AUSTRALIAN
AUTOMOBILE
ASSOCIATION

Submission to
Productivity Commission Inquiry

Constituent Members

NRMA
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RACT

Road and Rail Freight Infrastructure Pricing

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WORLD WIDE AFFILIATION THROUGH THE AIT AND FIA

Summary

This Inquiry is about the economic costs of freight infrastructure and efficient approaches to transport pricing. This cannot be separated from how cars and trucks should be charged for the use of the road and the way revenue collected should be used to build and maintain new road infrastructure.

Since we have little information on rail and our Constituency is principally road based, the focus of our submission is on road infrastructure, not rail infrastructure. Nonetheless, we would like to emphasise that our interest is one of price neutrality between road and rail as we believe our members' interests – indeed the community's interest - is best served by efficient pricing between car and truck (since they compete for road space) and between road and rail (since they compete for freight).

Motorists are charged for the use of the road via a range of mechanisms, including fuel excise, but they are only loosely related to actual expenditure on the road network. An annual total of $14 billion in fuel excise revenue is collected by the Commonwealth and only $2.7 billion is spent by the Commonwealth on roads.

Trucks are charged for road use via a reasonably complex charging methodology developed by the National Transport Commission (NTC) involving a registration charge and a so-called non-hypothecated road user charge. The approach used by the NTC is based on full cost recovery and is known as PAYGO (Pay as you Go). New charges were recently proposed by the NTC in a so-called 3rd Heavy Vehicle Charging Determination (although rejected by Commonwealth and State Transport Ministers early this year).

We believe that to achieve efficient use of existing roads, users should be charged the full marginal costs they impose when using the road and at the same time, relieved of fuel tax. Marginal social cost measures the resource cost to society of the road user's decision to make the journey. This is a very different approach to the PAYGO approach adopted by the National Transport Commission (NTC).

With the GST, fuel excises are no longer justifiable to raise revenue. And the appropriate tax on fuel for revenue raising purposes is, in our view, 10 per cent GST on all fuels, no indexation and no on-road/off road distinction. This treatment of fuel taxation avoids the taxation of intermediate inputs still present to some degree in current arrangements.

An ideal road user charge would *replace* fuel excise and have two components – an access charge and a user charge. The access charge would cover the cost of vehicle registration to enable monitoring for security and other reasons. The user charge would have four components:

- a road wear charge levied according to a proxy for the damage done - based on vehicle mass, axle load, distance travelled and location;

- an environmental charge levied according to engine type, efficiency and fuel type;

- a charge to reflect the external cost of vehicle crashes; and

- a congestion charge collected directly according to road location, time of day and type of vehicle.

Apart from accounting for these externalities, it needs to be emphasised that since roads provide national benefits not *all* of which are captured by road users, there is a strong case for funds from consolidated revenue as well as road charges to be allocated to road investment to ensure a socially and economic optimum supply of roads. There are national benefits from road construction as evidenced simply by the fact that road many projects have high benefit-cost ratios which encapsulate, in part, higher economic activity. Benefits also accrue to other non-road users, such as land owners, who benefit from the access that a road provides.

We have estimated charges which might apply to heavy vehicles – including buses - and light vehicles in urban and rural areas to cover the costs which they impose. These charges are expressed in terms of cents/litre so as to compare them with current fuel excise rates and rebates provided to certain heavy vehicle classes. While the costs can be recovered via a fuel charge, our preference is to move to a system where the costs are recovered more directly via electronic means. Whether GST should apply to the charges, would need to be resolved.

If the NTC methodology were extended to include external costs, we show that on a full cost recovery basis and with all external costs (other than congestion costs) included, the light vehicle fuel charges that could be justified in urban and rural areas are below the present excise of 38.143 cents/litre paid by motorists. The heavy vehicle charges which could be justified are well above the current road user charge for heavy vehicles of 19.633 cents/litre (the excise rate less the on-road grant, or rebate, of 18.51 cents/litre):

- the estimated total charge for light vehicles in urban and rural areas is 33.69 cents/litre and 34.56 cents/litre respectively; and
- the estimated total charge for heavy vehicles in urban and rural areas is 60.93 cents/litre and 32.65 cents/litre respectively.

It is clear that when all external costs (excluding congestion) are included, light vehicles are *overcharged* and heavy vehicles are considerably *undercharged*, particularly in the urban area.

We have also estimated charges which might apply under a short run marginal costing approach. These charges would replace fuel excise. Congestion charges could be applied if this approach were adopted, but charges would need to reflect location and time of day. In other words, they should only apply to vehicles operating in congested conditions.

Because of the large differences in estimates of the cost of congestion, we have not included congestion costs in our assessment. In any event, congestion pricing should only be introduced after other mechanisms, such as providing real time navigation information and provision of by-pass roads, selected investment in other road capacity and public transport improvements have first been addressed.

Electronic road pricing for trucks based on mass, distance and location has already been introduced in Austria – along with a reduction in motor vehicle tax - Switzerland and Germany. Ideally, such an approach should be introduced in Australia, perhaps first charging for trucks on the AusLink network. The costs of implementing such a scheme and the likely benefits should be examined and trialed soon.

As an interim approach to charging vehicles for the costs they impose, a charging approach based on a fuel charge could be introduced initially, with a staged approach moving towards marginal cost pricing and congestion pricing, provided it is accompanied by the removal of fuel excise. Direct charging, should be the ultimate goal provided the benefits of introducing it outweigh administrative and technical costs.

Total charges would involve a mix of fixed (registration) and usage charges.

1. Introduction

Unlike other forms of national infrastructure such as telecommunications, gas, water and electricity where charges include an access charge and usage charges – some of which vary by time of day - roads stand out as for the most part not being subject to user pays pricing rules. Roads are provided by Governments out of consolidated revenue and motorists are charged for their use through a variety of mechanisms, some of which are only loosely related to their use. There is no link between revenue collected and spending on roads.

AAA and its Constituent Clubs, which collectively represent over 6 million motorists, have long argued for the removal of the current arrangements for funding roads and replacing them with a market-based solution. The way motorists should be charged and they way revenue collected should be used to build and maintain new road infrastructure was clearly set out in AAA's detailed submission to the Fuel Taxation Inquiry Committee in 2001.[1] Our views have not changed since then. In essence, we have argued for the removal of fuel excise and its replacement with an access charge and usage charges.

Indeed, the views expressed in that submission are directly relevant to the scope of the Terms of Reference of the current Productivity Commission Inquiry which is to, inter alia, assess the full economic and social costs of providing and maintaining road and rail freight infrastructure.

AAA has also made regular submissions to the National Transport Commission (NTC) in its reviews of heavy vehicle charges determinations. Our submission to the recently concluded 3rd Heavy Vehicle Road Pricing Determination reiterated many of the pricing principles set out in our Fuel Tax Inquiry submission.[2]

In this submission, we will largely restate the key points made in our various submissions in the past on the topic of road user charges, with particular emphasis on the content of our Fuel Taxation Inquiry submission. We will also provide an update of the 'numbers' which were included as part of our 2001 submission by presenting estimates of charges which could apply to a range of externalities such as pavement wear, crash costs, air and noise pollution costs. These estimates are provided for cars and trucks.

Since we have little information on rail and our Constituency is principally road based, the focus of our submission is on road infrastructure, not rail infrastructure. Nonetheless, we would like to emphasise that our interest is one of price neutrality between road and rail as we believe our members' interests –

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[1] 'Towards a fairer fuel tax policy' Australian Automobile Association submission to the Fuel Taxation Inquiry Committee, October 2001; available at: http://www.aaa.asn.au/documents/submissions%2F2001%2Ffueltaxation.pdf

[2] http://www.aaa.asn.au/documents/submissions%2F2003%2FNRTC_Heavy_Vehicle_Pricing.pdf

indeed the community's interest - is best served by efficient pricing between car and truck (since they compete for road space) and between road and rail (since they compete for freight). There is thus inter-connectedness between cars, trucks and trains which impact on the economy. Competitive neutrality is, we believe, likely to offer significant gains to the economy.

