THIRD HEAVY VEHICLE PRICING DETERMINATION: NARROWING THE OPTIONS

DISCUSSION PAPER

October 2004

Prepared by

National Transport Commission

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FOREWORD

The National Transport Commission (NTC) is an independent body established under Commonwealth legislation, and funded jointly by the Australian Government, States and Territories. The NTC has an on-going responsibility to develop, monitor and maintain uniform or nationally consistent regulatory and operational reforms relating to road transport, rail transport and intermodal transport.

The NTC's heavy vehicle road pricing work forms part of a body of work aimed at improving the efficiency of land transport outcomes and ensuring transport is a more sustainable activity. This paper examines ways in which heavy vehicle road pricing can be used as part of smarter approaches to regulation, which provide both increased flexibility and greater certainty about the results achieved.

National heavy vehicle road use charges were first introduced in 1995-96 following the First Heavy Vehicle Road Pricing Determination. A Second Heavy Vehicle Road Pricing Determination was agreed and implemented in 2000. The Third Heavy Vehicle Road Pricing Determination is an efficiency initiative on the NTC's national regulatory reform agenda, and is focussed on:

1. ensuring the prices paid by trucks and buses for use of the road system reflect the pricing principles agreed by the Australian Transport Council (ATC), and in particular, continue to recover their share of the costs of providing and maintaining roads; and

2. the implementation of more flexible road pricing arrangements where appropriate.

This report relates to the second of these objectives.

It evaluates options for incremental and individual user pricing systems for possible incorporation in road user charges for heavy vehicles in Australia, with a view to narrowing the range of viable options which could be implemented within the agreed time frame for the Third Heavy Vehicle Road Pricing Determination. The Third Determination is to be submitted to the ATC for approval by early 2006, with implementation by jurisdictions by the end of 2006. This report has been prepared to assist the NTC in determining what charging mechanisms to recommend to the ATC as part of the Third Heavy Vehicle Road Pricing Determination, as well as what could be considered beyond that date.

The NTC has also prepared a supplementary information paper to accompany this report. The information paper is entitled: **Issues, Options and International Developments in Future Heavy Vehicle Road Pricing Mechanisms,** and has been developed to provide additional background information and detail on heavy vehicle pricing options. A series of national consultation workshops will be held in November 2004, to discuss the viable alternatives.

The outcomes expected from this report and the accompanying national consultation program are:

- productivity improvements for heavy vehicles able to participate in the proposed incremental pricing system;
- charges that closely reflect the cost of road wear;
- a nationally consistent framework and pricing mechanism for existing systems of this nature;
- an effective compliance mechanism; and

- enhanced fairness in the application of heavy vehicle charges.

This report has been prepared by the NTC's Road Pricing team comprising Chris Egger, Kerry Todero and Keith Lloyd, with special contribution from Barry Moore and Fiona Calvert.

Stuart Hicks
Chairman

*Comments are sought by **10 December 2004**. Submissions by e-mail are preferred (cegger@ntc.gov.au), however responses may be mailed to the following address:*

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SUMMARY

PURPOSE

Incremental and individual user pricing systems for vehicle travel on the road network may make a significant contribution to improved efficiency in the use of the transport system. This report evaluates options for incremental and individual user pricing systems for possible incorporation in road user charges for heavy vehicles in Australia. The purpose of this paper is to narrow the range of viable options which could be implemented within the established time frame for the Third Heavy Vehicle Road Pricing Determination.

FUTURE PRICING OPTIONS

The National Transport Commission (NTC), as part of its third review and update of heavy vehicle charges, is evaluating the extent to which more direct user pays based pricing mechanisms can be incorporated into Australia's heavy vehicle charging system. Australia's current heavy vehicle charging system is based on full recovery of the allocated heavy vehicle share of road construction and maintenance expenditure, with charges based on average vehicle road use within each vehicle class. The charges are divided into a fixed annual registration charge and a variable fuel charge.

The Australian Transport Council (ATC) has expressed a desire to move (over the longer term) to a system of more variable pricing more closely reflecting the cost of road wear at the point of use. In endorsing the pricing principles proposed by the NTC for the Third Determination, the ATC has accepted the need for arrangements that will enable national heavy vehicle road user charges to promote optimal use of infrastructure and transport modes. For heavy vehicles this means that charges would vary based on each heavy vehicle's characteristics and use, and would potentially include distance travelled, types of road travelled on, time of day, and mass carried.

As well as contributing to greater internal efficiency and equity within road user charges between different heavy vehicles, work surrounding the third determination endeavours to encourage neutrality between road transport and other transport modes. The aim of competitive neutrality is to seek to remove, or adjust for, any advantages or disadvantages that some enterprises may enjoy or incur as a result of government policies, taxation or charging arrangements. It seeks to improve resource allocation, and, as a consequence, overall economic efficiency. The synergies between road and rail in relation to this issue will be addressed in a separate paper, at a later date.

INTERNATIONAL DEVELOPMENTS

Internationally, there have been a number of important developments in heavy vehicle road pricing using new electronic based technologies (i.e. cameras,gantries and Dedicated Short Range Communication— DSRC) and GPS based solutions, which are aimed at measuring individual heavy vehicle use of the road system. These individual road user pricing systems—some of which are now in operation in countries such as Switzerland (2001) and Austria (2004), or are expected to begin operation in the short to medium term in Germany (2005) and the UK (2007/08)—do not offer a ready model for Australia to adopt.

These international systems would be difficult and costly to implement in Australia in the medium term. In addition, a move to individual user pricing of road use for heavy vehicles would have a substantial impact on intergovernmental revenue flows. Removal of the fuel excise component of current charges would reduce Commonwealth revenue from fuel use, whilst removal of the registration charge would reduce State and Territory Government revenue. However under a different system, the same revenues could still be collected, but in a different form. The proposed UK telematic system is the closest to what may be applicable to Australia over the longer term, as it intends to be a country-wide measurement system which will monitor and measure both distance travelled, time of day and the type of roads that vehicles use. However, measuring mass using telematics still remains technologically and commercially problematic – at least in the short term.

THIRD DETERMINATION TIMEFRAMES

The timetable for the Third Determination requires recommended changes to the heavy vehicle charging system to be submitted to the ATC for voting early in 2006, with implementation by jurisdictions by the end of 2006. Given this timetable, incorporation of an individual user pricing model into the 3rd Determination is not feasible due to technical, cost and institutional factors.

EXTERNALITY CHARGES

It was earlier intended that pricing for environmental externalities would be considered in the work on the Third Determination as part of an individual user pricing approach, as is provided for in the Third Determination pricing principles. However, given the difficulty of developing a suitable scheme with current data and technology which can be relied upon to send more accurate price signals to heavy vehicle operators, it is therefore proposed not to pursue consideration of individual externality charges relating to noise and air emissions of individual vehicles in the Third Determination. However, work is still proposed (to be reported in the Third Determination Regulatory Impact Statement) which will review the integrity of the data currently available on externalities, and the mechanisms that could be used to incorporate such charges into future road pricing. In addition, the feasibility of differentiating registration charges applicable to engines of different environmental standards will be examined as an option for the Third Heavy Vehicle Road Pricing Determination. This option would not involve the difficulties associated with individual externality charges.

A separate paper covering the scope and impact of differential registration charges based on engine environmental standards will be prepared in early 2005.

INCREMENTAL PRICING

One option that may be feasible within the timeframe of the Third Determination is an incremental pricing system for heavy vehicles. This system would offer potential productivity benefits to the heavy vehicle industry, enabling a vehicle to undertake an activity that is currently restricted in exchange for payment of a charge based on recovering the cost of any additional road and bridge wear.

It must be emphasised that, in proposing an incremental pricing system, the NTC is not developing or inferring acceptance of any proposal to allow heavy vehicles in general to operate under different conditions than is currently the case. Instead it is focussed on a tool to accompany any such scheme that enables any additional infrastructure costs to be recovered from road users and passed on to the road manager who permits the additional road wear to occur.

This tool could be used for a variety of activities, but the focus of this evaluation is its application based on allowing additional mass above current mass limits. Establishing a national incremental pricing scheme, apart from productivity benefits through higher mass, would provide a nationally consistent framework and pricing mechanism for existing systems of this nature, improve compliance mechanisms and will enhance fairness in the application of heavy vehicle charges.

The operating and technological characteristics of an incremental pricing system largely depend on the level of take-up. The more vehicles that participate, the higher the potential revenue and the more sophisticated technology can be used to measure costs and monitor payments. There is no point in designing an expensive technological system to measure and monitor if only a few thousand vehicles are likely to participate. The evidence from the systems mentioned above and the IAP Business Case clearly verify this point. The IAP feasibility project analysis suggested that the minimum vehicle volume that jurisdictions would collectively need to make available so as to provide incentive for at least three service providers to offer IAP services was 2,500 over a three-year period.

Determining to which applications incremental pricing would apply and the eligibility criteria for vehicles would be major questions for consideration. Assuming the scheme were based on vehicles that can carry additional mass above current limits, a key question would be whether these vehicles would need to be subject to safety assessments and accredited under a Performance Based Standard (PBS) system, (currently under development by NTC), to ensure compliance with safety requirements and/or be accredited under the National Heavy Vehicle Accreditation Scheme (NHVAS) for mass management to ensure compliance.

In this report the NTC has undertaken some case study analysis to illustrate how an incremental pricing system might work showing what would be the preferred characteristics.

CASE STUDY DESCRIPTIONS

Case Study 1: involves a scheme allowing one tonne extra on a triaxle (that is, one additional tonne on a 6-axle articulated truck, and two additional tonnes on a B–double). The scheme would be available for all vehicles including general access vehicles, B-doubles and vehicles operating under higher mass limits. It is assumed that there are no bridge impacts.

Case Study 2: involves charging bridge and road wear costs for vehicles with non-road friendly suspensions wishing to increase mass up to current higher mass limit levels.

Case Study 3: involves a 6 tonne increase on a 6-axle articulated truck, based on a specific route e.g. production point to a railhead with no bridge problems.

Conclusions Drawn From the Case Studies

For all three case studies, vehicle eligibility requirements that are set within each scheme using incremental pricing as a cost recovery tool appear to be the most suitable. Under this proposal, approved schemes would be checked to ensure that a mechanism for ensuring safe operations has been identified.

To determine incremental charges a system based on additional road and bridge costs, calculated as a network average using aggregate costs used in the NTC's base heavy vehicle pricing system would appear to be the most suitable for case studies 1 and 2. However, a system that could differentiate between major road types would be preferable if location/route monitoring for individual vehicles was available. In case study 3 the optimum would be a system that could measure the specific route costs, although the data requirements could be prohibitive.

For mass measurement, participation in the NHVAS mass management module would be the most suitable for case study 2 and 3. This assumes that NHVAS is modified to include recording of mass for each trip and regular calculation and reporting of additional mass carried, backed up by independent auditing. However, for marginal increases in mass used across the network, either an NTC assessed mass level scheme, by vehicle class or self declaration of the proportion of travel at different increments of the higher mass, would be suitable such as for case study 1.

For distance and location measurement, an NTC assessed distance by vehicle class scheme could prove to be the most effective. In this scheme, the NTC would make an assumption about the likely distances to be travelled by vehicles in each incremental pricing scheme and where this travel would be expected to occur. Such a scheme would be reliant on good information on road use, vehicle class, and location being available. Alternatively, if a telematics (GPS based) scheme using map referencing to monitor location and calculate distances is available, this would be preferable, but would have a considerable set-up cost. For case study 3, which would have only a small number of vehicles involved, a permit/declaration system would be the most suitable.

There are no easy answers in terms of who should best operate the incremental pricing system. A system of administration by road authorities may be the most acceptable to jurisdictions but there are a number of difficulties. These problems include operators crossing jurisdictions having to purchase incremental access from each jurisdiction, and the need for mutual recognition of permits and mechanisms for passing on revenues collected on behalf of local councils. Options involving certified third party service providers would be the most effective for transport operators to deal with, and for returning revenue to relevant road managers. These options are dependent on the availability of a telematics system.

The payment system used depends on the distance and mass measurement system that has been selected. If an NTC assessed system is used across all three case studies, a flat price would be required and either a permit fee or an annual charge would be suitable. The permit fee would be particularly relevant to case study 2, where some difference in charges is required across vehicle classes. A direct payment approach would be more suitable for case study 3, due to the need to have a more variable charge to suit individual vehicle circumstances.

The approach to compliance and audit and the approach to mass, distance and location measurement are closely linked. For case study 1 (with general access and a flat fee system) the most relevant current road-side enforcement and site checks may be sufficient. In case studies 2 and 3 (which could operate under NHVAS in respect of mass measurement), compliance and audit would be through NHVAS itself. Telematics could also be used to provide route compliance.

POTENTIAL BENEFITS

The benefits of incremental pricing are based on savings in total road user costs which include vehicle operating costs plus costs relating to capital, administration, indirect labour, registration and insurances. The benefit is derived by assuming that a reduced number of trips will be required to shift the same level of mass over a 12 month period resulting in an overall saving in road user costs. This takes into account the effect of higher costs on individual trips such as marginally higher fuel costs for moving a greater mass. Incremental costs are based on increased road wear and if relevant, bridge wear. The net benefit is the difference between the overall road user cost saving and the incremental cost based on road wear and bridge wear if relevant.

A summary of the potential benefits to heavy operators and likely incremental charges required to cover increased road-wear costs are shown in the following table.

Net Benefits of Incremental Pricing

	Benefit based on savings in road user costs (c/km)	Indicative incremental cost based on road wear (c/km)	Net benefit (c/km)
Heavy Rigid			
22.5 tonnes (Mass Limit)			
24.5 tonnes	14	9	5
26.5 tonnes	24	18	6
6 axle articulated vehicle			
42.5 tonnes (Mass Limit)			
44.5 tonnes	14	6	8
46.5 tonnes	23	11	12
B-Double 9 axle			
62.5 tonnes (Mass Limit)			
64.5 tonnes	11	5	6
66.5 tonnes	19	9	10
68.5 tonnes	26	13	13

Notes: Preliminary estimates only, in 2002 money values.

These estimates are only preliminary at this stage as the NTC has yet to recalculate its base heavy vehicle charges for the Third Determination. Once this calculation has been completed in early 2005, more accurate cost and benefit estimates for incremental pricing will be available.

The companion paper to this Evaluation report: Future Heavy Vehicle Road Pricing Mechanisms - Issues, Options and International Developments provides further analysis of the issues, options and international developments relevant to the consideration of future road pricing systems.

Comments are sought on this report particularly in regard to the following questions which are addressed in this paper.

