups of people are more susceptible than others, including people with existing respiratory disease or respiratory infections, asthmatics, the elderly and children.

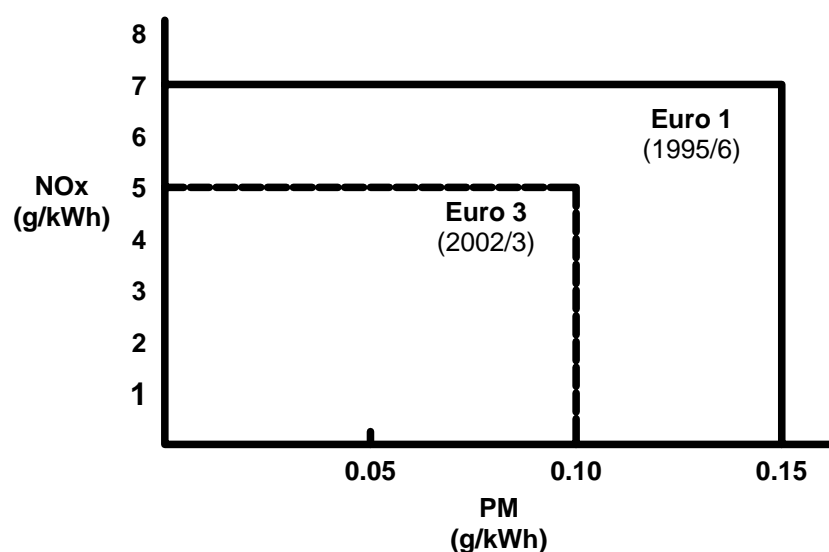
In a presentation by Martin Ericsson (Volvo 2004) it was noted that health and environmental effects of exhaust emissions include creation of acid rain and smog, chronic breathing problems and production of greenhouse gases.

Australian air quality is generally good but there are still significant concerns with ozone concentrations and there is a general aim to reduce motor vehicle emissions relating to oxides of nitrogen (NO<sub>x</sub>), hydrocarbons and particulate matter (PM).

Figure 7 illustrates the reductions in NO<sub>x</sub> and PM that occurred from the 1995/6 ADR standard of Euro 1 to the present Euro 3 standard introduced as ADR 80/00 in 2002/3.

The technology to achieve these improvements was achieved by manufacturers without loss of efficiency, with advances in engine management systems being the major contributor. However, future advances will need new approaches as detailed in Section 3.

**Figure 7: Emissions from previous standard (Euro 1) and present standard (Euro 3)**



In relation to noise emissions, the following points extracted from Close and Apelbaum (2001) illustrate the main community issues relating to road vehicle noise:

- Significant public concerns arising from road traffic noise are not confined to freeway traffic.
- The acceleration and braking of heavy vehicles (particularly the use of engine/exhaust brakes), exhaust noise from motor cycles and the use of horns or sirens are the most frequently cited by the public as major factors contributing to road traffic annoyance.
- The major factors associated with sleep disturbance from road traffic noise are the:
  - ⇒ peak level of noise;
  - ⇒ difference between the peak noise level from intermittent vehicle movements and the background noise;
  - ⇒ number of intermittent noise events during sleeping hours.
- Residents subject to a large number of noise disturbances on an intermittent basis (as compared to continuous background noise) wake up more often with subsequent impairment to their daily activities, deterioration in mood, depression, headaches, anxiety and reduction in work productivity.
- In Europe, the lowering of vehicle noise regulation limits has not significantly reduced actual traffic noise, particularly for traffic at constant speed. This may be largely due to the increase in the number of vehicles, the influence of noise arising from the road/tyre interface and the lack of in-service enforcement.

The last point is very relevant, particularly as Australia is adopting European vehicle noise regulation limits.

Historic ADR noise limits for heavy trucks are shown in Table 2. Again manufacturers accommodated the improvements that took place without efficiency losses.