We do not propose to answer the extremely detailed list of questions one by one that form part of the Commission's Issues Paper. Rather, the answers to many of the questions will become apparent as we present our arguments for pricing reform of roads. However, we do address in a detailed way – at least for roads - the PC's question *'what are the major externalities associated with road and rail freight infrastructure use?'*

2. Road spending and fuel excise revenue

Spending on roads is undertaken by the three levels of Government. At the Commonwealth level, the Government is expected to spend more than $2.7 billion in 2006/07 and a total of around $13.6 billion over the five year period of the first AusLink plan. This amount is allocated to the AusLink network, Roads to Recovery program, the Black Spot program and untied grants to local government identified for roads (see Table 1 showing Total road funding).

Table 1: Commonwealth Government road expenditure and petroleum excise collected, 2004/05-2008/09

	2004/05	2005/06	2006/07	2007/08	2008/09
Total road funding ($m)	2,158	2,116	2,721	3,231	3,407
Petroleum excise ($m)	13,682	13,740	14,180	14,520	14,870
Amount of excise spent on roads (cents per litre)	*6.0*	5.9	7.3	8.5	8.7

Source: Adapted from Commonwealth Budget 2006/07

By contrast, revenue collected from road users at the Commonwealth level from fuel excise amounts to over $14 billion per annum and is expected to continue to increase, largely in line with economic growth (see Table 1).

Thus the amount of excise spent by the Commonwealth on roads amounts to around 6 cents/litre, or 15 per cent of excise revenue collected. With the recently announced increase in road funding, this amount is expected to increase to almost 9 cents/litre (see Table 1). This is still well below what it was at the start of the 1980s, when Commonwealth funding for roads represented around 75 per cent of excise revenue.[3]

[3] AAA, Towards a Fairer Fuel Tax Policy, AAA Submission to the Fuel Taxation Inquiry, October 2001, page 8, Table 2.6

Fuel excises are therefore unrelated to road funding. We believe that to achieve efficient use of existing roads, users should be charged the full marginal costs they impose when using the road and at the same time, relieved of fuel tax. Marginal social cost measures the resource cost to society of the road user's decision to make the journey. We believe that there needs to be a link in place with charges set to recover the marginal social costs of road use. In this way, important signals on the need for and location of new roads, and the use of roads, will emerge. This is a very different approach to the PAYGO approach adopted by the National Transport Commission (NTC).

3. PAYGO (Pay As You Go)

The NTC's PAYGO approach of setting charges for heavy vehicles has some degree of merit in so far as it attempts to assess the costs imposed by each heavy vehicle class according to a range of parameters such as VKT, ESA-km, AGM-km and PCU-km.[4] In addition, the contribution which varying parameters make to the overall costs seems to be well researched, although we believe that some of the assumptions and the procedure for allocating costs between light and heavy vehicles, are biased in favour of lower charges for heavy vehicles. Indeed the NTC, in its 3rd Heavy Vehicle Road Pricing Determination draft RIS[5], state that they took a cautious, conservative and even sympathetic approach to its charging recommendations. The final recommendations were subsequently rejected by Commonwealth and State Transport Ministers.

However, we do acknowledge that the approach for determining how costs should be allocated between heavy and light vehicles is a difficult one. There are mechanisms for determining how so-called separable costs should be allocated. But it is difficult. Should simply the marginal costs of providing additional pavement strength (to address pavement wear), wider lanes (for wider vehicles), wider swept path (for an ability to turn easily) and lower gradients (to reduce load and fuel use - and to increase overtaking opportunities) be charged to heavy vehicles, or should some of the cost of providing a 'basic' road, suitable for cars be allocated, as well? And if so, how much? If a road were built solely for heavy vehicles, there would be no marginal costs associated with allowing light vehicles to use the road, except perhaps those associated with the need to increase road capacity.

For so-called common (non-separable costs), where trucks and cars jointly benefit from roadside features such as signposting and safety features, how should the costs of providing these features be allocated? Ulimately, the choice is likely to be somewhat arbitrary. There is no theoretically correct basis for allocating these costs.

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[4] VKT: vehicle kilometres travelled; ESA: equivalent standard axles - a measure of the relative road wear of different axles carrying different loads; AGM: Average Gross Mass – an average of the total mass of a vehicle and its load; PCU: Passenger Car Equivalent Units.

[5] http://www.ntc.gov.au/filemedia/general/RegulatoryImpactStatement.pdf

If cost recovery is *not* an issue then these questions become largely redundant. But since PAYGO is still on the agenda, it is worth noting a number of criticisms of the overall PAYGO approach:

- it is seriously flawed because the determined road charge is simply a notional one and the revenue is not hypothecated to roads – this is a fundamental deficiency of PAYGO;

- it is based solely on cost recovery rather than a preferred basis of marginal cost pricing;

- the cost base is rather limited, with cost recovery limited to past road expenditure rather than extending it to cover the cost of externalities such as crash, air and noise pollution costs – and this despite the fact that the Inter-governmental agreement gives the NTC the flexibility to address these externalities;

- the full cost recovery approach is based on actual expenditure and may not be the cost recovery needed for optimal road expenditure;

- although the heavy vehicle pricing principles require the NTC to have regard to other pricing applications such as light vehicle charges, trucks are undercharged compared to cars – as noted in the analysis (below), the fuel charge would be 10.8 cents/litre to recover light vehicle share of road costs compared to the 38.1 cpl which is actually paid;

- the charges are based on average distance and average mass for each vehicle class, creating equity problems within a class and possible efficiency losses as a result of distorted prices between classes – yet other countries such as New Zealand have been charging on a mass-distance basis for many years and technology based solutions (involving GPS) are now in place in Switzerland, Germany and Austria (see further discussion, below); and

- the charges are biased in favour of the heavy end of heavy vehicles which distorts road and rail freight movements as it is the heavy end which competes with rail – we note that under the draft 3rd determination, the charge subsidy for B-doubles was to be $7,500 in 2006 reducing to $5,500 in 2007.[6]

Notwithstanding the point we made earlier about the difficulty associated with allocating costs among vehicle classes, we still have some specific concerns about the PAYGO approach:

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[6] NTC, Third Heavy Vehicle Road Pricing Determination, Draft Regulatory Impact Statement, October 2005, page 10

- there is a surprisingly large amount of local road funding ($2870 million, or 65 per cent of the total) which is excluded from the cost allocation process because it is regarded as being unrelated to motorised road use; it is argued by NTC - and we think it is difficult to sustain - that it is to provide access, amenity or to provide for non-motorised road users[7];

- there appears to be too much emphasis on PCU-km as a parameter for allocating routine and periodic maintenance (37 and 10 per cent respectively), when one would have expected AGM-km to be the predominant parameter (as it was in the second determination) because of the predominant influence of load on pavement wear;

- the number of vehicles – perhaps expressed as PCUs – would seem to be a preferred parameter for allocating non-attributable costs rather than VKT, particularly since these costs are unrelated to road use (we acknowledge that this may result in a higher proportion of non-attributable costs being allocated to light vehicles); an alternative measure is a PCU weighted average of VKT which is used in some overseas countries;

- road expenditure on unsealed roads in remote areas has been deducted because the provision of these roads in remote areas has been regarded by NTC as a Community Service Obligation (CSO) – however, the transport operator is presumably benefiting from these roads and therefore ought to make some contribution towards the cost; and

- the NTC acknowledged that it encountered problems with setting charges because of the small sample sizes for certain vehicle types in the ABS Survey of Motor Vehicle Use – we believe that some of these problems could have been overcome by reference to the work of the Apelbaum Consulting Group which has attempted to address this problem of sample size by reference to data on the amount of fuel consumed by different vehicle types.

On a more positive note, we are pleased that the NTC acknowledges the safety issue in its charging approach. The recent draft Regulatory Impact Statement (RIS) notes the relative safety of B-doubles compared with road trains in terms of nationally agreed safety performance standards. We support the concept of setting charges to at least partly reflect the relative safety of different vehicle classes, to the extent that they are not internalised by insurance premiums.

4. A preferred system for road charging

Economic theory suggests that to achieve an efficient use of existing roads, road users should be charged the full marginal social cost they impose when using the

[7] It should be acknowledged, however, that some percentage of Council rates go towards recovery of some of the local road costs.

road – the so-called short run marginal cost pricing rule. Marginal social cost measures the resource cost to society of the road user's decision to make the journey. The cost of the original investment in the road is sunk and plays no role in the efficient pricing rule.