QUESTIONS AND ISSUES

Comments are sought on:

1. The NTC decision to not pursue individual road user pricing in the 3rd Determination (refer section 2.3)
2. The seven suggestions for objectives that should underlie an incremental pricing system (refer section 3.2.1)
3. The operational applications that incremental pricing should apply to (refer section 3.2.2)
4. The expected level of industry participation in an incremental pricing scheme (refer section 3.2.4)
5. Who should operate the system (refer section 3.4.8)
6. What should the rate of incremental charge cover (refer section 3.4.8)
7. How should mass be measured (refer section 3.4.8)
8. How should distance and location be measured (refer section 3.4.8)
9. Who should receive the revenue (refer section 3.4.8)
10. How should compliance and audit be addressed (refer section 3.4.8)

GLOSSARY

Term	Explanation
Articulated vehicle	A combination vehicle comprising a prime mover and semi-trailer.
B-double	An articulated vehicle consisting of a prime mover towing two semi-trailers, where the first trailer is hitched to the prime mover's fifth wheel and the second trailer is hitched to the fifth wheel on the frame of the first trailer (a fifth wheel is a device used to permit quick coupling or uncoupling of a semi-trailer).
Diesel fuel excise	Commonwealth tax charged on diesel fuel at the pump at rates of AU$0.38143 per litre for ultra low sulphur diesel and AU$0.39143 per litre for regular diesel (December 2003 rates).
Direct charge	Refers to a transaction directly between the road user causing the cost and the organisation that incurs the cost.
Dedicated Short Range Communication (DSRC)	The term given to microwave or infra-red communications between devices in relatively close proximity. In general, there is a need for a direct line of sight for the link to be established and operate**.** DSRC is generally applied in a vehicle-to-roadside communications context.
Equivalent standard axle (ESA)	A measure of the relative effect of a load and axle configuration on a road pavement, expressed in terms of the number of passes of a standard reference axle.
Externalities	Externalities can be of both a detrimental (external cost) or beneficial nature. Detrimental externalities are the result of an activity that causes damage to others with no corresponding compensation paid by those who generate the externality such as noise, air pollution and greenhouse emissions. Beneficial externalities are the result of activity which causes incidental benefits to others with no corresponding compensation provided to those who generate the externality.
Fixed charges	Heavy vehicle charges that have a set annual (or other time period) monetary value for each vehicle, such as the current heavy vehicle registration charges which only vary between different classes of vehicles.
Fourth power rule	Used to estimate ESAs by raising to the fourth power, divided by the reference load for that axle group. It provides a means of describing the relationship between road wear and axle load on a heavy vehicle.
Fuel charge	This is one of the two main components of the current heavy vehicle charge. The fuel charge was last updated in 2000 as a result of the Second Heavy Vehicle Road Pricing Determination, when it was set at 20 cents per litre. It is collected as part of diesel fuel excise by the Commonwealth.
Global Positioning System (GPS)	This involves use of a satellite-based navigation system to determine the location and time of an object. In conjunction with telecommunications technology, GPS can be used to determine the location of a vehicle and the distance it is driven.
Gross Combination Mass (GCM)	This refers to the maximum loaded mass of a vehicle and any trailers connected to it as specified by the vehicle manufacturer on a plate affixed to the vehicle, or as assessed by relevant road authorities in the absence of a plate.
Gross Mass	The maximum laden operating mass of a vehicle (including any trailers), including its load and tare (empty) mass. The gross mass of a particular vehicle will be determined by its operational needs, the Gross Vehicle Mass (GVM), Gross Combination Mass (GCM) and the relevant legal mass limits.

Term	Explanation
Gross Vehicle Mass (GVM)	This refers to the maximum loaded mass of a vehicle as specified by the vehicle manufacturer on a plate affixed to the vehicle, or as assessed by relevant road authorities in the absence of a plate.
Heavy vehicle registration charge	The component of the current two–part heavy vehicle charging system which is collected by State and Territory Governments. The charge is calculated to contain both an access and mass-distance component. The mass-distance component is based on average mass and distance travelled in each vehicle class.
Hypothecation	The practice of allocating all or part of revenue collected from a particular source for expenditure on a particular activity. In this paper it is used in reference to the expenditure of funds collected from road use charges on the relevant road infrastructure, rather than having those funds directed into consolidated revenue by the Commonwealth, State or Territory Governments.
Incremental pricing	Heavy vehicle pricing that would operate in addition to the existing heavy vehicle charges. The aim of incremental pricing is to provide opportunities for charges to be levied for specific activities, mainly (but not exclusively) to allow vehicles to operate at higher masses).
Individual user pricing	Pricing systems that either completely or predominantly recover the costs of road wear (or other infrastructure costs) in direct and correct proportion to the mass, distance and specific roads used by each heavy vehicle. Individual user charges could replace all or part of the present charging system with a pricing and collection method that is directly linked to use levels by individual vehicles.
Performance-Based Standards (PBS)	A proposed set of design standards that will regulate what a vehicle can do, subject to meeting safety and environmental conditions. The scheme allows for significant flexibility in how outcomes are achieved, as a departure from the more prescriptive dimension, mass and configuration rules that exist at present.
Road pricing	This term is used in its broadest context – i.e. pricing of road use rather than the narrower use of the term that is sometimes used to refer solely to pricing systems aimed at reducing congestion.
Road use charge	A fee for payment for use of the road system, which in the case of heavy vehicles, does not include: - nominal or other administration charges associated with registration of a vehicle; - stamp duties; - compulsory third party insurance premiums; - injury protection charges; and - administrative components of permit, licence or other fees. Current road use charges for heavy vehicles include both the registration charge (which includes both access and mass-distance components) and the fuel charge of AU$0.20 per litre.
Variable pricing	This form of pricing varies with use. However, the link with use can be indirect. For example, the AUD 0.20 per litre road use charge applied to fuel is an indirect variable charge, but it is not an individual user charge. If the road use charge was placed on the amount of travel undertaken, rather than the fuel used it would be a direct charge and therefore should be described as individual user pricing.

The following ISO 4217 international currency abbreviations are used in this paper:

AUD	Australian dollar
CHF	Swiss franc
EUR	European Euro
NZD	New Zealand dollar

Unless otherwise specified, monetary amounts are expressed in AUD.

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1. INTRODUCTION

The National Transport Commission (NTC) is investigating the extent to which more direct user pays based pricing mechanisms can be incorporated into Australia's heavy vehicle charging system, as part of the 3rd Determination review and update of heavy vehicle charges. Australia's current heavy vehicle charging system is based on full recovery of the allocated heavy vehicle share of government road construction and maintenance expenditure, with charges based upon average road use within each vehicle class. The charges are divided between a fixed annual registration charge and a variable fuel charge.

In 2002, Australia's transport Ministers (the Australian Transport Council-ATC), expressed a desire to move, over the longer term, to a system of more variable pricing. The ATC, in endorsing the pricing principles proposed by the NTC for the 3rd Determination, has accepted the need for arrangements that will enable national heavy vehicle pricing to promote optimal use of infrastructure and transport modes. For heavy vehicles this means that charges would vary based on individual heavy vehicle characteristics and use and would potentially include distance travelled, types of road travelled on, time of day and mass carried.

The main focus of this report is to:

- examine individual road user pricing developments, including a summary of lessons learnt from international developments;
- examine the possibility of including an incremental pricing system in the 3rd Determination; and
- estimate the cost and benefits associated with incremental pricing based on a higher mass application, and provide a broad indication of the order of magnitude for potential incremental charges.

2. INDIVIDUAL ROAD USER PRICING

2.1 General

An individual user pricing system recovers the costs of road wear for each vehicle, in direct proportion to the mass, distance and specific routes used. It is based on ensuring that road users face price signals that accurately reflect the costs associated with their activity. It is being considered because it would contribute to greater internal efficiency and equity within road user charges between different heavy vehicles, as well as encouraging neutrality between road transport and other modes (to the extent that users of other modes face price signals that accurately reflect the marginal social cost of their activity).

Individual user pricing for heavy vehicles in Australia would involve replacing the existing pricing system with a set of mass-distance related charges that users incur based on their actual road use. Implementation would involve measuring and monitoring road use to assess the cost responsibilities of individual vehicles, and collecting the revenue and re-distributing it as needed between various road managers.

A move to individual user pricing of road use for heavy vehicles would have a substantial impact on intergovernmental revenue flows if hypothecated. Removal of the fuel excise component of current charges would reduce Commonwealth revenue from fuel use, whilst removal of the registration charge would reduce State and Territory Government revenue and increase Local Government revenue.

2.2 International Developments in Individual Road User Pricing

Internationally, there has been a number of important developments in individual road user pricing systems for heavy vehicles. These systems are using new electronic based technologies (i.e. cameras, gantries, and Dedicated Short Range Communication (DSRC)) and GPS (Global Positioning System) based solutions, which are aimed at measuring individual heavy vehicle use. Some systems are now in operation in countries such as Switzerland (2001) and Austria (2004), or are expected to begin operation in the short to medium term in Germany (2005) and the UK (2007/08). However, these individual road user pricing systems do not offer a ready model for Australia to adopt. A summary of the characteristics of these systems is provided in Table 1.

Table 1. Electronic and Telematic Individual Road User Pricing System Characteristics

	Switzerland	Germany	Britain	Austria
Implementation dates	January 2001	January 2005 – pilot Jan 2006 full operation	2007/08 expected to start operation	January 2004
Length of roads monitored	71,186 km	12,000 km	372,000 km	2000 km
Truck weight charged	Over 3.5 tonnes	Over 12 tonnes	Over 3.5 tonnes	Over 3.5 tonnes
Numbers of Heavy vehicles participating	55,000	850,000	450,000	55,000
Type of charge – Distance based	All roads monitored – single tariff	Mainly motorways monitored - single tariff	All roads monitored with multiple tariffs based on time of day and road class	Motorways plus select expressways - single tariff
System set-up costs	€160M ($AUD 276.4M)	AUD$1.2B	Not yet operational	€290M ($AUD 500.9million
System operating costs / enforcement	59M Swiss francs – 2003 (5-7% of revenue)	Approx 24% of revenue	Approx 20%+ of revenue	€55M per year (10% of revenue)
Revenue raised	843M (gross) Swiss francs – 2003 ($AUD947.7m)	€2- €2.8Billion ($AUD3.4 billion)	NA	Approx €600M in 2004 ($AUD 1.036B)
Revenue use	Operational costs enforcement costs Modernise rail network	Infrastructure projects for roads/railways	Revenue neutral	Infrastructure projects
Technical/collection	Gantry based with GPS back-up	GPS based with gantry backup	GPS based	Gantry based

Source: NTC using various sources

The relative heavy vehicle charges that apply, or will apply with the individual road user heavy vehicle pricing systems are compared in Table 2. This table provides estimates in cents/km travelled and per tonne/km relative to the equivalent amount currently charged for a 40 tonne GVM heavy vehicle in Australia. The amount currently charged in Australia is based on the Second Heavy Vehicle Determination charge of 2000, which has been converted into 2004 terms using the Bureau of Transport and Regional Economics (BTRE) road construction and maintenance price index, and the CPI result for 2003/04. The results illustrate the Swiss system is the most expensive for heavy vehicle operators, compared to other systems surveyed in this report.

Table 2. Average Rates for Truck-km Charges (40 tonne truck)

Country	Date upon which charge is based	Charge basis	Australian cents equivalent per tonne/km	Australian cents equivalent per/km
Switzerland – applies to all roads	January 2004 January 2005	85% external cost recovery 15% road track costs	1.7 2.8	72 115
Austria – applies to motorways and select expressways	January 2004	100% road track costs plus reduction of motorway debt	1.1	47
Germany – applies to motorways only	January 2005, Planned rate	100% road track costs	0.5 0.6	21 26
UK	2007/07		NA	NA
Australia	Derived July 2004 rate based on 2000 2nd Determination data factored up.	100% road track costs	0.47	18.2

Source: ECMT (2004) and NTC estimates

Depending on the requirements of the electronic/telematic charging system, and which aspects are required to be measured and monitored, there is scale of complexity, cost and risk that needs to be considered. This is demonstrated in Table 3, which shows that the more aspects that are required to be measured, the more sophisticated and costly the systems become. As a result, the risks increase both politically and financially, and flexibility is reduced, since once a specific technology has been developed to measure and monitor a particular set of information, it generally cannot readily be adapted for other purposes at a later date.

Table 3. Network Level Approaches to Distance Charging

<table>
<tr><th colspan="2">Approach</th><th>Example</th><th colspan="4">Issues</th></tr>
<tr><td>1</td><td>All roads monitored (single tariff)</td><td>Swiss system (LSVA) (operational)</td><td rowspan="6">flexibility in future possible policy changes</td><td rowspan="6">costs necessitating increased vehicle fleet size (business case)</td><td rowspan="6">technical and operational complexity</td><td rowspan="6">risks</td></tr>
<tr><td>2</td><td>Some roads monitored (single tariff)</td><td>German Maut (GPS) System (proposed) or Austrian vehicle charge Dedicated Short Range Communications (DSRC) gantry based)</td></tr>
<tr><td>3</td><td>Monitoring by road class (multiple tariffs)</td><td>UK heavy vehicle charge (proposed)</td></tr>
<tr><td>4</td><td>Monitoring by road class and time of day</td><td>UK heavy vehicle charge (proposed)</td></tr>
<tr><td>5</td><td>Monitoring by road class and direct measurement of mass</td><td>None – currently proposed</td></tr>
<tr><td>6</td><td>Monitoring by road class, time-of-day and direct measurement of mass</td><td>None – currently proposed</td></tr>
</table>

An Australian heavy vehicle road pricing system would ideally include an ability to measure and monitor distance, road class and mass. This would be necessary in order to charge individual road users according to their actual road use. Presently, no such system is operating anywhere in the world, and there exists no established market for the provision of expertise and resources to provide the services necessary to support such a system.

The international systems detailed above are expensive to adopt, require wholesale change to national heavy vehicle pricing systems, require participation by all or a large part of the heavy vehicle fleet, and, above all, do not have the technical capability to measure all of the key aspects that would be ideally measured in an Australian heavy vehicle road pricing system.

The proposed UK telematic system is the closest to what may be applicable to Australia over the longer term as it intends to be a country-wide measurement system which will monitor and measure both distance travelled, time of day and the type of roads vehicles use. However, measuring mass accurately and in a tamper-evident manner using telematics remains technologically problematic.

Table 1 illustrates the high set-up and operating costs of overseas systems. It is expected that the German Toll Collect system will cost the German Government $AUD1.2B to operate, covering just 12,000 km of German motorways.

In Europe, new heavy goods vehicles (HGVs) in international transport are in most cases already equipped with GPS, and electronic tacographs will be mandatory for new European vehicles above 12 tonnes (and mandatory for all such vehicles as of 2005). Such a policy will need to be implemented in Australia in the longer term if individual user pricing is to be considered.

2.3 Why Individual User Pricing Does Not Appear Feasible in the Medium term

There are significant policy and institutional issues to be overcome before individual user pricing for heavy vehicles could be introduced. In addition, the technical cost of measuring mass and distance appears high, especially in relation to mass. Therefore individual user pricing does not appear to be realistically achievable within the time period of the 3rd Determination, which is due for implementation by the end of 2006.

At the meeting of Transport Agency Chief Executives (TACE) on 25 September 2002, members discussed the timing and scope of the three options presented. The possible approaches were: a mechanical update, to be implemented by July 2005; a medium extension, to be implemented by mid 2006; and a fundamental overhaul, which would be implemented end 2007.

A fundamental review of road pricing, including the establishment of a new pricing system covering additional issues such as recovery of externality costs, was not supported.

TACE members agreed that the medium extension of the current system was the preferred option, with the issue of externality costs to be addressed at a later date.

It was earlier intended that pricing for environmental externalities would be considered in the work on the Third Determination, if an individual user pricing mechanism was adopted as part of the Determination. However, given the difficulties with implementation of a suitable scheme over the medium term (highlighted above), this is now unlikely to occur. It is therefore proposed not to pursue consideration of externality charges relating to noise and air emissions in the determination of heavy vehicle charges, which is provided for in the Third Determination pricing principles. However, it is still proposed to review the current availability of information on externalities for incorporation into future road pricing. In addition, the possibility of differentiating registration charges applicable to engines of different environmental standards will also still be considered as an option for the Third Determination.

Full externality pricing for noise and air emissions requires similar measurement of activity and location to individual user pricing, but is not achievable in the time frame of the Third Determination. However, the NTC proposes to undertake a review of the information available to determine whether an environmental surcharge for poorly performing vehicles is achievable and warranted. It will set out the steps necessary to move to an individual user pricing system for heavy vehicle noise and air emissions, and investigate the extent to which such an approach would be effective in reducing environmental impacts.

Comments are sought on:

Q1. The NTC decision not to pursue individual road user pricing in the 3rd Determination.

3. INCREMENTAL PRICING

3.1 Description

Although more direct road user pricing through individual user pricing systems currently operating in, or planned for the UK and Europe are not feasible within the time period of the 3rd Determination, there would appear to be potential for incremental pricing for heavy vehicles which would be built onto the existing Australian heavy vehicle charges system.