**Table 2: Historic ADR noise limits for heavy trucks (dB)**

Engine power (kW)	1970s	1980s	1990s
≥150 < 270	92	89	84
≥ 270	92	89	87

Source: Close and Apelbaum (2001)

*Implications for the environment of the future freight task include that if truck productivity does not increase at the same rate as in recent years, the number of trucks will rise, with serious impacts on environmental outcomes. In addition, any disincentive to purchase new vehicles will exacerbate existing environmental problems.*

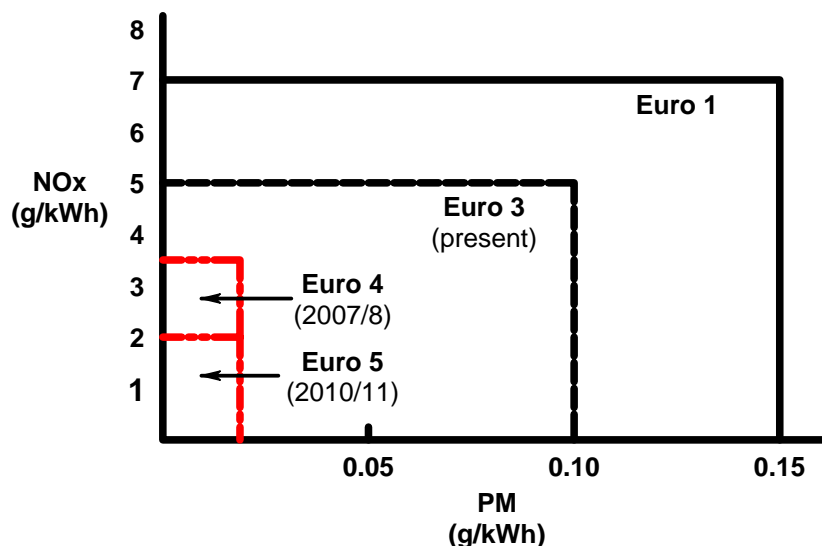
## SECTION 3: ENVIRONMENTAL AND ROAD SAFETY INITIATIVES AFFECTING NEW VEHICLES

In this section, the recently regulated initiatives affecting the environment and road safety are discussed, together with other proposals being examined at this time.

### 3.1 Gaseous emissions

Significant reductions in gaseous emissions from new motor vehicles have been achieved over the last decade. Despite these reductions, there are still concerns about oxides of nitrogen (NOx), hydrocarbons and particulate matter (PM). With the introduction of ADR 80/01 from 2007 requiring Euro 4 (or US 2004 as an equivalent), significant reductions will again occur. Present proposals would see the introduction of Euro 5 in 2010/2011 (LTEC 2004). Emissions reductions are shown by Figure 8. In general, truck manufacturers support these proposals as being a significant environment improvement for the whole community.

**Figure 8: Reductions in gaseous emissions with various Euro emission standards**



The reductions in emissions are being achieved in the main by one of two types of technology:

- Engine Gas Re-circulation (EGR), an internal means; and
- Selective Catalytic Reduction (SCR), an after-treatment.

With EGR, cooled exhaust gas is mixed with intake air, which means that additional cooling capacity is needed. Engine combustion peak temperature is reduced and therefore more particulates are produced which must be removed. Fuel economy is adversely affected.

With SCR, firing pressure is increased, leading to less particulates but higher NOx emissions. The NOx is treated with urea (ad-blue, an ammonia compound), resulting in the production of nitrogen and water. The requirement for ad-blue and associated equipment increases tare mass and reduces fuel capacity by about 5%. Overall, the penalty is likely to be between 200 kgs and 250 kgs of payload.

EGR is likely to be feasible for Euro 4 engines but SCR technology is more likely to be suitable for Euro 5. Despite the significant mass and dimension penalties, the only vehicle costs that were considered in the *Draft Regulatory Impact Statement* (MVEC 2004) were technology costs.

The *Draft Regulatory Impact Statement* (MVEC 2004) and the above discussion did not make reference to US emission standards. US standards are more stringent than Euro standards and the regulatory system is different. It appears likely that American engine manufacturers may develop alternative technologies but the principles discussed above remain the same.

*It must be remembered that reductions in gaseous emissions only come with new trucks. A challenge is to ensure that there are no disincentives to replacing existing vehicles with new vehicles.*

### 3.2 Heavy vehicle noise

Traffic noise is a significant community issue but “*there is little empirical data to support an accurate assessment of the proportion of Australian residences exposed to excessive traffic noise levels*” (Close and Apelbaum 2001). Vehicle noise is also very location specific, particularly with Australia’s urbanised living patterns.