How to achieve cost recovery for investments in new roads is a separate issue from achieving an efficient use of roads. If economies of scale are important then there is no guarantee that revenues collected under efficient pricing will achieve full cost recovery – though if congestion is priced realistically on urban roads, more than full cost recovery may eventuate.

If charges in excess of marginal costs are levied on road users to, say, achieve full cost recovery, then this is no different – from a resource efficiency viewpoint – to a revenue raising tax. The key point is that road users should pay the appropriate cost of their use of roads. This will ensure that the value they derive from road use will at least cover the costs to society of their use.

What this theoretical position highlights is that the current fuel taxation arrangements, and the NTC PAYGO approach, has a revenue raising objective rather than an objective of efficient resource allocation.

With the GST, fuel excises are no longer justifiable to raise revenue. And the appropriate tax on fuel for revenue raising purposes is, in our view, 10 per cent GST on all fuels, no indexation and no on-road/off road distinction. This treatment of fuel taxation avoids the taxation of intermediate inputs, still present to some degree in current arrangements.

An ideal road user charge would have two components – an access charge and a user charge. The access charge would cover the cost of vehicle registration to enable monitoring for security and other reasons.[8] The user charge would have four components:

- a road wear charge levied according to a proxy for the damage done - based on vehicle mass, axle load, distance travelled and location;
- an environmental charge levied according to engine type, efficiency and fuel type;
- a charge to help reflect the external cost of vehicle crashes; and
- a congestion charge collected directly according to road location, time of day and type of vehicle.

[8] Although we do not address the issue of the level of the access charge here, as a practical step to introducing direct charging, existing State registration fees could remain with subsequent reform and integration into a two-part ideal charging scheme.

A congestion pricing mechanism should only be considered if it were part of a comprehensive reform of the transport user charging system.

While there may be technological, institutional and regulatory impediments to installing a practical system to charge on this basis immediately – although there are GPS charging mechanisms already in place in Europe - a transitional arrangement relying more heavily on fuel charges as an indirect way of charging could be implemented quickly.

The charges could be based on the marginal costs of the various components and could be updated regularly to reflect changes in cost components. The system should not become entrenched, however, as it is designed to be transitional. Technological change in engines, fuels, vehicle and road safety as well as traffic management may substantially alter these externalities.

In the discussion which follows, we have estimated the charges which might apply to heavy vehicles – including buses - and light vehicles in urban and rural areas to cover the costs which they impose. These charges are expressed in terms of cents/litre so as to compare them with current fuel excise rates and rebates provided to certain heavy vehicle classes. While the costs can be recovered via a fuel charge, our preference is to move to a system where the costs are recovered more directly via electronic means. This issue will be discussed further in Section 11 (below). A charging system based on fuel charges could be a first step towards electronic charging.

Irrespective of the charging approach adopted, it needs to be emphasized that since roads provide national benefits not *all* of which are captured by road users, there is a strong case for funds from consolidated revenue as well as road charges to be allocated to road investment to ensure a socially and economic optimum supply of roads. There are national benefits from road construction as evidenced simply by the fact that many road projects have high benefit-cost ratios which encapsulate, in part, higher economic activity. In many cases, increased land values result from new roads and there is a case for the land owner to pay for the benefit which road access provides.

5. Charging for road use and wear

Road users 'use' infrastructure in that they wear and damage it. Pavement damage depends on the technical characteristics of the road, the axle configuration of vehicles and load per axle as well as distance travelled. In principle, charges can be set to match these costs – charges based on axle group/axle mass and distance travelled.

Heavy vehicles cause considerable pavement wear. Ideally this should be charged for directly. As noted earlier, the NTC charging approach for heavy vehicles is a budgetary one – full cost recovery – rather than the desired economic efficiency objective of marginal cost pricing of road use. There is no link between revenue collected from the charges and spending on roads.

By contrast, cars and light commercial vehicles cause negligible wear to most roads. An infrastructure use charging system operating through a charge on fuel used in road transport should reflect this by having only a very small charge for cars and light commercial vehicles and a much larger charge for heavy vehicles.

Charging for infrastructure use through a uniform charge on all vehicles will result in gross overcharging of light vehicles and undercharging of heavy vehicles. Fuel used off-road should not incur the infrastructure use charge.

In the Appendix to this submission, transport economist John Cox has estimated that on a cost recovery basis, and using the methodology employed by the NTC, the fuel charge for light vehicles would be 10.8 cents/litre compared to 18.2 cents/litre for heavy vehicles (see Table A2.2 in Appendix).

Cox also estimates a ‘road use cost’ for urban and rural areas for these two vehicle classes. For light vehicles, the charge is 10.29 and 12.35 for urban and rural areas respectively. The corresponding charges for heavy vehicles are 15.54 cents/litre and 21.75 cents/litre (see Table A8.1).

Since motorists pay 38.143 cents/litre in fuel excise (compared to a cost recovery estimate of 10.8 cents/litre) and heavy vehicles pay 19.6 cents/litre[9] (compared to a cost recovery estimate of 18.2 cents/litre), it is clear that on a full cost recovery basis, light vehicles are overcharged compared to trucks.

While this full cost recovery approach is not our preferred basis for charging, the analysis is introduced here to show the inequity between light and heavy vehicles in the current NTC charging process. As noted in the previous Section, our preference for charging is one based on marginal costs, the inclusion of externalities and the removal of fuel excise.

6. Charging for environmental damage

The use of vehicles can cause damage to the environment – through noise and emissions. Fuel combustion releases an array of pollutants including organic compounds, nitrogen oxides, carbon gases and particulates. These can be harmful to human health through exacerbating respiratory problems, although technical change in engines and fuels – and the adoption of stringent Euro emission standards legislation in Australia - is bringing about dramatic changes in

[9] Currently, all trucks over 20 tonnes, and all trucks between 4.5 and 20 tonnes used outside the metropolitan area, receive a rebate of 18.51 cents/litre on diesel. For administrative and equity reasons, this will change on 1 July 2006 when *all* trucks over 4.5 tones used for business can claim the on-road grant (rebate) for diesel *and* petrol. The difference between the excise rate and the rebate - 19.633 cents/litre - is regarded as a non-hypothecated road user charge.

emission levels and the air quality in Australian cities is improving. The environmental risks – both positive and negative - of greenhouse gases are well documented. Vehicle noise can also be regarded as a cost imposed by road users on others. Its cost is traditionally measured in terms of the reduction in house prices in affected areas.

It is appropriate that vehicle users be charged for the damage they do to the environment to internalise these costs. This will provide incentives for environmental damage to be reduced. It also provides funds to compensate the losers. That said, it still needs to be noted that external costs have most likely reduced over the past decade as government regulation in relation to fuel quality and vehicle emissions has been introduced. The costs of introducing these new regulations and standards have most likely been borne by road users.

The amount of environmental damage from emissions will vary according to the type of vehicle (particularly engine size and efficiency), the type and cleanliness of the fuel and where the vehicle is used. Charging directly and accurately for environmental damage is therefore difficult. A compromise is needed between the efficiency gains for a highly differentiated set of charges to reflect actual environmental damage in a particular situation and the administrative cost of greater complexity in the charging system. As an example of differential charges, the Commonwealth has imposed a higher excise for diesel with a higher sulphur content.

It may make sense to impose some of the environmental charge through registration fees – which could reflect, for example, engine size and CO_2 output. There is also an important role for different registration charges based on the fuel used in road vehicles. These charges should vary according to the cleanliness of the fuel.

There will be a need to identify the right mix of fixed and variable (road user) charges, which will be influenced, in part, on the sensitivity to price changes of each measure.

Determining an appropriate fuel charge component to account for vehicle emissions is difficult. Estimates by Cox (presented in detail in the Appendix) show that air pollution costs across the network range from 8.45 cents/litre for light vehicles to 14.83 cents/litre for heavy vehicles. The corresponding noise pollution costs range from 2.54 cents/litre to 9.41 cents/litre (see Table A8.1).

It is assumed in these calculations that rural travel will not cause health effects from emissions. Motor vehicle emissions and hence health costs have fallen sharply since the introduction of catalytic converters and the introduction of more stringent vehicle emission standards. This emphasises that a charge for environmental damage would need to be regularly reviewed and adjusted as new engine technologies and emissions standards are introduced. This regime should not be an impediment to the introduction of new technologies and should be used as a tool for encouragement.