Incremental pricing is a process whereby road users are charged additional fees (over and above 'base' charges) for particular activities that are not normally allowed. This evaluation is focussed on providing for additional mass with a fee being charged equal to the cost of the additional road and or bridge wear. For example, a logging truck might be permitted, for a fee, to use a section of road at higher masses than normal limits. The fee would be calculated to cover the truck's contribution to road wear costs, over and above the costs that can occur under normal access arrangements that are collected through the standard charges.

It must be emphasised, that in proposing an incremental pricing system, the NTC is not developing or inferring acceptance of any proposal to allow heavy vehicles in general to operate under different conditions than is currently the case. Instead it is focussed on a tool to accompany any such scheme with a mechanism that enables any additional infrastructure costs to be recovered from road users and passed on to the road manager who allows the additional road wear to occur. Each specific proposal to allow vehicles to access the road network, or parts of the road network, under different arrangements than currently apply, would need to be developed and considered on its merits.

Incremental pricing offers the potential for productivity improvements, national consistency in incremental pricing, and the potential to return or hypothecate revenues back to road managers.

Several past studies have suggested that the cost savings to industry through being allowed to operate at higher masses can more than outweigh the incremental cost of maintaining the infrastructure (NAASRA (1985) and NRTC (1996). It is unlikely that transport operators would choose to operate under an arrangement that allowed higher masses or greater access unless this was the case. However, it is important to ensure that the structure of an incremental pricing system and the method of collection and/or distribution of funds are cost effective.

In addition, higher mass and other characteristics would still need to be subject to upper bounds, for reasons such as protecting against sudden pavement or structural failure, or unacceptable safety risk. Previously such limits were undefined but are now better understood or are being investigated through Performance-Based Standards work.

Keys to a successful incremental pricing regime would include:

- transparency in identifying and allocating the incremental costs, and who collects the charges;
- careful analysis to ensure that the charges capture only the additional costs and that they do not introduce any double counting or over-recovery; and
- cost efficiency, to ensure that the costs of recovering the charges are reasonable.

A number of different operating models and mechanisms could be used for an incremental charging system. These range from simple permit systems operated directly by relevant authorities, through to comprehensive road use monitoring systems using GPS and communications technology operated by independent private sector service providers, depending upon the level of vehicle participation.

3.2 Issues for Incremental Pricing

Incremental pricing involves a number of issues that require exploration and decisions to be made if such a system is to prove feasible. These include:

- the objectives the system will have;
- the operational applications that incremental pricing would be used with;
- the expected level of take up or participation and how vehicle eligibility will be established;
- how consistency and relationships with existing systems such as Higher Mass Limits will be determined;
- issues of legality that may accrue due to the power to levy, collect and distribute revenue; and
- whether existing heavy vehicle charges will have to be modified for vehicles that do not or cannot participate in this new system.

3.2.1 Objectives

The proposed objectives of an incremental pricing system are that the system:

1. ensures that charges for use of the road system utilising incremental applications accurately reflects the cost of providing and maintaining the road system, including additional pavement and bridge wear;
2. improves heavy vehicle productivity;
3. balances of administrative simplicity, efficiency and equity;
4. is cost efficient to ensure the costs of recovering the charges are reasonable;
5. conformances with accepted safety standards;
6. is transparent in the application of incremental pricing and receipt of revenues;
7. ensures (where feasible) that road managers are compensated for allowing additional road or bridge wear to occur.

Comments are sought on:

Q2. The seven suggestions for objectives that should underlie an incremental pricing system.

3.2.2 Operational Applications for Incremental Pricing

There are many potential applications for incremental pricing. The options, discussed below include a surcharge on particular routes, a surcharge on a road network, a surcharge for a specific activity, and pricing to cover the cost of upgrading bridges for higher mass vehicle operations.

Imposing surcharges on particular routes is seen as a means of recovering a variety of costs, including additional pavement and bridge wear caused by vehicles operating in excess of statutory mass limits; additional works required to accommodate vehicles that require more road space; or the costs of keeping a road open in periods of inclement weather.

An example of this is logging roads, where some authorities have entered into arrangements with forest owners whereby logging companies pay a surcharge for the damage caused to low strength local roads by logging trucks.

Successsful implementation of this system of incremental pricing might require the monitoring of vehicle location, mass and distance travelled.

It may be possible to designate a network of suitably constructed roads for use by overweight vehicles, in return for payment to cover the extra wear caused by additional mass. This is based on the premise that the cost savings accruing to industry through being permitted to operate at higher vehicle masses more than outweighs the incremental costs of maintaining the infrastructure. Such a system would be administered through GPS vehicle monitoring, or perhaps a permit or sticker arrangement.

Another approach could be to consider each incremental loading arrangement on a case-by-case basis, perhaps utilising Performance-Based Standards as the qualifying criteria instead of establishing an agreed load limit for a set of loads.

Delivery vehicles, such as fuel and perishable food deliverers, only utilise their total available mass for small sections of their journey. Incremental pricing could permit such vehicles to undertake parts of their trip with loads above statutory mass limits, to ensure that capacity is more efficiently utilised while partially loaded.

Access for overweight containers to and from an intermodal terminal or railhead is another activity that could be subject to a pricing regime. This approach could utilise local roads around intermodal rail terminals in regional centres, and may also be employed on roads in close vicinity of ports, for transporting overweight containers between nearby factories and the port. It would avoid the need to repack, consolidate or deconsolidate loads for the road leg of an intermodal journey. Hence, incremental pricing may realise greater industry efficiencies, and more efficient use of land and transport systems. Imposing a surcharge on a specific activity might require the recording of the number of trips, the mass and distance of each trip and monitoring of location.

Comments are sought on:

Q3. The operational applications to which incremental pricing should apply.

3.2.3 The WA experience

The Western Australian concessional loading schemes are included here as examples of existing systems that might migrate to using an incremental pricing tool, if it were available. These schemes are summarised briefly below.

Concessional loading schemes were introduced in Western Australia in the mid-1990s. These incremental pricing schemes were introduced to provide for higher axle mass limits for operators with excellent loading controls in place. This virtually eliminated incidences of extreme overloading. Briefly, these schemes include:

- The Bulk Cargo scheme commenced in l995, and allows participants to operate higher mass limits on triaxle groups only, up to 23.5 tonnes.

- The Import/Export containers scheme commenced in 1997, and is available to operators transporting overweight containers to or from rail shipping facilities only. It provides for the carriage of one heavy container on a trailer or combination and up to 9 tonnes extra mass on a vehicle with up to 7 tonnes on a triaxle group and up to 1.5 tonnes extra on a tandem group. Most users of this scheme operate from the Port of Fremantle.

- The Livestock Scheme introduced in 1986 allows for the variable weight of animal and addresses the fact that part-loading of trucks with animals often results in unsatisfactory animal welfare conditions. This scheme limits livestock crates to a length of 12.5m and provides for two decks of cattle and 4 decks of sheep. This volumetric limit physically limits the mass of the load that can be carried. Vehicles carrying animals have mass limits of 23 tonnes on triaxles and 18.5 tonnes on tandems. These limits ensure the tare mass of the truck is not excessive.

- The Certified Weighbridge Mass Management scheme was introduced in 2003, and provides for 21.5 tonnes on triaxles and 17 tonnes on tandems where the truck is weighed on a certified weighbridge prior to using the public road system. This scheme was introduced as an incentive for operators and suppliers to become involved in mass management schemes.

Members of all four schemes are charged at the rate of $4 per tonne per month for all mass permitted in excess of regulation axle mass limits. These charges are levied through permit arrangements. This $4 per tonne per month charge would not recover additional costs.

3.2.4 Expected level of take up

A key issue for incremental pricing is ascertaining the magnitude of the potential market in relation to vehicle participation, such that the potential revenue can be determined and an assessment made of whether the administration and system set-up costs will be accommodated by the additional revenue, i.e. will the system be cost effective.

Estimates of the size of the Australian heavy vehicle fleet classified by vehicle class are provided in Appendix 1, based on Australian Bureau of Statistics (ABS) Survey of Motor Vehicle Use data. This shows that in 2002 there were around 247,000 rigid trucks and 58,000 articulated trucks (of which 6,200 are B-doubles and 4,500 are road trains). An important question is what proportion of this fleet would be amenable to participating in an incremental pricing scheme. The answer to this will depend largely on what applications incremental pricing will apply to.

In the business case for the proposed Performance Based Standards (PBS) system, it was assumed that there would be participation of 10,000 vehicles from the articulated fleet within 10 years. This estimate was very conservative and only included a very marginal increase in mass. This system in its current format would allow the operator who wants to operate a vehicle beyond current prescribed limits to do so, so long as they met the sixteen safety standards and the four infrastructure protection performance standards (which do not allow any additional road or bridge wear to occur). Given that the current proposed PBS system is based on vehicles not causing additional road wear and incremental pricing is about allowing additional road and bridge wear in exchange for payment of a charge to compensate the road manager for that additional wear, it is unlikely that incremental pricing would operate within the current proposed PBS system.

Nevertheless, a mechanism is needed to ensure that vehicles subject to incremental pricing operate safely and within maximum infrastructure protection limits.

Comments are sought on:

Q4. The expected level of industry participation in an incremental pricing scheme.

3.2.5 Relationships With Existing Systems Such as Higher Mass Limits

The Higher Mass Limits (HML) currently (in summary) provides for an additional 0.5 tonnes on a tandem axle and an extra 2.5 tonnes on a tri-axle under three conditions. HML requires that the vehicle has road friendly suspensions on all the axle groups operating at the higher masses, approved HML routes are used and the operators of vehicles with tri-axles are accredited in NHVAS mass management. Incremental pricing would apply to mass in excess of current entitlements, whether standard or HML.

Currently, jurisdictions are at various stages of implementing Higher Mass Limits, with Victoria and Northern Territory the most advanced, providing almost 100 per cent access to their respective arterial road networks.

3.2.6 Legal Issues

Legal advice is being sought regarding constitutional constraints on federal, State or local governments in implementing incremental pricing.

For a new pricing system such as incremental pricing, issues concerning the legality and power of jurisdictions, road owners or possible third party service providers still need to be clarified.

3.2.7 Effects of Incremental Pricing on Existing Heavy Vehicle Charges

If incremental pricing applies only to the increment, base charges are unaffected. It should be noted that the incremental pricing pertains to the mass entitlement, and not to the average mass for the class. Widespread take-up of incremental pricing could push down average mass (net of the increment), and force down base charges, depending on how average mass (net of the increment) is measured. However, only vehicles that currently mass–out would choose to operate in an incremental pricing scheme, leaving volume operators only paying the base charge. This would mean base charges would more accurately reflect costs of these operators. Care would need to be taken to ensure that vehicles operating within incremental pricing schemes continue to meet their full share of costs.

3.2.8 Receipt of revenue

There are three main approaches that could be adopted to the receipt of revenue from incremental pricing, being:

(a) revenue goes to consolidated treasury funds with funding decisions taking account of road needs;

(b) central collection by the State of registration and redistribution to road managers;

(c) revenues paid direct to road managers.

Whether options (b) and (c) are available will be a policy decision in each jurisdiction. Option (c) will not be cost effective unless revenues are collected by a third party service provider or a centralised system administrator who is able to distribute revenue directly to the appropriate road manager(s), and the amount to be passed to each road manager is clear. Under each approach, a mechanism for determining the amount of revenue that should flow to different road managers (either from an individual vehicle or from an incremental pricing scheme in total) will be required. This is essential to the objective of compensating road managers for allowing additional road and bridge wear to occur.

3.3 Incremental Pricing System – Case Studies

Three case studies have been devised to illustrate how incremental pricing might work, and explore the feasibility of various system characteristics. The NTC is not promoting these applications, rather they are purely exploratory, for the purposes of identifying those features required to ensure incremental pricing tools are effective.

The case studies are:

1. An additional one tonne on all triaxles (providing an additional 1 tonne on a 6–axle articulated truck and an additional 2 tonnes on a 9–axle B–double) for all vehicles including general access vehicles, B–doubles and Higher Mass Limits (HML) vehicles (excludes road trains and assumes no bridge effects due to the marginal increase).
2. Charging bridge and road wear costs for vehicles with non-road friendly suspensions wishing to increase mass up to current HML levels.
3. A 6 tonne increase on a 6-axle articulated truck, based on a specific route, e.g. production point to a railhead, with no bridge problems.

These are useful case studies as they encompass a cross section of small, medium and large increases in mass and across various network/route scenarios.

The following three sections describe each of the case studies, the assumptions behind them and the expected benefits and incremental costs accruing from their use. The final section discusses the main issues to be considered in each case.

3.3.1 Case Study 1

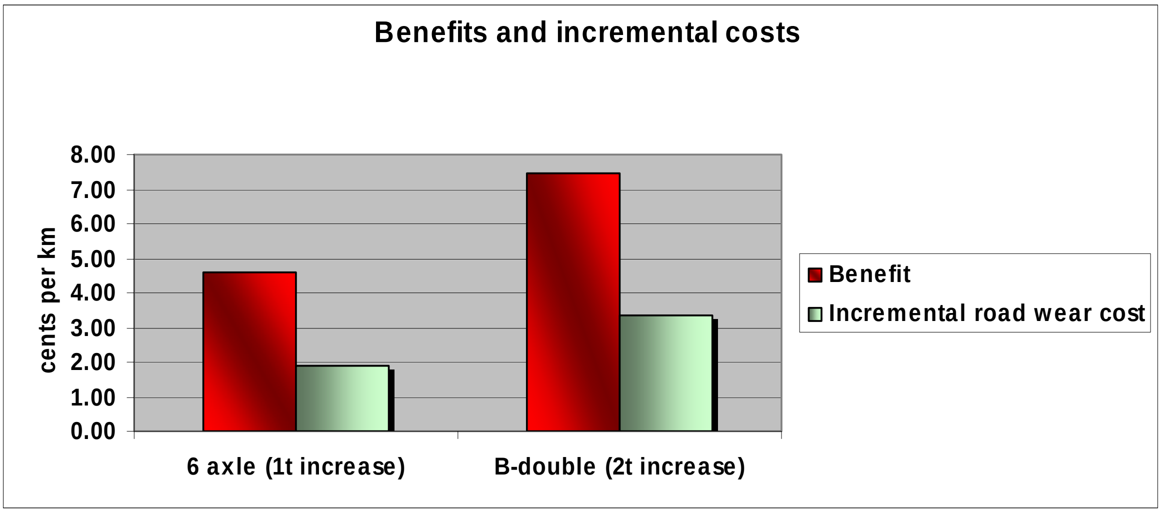
Under this application, an additional 1 tonne would be permitted on all triaxles. This would enable a general access 6- axle articulated truck to operate at 43.5 tonnes and a B-double could operate on B-double routes at 64.5 tonnes. A HML 6-axle articulated truck could operate at 46 tonnes on HML routes.

This case study assumes:

- no route restrictions for current general access vehicles and no additional route restrictions for B–doubles or HML vehicles;
- no adverse bridge effects due to the marginal increase in mass, so incremental costs are based on road wear only; and
- local and arterial roads are accessed.

The benefits and incremental costs associated with this case study are shown in Figure 1.

Figure 1. Benefits and incremental costs for Case Study 1



3.3.2 Case Study 2

This case study involves charging for vehicles with non-road friendly suspensions wishing to increase mass up to current HML levels. As the introduction of HML resulted in the need for additional bridge upgrading and monitoring, the issues involved in levying a charge for extra bridge wear cost are considered as well.

This case study assumes:

- participating vehicles are restricted to HML routes ; and
- some local roads are involved, but use is predominantly concerned with arterial roads as these roads form the majority of HML routes.

This case study explores issues about costing long-life asset upgrading as well as widely available mass increases on restricted routes.