Reducing the noise emissions from new motor vehicles is one of a number of strategies that aim to reduce noise, with other strategies including roadside noise barriers and better road surfaces. The noise limits to be introduced in ADR 83 with effect from January 2006 impose significant reductions from an historical context, as shown by Table 3.

**Table 3: ADR noise limits for heavy trucks (dB)**

Engine power (kW)	1970s	1980s	1990s	new from 2006
≥150 < 270	92	89	84	80
≥ 270 ≤ 320	92	89	87	80
>320	92	89	87	83

Source: derived from Close and Apelbaum (2001)

Apart from high-powered trucks, the maximum noise levels derive from the limits in the United Nations Economic Commission for Europe (UNECE) regulations. The 3 dB concession for vehicles with engine power greater than 320 kW (basically B-doubles and road trains) arises from recognition that Australia has a unique environment of heat, high gross mass and long distances for these vehicle types.

Noise limits are based on a logarithmic scale, with noise at 90 dB being perceived as twice as loud as noise at 80 dB. Therefore, a reduction from the present limit of 87 dB to 80 dB represents an approximate 60% reduction for trucks with engine power of 270 kW to 320 kW, a very significant reduction to achieve. The 4 dB reduction for the other trucks is approximately 30%.

The only practical means to comply with new ADR 83 noise limits is to encapsulate the engine in sound resistant material. This solution has a number of implications, including ventilation difficulties, leading to the generation of increased heat and subsequent cooling problems. It is possible that engine power may need to be de-rated. Larger engine bays will be required. Tare mass will be added, reducing payload by between 50 kgs and 100 kgs.

However, the only costs that were considered in the *Regulatory Impact Statement* (NRTC & Aloss 2002) were:

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

*No costs were attributed to loss of payload, efficiency or the potential impacts on the vehicle fleet.*

### 3.3 Road safety

The major safety initiatives being investigated for heavy vehicles are:

- cabin strength;
- heavy vehicle safety strategy underrun barriers (otherwise known as front underrun protection systems – FUPS);
- three point integrated seatbelts; and
- ABS brakes.

FUPS is an energy absorbing system fitted to the front of trucks. It was mandated in Europe in August 2003.

While the mass penalty of each individual initiative may not in itself be very large, as a cumulative effect the mass implications are significant, as shown in Table 4.

**Table 4: Mass penalties for various safety initiatives**

<b>Initiative</b>	<b>Mass penalty (kgs)</b>
Cabin strength	150 – 200
Heavy vehicle safety strategy underrun barriers (front underrun)	120 – 180
Three point integrated seatbelts for heavy vehicles	50 – 70
ABS brakes for heavy vehicles	20 – 40
<b>Total</b>	<b>say 400</b>

In addition, the fitment of FUPS will almost certainly require a longer front overhang of cab-over prime movers, which has significant implications for the length of B-doubles as described in NTC (2004).

The estimates above do not include loss of payload due to side and rear underrun barriers on trailers, which would reduce payload even further, perhaps by as much as 200 kgs for a single trailer and 400 kgs for a B-double.

Another possible mass penalty would arise if driving hours regulations were to require greater use of two-up drivers. A penalty of more than 100 kgs (driver and personal equipment) would be incurred.

### 3.4 Comparison of European and Australian trucks

ADRs 80 and 83, together with FUPS, all represent the adoption of European requirements. However, there are vast differences between European and Australian trucks.

As shown in Figure 3, the vast majority of Australian freight is carried on articulated trucks, principally:

- 6-axle articulated vehicles to 42.5 tonnes;
- B-doubles to 62.5 tonnes; and
- road trains in excess of 115 tonnes.

In contrast, European Directive 96/53/EC does not permit a vehicle to exceed 40 tonnes unless carrying a 40 ft ISO container, when 44 tonnes is permitted. Of equal significance are the allowable loads on individual axles as outlined in Table 5.