Emissions of carbon dioxide from motor vehicles could also have an impact on the future global climate in the 'greenhouse effect'. Road transport accounts for around 16 per cent of Australia's net carbon dioxide emissions and only 13 per cent of Australia's total greenhouse gas emissions. This equates to 66 million tonnes of emissions each year.[10]

Energy use in the road transport sector is projected to grow by 1.6 per cent a year over the next 15 years.[11] According to ABARE, this growth is largely driven by 'other road transport' (mainly road freight) for which energy use is projected to grow by around 2.5 per cent a year, substantially higher than the 1.0 per cent a year projected for the passenger car sector. This outcome, ABARE argues, reflects, in large part, the relatively stronger role that economic growth is assumed to have in determining energy use in the freight transport area, compared with the passenger motor vehicle sector.

Given that emissions depend on fuel use and efficiency of fuel, a fuel charge may be appropriate means of reducing emissions. The appropriate rate of the charge, however, depends on the overall policy framework Australia adopts in order to reduce greenhouse gas emissions.

It is a well established principle that the optimal approach to greenhouse gas abatement is to find a policy framework that equates the marginal cost of abatement for *all* emitting sectors. The key features of this principle are that:

- it is not appropriate for any single sector to bear the full burden of abatement; and
- abatement should take place where it is least costly to do so.

It is inappropriate for the transport sector (or any other sector) to go it alone in emissions reductions. Rather, any policy should have the broadest possible coverage. There are two broad categories of policy that satisfy this principle: a uniform carbon tax (or carbon equivalent) or some form of emissions trading scheme.

Having outlined these principles, there is more we could say about how permit prices under emissions trading, or what level of carbon tax, might emerge. This is a subject for another day.

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[10] Australian Greenhouse Office, National Greenhouse Gas Inventory (2003)
[11] ABARE, Australian Energy: National and State projections to 2019-2020 (August, 2004)

7. Charging for vehicle crashes

Much of the potential costs of vehicle crashes are already internalised to the road user – through the purchase of safe vehicles and various insurance. But there are also external costs that need to be charged back to road users to ensure that they face the full social costs of their road use.

There were 1636 fatalities on Australian roads in 2005. Most of those killed (73 per cent) were male. Most of the deaths (58 per cent) were people under 40, with 17 to 25 year olds accounting for a quarter of deaths. Of those killed, almost half were drivers, 21 per cent were passengers and 14 per cent were pedestrians (the remainder being either motor cyclists or cyclists).

Around 45 per cent of fatal crashes involved a single vehicle, 15 per cent involved pedestrians with the remainder being multiple vehicle crashes. There were 135 fatal crashes and 158 fatalities involving articulated trucks.[12]

According to the BTE[13] the cost of road crashes in Australia in 1996 was $15 billion. At issue is how much of these costs are not internalised through third party and private property damage insurance and need to be charged for through some other mechanism. There is no consensus in the literature on this. One position is that all crash costs should be regarded as externalities, while others argue that all relevant costs are already internalised. The majority of analysts take a mid point position.

In his treatment of crash costs in the Appendix, Cox uses the BTE 1996 cost estimate as a starting point, then modifies it by what he regards as a more appropriate discount rate (7 per cent used in most transport projects, rather than the BTE 4 per cent), adjusts for CPI from 1996 and then further adjusts for the reduction in the number of fatalities over the past decade to arrive at a revised estimate. Cox then deducts insurance premiums of over $7 billion (2004/05 dollars) and other costs internalised by road users and arrives at an estimate for the external cost of crashes ($4.97 billion).

Cox then argues that not all external costs should be attributed to ordinary road users, but should be targeted, for maximum effect, on those that are causing many of these crashes, namely drunk and speeding drivers. A proportion of total external crashes are then allocated to these groups of drivers, leaving $2.98 billion to be charged to motorists through a fuel charge.

Using this crash cost number and fuel consumed by vehicle class in urban and rural areas, Cox estimates fuel charges to cover external crash costs. The costs for light vehicles range from 8.72 cents/litre for urban to 22.21 cents/litre for rural.

[12] ATSB Statistical Summary, 2005
[13] Bureau of Transport Economics, Road Crash Costs in Australia, Report 102, 2000

The corresponding charges for heavy vehicles are 3.30 cents/litre and 10.90 cents/litre (see Table A8.1).

8. A road use charge for full cost recovery

By bringing it all together – the costs of road use, air and noise pollution and crashes – using the NTC cost recovery methodology - we can see the fuel charge that would be appropriate for full cost recovery to address all components of external costs. The complete picture for light and heavy vehicles for urban and rural areas is presented in Appendix A8.1 and reproduced here as Table 2.

Table 2: Estimate of externality costs classified by area and vehicle type expressed in cents/litre (2004/05)

	Light Vehicles			Heavy Vehicles			All Vehicles		
	Urban	Rural	Totals	Urban	Rural	Totals	Urban	Rural	Totals
Air Pollution	11.28	0.00	8.45	25.75	0.00	14.83	13.85	0.00	9.85
Noise	3.39	0.00	2.54	16.34	0.00	9.41	5.69	0.00	4.05
Crash	8.72	22.21	12.10	3.30	10.90	6.52	7.76	18.57	10.88
Road Use less Registration	10.29	12.35	10.81	15.54	21.75	18.17	11.22	15.38	12.42
Totals	33.69	34.56	33.90	60.93	32.65	48.94	38.52	33.94	37.20

Note: The Total, or average fuel charge, is the total externality cost for light and heavy vehicles divided by the total Australian vehicle – km of these vehicles. This national average would be used if it were not possible to separate charges into urban and rural categories.

The results show that on a full cost recovery basis and with all external costs (other than congestion costs) included, the light vehicle fuel charges that could be justified in urban and rural areas are below the present excise of 38.143 cents/litre. While light vehicles are *overcharged*, heavy vehicles are considerably *undercharged*, particularly in the urban area.

The point of these calculations is to illustrate that to the extent that fuel excise can be envisaged as including a charge for recovery of road expenditures and other externalities, passenger motor vehicle drivers should be charged around 34 cents/litre, or less than the current excise. Put another way, motorists more than ‘pay their way’.

It is important to note however, that full cost recovery will not generate the first best economically efficient charging regime for roads. As pointed out earlier, the efficient use of roads is achieved when road users pay the full *marginal* social cost of their road use. More on this later.

9. Congestion

The road costs used in the analysis so far are based on full cost recovery that includes all capital costs used to reduce congestion and not the marginal costs of road use, such as the extra maintenance costs from additional traffic. Thus it would be inappropriate to add a further charge to cover the cost of congestion as this would involve an element of double counting.

However, there is a need to recognise the costs of congestion and how to deal with it. Roads with low volumes are viewed in economic jargon as pure public goods – their use by one motorist does not detract from their use by others. But many roads are becoming increasingly congested, particularly in urban areas. The number of vehicles using the road at any given point in time exceeds the ability of the road to carry them at generally acceptable service levels.

Congestion imposes costs on other road users in the form of increased travel time and running costs and on society through increased localised pollution. Typically, road users are not charged for these costs and in the absence of a price mechanism to allocate a road to those users who most value it, many roads are over used (congested) at particular times. The result is inefficiencies in road use, in vehicle use, and in the use of motorists' time. The existence of congestion might imply underinvestment in the road network.

Because of the complexity of urban travel behaviour, estimating congestion costs is not straightforward. Congestion costs are, however, believed to be large. But even then, this depends on how congestion is measured.

The Bureau of Transport Economics (BTE) has estimated that the cost of congestion is $12.8 billion per annum.[14] This is much higher than other estimates. However, in an earlier Bureau report,[15] the following point is made:

'The cost of congestion is the estimated value of the excess travel time and other resource costs (such as extra fuel use) incurred by the actual traffic over those that would have been incurred had that traffic volume operated under *completely free-flow conditions*. It should be noted that for actual road systems, such conditions are, of course, an unrealisable hypothetical situation. Therefore the cost of congestion, so defined, is primarily a measure of the scale of the problem, rather than a measure of the actual savings that can be made. A policy response to congestion can serve to reduce this cost, but it will not be possible (nor desirable on economic grounds) to eliminate it altogether'. In other words, the optimal level of congestion is not zero.