Bridge Cost Estimates

The indicative bridge costs presented here are illustrative, rather than close estimates. They are based on the May 1996 NRTC report, *Mass Limits Review, Technical Supplement No.4 Operational, Financial and Charging Impacts*. This report provided much of the basis for the current HML system. While later work updated estimates of bridge costs associated with the introduction of HML, those estimates were incomplete (with no estimates available for those jurisdictions) and consequently are not able to be used.

The May 1996 study estimated bridge costs as follows: (see also Figure 2)

- 3 axle rigid truck - $23/per annum or less than 1 cent per km[1]
- 6 axle articulated truck -$1220/per annum or 2.7 cents per km[2]
- 9 axle B-double - $4900/per annum or 5.6 cents per km[3].

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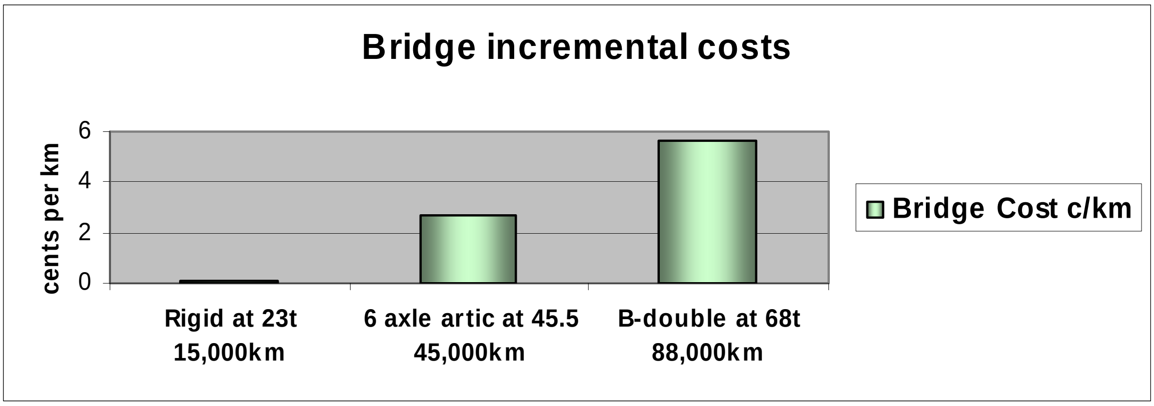
[1] Assumes the vehicle travels 15 000 km pa at the higher mass.
[2] Assumes the vehicle travels 45,000 km pa at the higher mass.

Figure 2. Benefits and incremental bridge costs for Case Study 2



The bridge costs detailed above are based on the following assumptions:

- mass increases of 0.5 tonnes on the tandem axle group of 3 axle rigid trucks, 3 tonnes on a 6 axle articulated truck[4] and 5.5 tonnes on 9 axle B–doubles[5];
- travel at higher mass is based on 2002 SMVU average travel for the vehicle class and an assumption that 50% of all travel is at the incremental mass level; and
- the 1995/1996 data used in the May 1996 report has been revised to 2001/02 money values using the BTRE Road Construction and Maintenance Price Index use to be more consistent with the ARRB June 2002 vehicle cost data used in the discussion paper.

The HML review found that while vehicles fitted with road–friendly suspensions operating at these masses would not lead to any additional pavement wear, some bridges would require upgrading. Different bridges are affected by different axle/vehicle configurations. Generally very short span structures (less than 8m) such as culverts will be the only structures affected by additional loads on tandem axles. Older short span bridges (8m to 13m spans) in poor condition would be affected by the additional load on a triaxle group. Medium span bridges (13m to 30m spans) would be affected by the gross mass of a single trailer combination. Longer span bridges (over 30m spans) would be impacted by the gross mass of a B-double, particularly if the bridge is older and in poor condition.

A major issue for estimating bridge costs is the timeframe over which the costs of bridge upgrades are amortised. Bridges can have a very long life of 60 to 100 years and required expenditure on bridge upgrades will therefore have benefits long into the future. Recovery of this expenditure could therefore be spread over a long period. This approach would mean road authorities would be out of pocket for some time. The illustrative estimates above are based on recovering the full amount of expenditure required (a total of $125 million in present value terms) over a relatively short period of around 6 years ($22.7 million per annum).

Clearly the period over which long–life asset upgrading is amortised would have a significant impact on both the level of charges to be obtained and the rate at which road authorities recover their expenditure over time. One approach to this problem suggested as part of the

[3] Assumes the vehicle travels 88,000 km pa at the higher mass.
[4] 0.5 tonnes on the tandem group and 2.5 tonnes on the triaxle group.
[5] 0.5 tonnes on the tandem group and 2.5 tonnes on each of the two triaxle groups.

HML background work was to set charges at an initially higher level and decrease them over time. This issue will arise with any incremental pricing application required to recover a large lump sum, up–front expenditure that has long–lived benefits.

A second difficulty with setting incremental prices for future infrastructure upgrading needs is that at the time the prices are determined, the expenditure is futuristic, in that it has not yet occurred. Estimating what this expenditure will be has its own difficulties.

For example, the bridge costs were originally based on relatively conservative theoretical engineering estimates and therefore could be considered to be at the high end of estimates. It is likely that, in practice, bridge upgrading needs have not proven to be as widespread as the theoretical analysis suggested. A further issue in this case study is how to allocate the bridge upgrading expenditure needs between vehicles. HML vehicles have not been charged for bridge upgrading at this stage. The costs of bridge upgrading are not increased if additional vehicles operate at the higher limits, but the benefits are shared over a larger number of vehicles. The simplest approach would be to estimate the take–up of both HML and vehicles operating under Case Study 2 and split the bridge expenditure between all vehicles.

3.3.2 Charges for vehicles with non-road friendly suspension systems wanting to operate at current HML mass limits

Additional benefits are estimated by assuming that the vehicles increase from 22.5 to 23.0 tonnes for a 3 axle rigid, from 42.5 to 45.5 tonnes for a 6 axle articulated vehicle and from 62.5 to 68 tonnes for a B–double (see Figures 3 and 4). The incremental cost will be based on incremental bridge costs and road wear costs using the NTC ESA based formulae.

Figure 3. Benefits and incremental road wear costs for Case Study 2

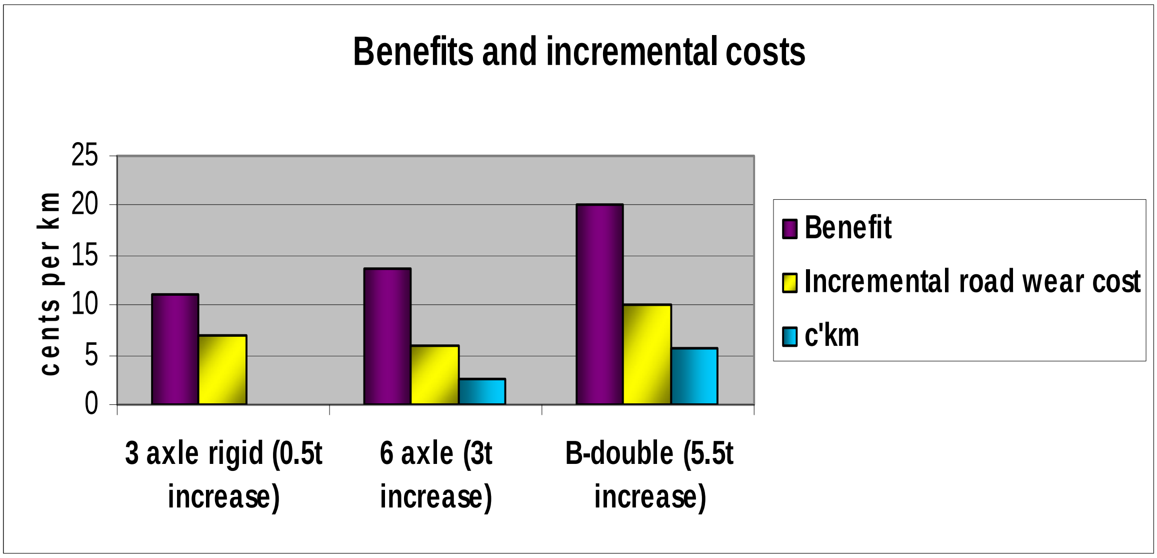
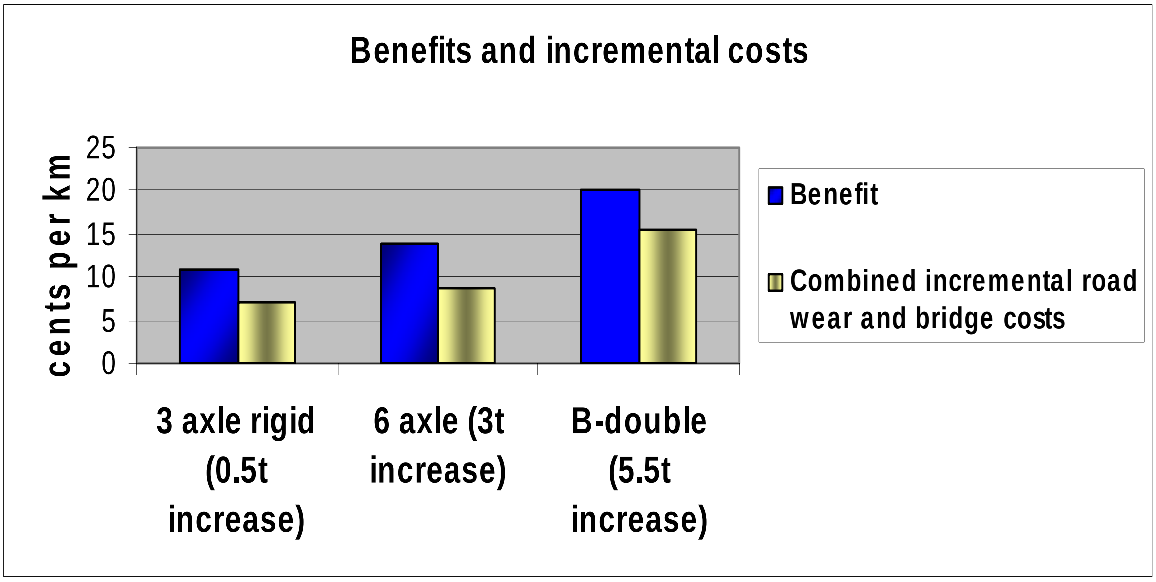


Figure 4. Benefits compared with combined incremental road wear and bridge costs for Case Study 2.



3.3.3 Case Study 3

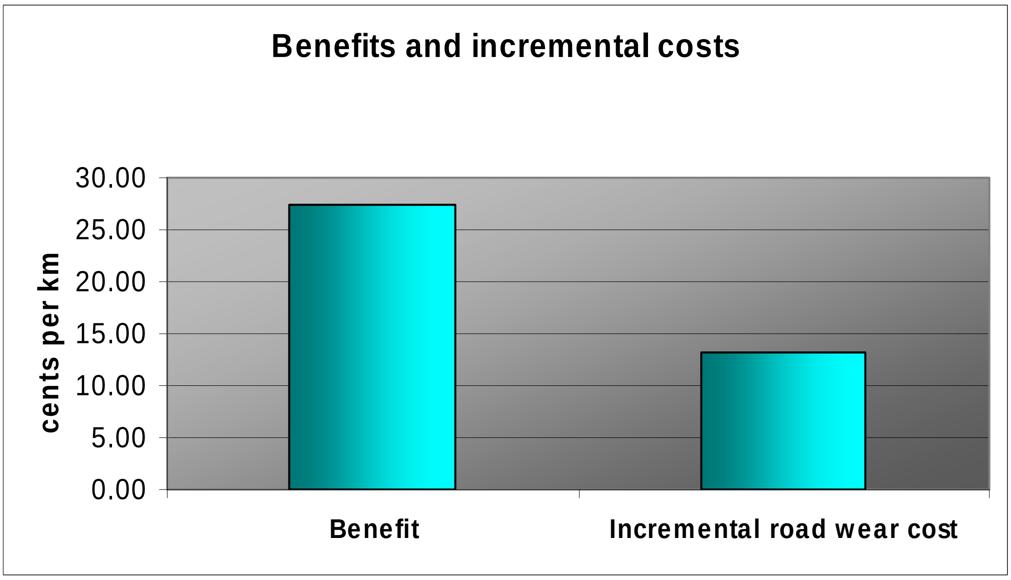
This case study involves a 6 tonne increase on a 6-axle articulated truck, based on a specific route eg. export container of fruit from somewhere to a railhead.

Assumptions that have been made are:

- no alternate routes exist that the vehicles involved could viably choose;
- the route has no bridge problems (that is, all structures on the route have been built to newer bridge design standards and are able to safely carry the additional load);
- the case study does not involve B-doubles as the route is not a B-double route;
- the route involves both arterial and local roads, so local councils involvement is necessary; and
- the 6 tonnes is spread over the vehicle, with 2 tonnes on the tandem axle and 4 tonnes on the tri-axle.

The benefits and incremental costs associated with this case study are shown in Figure 5.

Figure 5. Benefits and incremental costs for Case Study 3



3.4 Case Study Issues and Options

The following analysis outlines key aspects that need to be considered in setting up an incremental pricing system, possible options and discusses their feasibility for each of the three case studies.

3.4.1 Vehicle eligibility

Vehicles will only be eligible to operate in excess of standard mass limits if agreed safety standards are met.

Options for determining which vehicles are eligible to participate are:

(a) Individual vehicle performance assessment to show it meets PBS safety standards, but with the vehicle operating outside the formal PBS system.

(b) Fleet-wide vehicle assessments to show that the eligible class of vehicles meets the PBS safety standards, but with the vehicles operating outside the formal PBS system.

(c) Eligibility requirements are set within each scheme using incremental pricing as a cost recovery tool. Approved schemes are checked to ensure that a mechanism for ensuring safe operations have been identified. In some cases, previous experience might indicate that no further assessment of safety performance is necessary.

The three options for vehicle eligibility are based on satisfying the PBS safety standards, as this would be a basic requirement for jurisdictions to accept higher masses than are currently permitted. Option (a) is based on an individual assessment system for vehicles operating outside the PBS system. Option (b) is based on fleet-wide assessments examining worst case performance for a range of configurations outside of PBS. The marginal increase in mass for case 1 is expected to be very popular, with most of the 33,000 6 axle articulated trucks and 6000 B-doubles participating. Option (c), would seem to be the most practical for case study 1, given the small mass involved and recognising that a number of vehicles have operated without safety problems at similar masses under a variety of arrangements. Option (b) could also be a possibility for case study 1, but would not be as flexible as Option (a) given that it is fleet based. Option (a) would be very costly, for operators having assessments, and for administrators keeping track of the results.

Around 9000 vehicles operate within the HML system. With case study 2, it is expected that a fair proportion of vehicles with non-road friendly steel suspensions who mass-out would opt for operating at equivalent HML levels in exchange for payment of a charge, given the net benefit shown earlier in Figures 3 and 4. This would include heavier 3 and 4 axle rigid trucks that mass-out around 50,000 rigid trucks that are 18.0 tonne GVM and above.

For vehicles wanting to operate at HML equivalent mass levels, whilst subject to the same route restrictions as current HML vehicles, Option (c) would seem the most suitable. In considering the HML increases, fleet-wide analyses of safety performance were undertaken (Option (b)). A similar analysis is required for extending access to HML to non-road friendly vehicles in exchange for a charge. However, this analysis may identify some vehicle configurations or features that would not be able to safely operate[6]. If this were to occur, additional operating restrictions or limits on which vehicles are eligible may be needed. These are best determined as a set for the scheme, rather than individually for each vehicle or as part of the incremental pricing system. Options (a) and (b) are less appropriate for the same reasons given for case study 1.

With case study 3, overall participation is expected to be relatively small, due to the specific route nature of the case study. The 6 tonne increase is significant for a 6-axle articulated truck and mass levels of that extent are unlikely to have demonstrated an ability to operate without safety problems at similar masses under a variety of arrangements. Therefore Option (b) would not be appropriate, and a more stringent eligibility system would be required. Option (a) would be suitable as it is geared to accreditation of a particular vehicle. However, Option (c) would allow the safety issues involved to be investigated as part of the development of the scheme, thereby assessing whether the particular type of load to be carried has any general implications for safety that can be taken into account.