**Table 5: Mass limits for trucks – steer and drive axles**

<b>Axle mass limit</b>	<b>Europe</b>	<b>Australia</b>	<b>Difference</b>
Steer axle	no specific maximum	6.0 tonnes	significant
Single axle (dual tyres): driven axle	11.5 tonnes	9.0 tonnes	-2.5 tonnes
Tandem axle (dual tyres): driven axle	19.0 tonnes	17.0 tonnes	-2.0 tonnes

Note 1: European limits apply if the suspension is “equivalent to air”. Australian tandem limit applies to an axle group fitted with a road friendly suspension system.

As a consequence, European prime movers are generally 2 axles while all Australian heavy-duty prime movers have 3 axles.

European travel conditions are characterised by colder climates, shorter distances and lower gross vehicle mass than comparable Australian conditions. Yet European requirements are being imposed on the Australian new vehicle fleet without compensatory considerations, apart from some noise concessions in ADR 83. The effects are significant for the future freight task in terms of lost productivity.

Emission standards in the US are an alternative in ADR 80 but US trucks do not have a limit on the length of the prime mover or a steer axle limit of 6 tonnes. The maximum mass of US trucks is generally less than 40 tonnes.

*Overall, Australian trucks operate in a unique climate of heat, long distances and high gross vehicle mass.*

## SECTION 4: IMPLICATIONS OF RECENT AND POSSIBLE INITIATIVES

### 4.1 Possible mass penalties

Table 6 shows the possible mass penalties arising from recent and possible environmental and safety initiatives.

**Table 6: Mass penalties arising from recent and possible initiatives**

Initiative	Mass penalty (kgs)
Gaseous emissions	200 – 250
Heavy vehicle noise	50 – 100
Road safety	say 400
Total	650 – 750

Including a mass allowance for side and rear underrun barriers on trailers, such mass penalties are of the order of 3.8% of present payload of a single articulated vehicle and about 3.0% of the payload of a B-double. Without any additional increase in the future freight task, the number of trucks would have to increase by the percentage loss of payload, leading to about 600 additional 6-axle articulated vehicles and possibly more than 175 additional B-doubles by 2007 when all requirements are implemented. Additional transport costs would be in the order of \$200 million to \$250 million every year.

Of particular importance is that most of the mass penalty is taken on the steer axle. With a mean B-double steer axle mass already of 5.62 tonnes (Table 7), a B-double would not be viable for many applications in the future and the steer axle mass of all other major truck configurations is under significant pressure.

**Table 7: Mean steer axle mass of prime movers**

Configuration	Mean mass (tonnes)
Single articulated vehicle	5.27
B-double	5.62
Double road train	5.21
Triple road train	5.32

Source: NRTC (2001)

### 4.2 Other implications for B-doubles

Australia's B-doubles operate at higher temperatures over longer distances and at higher gross mass than their European or North American equivalents.

Because of dimensional limitations, B-double prime movers are virtually all cab-over engine trucks. As a consequence of the encapsulation of the engine arising from compliance with ADR 83, together with the consequences of some of the emissions technology required to meet ADR 80, cooling of cab-over trucks with high horsepower will be a major issue. Engine power will be reduced, leading to longer trip times and higher costs. Some industry experts consider that the new requirements could even threaten the viability of some B-double applications.

The additional dimensions that are required for the front underrun protection systems would be virtually impossible to add to many B-doubles without a 6% loss of productivity, which would require a possible additional 200 B-doubles, without any increased numbers due to other regulatory incentives.

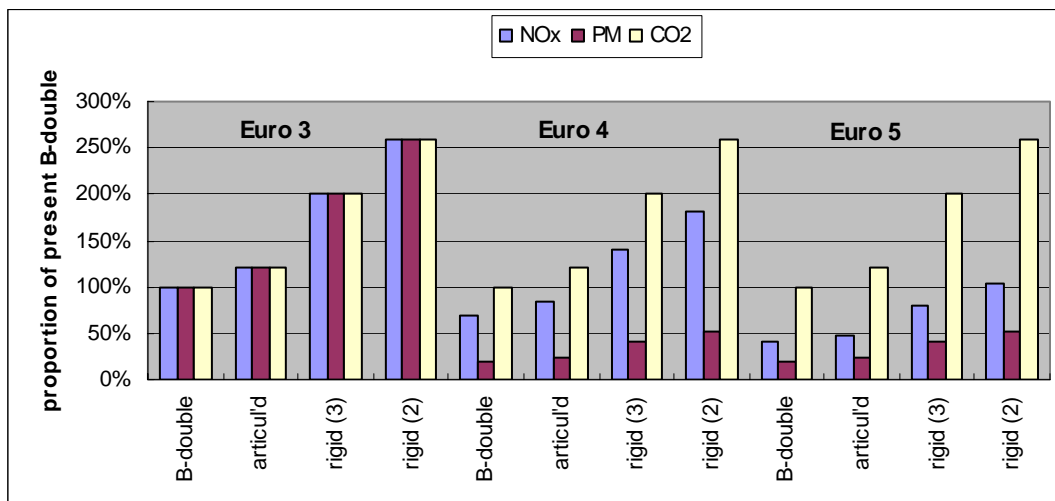
### 4.3 Disincentive to purchase of new trucks