[14] BTE Information Sheet 16, May 2000, Urban Congestion - Implications for Greenhouse Gas Emissions.
[15] BTCE Report 92, Traffic congestion and road user charges in Australian capital cities, March 1996.

The report also states that 'The net benefits from congestion charges is the measure of what can, in principle, be achieved by tackling the congestion problem. It is of greater policy relevance than the cost of congestion…'

In the same report, estimates of net benefits from congestion pricing of $1.1 billion in total for all Australian cities for morning peak hour is reported (a far cry from the $12.8 billion).

Since there are wide differences in way congestion is measured[16] and its cost (see Appendix, Section A1), we have omitted this externality in the calculation of total costs to be recovered from motorists when applying marginal costs analysis (see Section 10, below). In any event, it would not make sense to calculate a blanket congestion charge to be imposed on all motorists because congestion costs need to be identified according to the level of congestion existing at a particular time and a particular location.

There may also be other instruments which should be explored before the introduction of congestion pricing such as improved traveller information services (e.g. navigation systems, variable message signs for incident reporting and travel time estimates), reform of parking charges, increased investment in public transport and even increased road capacity.

In other words, congestion pricing should be seen as part of comprehensive transport reform and, if it were introduced, it should only apply to vehicles actually operating in congested conditions.

10. Marginal cost pricing

In Section 8 of this submission, we provided estimates of charges which would cover the external costs of road use. They were based on a full cost recovery methodology. However, we argued elsewhere that an appropriate basis for setting charges was on a marginal cost basis.

In the Appendix, Cox addresses the issue of marginal costs and quotes Green and Jones, noting that ‘constant average costs may characterise some transportation externalities reasonably well.’ For this reason, he equates the *average* costs for air and noise pollution and crash estimates, as *marginal* cost estimates.

However, for road use, he identifies those components of expenditure that are due to additional traffic, namely pavement and rehabilitation costs. The NTC Technical Report released in October last year,[17] identifies this expenditure as

[16] See, for example, the recent report by the Victorian Competition and Efficiency Commission, ‘Making the Right Choices, Options for Managing Transport Congestion’, Draft Report, April 2006, pp 61-64

[17] http://www.ntc.gov.au/filemedia/Reports/ThirdHVRPTechRepFinalOct2005.pdf

$560 million on routine maintenance, $402 million on periodic maintenance of sealed roads and $654 million of road rehabilitation – a total of $1616 million.

On the basis of the allocation parameters used by the NTC to apportion maintenance and rehabilitation expenditures, Cox then estimates the marginal costs which should be attributed to light and heavy vehicles in urban and rural areas.

Assuming that marginal externality costs for air and noise pollution and crashes are the same, and adding the marginal costs of road use, we arrive at a total marginal cost of road transport in Australia (excluding the marginal cost of congestion). These costs are shown in Appendix Table A9.6 and reproduced here as Table 3.

Table 3: Estimate of Full Marginal Social Cost of Road Transport in Australia (cpl)

	Light Vehicles			Heavy Vehicles			All Vehicles		
	Urban	Rural	Totals	Urban	Rural	Totals	Urban	Rural	Totals
Air Pollution	11.28	0.00	8.45	25.75	0.00	14.83	13.85	0.00	9.85
Noise	3.39	0.00	2.54	16.34	0.00	9.41	5.69	0.00	4.05
Crash	8.72	22.21	12.10	3.30	10.90	6.52	7.76	18.57	10.88
Marginal Road Use	1.51	11.96	4.13	5.94	20.64	12.18	2.30	14.76	5.89
Totals	24.91	34.17	27.23	51.33	31.54	42.94	29.60	33.33	30.67

Note: The average marginal fuel charge is the total externality cost for light and heavy vehicles divided by the total Australian vehicle – km of these vehicles. This national average would be used if it were not possible to separate charges into urban and rural categories.

A comparison of the estimated marginal costs (in Table 3) with average costs based on cost recovery (in Table 2), is shown in Table 4. It can be seen that costs for light vehicles across the network are 27.23 cents/litre, below the cost based on full cost recovery, and still well below the 38.143 cents/litre which motorists pay in fuel excise.

Table 4: Comparison of Average Full Recovery Costs with Marginal Costs (cpl)

	Light Vehicles			Heavy Vehicles			All Vehicles		
	Urban	Rural	Totals	Urban	Rural	Totals	Urban	Rural	Totals
Average Full Recovery Cost	33.69	34.56	33.90	60.93	32.65	48.94	38.52	33.94	37.20
Marginal Costs	24.91	34.17	27.23	51.33	31.54	42.94	29.60	33.33	30.67

On this basis, motorists are grossly overcharged compared to trucks which should pay 42.94 cents/litre on a marginal cost basis, whereas they actually pay 19.633 cents/litre as a road user charge.

11. Electronic road pricing in Europe

There currently exists the technology for charging vehicles for the use of the road network in line with the charges set out above. City Link in Melbourne is an example of a road using free-flow technology (i.e. no toll gates) where tolls are largely based on distance travelled and trucks pay a higher charge.

There are many other applications to be found around the world, with electronic charging for trucks already in place in Switzerland (introduced 2001), Austria (introduced January 2004) and Germany (introduced January 2005). They are satellite-based systems with trucks being monitored via on-board units (OBU). In Austria, we are advised from our motoring Club counterpart (OeAMTC), that when road pricing for trucks was introduced there in 2004, motor vehicle tax was reduced by an average of one-third.

In these countries, charges are set to cover mass carried and distance travelled. The German system covers the 12,000 kilometre national motorway network. Toll charges are applied according to the numbers of kilometres travelled, the axle class and emissions category. There are three categories of vehicle broadly corresponding to their Euro emissions class for new heavy vehicles and within each category there are two rates depending on the number of axles, such that the more axles, the higher the rate charged. More details are available at www.toll-collect.de which also reports that some 322,000 German trucks and 180,000 vehicles registered outside Germany are now equipped with On-Board Units (OBUs).

The European Union adopted a Directive on interoperability for electronic fee collection throughout Europe in 2004. It envisages a European electronic fee collection service starting with heavy goods vehicles and long distance coaches by mid 2009 and all vehicles by 2011. The basic approach is that a vehicle equipped with a single OBU will be able to handle any toll in any country with a consistent standard of service.[18]

According to ITS Australia News, the next generation of the toll company's charging software to be introduced this year, promises greater flexibility including adding of new road links, vehicle classes and road segment specific characteristics. The ability to add links very close to, and parallel to, the motorways will make it easy to charge trucks that currently avoid the motorway toll.

[18] ITS Australia News, January 2006

There seems to be little reason why a similar approach for charging trucks could not be undertaken in Australia. At least the potential for a similar scheme ought to be seriously reviewed and trialed in Australia, perhaps on the Commonwealth Government's identified AusLink national network in the first instance. Obviously the implications for Commonwealth and State revenues would need to form part of the review. The Intelligent Access Project (IAP) is a step in the right direction and perhaps is superior in some respects to the European charging approach, as it is not only comprises a charging mechanism, but it is designed to encourage more efficient road use. The IAP will remotely monitor the operational compliance of heavy commercial vehicles to ensure they meet agreed operating conditions and to ensure they operate how, where and when they should.[19]

12. Conclusion

The way that road users are charged for the use of roads is an inefficient one. Motorists are charged an array of taxes and charges which only loosely relate to road usage. And the amount collected from Commonwealth fuel excise, some $14 billion per annum, is well in excess of the amount the Commonwealth spends on roads – around $2.7 billion per annum.

Even if the external cost of air and noise pollution and crashes were factored in, then motorists would still be paying in excess of the costs attributed to them through the 38 cents/litre tax on petrol. The opposite is true for trucks.

The current pricing system, however, is not structured in such a way as to ensure pricing neutrality between different classes of vehicles or within each class of vehicle. We need a system which ensures that the road network is used efficiently and resources are allocated to those parts of the network which are in greater need of investment. At present, light vehicles are overcharged for the use of the road network and heavy vehicles are undercharged.

An appropriate pricing system should also ensure neutrality between road and rail so that freight and passengers move around on the road and rail networks in a way that makes best use of resources. It would also provide more appropriate road investment signals.