3.4.2 Determination of the Incremental Charge

Options for the way in which the charges apply under an incremental pricing system are:

(a) Additional road and bridge costs are calculated as a network average based on the aggregate costs used in the NTC's heavy vehicle pricing system.

(b) Additional road and bridge costs are calculated as a network average depending on broad classes of roads (for example, urban arterial, rural arterial, urban local and rural local roads) based on the aggregate costs used in determining the base heavy vehicle road use prices.

(c) Additional road and bridge costs specific to the routes being used to determine charges.

Options (a) and (b) are based on allocating government expenditure on road construction and maintenance across the whole network and deriving average unit values, whereas Option (c) would require obtaining specific information on whole of life costs, including road and bridge maintenance and construction, on specific routes.

[6] Under the HML analysis, the presence of road-friendly suspensions gave additional safety benefits in improving some aspects of vehicle stability, as well as reducing pavement wear. Some vehicles without these suspensions may not meet the PBS safety standards when operating at the same mass.

For case study 1 where access is network-wide, Option (a) would be the most appropriate. Option (b) would require location/route monitoring for individual vehicles to determine to what extent they use each of the road classes for which a different charge applies. However, this option has the benefit of more accurately reflecting the costs each road manager would incur by agreeing to the scheme, and provide greater potential for them to be compensated for these costs. Option (c) would also require location/route monitoring for individual vehicles along with complex estimates of costs for each link in the network. This option would therefore be inappropriate for the network–wide nature of case study 1.

A similar situation applies with case study 2. Again, either Option (a) or Option (b) would be the most appropriate, because although this case study involves restricted access to the road network, relatively wide spread use of the arterial road network is possible.

For case study 3, Option (c) would be the most appropriate as it is based on measuring road and bridge costs for specific routes and this case study is about access to a specific route. Options (a) or (b) could not be guaranteed to match the costs for the particular road involved as the aggregate approach is only applicable at a network level. Nevertheless, Option (c) is much more data intensive.

3.4.3 Mass Measurement

There are two reasons for wishing to monitor the mass of vehicles. The first relates to ensuring that the charge levied reflects the costs arising from use of the vehicle. The second relates to ensuring that the vehicle complies with the relevant operating conditions and is not overloaded. This latter issue is dealt with in section 3.4.7. In measuring mass as part of the process of establishing the appropriate charge for an individual vehicle, not only the quantum of the mass is needed, but how much of the time the vehicle operates at this mass.

Options for measurement of mass are:

(a) Dynamic vehicle based weighing using on-board measuring units.

(b) Participation in the National Heavy Vehicle Accreditation Scheme (NHVAS) mass management module, modified to include recording of mass for each trip and regular calculation and reporting of additional mass carried, backed up by independent auditing.

(c) Installation of weigh in motion devices on affected routes along with transponders on participating vehicles to allow them to be automatically identified by the weigh in motion devices.

(d) NTC-assessed mass levels by vehicle class, with no direct measurement of individual vehicle masses.

(e) Self declaration of the proportion of travel at different increments of the higher mass.

Mass measurement has a number of possibilities. Option (a) would involve an in-vehicle mass measurement unit. Electronic in-vehicle units are currently at a testing/experimental stage. Queensland has a test underway and the costs of the unit are around $20,000. There is no large scale use of these units in the world currently. The Intelligent Access Program considered incorporating these units in its Stage One, but found that they require ongoing adjustment and are not tamper evident at this point.

NHVAS requires accredited transport operators to maintain a record of mass and vehicle characteristics for each vehicle trip. This system could be modified to calculate how much additional mass has been carried, or as a compliance tool it can be used to ensure the vehicle does not exceed an agreed mass above the statutory limits.

Static road-side weighing sites are the most reliable methods of measuring vehicle mass, but require compliance staff to stop and direct a vehicle to a weighing facility for testing. This is unlikely to be feasible in most situations, given the small number of weighing facilities in operation. Weigh-in-motion systems have been under development for many years. The main problem from a pricing point of view is that such systems may not provide sufficient accuracy of measurement and are not situated at all locations across the road network. To make such facilities effective in measuring and recording masses of specific vehicles participating in an incremental pricing scheme, they would need to be combined with transponders on the vehicles to allow the weigh in motion device to identify individual vehicles.

Another possibility for the NTC is to make assessments of what masses are likely for participants within individual vehicle classes. Such an approach would assume all vehicles operate with a similar mass for the purposes of calculating charges to apply. This approach will be most suited to incremental pricing schemes where little variation in use of the incremental mass is involved.

A self declaration system would be relatively simple to administer, but would depend on an effective system of auditing and checking to be meaningful. Such a system would require frequent roadside enforcement and site checks to ensure the pattern of loading matched that declared. Increments of mass that are to be declared within the additional mass allowed in each incremental pricing scheme would need to be established.

For case study 1 a marginal additional mass is involved. Determining how often an individual vehicle operates within different increments of mass in the additional 1 tonne will provide only small changes to the amount to be charged. Consequently, a low cost system that can be measured for vehicles across the whole network and requires minimal additional enforcement effort is likely to be the most cost effective. Options that fit this requirement best are Options (d) and (e). Given the marginal tonnage increase and an expectation that this application would be very popular and utilised across a large proportion of the fleet, a system where the NTC determines a charge for a vehicle class based on an assumption about the proportion of travel that will occur at the incremental mass is likely to be sufficient. Other options would either be too expensive for a small mass increase, (Option (a)), or too limited in site availability, (Option (c)), or, administratively too costly for the additional recording required, (e.g. under NHVAS), for small mass increases.

In case study 2 there is a greater need for individual mass assessment due to the generally higher masses involved. At the same time, the ability to measure mass across much of the arterial road network is needed. NHVAS mass management (with recording of mass for each trip and regular calculation of additional mass carried) would potentially be the most attractive of the options. This approach is particularly attractive for this case study, as the HML operating requirements include NHVAS mass management accreditation for vehicles with triaxles, and a similar compliance requirement could be expected to form part of this scheme. Static or dynamic weigh-in-motion sites would be too limited in terms of the location availability. At this point in time, on-board weighing systems are considered too expensive and insufficiently tamper evident. Self declaration would be less feasible because of the relatively large numbers of vehicles involved with variable patterns of use. However, for rigid trucks with only an additional 0.5 tonnes allowed, NTC assessed mass levels would be an attractive low cost option.

For case study 3 with high additional mass along a specific route, self declaration would be a more viable approach provided there was a sufficiently robust mass compliance and audit system to back it up. Option (b) would also be appropriate for this case study.

3.4.4 Distance and location measurement

The purpose of measuring distance is to link the charges paid by an individual vehicle for incremental mass operations to the costs resulting from their vehicle use. Location measurement, where this travel occurs, is necessary if:

- charges vary by road type; and
- the amount of revenue that should be directed to each State, Territory and local government road manager is to be calculated directly from data on the use of their roads by vehicles in the incremental pricing scheme.

In addition, location may also need to be monitored to ensure compliance with route restrictions applying under the incremental pricing scheme. Clearly if location monitoring is necessary for compliance purposes, the additional costs involved in measuring where travel occurs will be reduced.

Options for assessing the distance to be charged and where travel has occurred are:

(a) A permit/declaration system, where operators would be required to apply to operate under a specific incremental pricing scheme and as part of their application declare what distance they will travel and where that travel will occur.

(b) Telematics (GPS based) using map referencing to monitor location and calculate distances travelled, based on information in electronic maps about distances between points.

(c) Gantries which record each time a vehicle passes a specific location on the road network. Gantries may be physical or virtual, and may use a variety of technologies to identify vehicles as they pass the gantry, including cameras (as in the London congestion charging scheme), DSRC (as in the Austrian heavy vehicle motorway scheme) or electronic transponders (as in the Melbourne Citylink tollway). Distance is measured by checking which gantries a vehicle passes across the network, where the distances between each pair of gantries is known.

(d) Hubodometers which are attached to the vehicle axle and record distance travelled as the axle rotates. Hubodometers on their own are not able to monitor location.

(e) NTC assessed distance by vehicle class, where the NTC makes an assumption about the likely distances to be travelled by vehicles in each incremental pricing scheme and where this travel would be expected to occur. Typical distances associated with each application would be assessed on approval of the application for use with incremental pricing. Users operating in that application would be assumed to travel the relevant distance. Different typical distances would be set for different applications. It implies that a register or approval system is required for applications using incremental pricing.

For case study 1, Option (e), may be sufficient, but is reliant on good aggregate information on road use, vehicle class and location being available. This approach is appropriate for case study 1, due to the large numbers of vehicles involved and the network-wide access concerned. The major difficulty is that an assessment of the use of all State, Territory and local government roads would need to be made and agreed. Once map referencing for the entire road network is undertaken, a telematics option (Option (b)) may be viable, but there is considerable cost and effort involved in map referencing. An advantage of this approach is that it is able to monitor both distance and where travel occurs.

A permit/declaration system (Option (a)) will be expensive to record, monitor and enforce, given the large numbers of vehicles expected to be involved. Gantries (Option (c)) are not suited to case study 1, as the cost of setting up gantries across the entire road network would be prohibitive. Hubodometers (Option (d)) provide a simple means of measuring distance for individual vehicles, but there is considerable effort involved in checking and recording distances over a large fleet. No location measuring is possible. Consequently, this option is not suited to case study 1.

A similar situation applies with case study 2. This case study also involves relatively large numbers of vehicles and access to a wide number of routes. Consequently, Options (e) and (b) would be the most suited to this case study.

The situation with case study 3, on the other hand, is quite different. There are small numbers of vehicles, and the route involved is highly restricted. As a result, Options (a) and (c) are more likely to be viable. NTC assessment (Option (e) and telematics Option (b)) would also be workable. The costs of gantry and telematics approaches would need to be carefully assessed. They may depend in part on the importance of location monitoring for compliance purposes.

3.4.5 System Operation

Options for administration of the incremental pricing arrangements are:

(a) Certified competing third party providers.

(b) Centralised government administration recognised by all jurisdictions.

(c) Administration by road authorities in each jurisdiction.

(d) Centralised third party certified jointly by all jurisdictions.

Option (b) may not be acceptable to State and Territory governments, but along with Options (a) and (c), has the advantage of ensuring vehicle operators only deal with a single administrator. Options (a) and (c) are particularly suited to a system where there is a significant data collection task as well as a revenue collection task, e.g. where telematics is used to measure distance and the same service provider arranges the exchange of money from the operator to the relevant road manager(s).

Case study 1 has large numbers of participants, small additional mass involved and no special route restriction. Consequently, government administration, either by individual jurisdictions or central government, would appear to be the most cost effective approach. This assumes that a flat fee is applied to all vehicles in the same class, rather than measuring individual masses and distances and varying the charge with individual use.

Option (c) may not be the easiest option. It assumes that either:

- operators will need to purchase incremental access from each jurisdiction; or
- mutual recognition of permits is needed (for cross jurisdictional activities) and mechanisms are established for exchanging money between jurisdictions and levels of government.

A further problem with Option (c) is that a mechanism for the State or Territory government to pass on revenues collected on behalf of local governments would need to be established.

Option (d) is the furthest from most current government revenue collection systems. It requires secure systems of funds transfer to be established, and raises a number of issues about the financial probity and potential for fraud which would need to be addressed in certifying third party service providers. However, it has the advantage of providing a single contact point for transport operators, and by combining charge calculations with data collection tasks, is likely to be administratively less costly.

3.4.6 Payment System

Options for the type of payment system used in incremental pricing are:

(a) Permit fee.

(b) Annual charge added onto existing heavy vehicle registration.

(c) Direct payment transaction technology.

The appropriate option depends on the distance and mass measurement system that has been selected. Options for mass and distance measurement that record the use of individual vehicles will allow charges levied to vary with use, (ie. variable charges). Options such as using a NTC assessment of the likely distance travelled, which mean a common estimate of use will be used across a class or group of vehicles, indicate that a flat price will be levied.

Options (a) and (b) are most suited to a flat fee, while Option (c) is most suited to a variable charge.

If a measuring tool is developed to allow for variable charges, then regular payments would be paid through a separate, direct mechanism (probably using third parties who would arrange for the money to be forwarded to road managers). It would be necessary to record receipts of payments on registration databases (or NEVDIS at least) to allow compliance checks to be made, ie. road-side checks would be needed to make sure that vehicles meet the relevant operating conditions and have paid the correct charge.

The distinction between Options (a) and (b) is essentially one of the administrative arrangements for how the payment is processed. There may be greater flexibility with a permit fee to apply for a short term or to vary some separate characteristic of the vehicle than what applies in the current registration system.

Consequently for case study 1, where mass and distance measurement are not essential given the small increments and wide application, Options (a) and (b) are probably suitable. The most likely lowest cost approach for the large numbers involved in case study 1 is Option (b).

Option (a) would be more suited to applications where some difference in charges is needed between vehicles in the same class, such as occurs with case study 2.

A direct payment approach (Option (c)) may be more suited to case study 3. In this case, a registration charge will be difficult to apply, as the amount to be charged is more likely to be a variable amount that is dependent on the use of the individual vehicle.

There is also a need to provide for a payment mechanism for ad hoc users. For example, a truck that normally operates under an incremental pricing scheme may be off the road for some reason (maintenance, repairs, etc) and a substitute is used that is not normally part of the system. Some means of providing for the substitute vehicle and ensuring the correct charge is levied is needed.

3.4.7 Compliance and Audit

Compliance and audit will be important aspects of incremental pricing schemes for two reasons:

1. to ensure that the vehicle is paying the correct charge; and
2. to ensure that the vehicle meets the relevant operating conditions, such as route restrictions or conditions applied to ensure a safe operation.

Compliance and audit options central to incremental pricing may be considered in two groups: those relating to mass measurement and those relating to distance and location. Options are:

Mass related

(a) On-board vehicle weighing.

(b) Accreditation to mass management under NHVAS.

(c) Weigh–in–motion linked to vehicle identification.

(d) Road–side enforcement and site checks.

Distance and location

(e) Telematics.

(f) Road-side enforcement and site checks (location only).

The approach to compliance and audit and the approach to mass, distance and location measurement are closely linked.

Under case study 1, general access is available, so location monitoring is not an essential feature. If a flat fee is to apply, not based on individual vehicle use (for either mass or distance), current road-side enforcement approaches may be sufficient for this case study, as the main concern will be that the vehicle is not overloaded (that is, above the additional tonne provided for in the case study).

In case study 2, it is likely that participating vehicles would be required to be accredited to mass management under NHVAS, in line with road–friendly vehicles operating in HML. Assuming the distance travelled is not directly measured, no further monitoring of distance is required. However, some location monitoring arrangements might be necessary to ensure vehicles comply with route restrictions, suggesting that option (e) might be considered further.

Mass, distance and location monitoring may all be important compliance considerations in case study 3. For this case study, options (b) or (c) and (e) may be the most cost effective.

3.4.8 Comments Sought

Based on the case studies discussed, the NTC is seeking responses to the following questions.

Comments are sought on:

Q5. Who should operate the system?

Q6. What should the rate of incremental charge cover?

Q7. How should mass be measured?

Q8. How should distance and location be measured?

Q9. Who should receive the revenue?

Q10. How should compliance and audit be addressed?