Any replacement truck that has a lower payload than an existing truck will be at a distinct disadvantage in a commercial environment. It is likely that vehicle replacement programs will be cut back with obvious environmental and road safety implications for the success of the new initiatives. Exacerbating the loss of new emissions advances, older trucks will produce even more gaseous emissions and noise as engines deteriorate.

Figure 9 illustrates the emissions outcomes as a percentage of the gaseous emissions arising from present B-doubles for a given freight task. The main points to note about this figure include:

- any disincentive to purchase new trucks will not produce the expected environmental improvements;
- environmental outcomes are significantly better if greater use of B-doubles is facilitated; and
- CO<sub>2</sub> emissions do not reduce with the introduction of Euro 4 or Euro 5 engines and therefore CO<sub>2</sub> emissions can only be reduced by reducing the actual vehicle kilometres of travel, achieved by facilitating greater payload on trucks and certainly not by effectively reducing payload.

**Figure 9: Comparison of emissions output of a B-double to other vehicle types for a given freight task**



Note: rigid (2) means a 2-axle rigid truck; rigid (3) means a 3-axle rigid truck

## SECTION 5: IMPLICATIONS OF THE INCREASE IN THE FUTURE ROAD FREIGHT TASK

### 5.1 Introduction

The basic measure of the road freight task is tonne kilometres of travel but this measure does not give an indication of the number of trucks, the mass, or the distance travelled. For example, take a freight task of transporting 10,000 tonnes over a distance of 100 kilometres, which is 1 million tonne kilometres of freight. This task could be undertaken by 2,000 trucks each carrying 5 tonnes or it could be undertaken by 500 trucks each carrying 20 tonnes. As shown by Table 8, the total truck kilometres of travel are very different. Truck kilometres of travel are directly related to payload, which is in turn directly related to the regulatory mass limits and the vehicle configuration (B-double etc.). Truck kilometres of travel directly affects diesel emissions and road safety.

**Table 8: Examples of the effects of payload on vehicle kilometres of travel for the same freight task**

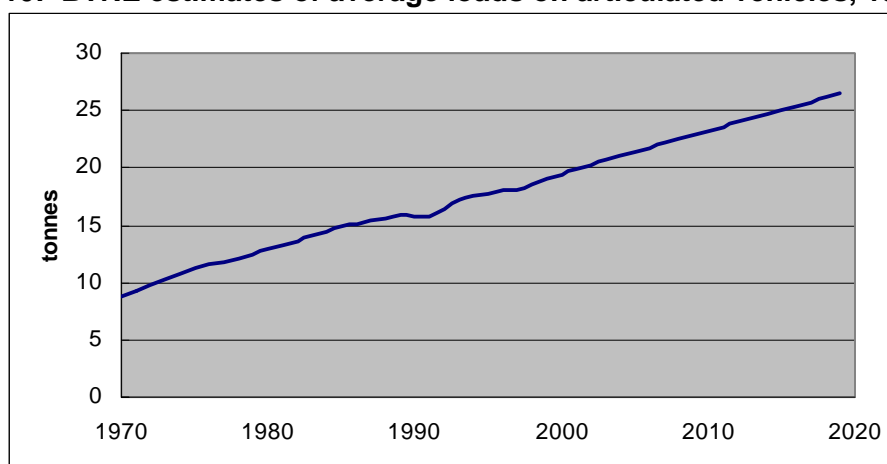
	Case 1	Case 2	Case 3
Total freight	10,000 tonnes	10,000 tonnes	10,000 tonnes
Distance to be travelled	100 kms	100 kms	100 kms
Total freight task	1,000,000 tonne kms	1,000,000 tonne kms	1,000,000 tonne kms
Load per truck	5 tonnes	20 tonnes	20 tonnes
Number of trucks required	2,000	500	two trips for 250
Total truck travel (vkt)	200,000 kms	50,000 kms	50,000 kms