In the road sector, an appropriate pricing regime is one where the fuel tax is replaced by an access charge and a usage charge. The usage charge should reflect external costs but these charges would need to be constantly reviewed to reflect improving technologies which reduce the costs of crashes and improve the quality of fuels and engines. Apart from applying as a fuel charge, the different costs – or some of them - could alternatively be implemented as differentials in registration fees. The merits of each approach needs to be examined more closely so as to determine the best mechanism for dealing with the externality.

[19] For further information on IAP, see the Transport Certification Australia Limited website www.tca.gov.au

The ability to charge vehicles for distance travelled and mass carried is already in place in a number of European countries. Truck movements could be monitored, for example, through an on-board unit and satellite navigation. Indeed many fleets already use some form of this technology to monitor truck movements for logistics and safety reasons. An immediate review to implement a proposal along these lines should be seriously considered by the Commonwealth government in cooperation with the States.

There is no reason why Australia could not implement a direct charging mechanism. The technology is available. However, the feasibility and cost of doing so needs to be explored in detail.

In this submission we have identified the external costs of road use and expressed them on a cents/litre basis. A system of fuel based charges could be introduced as an interim measure to charge for road use, but if our preferred approach of direct charging were to be implemented, the estimates could be readily converted to charges expressed on a per kilometre basis. And some charges could be implemented as differentials in registration fees, although the implications for State revenues would need to be carefully considered.

Appendix

This Appendix was prepared for the Australian Automobile Association by Dr. John B. Cox, Transport Consultant.

A1. INTRODUCTION

This report on road transport externalities has been prepared in response to a Productivity Commission inquiry on "Road and Rail Freight Infrastructure Pricing". It contributes to the determination of the "*efficient pricing of road and rail freight infrastructure"* and in particular to the question "*What are the major externalities associated with road and rail freight infrastructure use?"*

The report updates work on road transport externalities that was carried out in 1994 (Cox 1994), 1997 (Cox and Meyrick 1997) and 2001 (Cox 2001a). There has been some new basic work carried out on the costs of transport emissions in Australian urban areas (BTRE 2005) while there has been a major upgrading of expenditures for road use in a third road user charges determination by the National Transport Commission (NTC 2005). There has, however, been very little additional basic work on the externalities of road crashes and noise and it will be necessary to extrapolate the results of previous crash and noise costs using trends in the basic data for these externalities.

There have also been several reviews of externality costs in Australia by transferring overseas data on externalities (BIC 2001, Tsolakis and Houghton 2003, Austroads 2003, Laird 2005) and these results will be compared with the results obtained in this report.

The report uses the National Transport Commission (NTC) PAYGO cost recovery methodology for heavy vehicles to determine a road use fuel charge for light vehicles that corresponds to the existing heavy vehicle fuel charge of 20 c/l[1]. Unlike the NTC methodology it also determines the external costs from road transport of air pollution, noise pollution and road crashes and adds these costs to obtain both heavy and light vehicle fuel charges. Charging on the basis of such full social costs (not just road use costs) is necessary to produce efficient resource allocation outcomes.

A further division of road use, crash, air pollution and noise pollution costs into urban and rural costs was made because some of these costs were more attributable to urban areas, such as air pollution, while others such as road use costs derived from road expenditures were more attributable to rural areas. These urban and rural costs were then divided by an estimate of light and heavy vehicle fuel consumption in these two areas to come up with a fuel charge for light and heavy vehicles in both of these areas.

It should be noted that this division into urban and rural areas is different from previous studies in Cox and Meyrick (1996) and Cox (2001a) where the division was by capital city and regional areas. The main reason for this change is that both of the new studies on air pollution costs (BTRE 2005) and road expenditure costs (NTC 2005) use these categories.

The estimated fuel charges do not include any allowance for congestion charges in metropolitan areas where there is still presently a very wide range of published congestion costs varying from about $5 billion (Luk and Hepburn 1995, Cox and

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[1] Light vehicles comprise passenger cars, motor cycles and the growing light commercial vehicle fleet while heavy vehicles comprise rigid trucks, buses, articulated trucks and road trains.

Meyrick 1997) to $13 billion (BTE 2000). It is generally thought that these charges should be charged for directly rather than be attributed to a fuel charge as they are a function of particular roads and the time of day that they are being used.

Road use costs that are based on full cost recovery includes all of the capital costs used to reduce congestion. There will therefore be a double counting of charges if congestion charges are applied on top of fuel charges based on these full cost recovery costs.

Lastly, this analysis does not include allowance for positive externalities due to improved productivity in the economy and in companies from investment in the road transport sector. Nor does it consider the institutional failures resulting in the underinvestment in roads in urban areas, which is a major factor in the magnitude of the externalities being evaluated.

A2. ROAD USE COSTS

The National Road Transport Commission carried out a third heavy vehicle charges determination in 2005 (NTC 2005). They estimated that the average total expenditures by road authorities in 2002/03, 2003/04 and 2004/05 was $10,395 million ($5,237 million for urban roads and $5,155 million for rural roads) and that these figures included expenditures that were not attributable to road use. These will be called 2004/05 road expenditure figures even though they are called 2005/06 figures in the NTC reports.

They then subtracted non road use expenditures such as the administration of driver licensing and vehicle registration from arterial roads expenditure ($506 million) and the costs of providing access to private homes from local road expenditure ($2,870), most of which is recovered in Council rates. If these unallocated costs are subtracted from total road expenditures then the costs needing to be recovered from charges were found to amount to $6,770 million, as shown in Table 2.1. This was up from $4,570 million in the 1988 second determination, and mainly due to a $1.5 billion increase in non-pavement expenditures.

The NTC also divided this $6,770 million into the costs that can be attributed to road use, such as maintenance, and those that cannot be attributed to road use, such as bridge expenditures, cleaning of drains, maintenance of street lighting and traffic signals, etc. They found $3,140 million in attributable costs and $3,640 as non-attributable costs (NTC 2005). These non-attributable costs are those costs that would be incurred regardless of the level of use of the road network – and also of the need to provide additional road capacity.

The NTC methodology also determined the costs which should be attributed to heavy vehicles and to light vehicles and came up with heavy vehicle costs that needed to be recovered through charges of $1,640 million, or about 24.2% of total costs (see Table A2.1). This was a reduction from the 28% in the second determination, therefore indicating that light vehicles were apportioned a greater share of costs in this third determination. These heavy vehicle costs were to be recovered through a combination of registration charges and a fuel charge of 22 c/l, an increase from the 20 c/l in the second determination.

Table A2.1: Determination of Allocated Costs to be Recovered, 2004/05

NRTC Road Transport Allocation in 2004/05	Total Exp. ($ million)	Unallocated ($ million)	Costs to be Recovered ($ million)	
Arterial Roads	5962	742	5220	
Local Roads	4433	2873	1560	
Totals	10395	3625	6770	
Heavy Vehicle Allocation for Vehicle Use			1640	24.2% of total costs to be recovered
Light Vehicle Allocation for Vehicle Use			5130	
			6770	

Source: NTC 2005

If the same NTC methodology is used for light vehicles as is carried out for heavy vehicles, then taking off existing light vehicle registration charges from these total recoverable costs will enable a fuel charge for light vehicles to be estimated. Table A2.2 shows that this light vehicle fuel charge is only 10.8 c/l compared to the heavy vehicle charge of 18.2 c/l. The reason for the NTC coming up with a higher fuel charge of 22 c/l is that there is greater revenue from actual registration fees than is assumed in their theoretical calculation because of a need for a minimum charge for the smaller rigid truck category. When this higher registration revenue is used in the above table it results in a lower fuel charge than the theoretical charge.