3.4 Summary of What the System Might be Like

Based on the applications described in the above case studies, an incremental pricing system could have the following preferred characteristics;

- For all three case studies, vehicle eligibility requirements that are set within each scheme using incremental pricing as a cost recovery tool appear to be the most suitable. Under this proposal, approved schemes would be checked to ensure that a mechanism for ensuring safe operations has been identified.
- To determine incremental charges a system based on additional road and bridge costs, calculated as a network average using aggregate costs used in the NTC's base heavy vehicle pricing system would appear to be the most suitable for case studies 1 and 2. However, a system that could differentiate between major road types would be preferable if location/route monitoring for individual vehicles was available. In case study 3 the optimum would be a system that could measure the specific route costs, although the data requirements could be prohibitive.
- For mass measurement, participation in the National Heavy Vehicle Accreditation Scheme (NHVAS) mass management would be the most suitable for case study 2 and 3. This assumes that NHVAS is modified to include recording of mass for each trip and regular calculation and reporting of additional mass carried, backed up by independent auditing. However, for marginal increases in mass used on a widespread basis across the network, either an NTC assessed mass level scheme by vehicle class or self declaration of the proportion of travel at different increments of the higher mass would be suitable such as for case study 1.

- With distance and location measurement an NTC assessed distance by vehicle class scheme could prove to be the most effective. In this scheme the NTC would make an assumption about the likely distances to be travelled by vehicles in each incremental pricing scheme and where this travel would be expected to occur. Such a scheme would be reliant on good information on road use, vehicle class and location being available. Alternatively, if telematics (GPS based) scheme using map referencing to monitor location and calculate distances is available this would be preferable, but would have a considerable set-up cost. For case study 3, which would have only a small number of vehicles involved, a permit/declaration system would be the most suitable.

- There are no easy answers in terms of who should best operate the incremental pricing system. A system of administration by road authorities may be the most acceptable to jurisdictions but there are a number of difficulties. These problems include operators crossing jurisdictions having to purchase incremental access from each jurisdiction, and the need for mutual recognition of permits and mechanisms for passing on revenues collected on behalf of local councils. Options involving certified third party service providers would be the most effective for transport operators to deal with, and for returning revenue to relevant road managers. However they depend on a telematic based system being available to measure incremental use.

- The payment system used depends on the distance and mass measurement system that has been selected. If as described above an NTC assessed system is used across all three case studies, then a flat price would be required and therefore either a permit fee or an annual charge would be suitable. The permit fee would be particularly relevant to case study 2 where some difference in charges is required across vehicle classes. A direct payment approach would be more suitable for case study 3, due to the need to have a more variable charge to suit individual vehicle circumstances.

- The approach to compliance and audit and the approach to mass, distance and location measurement are closely linked. For case study 1, (general access case with a flat fee) current road side enforcement and site checks may be sufficient. In case studies 2 and 3 (which could operate under NHVAS in terms of mass measurement), compliance and audit would be through NHVAS itself. Telematics could also be used to provide route compliance.

4. EVALUATION OF AN INCREMENTAL PRICING SYSTEM BASED ON HIGHER MASS

The following evaluation explores whether incremental pricing is likely to be viable. This is not intended to be an in-depth assessment of an incremental pricing application and the charges that would apply, but rather a broad estimation to check that the benefits are likely to exceed the costs. This example is based on an incremental pricing system that allows higher mass limits above current NTC statutory limits in exchange for payment of an incremental charge over and above normal vehicle registration charges.

Three vehicle types have been modelled in this report, 3 axle heavy rigid trucks (over 20 tonnes GVM), 6 axle articulated trucks and 9 axle B-double trucks. Incremental mass increases are based on increased tonnages above current NTC mass limits which in the case of 3 axle rigid trucks is 22.5 tonnes GVM, for 6 axle articulated trucks 42.5 tonnes GVM and for 9 axle B-doubles 62.5 tonnes GVM.

4.1 Assumptions Behind the Cost and Benefit Estimates

The effect on vehicle operating costs and road user costs have been modelled based on ARRB Transport Research Ltd estimates for June 2002 using the Austway and HDM 4 models (see Appendix 2 for further details).

The analysis in this chapter is based on the following assumptions:

- that all three vehicle types over a one year period will travel 50% of the distance with the incremental mass, 25% of travel will be partly loaded (50% of the normal mass limit) and 25% unloaded;
- annual travel is assumed to be 80% on flat road, 15% on undulating and 5% on hilly/curvy; and
- the base mass is 22.5 tonnes GVM for 3 axle rigid trucks is 42.5 tonnes GVM for 6 axle articulated trucks and 62.5 tonnes GVM for 9 axle B-doubles.

The benefits in this report are based on assuming that the incremental mass will allow an operator to reduce the overall trips required to move the same amount of mass over a 12 month period, therefore increasing productivity and reducing the costs that otherwise would have been incurred. The gross benefit to the operator is then taken as a percentage of the load factor after the increment, compared to the load factor at the NTC mass limit. For example, for a 6 axle articulated truck wanting to carry an additional 5 tonnes above the normal mass limit of 42.5 tonnes such that the net load (relative to tare) increases from 27.1 tonnes to 32.1 tonnes will equal a gross benefit of (32.1/27.1) =18.5%. This gross benefit is then adjusted to take into account additional costs from carrying the extra mass such as higher fuel costs. The adjusted benefit is what is shown in Figures 6 to 8.

4.2 Deriving Incremental Charges

The incremental costs used in this report are based on the NTC method of deriving pavement costs for heavy vehicles. This method is based on research by ARRB Transport Research Ltd that showed that some forms of road wear (major forms of pavement wear requiring reconstruction or rehabilitation) are related to the Equivalent Standard Axle (ESA) 4^{th} power rule, in which the cost of road wear caused by the type of vehicle is dependent on its operating mass and axle composition. ARRB Transport Research Ltd's work showed other pavement costs (routine and periodic maintenance) are related to gross mass tonne-km.

Unit costs in the ESA calculations used in this report are based on estimates used in the 2nd Determination for cents per ESA-km and cents per Average Gross Mass (AGM) tonne-km. These estimates have been updated from 2000 to 2002 money values to match the cost data used in this report. The BTRE road construction and maintenance index was used to update these values for the time being as these numbers have yet to be re-estimated as part of the 3rd Determination.

The revised cents per ESA-km and cents per Average Gross Mass (AGM) tonne-km are then applied to the ESA formula which compares the difference between ESA estimates at the normal mass limit relative to the standard mass limit with the ESA estimate at the incremental mass level compared to the standard mass limit. The AGM figures are applied to separate estimates of AGM, and the net difference in the two provides the net ESA factor at the incremental mass level. This is then used to derive an ESA cost in c/km to which is added the extra cost derived from multiplying the extra tonnes by the cents per Average Gross Mass (AGM) tonne-km. The sum of these two numbers provides the incremental charge applicable in c/km.

The incremental costs are only incurred when the vehicle is operating at that higher mass level which in this analysis means the 50% of travel undertaken at the incremental mass level. No extra cost is assumed to be incurred at the normal mass limit or lower.

The question of whether this 4th power rule is an appropriate measure has been the topic of considerable debate since it emerged from tests done in the United States in the 1950's. However, it is generally regarded as appropriate for the unbound granular pavements that make up 90 to 95% of Australia's road network. It is thought likely that a higher exponent should apply for the other pavement types that make up the rest of the network. Exponents from five for deep asphalt pavements and up to twelve for concrete or stabilised granular pavements have been suggested. Until adequate research on axle load equivalency identifies the appropriate exponents to be used for different pavement types in Australia, this issue will not be fully resolved.

A discussion of the relationship between the 4th power rule used in incremental pricing, and the 12th power rule utilised in the PBS system will be incorporated in the recalculation of heavy vehicle charges.

The nature of the incremental cost calculation is that net productivity benefits will accrue up to a certain point. This is shown by Figure 1 for a 3 axle rigid truck where due to the ESA 4th power rule, as mass increases, the pavement costs under the present formulae will eventually increase sharply and absorb all of the potential benefit, which in this case is at the level of 9 tonnes above the current mass limit level of 22.5 tonnes for a triaxle.

Figure 6, shows that for 3 axle rigid trucks there is a surplus or net benefit to be gained from incremental tonnages between 1 and 8 tonnes above current NTC mass limits, with the net benefit maximised at around the 4 to 5 incremental tonne level at around 5.7 cents/km.

Figures 7 and 8 show the relative incremental charges and benefits that would apply to 6 axle articulated trucks and 9 axle B-doubles. Estimates of the point at which the net benefit is eliminated for these two vehicle types are not currently available due to a lack of road user cost estimates above the 12 tonne increment level. However, what is clear is that both vehicle types can utilise additional mass above current mass limits and not have the incremental charge applicable eliminating any benefit that is derived.

Figure 6. Incremental charging effects on 3 axle rigid trucks over 20 tonnes GVM

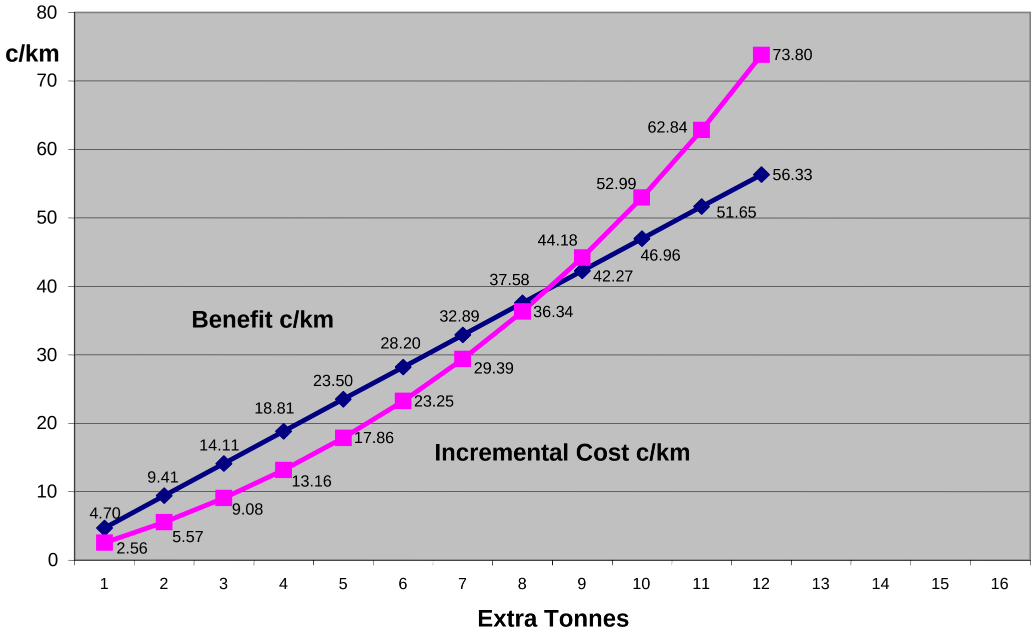


Figure 7. Incremental charging effects on 6 axle articulated trucks

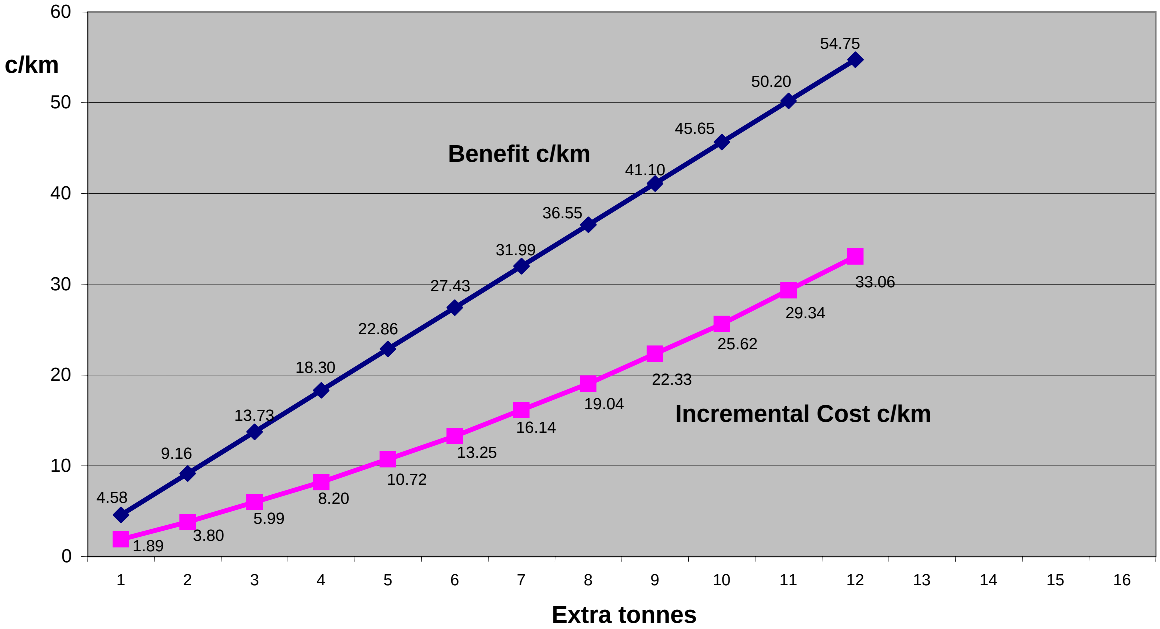
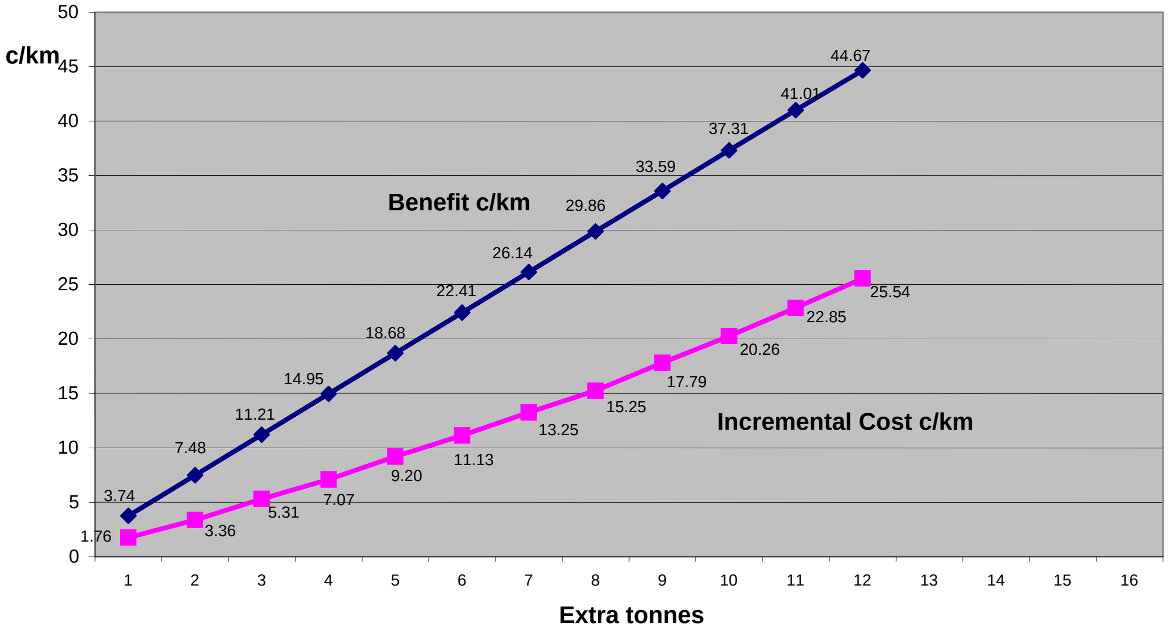


Figure 8. Incremental charging effects on 9 axle B-double trucks



5. CONCLUSION

This preliminary evaluation indicates that it is apparent that individual road user pricing systems for heavy vehicles that are operating or planned in Europe and the UK are not viable options for Australia to adopt within the time frame of the 3rd Determination. However, there are prospects for at least incremental pricing for heavy vehicles over the medium term, which allow vehicle operators the choice of paying an additional fee to allow additional access and/or mass than is currently permitted. For operators with vehicles that are not volume or mass constrained, there are indicative benefits from incremental pricing compared to the relative level of incremental heavy vehicle charge that would equate to the higher mass level (up to a given point).