### 5.2 BTRE estimates of future truck numbers

The Bureau of Transport and Regional Economics (BTRE) has forecast that there will 86,700 articulated vehicles in 18 years time, an increase of 34% on the total number today (BTRE 2004). Included in the total number of articulated vehicles was an increase of 10,000 B-doubles.

However, these estimates are based on significant increases in payload and travel by individual vehicles and the B-double numbers assume that access difficulties (such as access to local roads) are overcome. For example, BTRE used estimates suggesting that the increases in average payload over the last 30 years would continue (Figure 10). For the reasons outlined in Section 2.2.2, such an increase is extremely unlikely under present conditions. The influence of the mass limit increases and the introduction of B-doubles, as shown in Figure 5, are both significant contributors to historic increases in average payloads.

**Figure 10: BTRE estimates of average loads on articulated vehicles, 1970–2020**



Source: BTRE 2004

Similarly, the increase in average annual travel by trucks was expected to rise at a rate similar to increases in the last 20 years. This increase does not account for the fact that technological advances in engine power have slowed. As a result, average travel speed has probably reached a plateau and average annual travel is unlikely to increase at the same rate as in previous years.

### 5.3 More realistic estimates of future truck numbers

The very optimistic BTRE assumptions mean that the number of future trucks forecast by BTRE is underestimated. There could be nearly 110,000 articulated trucks in the 18-year time frame adopted by BTRE in the worst case scenario *if no regulatory action is taken on payload and access*. This estimate takes account of the loss of payload due to recent and forecast environmental and safety initiatives, the clear message that significant mass limit increases are unlikely, and the difficulties of achieving extended access for high productivity vehicles such as B-doubles and articulated vehicles carrying Higher Mass Limits.

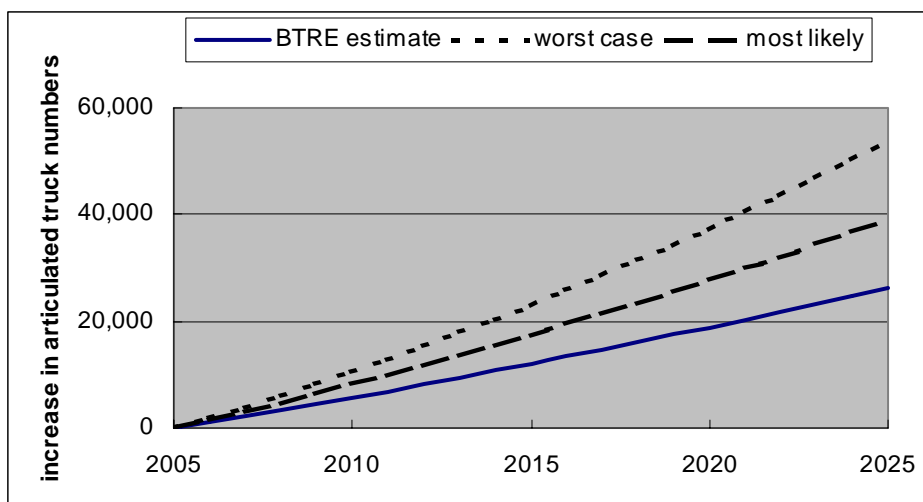
About 2,000 of these trucks will be needed simply because of the loss of payload due to recent and forecast environmental and safety initiatives. In other words, in the absence of regulatory initiatives to increase average payloads, a doubling of the freight task will bring about more than double truck numbers. As outlined earlier, Performance Based Standards are not the panacea for reducing truck numbers.

The “most likely” scenario will be somewhere between the BTRE estimates and the “worst case” scenario as there should be some efficiency improvements during the period. Likely improvements introduced by industry include lower tare mass with the use of lighter materials, use of Intelligent Transport Systems (ITS) which will lead to better vehicle scheduling and some extensions in routes and areas available for high productivity vehicles. The introduction of Performance Based Standards (PBS) will also assist. However, the productivity gains from these improvements are but a fraction of what has been made available in the past due to increases in legal mass limits and the introduction of B-doubles.