Table A2.2: Determination of Average Heavy and Light Vehicle Fuel Charges, 2004/05

	Heavy Veh.	Light Veh	Totals	
NRTC Allocated Costs	1640	5130	6770	
Registration Charges	548	2816	3364	Note 1
Fuel Charge ($ million)	1092	2314	3406	Allocated costs less rego charges
Fuel Consumed (mill. L)	6005	21500	28055	Note 2
Fuel Charge (cents/l)	18.2	10.8		

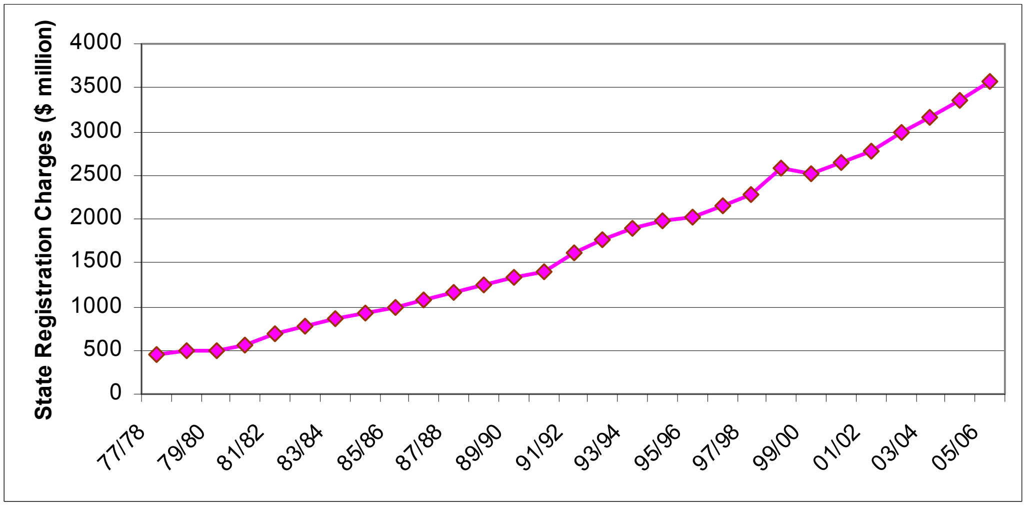
Notes:

1. Total 2004/05 registration charges taken as 2002/03 value (BTRE 2005) was extrapolated for two years by the average annual percentage increase between 1999/00 and 2002/03.
2. 2004/05 fuel use taken as 2004 use in ABS 2004 and includes petrol, diesel and LPG/CNG

Source: NTC 2005, BTRE (2005a) and ABS 2004 (Table 5)

Some explanation of the registration figures for light and heavy vehicles in this table is required. The total 2002/03 registration figure for all States was obtained from BTRE (2005a) and was extrapolated for two years on the basis of the average annual increase in the last three years, giving a total of $3,364 million for total registration charges in 2004/05. The extrapolation of these total registration charges is shown in Figure A2.1 below.

Figure A2.1: Trend in State Registration Charges



Source: BTRE (2005a)

Although there is no separation of light and heavy vehicle registration figures in BTRE (2005a) the NTC have also extrapolated heavy vehicle registration charges to 2004/05 and came up with a total of $548 million in this year. If these heavy vehicle charges are subtracted from the total then this leaves registration charges of $2,816 million for light vehicles. As there were 12,594,508 light vehicles in 2004, as given in ABS (2005), this gives an average registration figure of $223 per light vehicle.

Table A2.2 shows that after subtracting registration charges, we need to recover road use amounts of $1,092 million from heavy vehicles and $2,314 million from light vehicles with a fuel charge. As we plan to estimate the fuel charge to be recovered for road use in both rural and urban regions these total charges for light and heavy vehicles are broken down on the basis of the travel by both light and heavy vehicle road use in these two regions.

The travel figures are given on the left hand side of Table A2.3 while the allocation of light and heavy vehicle costs to urban and rural areas is estimated based on the ratio of urban to total vehicle-km and ratio of rural to total vehicle-km respectively.

Table A2.3 Fuel Charge Cost Allocation to Urban and Rural Regions for Road Use

TRAVEL BY URBAN AND RURAL REGIONS (bill veh-km)				ALLOCATION BY URBAN AND RURAL REGIONS ($ MILL		
	Light Veh	Heavy Veh	Total	Light Veh	Heavy Veh	Total
Urban	130.73	7.80	138.53	1651	538	2189
Rural	52.48	8.04	60.52	663	554	1217
Total	**183.21**	**15.84**	**199.05**	**2314**	**1092**	**3406**

Source: ABS 2004, Table 6 and Table A2.2 above.

The left hand side of Table A2.3 shows that there is a major difference in travel characteristics between light and heavy vehicles as there is a greater percentage of light vehicle travel in urban areas and greater heavy vehicle travel in rural areas.

A3. AIR POLLUTION COSTS

The previous estimate of air pollution externality costs (Cox 2001a) was based on the NRTC study of particulate emissions for all diesel vehicles in the year 2000 for all capital cities by vehicle type (Cox 2001). These emissions were based on emission tests of actual diesel vehicles in the Australian vehicle fleet (Parsons 2000) which were then increased by an estimate of particulate emissions from petrol powered light vehicles. This calculation gave particulate emissions of 4,890 tonnes and a pollution cost of $1,095 million for these 8 Australian capital cities.

The most recent study of air pollution costs (BTRE 2005) considered all urban areas (eg the Newcastle-Sydney-Wollongong area) and came up with a much higher estimate of 12,600 tonnes of particulate emissions and costs of $2,700 million for all urban areas in Australia. The major reasons for the difference in the magnitude of particulate emissions are the extension of the catchment areas from capital cities to all urban areas and also that Cox (2001a) extrapolated diesel particulate emissions by using petrol emissions from cars as 27% of the total emissions (EPA 1998). The car emissions in BTRE (2005) are larger than this.

The total air pollution cost of $2,700 million is significantly higher than the previous estimates of $46 million (Segal 1995), $545 million (Cox and Meyrick 1997) and $1,095 million (Cox 2001a). It is, however, lower than the estimate given in BIC (2001) of $4,300 million and considerably lower than the extraordinary estimate of $30.4 billion given by Beer (2002).

This BTRE (2005) estimate used a method where the long term health impacts of ambient air pollution was based on particulate matter (PM10) being used as a surrogate for all air pollutants. This surrogate method gave a cost of $2,700 million/12,600 tonnes = $214,300/tonne of particulates.

This value was similar to the value used in the previous study (Cox 2001a), which assumed that the health costs of particulates amounted to $224,000 per tonne. The figure was based on the ExternE project in Europe (EC 1998) and comprised a cost of $129,300 per tonne for 'excess mortality' and $95,000 per tonne for 'morbidity. The BTRE (2005) and Cox (2001a) figures are similar (and higher than previous estimates) because they are based on willingness to pay criteria for human lives. This assumption has not been used in Australia to the present time (BTE 2000a) as the human capital approach has previously been used.

The BTRE report also estimated that 67% of particulate emissions were produced by light vehicles (49% cars and 18% light commercial vehicles). This split is given in Table A3.1 and used with the 2004 travel figures for all urban areas to give the air pollution externality cost for both light and heavy vehicles. It is seen that these newer costs in cents/km are higher than the previous estimate in Cox (2001a).

Table A3.1: Calculation of Air Pollution Externality, 2004

Cost of Particulate Emissions in Urban Areas	PM10 Emissions (tonnes)	Unit Rate ($/tonne)	Cost ($ million)	Vehicle Travel (billion)	Cost (cents/km)	Previous Estimate (cents/km)
Light Vehicles	8442	214,300	1809.1	130.74	1.38	0.74
Heavy Vehicles	4158	214,300	891.1	7.80	11.42	8.12
Totals	**12600**		**2700.2**	**138.54**	**1.95**	

Note: Total PM 10 emission of 12,600 tonnes are split 67:33 to light and heavy vehicles based on Figure 3.11 in BTRE (2005)

Sources: BTRE (2005), ABS (2005)

Tsolakis and Houghton (2003) and AUSTROADS (2003) transferred the air pollution cost data from 5 of the 17 European countries (Denmark, Ireland, Greece, Portugal and Spain), which had similar population densities to Australia compared to the full set of 17 EU countries. They came up with 1.7 Australian cents/vehicle km for light vehicles which is similar to the 1.38 cents/vehicle km in the above table. The similarity is surprising in that the Australian estimate should be significantly lower as Australia introduced catalytic converters 10 years before Europe and light vehicle particulate emissions and costs in Australia should be considerably lower.

It should be noted that projections of particulate emissions from diesel vehicles, as well as all other air pollutants, will reduce in the future and reduce this cost (Cox 2001).

No allowance for greenhouse gas emissions have been made in this externality study, as other sectors of the economy do not experience this type of charge. This is best taken into account with a separate carbon tax that is applied to all sectors of the economy.