This report is only the first step in establishing net benefits, and whether incremental pricing is viable depends on both the associated administrative costs and the confidence with which marginal road damage can be estimated.

Establishing a national incremental pricing scheme, apart from productivity benefits through higher mass, would provide a nationally consistent framework and pricing mechanism for existing systems and could provide a basis for recovery of charges back to road owners who undertake the actual road expenditure.

The next steps will be to explore the costs of the various implementation options and compare them to the benefits.

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APPENDIX 1

2002 Heavy Vehicle Data by Classification, Distance Travelled and Fuel Consumption

Heavy Vehicle Classes		Number of Vehicles	Distance Travelled		Fuel Consumption -all types			Tonnes kilometres	
			total vkt	vkt/vehicle	total litres	litres/vkt	l/100km	total tonne kms	tonne kms/vehicle
Rigid	Rigid trucks: 2 axle: no trailer: GVM 4.5 to 7.0 tonne	49,426	732,807,000	14,826	146,441,000	0.1998357	19.98	3,050,256,000	61,714
	Rigid trucks: 2 axle: no trailer: GVM 7.0 to 12.0 tonne	84,912	1,739,934,000	20,491	399,459,000	0.2295828	22.96	11,692,882,000	137,706
	Rigid trucks: 2 axle: no trailer: GVM over 12.0 tonne	47,916	1,069,533,000	22,321	312,140,000	0.2918470	29.18	11,295,748,000	235,741
	Rigid trucks: 2 axle: with trailer: GCM to 12.0 tonne	2,613	39,467,000	15,104	7,290,000	0.1847113	18.47	232,500,000	88,978
	Rigid trucks: 2 axle: with trailer: GCM over 12.0 tonne	7,103	208,168,000	29,307	60,228,000	0.2893240	28.93	3,014,090,000	424,340
	Rigid trucks: 3 axle: no trailer: GVM 4.5 to 7.0 tonne	256	3,693,000	14,426	1,321,000	0.3577038	35.77	16,625,000	64,941
	Rigid trucks: 3 axle: no trailer: GVM 12.0 to 15.0 tonne	631	11,726,000	18,583	4,292,000	0.3660242	36.60	125,525,000	198,930
	Rigid trucks: 3 axle: no trailer: GVM 15.0 to 18.0 tonne	2,098	39,060,000	18,618	15,379,000	0.3937276	39.37	448,632,000	213,838
	Rigid trucks: 3 axle: no trailer: GVM over 18.0 tonne	34,402	1,036,161,000	30,119	431,317,000	0.4162645	41.63	16,497,607,000	479,554
	Rigid trucks: 3 axle: with trailer: GCM over 18.0 tonne	9,553	601,850,000	63,001	296,152,000	0.4920695	49.21	17,937,704,000	1,877,704
	Rigid trucks: 4 axle: no trailer: GVM 15.0 to 25.0 tonne	2,611	34,987,000	13,400	16,035,000	0.4583131	45.83	603,451,000	231,119
	Rigid trucks: 4 axle: no trailer: GVM over 25.0 tonne	4,369	160,336,000	36,699	77,368,000	0.4825367	48.25	3,118,303,000	713,734
	Rigid trucks: 4 axle: with trailer	1,655	117,772,000	71,161	62,630,000	0.5317902	53.18	3,892,396,000	2,351,901
Articulated	Articulated trucks: no trailer	264	192,000	727	103,000	0.5364583	53.65	1,779,000	6,739
	Articulated trucks: single trailer: 3 axle rig	1,352	27,143,000	20,076	16,530,000	0.6089968	60.90	405,943,000	300,254
	Articulated trucks: single trailer: 4 axle rig	4,444	217,614,000	48,968	77,129,000	0.3544303	35.44	5,043,056,000	1,134,801
	Articulated trucks: single 3 axle trailer: 5 axle rig	1,581	96,142,000	60,811	43,837,000	0.4559610	45.60	2,760,995,000	1,746,360
	Articulated trucks: single 2 axle trailer: 5 axle rig	5,454	265,757,000	48,727	130,635,000	0.4915581	49.16	6,983,590,000	1,280,453
	Articulated trucks: single trailer: 6 axle rig	32,562	2,932,424,000	90,057	1,468,856,000	0.5009016	50.09	96,765,156,000	2,971,720
B-Double	Articulated trucks: B-double: < 8 axle rig	388	69,259,000	178,503	37,009,000	0.5343565	53.44	2,754,650,000	7,099,613
	Articulated trucks: B-double: 8 axle rig	791	144,486,000	182,662	81,893,000	0.5667885	56.68	6,758,367,000	8,544,080
	Articulated trucks: B_double: 9 axle rig	4,994	882,977,000	176,808	514,285,000	0.5824444	58.24	45,876,677,000	9,186,359
	Articulated trucks: B-double: > 9 axle rig	60	9,404,000	156,733	5,653,000	0.6011272	60.11	476,114,000	7,935,233
Road Train	Articulated trucks: Road train: 2 trailers	3,163	416,101,000	131,553	278,702,000	0.6697941	66.98	24,889,629,000	7,868,994
	Articulated trucks: Road train: 3 trailers	1,282.00	210,421,000	164,135	167,539,000	0.7962086	79.62	17,996,088,000	14,037,510
	Articulated trucks: > 6 axle rig (not elsewhere classified)	1323	145,671,000	110,107	96,179,000	0.6602481	66.02	7,971,107,000	6,025,024
	Articulated trucks: <= 6 axle rig (not elsewhere classified)	287	7,004,000	24,404	3,981,000	0.5683895	56.84	211,152,000	735,721
(Other)	Other trucks	16,403	229,760,000	14,007.19	58,756,000	0.2557277	25.57	N/A	N/A
Buses	Buses: 2 axle: GVM 3.5 to 4.5 tonne	4,575	73,679,000	16,104.70	11,147,000	0.1512914	15.13	N/A	N/A
	Buses: 2 axle: GVM 4.5 to 10.0 tonne	10,919	304,190,000	27,858.78	60,833,000	0.1999836	20.00	N/A	N/A
	Buses: 2 axle: GVM over 10.0 tonne	18,031	750,392,000	41,616.77	289,547,000	0.3858610	38.59	N/A	N/A
	Buses: 3 axle	2,900	180,370,000	62,196.55	66,257,000	0.3673394	36.73	N/A	N/A
	Buses: articulated	168	7,487,000	44,565.48	3,764,000	0.5027381	50.27	N/A	N/A
(Other)	Buses: other	14	1,707,000	121,928.57	444,000	0.2601054	26.01	N/A	N/A
Total		**358,500**	**12,767,674,000**		**5,243,131,000**		**Average: 43.37**	**290,820,022,000**	**(N/A - Not available)**

Source: 2002 ABS Survey of Motor Vehicle Use

APPENDIX 2

The following four tables contain ARRB Transport Research Ltd estimates of the effect on vehicle operating costs and road user costs of incremental increases in mass in above current NTC mass limits for three different road and vehicle types.

The costs include:

Vehicle Operating Costs=
fuel+
direct labour+
oil+
vehicle maintenance+
tyres

Road User Costs=
vehicle operating costs+
a capital charge (vehicle purchase, depreciation or hire)+
administration+
indirect labour+
normal registration+
vehicle insurances

The estimates were derived from use of both the Austway model and the HDM 4 model and are based on non-urban travel.

The first of the four tables provides a summary of road user cost effects based on additional mass, assuming that vehicles over a 12 month period travel 80% of all distance travelled on flat roads, 15% on undulating and 5% on hilly and curvy roads. The increments for the 6 axle articulated truck and the B-Double are based on increments of 1 tonne each, whereas the heavy rigid estimates are based on increments of half a tonne each.

Total Road User Cost (June 2002) Market Prices

Mass in tonnes	Heavy Rigid in $/000km	6 axle artic in $/000km	B-Double 9 axle in $/000km
Fully loaded	1,219.62	1,338.51	1,608.66
Increment 1	1,221.37	1,342.10	1,612.82
Increment 2	1,223.13	1,345.74	1,617.01
Increment 3	1,224.92	1,349.40	1,621.22
Increment 4	1,226.70	1,353.09	1,625.45
Increment 5	1,228.52	1,356.82	1,629.71
Increment 6	1,230.36	1,360.57	1,633.99
Increment 7	1,232.21	1,364.35	1,638.25
Increment 8	1,234.08	1,368.17	1,642.57
Increment 9	1,235.97	1,372.01	1,646.91
Increment 10	1,237.87	1,375.88	1,651.27
Increment 11	1,239.56	1,380.22	1,655.85
Increment 12	1,241.27	1,384.71	1,660.81
Increment 13	1,243.88	1,387.47	1,664.52
Increment 14	1,245.19	1,391.64	1,668.93
Increment 15	1,247.51	1,395.78	1,673.89
Increment 16	1,249.33	1,399.29	1,677.03

NTC estimates based on ARRB Transport Research Ltd data

Load State	GVM (Kg)	Fuel Consum (Variable Speed) litres/100km	Fuel Cost $ '000/km	Crew Costs $ '000/km	Total VOC $ '000/km	Total RUC $ '000/km	Travel Speed km/h
Flat Straight Road (1% average grade, Curvature 10 deg km, MRS 11(Undivided 3.9m), Roughness = 50							
Tare (unladen)	10000	40.0	342.0	199.4	967.6	1167.0	101.4
Quarter Load	13125	41.0	350.8	201.0	971.8	1172.8	100.6
Half Load	16250	42.0	359.0	202.9	978.1	1181.0	99.7
Three Quarter Load	19375	42.9	366.7	205.2	985.3	1190.5	98.5
Fully Laden	22500	43.7	374.0	207.9	993.0	1200.9	97.3
Increment 1	23000	43.9	375.2	208.4	994.3	1202.7	97.0
Increment 2	23500	44.0	376.3	208.9	995.6	1204.5	96.8
Increment 3	24000	44.1	377.4	209.3	996.9	1206.2	96.6
Increment 4	24500	44.3	378.6	209.8	998.2	1208.1	96.4
Increment 5	25000	44.4	379.7	210.3	999.5	1209.9	96.1
Increment 6	25500	44.5	380.8	210.9	1000.9	1211.7	95.9
Increment 7	26000	44.7	381.9	211.4	1002.2	1213.6	95.6
Increment 8	26500	44.8	383.0	211.9	1003.6	1215.5	95.4
Increment 9	27000	44.9	384.1	212.5	1004.9	1217.4	95.2
Increment 10	27500	45.0	385.2	213.0	1006.3	1219.3	94.9
Increment 11	28000	45.2	386.3	213.6	1007.7	1221.3	94.7
Increment 12	28500	45.3	387.4	214.2	1009.1	1223.3	94.4

Load State	GVM (Kg)	Fuel Consum (Variable Speed) litres/100km	Fuel Cost $ '000/km	Crew Costs $ '000/km	Total VOC $ '000/km	Total RUC $ '000/km	Travel Speed km/h
Undulating Road (3% average grade, Curvature 120 deg km, MRS 11(Undivided 3.9m) , Roughness =85							
Tare (unladen)	10000	35.2	301.0	233.3	961.8	1195.1	86.7
Quarter Load	13125	36.7	313.7	238.1	977.7	1215.8	84.9
Half Load	16250	37.6	321.7	245.2	991.8	1237.0	82.5
Three Quarter Load	19375	41.0	350.1	254.7	1028.8	1283.5	79.4
Fully Laden	22500	44.3	378.7	266.1	1067.9	1334.0	76.0
Increment 1	23000	44.8	383.3	268.0	1074.4	1342.5	75.4
Increment 2	23500	45.4	388.0	270.0	1081.0	1351.0	74.9
Increment 3	24000	45.9	392.7	272.0	1087.6	1359.7	74.3
Increment 4	24500	46.5	397.5	274.1	1094.4	1368.4	73.8
Increment 5	25000	47.1	402.3	276.1	1101.1	1377.3	73.2
Increment 6	25500	47.6	407.1	278.2	1108.0	1386.2	72.7
Increment 7	26000	48.2	412.0	280.4	1114.9	1395.3	72.1
Increment 8	26500	48.8	416.9	282.5	1121.9	1404.4	71.6
Increment 9	27000	49.3	421.8	284.7	1128.9	1413.6	71.0
Increment 10	27500	49.9	426.8	286.9	1136.0	1422.9	70.5
Increment 11	28000	50.5	431.8	289.1	1143.2	1432.3	69.9
Increment 12	28500	51.1	436.8	291.3	1150.4	1441.7	69.4

Load State	GVM (Kg)	Fuel Consum (Variable Speed) litres/100km	Fuel Cost $ '000/km	Crew Costs $ '000/km	Total VOC $ '000/km	Total RUC $ '000/km	Travel Speed km/h
Hilly/Curvy Road (5% average grade, Curvature 120 deg km, MRS 11(Undivided 3.9m), Roughness =100							
Tare (unladen)	10000	36.6	313.2	295.1	1056.3	1351.4	68.5
Quarter Load	13125	43.3	370.6	301.6	1128.7	1430.3	67.0
Half Load	16250	49.3	421.8	314.4	1199.4	1513.8	64.3
Three Quarter Load	19375	55.0	470.3	332.8	1271.7	1604.5	60.8
Fully Laden	22500	60.8	520.2	354.5	1348.6	1703.1	57.0
Increment 1	23000	61.8	528.4	358.2	1361.3	1719.5	56.4
Increment 2	23500	62.8	536.7	362.0	1374.2	1736.1	55.9
Increment 3	24000	63.7	545.0	365.8	1387.2	1753.0	55.3
Increment 4	24500	64.7	553.3	369.2	1399.8	1769.0	54.8
Increment 5	25000	65.7	561.8	372.9	1413.0	1785.9	54.2
Increment 6	25500	66.7	570.3	376.7	1426.2	1802.9	53.7
Increment 7	26000	67.7	578.9	380.6	1439.5	1820.0	53.1
Increment 8	26500	68.7	587.5	384.4	1452.8	1837.3	52.6
Increment 9	27000	69.7	596.2	388.3	1466.3	1854.6	52.1
Increment 10	27500	70.7	604.9	392.2	1479.8	1872.0	51.6
Increment 11	28000	71.8	613.7	396.1	1493.4	1889.5	51.0
Increment 12	28500	72.8	622.5	400.0	1507.1	1907.1	50.5

Load State	GVM (Kg)	Fuel Consump (Variable Speed) litres/100km	Fuel Cost $ '000/km	Crew Costs $ '000/km	Total VOC $ '000/km	Total RUC $ '000/km	Travel Speed km/h
Flat Straight Road (1% average grade, Curvature 10 deg km, MRS 11(Undivided 3.9m), Roughness = 50 NRM, n							
Tare (unladen)	15400	50.0	400.2	201.8	1008.9	1210.6	103.8
Quarter Load	22190	52.7	421.6	203.0	1026.9	1229.8	103.2
Half Load	28960	55.3	442.0	204.9	1047.4	1252.2	102.2
Three Quarter Load	35730	57.6	461.1	207.6	1068.7	1276.3	100.9
TWU Load (23t)	*38500*	*58.6*	*468.4*	*209.0*	*1077.6*	*1286.6*	*100.2*
Fully Laden	42500	59.8	478.7	211.3	1090.5	1301.8	99.1
Increment 1	43500	60.2	481.2	212.0	1093.7	1305.7	98.8
Increment 2	44500	60.5	483.7	212.6	1097.0	1309.6	98.5
Increment 3	45500	60.8	486.2	213.3	1100.3	1313.6	98.2
Increment 4	46500	61.1	488.6	214.0	1103.5	1317.6	97.8
Increment 5	47500	61.4	491.0	214.8	1106.9	1321.6	97.5
Increment 6	48500	61.7	493.4	215.5	1110.2	1325.7	97.2
Increment 7	49500	62.0	495.8	216.3	1113.5	1329.8	96.8
Increment 8	50500	62.3	498.2	217.1	1116.9	1333.9	96.5
Increment 9	51500	62.6	500.6	217.9	1120.2	1338.1	96.1
Increment 10	52500	62.9	502.9	218.7	1123.6	1342.4	95.7
Increment 11	53500	63.2	505.3	219.6	1127.1	1346.6	95.4
Increment 12	54500	63.5	507.6	220.5	1130.5	1351.0	95.0