Figure 11 illustrates the increase in truck numbers under the two scenarios of “most likely” and “worst case”, together with the BTRE estimates.

Given these scenarios, the truck numbers in 20 years will be at least 16% higher (“most likely” scenario) and possibly up to 30% higher (“worst case” scenario) than forecast by BTRE *and increasing rapidly*.

**Figure 11: Likely increase in articulated truck numbers, 2005–25**



Most of the increases will occur in the Eastern States, which have the highest number of trucks already. Estimated increases by certain intermediate years are shown in Table 9. The first two years shown, 2007 and 2010, coincide with the proposed introduction of Euro 4 and Euro 5 respectively.

**Table 9: Estimated increase in numbers of articulated trucks, 2007–20**

year	NSW	Vic	Qld	remainder of Australia	Total
<i>“worst case” estimates</i>					
2007	1,500	700	800	800	3,800
2010	3,700	2,000	2,200	2,600	10,500
2015	8,000	4,400	4,800	5,700	22,900
2020	12,500	7,000	7,800	10,000	37,300
<i>“most likely” estimates</i>					
2007	1,200	500	600	600	2,900
2010	2,900	1,500	1,700	1,900	8,000
2015	6,000	3,300	3,600	4,400	17,300
2020	9,500	5,000	6,000	7,200	27,700

Note: based on area of operation

As noted in Section 2.2, this paper has concentrated on articulated trucks, but there are likely to be the same number of additional rigid trucks under each scenario. The numbers of trucks in Table 9 should therefore be doubled to provide an estimate of the total numbers of trucks under each scenario. Therefore, there are likely to be at least 15,000 additional trucks in 5 years time and at least 50,000 additional trucks by 2020 if decisions are made that no productivity improvements will be granted.

#### 5.4 Implications for environmental and road safety initiatives

The *Draft Regulatory Impact Statement for Vehicle Emission and Fuel Quality Standards post 2006* (MVEC 2004) used estimates of emissions presented in the cost benefit analysis of Coffey Geosciences (2003). The estimates of total truck travel in the cost benefit analysis were sourced from the BTRE and are based on truck numbers and average annual travel.

It is likely that BTRE made the same assumptions on payload increases that have been shown to substantially underestimate truck numbers. Consequently, there must be questions relating to the efficacy of the projected emissions savings and the cost benefit analysis in MVEC (2004).

According to the *Draft Regulatory Impact Statement* (MVEC 2004), articulated trucks are significant contributors to NO<sub>x</sub> and PM, which are in turn directly related to vehicle travel. Similarly, CO<sub>2</sub> emissions are directly related to vehicle travel.

Even if the estimated increases in truck average annual travel are correct, the number of trucks contributing emissions are almost certainly too low. As a result, emissions projections will be too low by at least 20% in the forecast period, and getting higher all the time.

Similarly, road safety is directly related to the total number of trucks, the total travel by trucks, and to the types of trucks, with B-doubles showing superior safety and contributing to less travel because of higher payloads. Any action, or lack of action, that inhibits change from single articulated vehicles to B-doubles, or contributes to the B-doubles becoming unviable, will certainly lead to lesser road safety outcomes.

## SECTION 6: RECOMMENDATIONS

Australia's truck industry can and will meet recent environmental and road safety initiatives. The industry will most probably be able to meet any future challenges thrown up by these vital issues to further address community concerns. However, compliance with new requirements will come at a cost to transport productivity and efficiency, with resultant erosion of community benefits over time.

Australia has developed a highly efficient road transport fleet, which has provided significant benefits for the Australian economy and the community. Over the last 30 years, crucial productivity gains have ensured that the growing economy is serviced with a minimum number of trucks, which have also substantially improved environmental and road safety outcomes and reduced truck congestion.

Productivity improvements allowed by regulation have substantially slowed. Unless regulatory initiatives are taken to increase average truck payload, the benefits of recent environmental and road safety initiatives will be severely compromised.

Improved outcomes also arise when newer vehicles are used and any impediments to fleet changeovers will severely disbenefit community interests. New regulations that unduly hinder fleet efficiency, or which do not consider fleet efficiency, must not be permitted.

Because of increased future freight demand, the environmental and road safety benefits of new requirements could be even greater if a holistic view is taken when determining new requirements for Australian trucks. The present approach considers changes individually and does not account for cumulative productivity losses.

The industry is willing to work cooperatively for the community benefit but that can only happen when administrative systems are in place that take account of all concerns with all issues. Greater flexibility in establishing national standards would also assist. For example, introduction of new safety initiatives could begin earlier if it were possible to trade-off requirements or if only some groups of heavy vehicles were required to be fitted.

The piecemeal approach to setting national standards that have imposed recent initiatives without consideration of the overall impacts on trucks and the freight task needs to be improved. Action needs to be taken now to ensure a holistic approach to future truck regulation and to introduce a more flexible approach to national standards.

In establishing new environmental and safety initiatives, account must be taken of Australia's unique road transport environment, including greater heat, longer distances and higher gross vehicle mass, but lower axle weights, when adopting overseas safety and emissions standards. Anti-lock brake systems (ABS) for Australia's unique road trains are a perfect example of where overseas standards do not work for particular segments of our road transport industry.

Other regulations must also reflect our unique environment. Take our B-doubles that are among the safest and most efficient trucks in the world. Present length regulations must be changed for all the reasons given by the National Transport Commission in their *Draft Regulatory Impact Statement* on the length limits for B-doubles.

Steer axle masses need to be specifically addressed, as they are lower than in place in overseas countries and do not account for our unique operating environment.

Both TIC and CVIAQ are committed to providing safe and environmentally friendly heavy vehicles. Both organisations are also committed to providing a productive and efficient transport fleet that fully supports our economy. It is expected that governments have the same objectives. Therefore, the recommendations that follow are based on what is perceived as being in the best interests of Australia's community, environmental health and road safety.

**Recommendation 1.**

That government and industry adopt the following mission statement (or a modified version with similar intent):

*The mission of government and industry is to develop a set of national standards and regulations to achieve a safe, environmentally friendly, but also productive and efficient, heavy vehicle fleet.*

**Recommendation 2.**

That the Department of Transport and Regional Services, in conjunction with key industry organisations, be asked to provide a report by July 2005 on:

- a. regulatory, policy and other barriers that prevent a holistic approach to national standards for new trucks;
- b. regulatory, policy and other barriers that prevent a flexible approach to national standards for new trucks; and
- c. recommended changes to enable a more holistic and flexible approach to the introduction of new road safety and environmental initiatives, together with any other changes that would enable a more focussed and efficient standards setting process.

**Recommendation 3.**

That the Bureau of Transport and Regional Economics, in conjunction with key industry organisations, be asked to provide revised estimates of the likely effects on truck numbers due to the expected increase in the road freight task, taking into account industry advice on the likely average payload and travel distance of articulated trucks.

**Recommendation 4.**

That the National Transport Commission, in conjunction with key industry organisations, be asked to provide a report to the Australian Transport Council no later than September 2005 on:

- a. appropriate strategies to enable the average payload of trucks to continue to increase, taking account of administrative and legal systems for approving access to local roads for high productivity vehicles and regulatory and infrastructure barriers to improving payload;
- b. appropriate strategies to ensure that no future initiatives, including environmental and road safety initiatives, are compromised by loss of truck payload and efficiency; and
- c. an appropriate increase in the legal limits for steer axles, accompanied if necessary by new requirements on tyre width, that account for new and envisaged environmental and road safety initiatives.

The recommendations above are based on the following key factors:

- opportunities for increased substantial improvements in productivity and efficiency are almost exhausted;
- without regulatory intervention to increase truck productivity and efficiency, the numbers of vehicles are likely to rise significantly with consequent implications for road safety and environmental outcomes, both probably being at least 20% higher than expected;
- any disincentive to purchase new vehicles will exacerbate existing environmental and road safety problems; and
- a holistic approach to new safety and environmental regulation of trucks is necessary.

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# Trucks to Meet the Future Road Freight Task

*challenges and directions*

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Industry Issues Paper prepared by

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Commercial Vehicle Industry Association of Q'ld (CVIAQ)

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