Load State	GVM (Kg)	Fuel Consump (Variable Speed) litres/100km	Fuel Cost $ '000/km	Crew Costs $ '000/km	Total VOC $ '000/km	Total RUC $ '000/km	Travel Speed km/h
Undulating Road (3% average grade, Curvature 120 deg km, MRS 11(Undivided 3.9m) , Roughness =85 NRM, n							
Tare (unladen)	15400	38.8	310.5	269.6	1035.1	1304.7	77.7
Quarter Load	22190	48.0	383.9	271.8	1118.1	1389.8	77.1
Half Load	28960	56.8	454.4	277.6	1203.4	1481.0	75.4
Three Quarter Load	35730	65.0	520.1	289.2	1291.1	1580.3	72.4
TWU Load (23t)	*38500*	*68.3*	*546.2*	*295.6*	*1328.2*	*1623.7*	*70.8*
Fully Laden	42500	73.0	584.0	305.9	1383.4	1689.3	68.4
Increment 1	43500	74.2	593.5	308.7	1397.5	1706.2	67.8
Increment 2	44500	75.4	603.1	311.5	1411.8	1723.3	67.2
Increment 3	45500	76.6	612.7	314.4	1426.1	1740.5	66.6
Increment 4	46500	77.8	622.3	317.3	1440.6	1757.9	66.0
Increment 5	47500	79.0	632.0	320.2	1455.2	1775.5	65.4
Increment 6	48500	80.2	641.8	323.2	1470.0	1793.2	64.8
Increment 7	49500	81.5	651.6	326.3	1484.8	1811.1	64.2
Increment 8	50500	82.7	661.5	329.3	1499.7	1829.0	63.6
Increment 9	51500	83.9	671.4	332.4	1514.8	1847.2	63.0
Increment 10	52500	85.2	681.4	335.5	1529.9	1865.4	62.4
Increment 11	53500	86.4	691.4	338.7	1545.1	1883.8	61.8
Increment 12	54500	87.7	701.5	341.8	1560.4	1902.2	61.3

Load State	GVM (Kg)	Fuel Consump (Variable Speed) litres/100km	Fuel Cost $ '000/km	Crew Costs $ '000/km	Total VOC $ '000/km	Total RUC $ '000/km	Travel Speed km/h
Hilly/Curvy Road (5% average grade, Curvature 120 deg km, MRS 11(Undivided 3.9m), Roughness =100 NRM, n							
Tare (unladen)	15400	49.1	392.8	348.3	1300.2	1648.5	60.1
Quarter Load	22190	63.9	511.5	351.4	1447.9	1799.3	59.6
Half Load	28960	78.1	624.9	363.6	1601.1	1964.7	57.6
Three Quarter Load	35730	91.3	730.8	388.5	1762.1	2150.6	53.9
TWU Load (23t)	*38500*	*96.8*	*774.0*	*401.1*	*1831.1*	*2232.1*	*52.2*
Fully Laden	42500	104.7	837.5	420.5	1933.5	2354.0	49.8
Increment 1	43500	106.7	853.6	425.5	1959.5	2385.0	49.2
Increment 2	44500	108.7	869.8	430.6	1985.7	2416.3	48.6
Increment 3	45500	110.8	886.1	435.6	2012.1	2447.7	48.1
Increment 4	46500	112.8	902.4	440.8	2038.5	2479.3	47.5
Increment 5	47500	114.9	918.8	445.9	2065.1	2511.1	47.0
Increment 6	48500	116.9	935.3	451.1	2091.9	2542.9	46.4
Increment 7	49500	119.0	951.9	456.3	2118.7	2574.9	45.9
Increment 8	50500	121.1	968.5	461.5	2145.6	2607.1	45.4
Increment 9	51500	123.1	985.2	466.7	2172.6	2639.3	44.9
Increment 10	52500	125.2	1001.9	471.9	2199.7	2671.6	44.4
Increment 11	53500	127.3	1018.7	477.2	2226.8	2704.0	43.9
Increment 12	54500	129.4	1035.5	482.5	2254.1	2736.5	43.4

Load State	GVM (Kg)	Fuel Consump (Variable Speed) litres/100km	Fuel Cost $ '000/km	Crew Costs $ '000/km	Total VOC $ '000/km	Total RUC $ '000/km	Travel Speed km/h
Flat Straight Road (1% average grade, Curvature 10 deg km, MRS 11(Undivided 3.9m), Roughness = 50							
Tare (unladen)	23800	57.6	460.9	205.9	1186.5	1392.4	103.4
Quarter Load	33475	61.4	491.1	208.3	1217.7	1426.0	102.2
Half Load	43150	64.9	518.8	212.3	1250.6	1462.9	100.3
Three Quarter Load	52825	68.0	544.2	218.0	1284.9	1502.9	97.6
Fully Laden	62500	71.0	568.2	225.5	1320.9	1546.4	94.4
Increment 1	63500	71.3	570.6	226.3	1324.8	1551.1	94.1
Increment 2	64500	71.6	573.1	227.2	1328.7	1555.9	93.7
Increment 3	65500	71.9	575.5	228.1	1332.6	1560.7	93.3
Increment 4	66500	72.2	578.0	229.0	1336.5	1565.5	93.0
Increment 5	67500	72.6	580.5	229.9	1340.5	1570.4	92.6
Increment 6	68500	72.9	582.9	230.8	1344.5	1575.3	92.2
Increment 7	69500	73.2	585.4	231.7	1348.6	1580.3	91.9
Increment 8	70500	73.5	587.9	232.7	1352.6	1585.3	91.5
Increment 9	71500	73.8	590.4	233.6	1356.7	1590.4	91.1
Increment 10	72500	74.1	592.9	234.6	1360.8	1595.5	90.7
Increment 11	73500	74.4	595.4	235.6	1365.0	1600.6	90.4
Increment 12	74500	74.7	597.9	236.6	1369.2	1605.8	90.0

Load State	GVM (Kg)	Fuel Consump (Variable Speed) litres/100km	Fuel Cost $ '000/km	Crew Costs $ '000/km	Total VOC $ '000/km	Total RUC $ '000/km	Travel Speed km/h
Undulating Road (3% average grade, Curvature 120 deg km, MRS 11(Undivided 3.9m) , Roughness =85							
Tare (unladen)	23800	52.3	418.4	275.9	1315.0	1590.8	77.2
Quarter Load	33475	65.1	520.9	283.9	1440.5	1724.4	75.0
Half Load	43150	76.9	615.3	301.6	1573.7	1875.3	70.6
Three Quarter Load	52825	88.7	709.3	326.0	1718.1	2044.2	65.3
Fully Laden	62500	100.9	807.0	353.4	1872.0	2225.4	60.2
Increment 1	63500	102.2	817.4	356.3	1888.4	2244.7	59.8
Increment 2	64500	103.5	827.7	359.2	1904.7	2264.0	59.3
Increment 3	65500	104.8	838.1	362.2	1921.2	2283.4	58.8
Increment 4	66500	106.1	848.6	365.2	1937.7	2302.8	58.3
Increment 5	67500	107.4	859.0	368.1	1954.3	2322.4	57.8
Increment 6	68500	108.7	869.5	371.1	1970.9	2342.0	57.4
Increment 7	69500	110.0	880.0	373.9	1987.2	2361.1	56.9
Increment 8	70500	111.3	890.6	376.9	2003.9	2380.8	56.5
Increment 9	71500	112.6	901.2	379.9	2020.6	2400.5	56.0
Increment 10	72500	114.0	911.8	382.9	2037.4	2420.3	55.6
Increment 11	73500	115.3	922.4	385.9	2054.2	2440.1	55.2
Increment 12	74500	116.6	933.1	388.9	2071.0	2459.9	54.7

Load State	GVM (Kg)	Fuel Consump (Variable Speed) litres/100km	Fuel Cost $ '000/km	Crew Costs $ '000/km	Total VOC $ '000/km	Total RUC $ '000/km	Travel Speed km/h
Hilly/Curvy Road (5% average grade, Curvature 120 deg km, MRS 11(Undivided 3.9m), Roughness =100							
Tare (unladen)	23800	69.5	556.3	356.7	1713.6	2070.2	59.7
Quarter Load	33475	90.0	720.2	373.5	1938.0	2311.4	57.0
Half Load	43150	109.1	873.2	409.6	2182.6	2592.1	52.0
Three Quarter Load	52825	128.8	1030.5	453.5	2445.2	2898.7	46.9
Fully Laden	62500	149.1	1193.2	499.4	2717.6	3217.0	42.6
Increment 1	63500	151.3	1210.2	504.2	2746.0	3250.3	42.2
Increment 2	64500	153.4	1227.3	509.0	2774.6	3283.6	41.8
Increment 3	65500	155.5	1244.4	513.9	2803.2	3317.0	41.4
Increment 4	66500	157.7	1261.5	518.7	2831.8	3350.4	41.0
Increment 5	67500	159.8	1278.7	523.5	2860.4	3383.9	40.7
Increment 6	68500	162.0	1295.8	528.3	2889.1	3417.5	40.3
Increment 7	69500	164.1	1313.0	533.2	2917.9	3451.0	39.9
Increment 8	70500	166.3	1330.3	538.0	2946.6	3484.6	39.6
Increment 9	71500	168.4	1347.5	542.8	2975.4	3518.3	39.2
Increment 10	72500	170.6	1364.8	547.7	3004.3	3552.0	38.9
Increment 11	73500	172.8	1382.1	552.5	3033.1	3585.7	38.5
Increment 12	74500	174.9	1399.4	557.4	3062.0	3619.4	38.2

APPENDIX 3

This example walks the reader through the incremental pricing charges model, demonstrating the benefits accrued by an extra 3t mass on a 9 axle B–double:

Axle load breakdowns		Axle type	Tyre type	Average load	NTC limit	+1 tonne	+2 tonne	+3 tonne	+ 4 tonne	+ 5 tonne	+ 6 tonne	+ 7 tonne	+ 8 tonne	+ 9 tonne	+ 10 tonne
	a	Single	Single	5.40	6	6	6	6	6	6	6	6	6	6	6
	b	Tandem	Dual	13.70	16.5	16.8	17.1	17.4	17.7	18.0	18.3	18.5	18.8	19.1	19.4
	c	Triaxle	Dual	18.65	20.0	20.4	20.7	21.1	21.4	21.8	22.1	22.5	22.8	23.2	23.5
	d	Triaxle	Dual	18.65	20.0	20.4	20.7	21.1	21.4	21.8	22.1	22.5	22.8	23.2	23.6
		Total		56.40	62.5	63.5	64.5	65.5	66.5	67.5	68.5	69.5	70.5	71.5	72.5
						63.5	64.5	65.5	66.5	67.5	68.5	69.5	70.5	71.5	72.5
		% increase in AGM				1.60%	3.20%	4.80%	6.40%	8.00%	9.60%	11.20%	12.80%	14.40%	16.00%

Assume equal proportionate increase in mass on axles other than the steer axle

	NTC limit	+1 tonne	+2 tonne	+3 tonne	+ 4 tonne	+ 5 tonne	+ 6 tonne	+ 7 tonne	+ 8 tonne	+ 9 tonne	+ 10 tonne
a factor	6	6	6	6	6	6	6	6	6	6	6
Net Change	56.5	57.5	58.5	59.5	60.5	61.5	62.5	63.5	64.5	65.5	66.5
	62.5	63.5	64.5	65.5	66.5	67.5	68.5	69.5	70.5	71.5	72.5
	62.5	63.5	64.5	65.5	66.5	67.5	68.5	69.5	70.5	71.5	72.5
b, c & d factor % increase		1.77%	3.54%	5.31%	7.08%	8.85%	10.62%	12.39%	14.16%	15.93%	17.70%

Incremental Charge Calculations in June 2002 prices

9 axle B double - that travels 88,000 kpa fully laden	Axle type	Tyre type	Load	Standard Load	ESA	Total ESA	Net ESA	Fully laden kms at incremental mass	ESA kms	Unit cost c/ESA km All Roads	ESA Cost $
Loaded to 1997 average AGM for vehicle class	Single	Single	**6.00**	5.4	1.524						
	Tandem	Dual	**16.50**	13.6	2.167						
	Triaxle	Dual	**20.00**	18.5	1.366						
	Triaxle	Dual	**20.00**	18.5	1.366	6.423					
	Total		**62.50**	56.0							
Loaded to x GVM	Single	Single	6	5.4	1.524						
	Tandem	Dual	17.4	13.6	2.679						
	Triaxle	Dual	21.1	18.5	1.692						
	Triaxle	Dual	21.1	18.5	1.692	7.588					
	Total		65.5	56.0							
							1.165	88,000	102543	4.22	**4327.31**
Distance travelled	88,000										
Extra tonnes	3										
Unit Cost Average Gross Mass c/tonne	0.130										
Extra AGM cost $	**343.2**										
Extra AGM cost c/km	**0.39**										
Extra ESA cost $	**4327**										
Extra ESA cost c/km	**4.92**										
Total incremental cost	**4671**										
Total incremental cost c/km	5.31										

Assumed for illustrative purposes

Fixed value

Change the value in these cells to reflect the additional incremental unit mass being calculated.

Change the value in this cell to reflect the additional incremental unit mass being

Transfer unit cost of extra ESA & AGM cost c/km

Separable cost c/km

9 axle b double - that travels 88,000 kpa fully laden at incremental mass	Tonnes	Extra AGM	Extra ESA	Total
	1	0.130	1.63	1.76
	2	0.260	3.10	3.36
	3	0.390	4.92	5.31
	4	0.520	6.55	7.07
	5	0.650	8.55	9.20
	6	0.780	10.35	11.13
	7	0.910	12.34	13.25
	8	1.040	14.21	15.25
	9	1.170	16.62	17.79
	10	1.300	18.96	20.26

1. 88,000km is based on 50% of average distance travelled based on ABS data for this vehicle class.

2. 4.22c/ESA is based on 2nd Determination estimates based on 2002 money values.

Transfer calculated extra separable cost charge in c/km

Benefit estimate of incremental mass increase for a 9 axle B-double.

B-Double 9 axle in $/000km	Mass kgs	Net Load kgs	Gross benefit increase	Gross benefit c/km	Total RUC c/km	Extra cost from higher mass c/km	Net benefit c/km
Tare	23800						
Fully loaded	62500	38700			160.87		
Increment 1	63500	39700	2.58%	4.16	161.28	0.42	3.74
Increment 2	64500	40700	5.17%	8.31	161.70	0.83	7.48
Increment 3	65500	41700	7.75%	12.47	162.12	1.26	11.21
Increment 4	66500	42700	10.34%	16.63	162.55	1.68	14.95
Increment 5	67500	43700	12.92%	20.78	162.97	2.10	18.68
Increment 6	68500	44700	15.50%	24.94	163.40	2.53	22.41
Increment 7	69500	45700	18.09%	29.10	163.83	2.96	26.14
Increment 8	70500	46700	20.67%	33.25	164.26	3.39	29.86
Increment 9	71500	47700	23.26%	37.41	164.69	3.83	33.59
Increment 10	72500	48700	25.84%	41.57	165.13	4.26	37.31

Based on ARRB Transport Research Ltd data

Transfer net benefit c/km

Extra Tonnage	1	2	3	4	5	6	7	8	9	10
Benefit (c/km)	3.74	7.48	11.21	14.95	18.68	22.41	26.14	29.86	33.59	37.31
Extra Separable cost charge (c/km)	1.76	3.36	5.31	7.07	9.2	11.13	13.25	15.25	17.79	20.26