A4. NOISE POLLUTION COSTS

There has not been any new work carried out on the costs of noise pollution in Australia since 2001. The Inter-State Commission estimated noise pollution costs in 1990 of $389 million for all urban areas in Australia (ISC 1990) that were based on the unit costs in cents/km for various vehicle types given in Table A4.1 (the 89/90 values). These unit costs were based on measured noise levels of actual vehicles and gave total noise costs of $389 million.

The cost of traffic noise in Melbourne was estimated by Nairn et al (1994) as between $43 and $86 million in 1992 prices. Segal (1995) extrapolated these figures to "a value for Australia of, at most, $200 to $400 million per year". These costs were based on the observed reduction in house prices in residential area (using a Noise Depreciation Sensitivity Index of between 0.5 and 1.0%) and relates to a house owners willingness to pay (or not to pay) for these noise effects. As these indices do not take into account the impacts of road transport noise on business and recreational areas, the upper limit of $400 million of Segal (1995) would therefore seem to be closer to total road transport noise costs - and is similar to the ISC (1990) value at that time.

As noise costs are related to reductions in house prices adjacent to roads, these 1989/90 vehicle unit costs were adjusted by the 320% increase in house prices between 1989 and 2004, as given in Productivity Commission (2004). The revised unit costs for 2004/05 were used with the 2004 SMVU travel data (ABS 2005) to give preliminary noise costs for all urban areas, as shown in Table A4.1. A summation of the total light and heavy vehicle costs has also been calculated for these urban areas and is shown at the bottom of Table A4.1.

Table A4.1: Preliminary Calculation of Noise Pollution Externality

	Unit Noise Costs (c/km)		Urban vkm	Urban Cost
	89 / 90	**04 / 05 (1)**	**2004 (10^9)**	**2004 ($ million)**
Passenger vehicles	0.13	0.416	110.79	460.89
Motor cycles	0.13	0.416	1.18	4.91
Light commercial vehicles	0.13	0.416	18.92	78.71
Rigid & Other trucks	1.85	5.920	5.00	296.00
Articulated trucks	7.06	22.592	1.44	325.32
Buses	7.06	22.592	1.36	307.25
Housing Ratio 2003/89=	3.20	**Totals**	**138.69**	**1473.08**
	Light Vehicles ($ million)			**544.50**
	Heavy Vehicles ($ million)			**928.58**

Notes: 1. 1989 ISC costs updated by increase in house prices between 2004 and 1989

Sources: ISC (1990), Productivity Commission (2004), ABS (2005)

The transfer of the results from 5 European countries to Australia (Tsolakis and Houghton 2003, AUSTROADS 2003) gave a result of 0.7 c/km for cars compared to the 0.42 c/km in the above table. The European work, however, uses a different methodology as it uses a combination of this willingness to pay effect plus an estimated health component based on stress effects. This has the effect of raising the willingness to pay costs by about 67%.

If this health component is subtracted from the transferred European result of 0.7 c/km then the results are identical at 0.42 c/km. The BIC estimates a lower figure of 0.3 c/km for light vehicles (BIC 2001). Given that there is no compelling reason to change the derived 0.42 c/km this value will be used for light vehicles.

The results for heavy vehicles in the above table of 5.92 c/km for rigid trucks and 22.59 c/km for articulated trucks and buses are considerably higher than other estimates and would indicate that there has been a countervailing trend of better engine and tyre technology since 1989 that has reduced heavy vehicle noise effects.

BIC (2001) estimates values from US data of 1.8 c/km for rigid trucks, 1.8 c/km for buses and 5 c/km for heavy trucks. AUSTROADS (2003) also gives a figure for buses of 1.7 c/km using European data. This latter study only gives a noise figure of 3 cents per 1,000 tonne-km for heavy trucks. Using the 2004 ABS figure for the tonne-km of rigid and heavy vehicles of 151.0 billion gives an Australian noise figure for heavy vehicles of only $45.3 million, which converts to a cost of 8.4 c/km per vehicle-km of travel. The revised estimates of noise costs using these later unit noise figures for heavy vehicles are given in Table A4.2 below.

Table A4.2: Final Calculation of Noise Pollution Externality

	Unit Noise Costs (c/km)			Urban vkm	Urban Cost
	89 / 90	04 / 05 (1)	Revised 04/05	2004 (10^9)	2004 ($ million)
Passenger vehicles	0.13	0.42	0.42	110.79	460.89
Motor cycles	0.13	0.42	0.42	1.18	4.91
Light commercial vehicle	0.13	0.42	0.42	18.92	78.71
Rigid & Other trucks	1.85	5.92	8.40	5.00	420.00
Articulated trucks	7.06	22.59	8.40	1.44	120.96
Buses	7.06	22.59	1.80	1.36	24.48
Housing Ratio 2004/89=	3.20	**Totals**		**138.69**	**1109.94**
		Light Vehicles ($ million)		**544.50**	
		Heavy Vehicles ($ million)		**565.44**	

Notes: 1. 1989 ISC costs updated by increase in house prices between 2004 and 1989
2. Heavy vehicle unit prices revised based on AUSTROADS 2004 and BIC 2001

The updated noise cost for all Australian urban areas gives an estimate of $1,110 million, which is higher than the $450 million in the previous estimate of Cox and Meyrick (1997) and $510 million in Cox (2001a), which were for capital city areas only. The cost is similar to the recent estimate of BIC (2001) of $1,200 million in 2001, which was based on US work on the marginal noise cost of various vehicle types (Delucchi and Hsu (1998).

A5. ROAD CRASH COSTS

No new major work on Australian crash costs has been carried out since the estimate of crash costs in Australia (BTE 2000), which gave the costs shown in Table A5.1. The total crash costs in this table of $13.16 billion are lower than the $15 billion total quoted in many papers from this reference because the values for a 7% discount rate are given instead of the 4% value used to give the $15 billion total. Most transport economic valuations use a discount rate closer to 7% than 4%.

Table A5.1: Australian Crash Costs, 1996 adjusted to 2004

		$ billion	$ billion	Comments	
Human Costs			6.56		
	Medical	1.73			
	Lost Labour	1.92		$0.87 billion is for lost labour in households	
	Quality of Life	1.77		Pain & suffering	
	Other	1.14		Legal, workplace disruption, funeral etc	
Vehicle Costs			4.11	Mainly vehicle repairs	
General Costs			2.49		
	Travel Delays	1.45			
	Insurance Admin	0.93			
	Other	0.11		Police, property, fire	
Total	**1996 Crash Cost (BTE 2000)**		**13.16**		
	Updated by CPI 2004-1996		**16.03**	Ratio Dec 2004 to Dec 96 =	1.218
	Fatality Adjustment		**0.56**	374 fatalitiy reductions @$1.5 million	
	Adjusted 2004/05 Road Crash Cost		**15.47**		

Notes:

1. Willingness to pay not used in these crash cost determinations. This would raise crash costs by a further $9 billion.
2. A discount rate of 7% is used to discount future labour costs in the human capital method.

As most of the above costs are related to the cost of living (CPI), the total crash costs have been updated to 2004/05 costs in the above table by multiplying by the ratio of the December 2004 CPI value to the December 1996 value, ie 146.5/120.3 = 1.218. This brings the total crash costs in 2004/05 to $16.03 billion.

This 2004/05 crash cost will be modified by the change in fatal and serious injuries between 1996 and 2004. An examination of databases of the Australian Transport Safety Bureau (ATSB) shows very little change in serious and minor injuries in this period (ATSB 2004) but a reduction in fatalities from 1,970 to 1,596 between 1996 and 2004. The BTE(2000) report gives a cost of a fatal accident of $1.5 million so the $16.03 billion will be reduced by 374 fatalities X $1.5 million = $561 million to make the adjusted cost base in 2004/05 the sum of $15.47 billion.

Not all of these crash costs are road transport externalities as road users, both private and commercial, in 2002 pay compulsory third party insurance premiums ($1,975 million), commercial motor vehicle premiums ($1,120 million) and domestic motor vehicle premiums ($3,709 million) totalling $6.81 billion (APRA 2002). These premiums are increasing at about $240 million per year so the adjusted 2004/05 figure taken for these premiums will be $7.28 billion. These are subtracted from total crash costs in Table A5.2.

If these transfers are deducted from the adjusted 2004/05 road crash costs of $15.47 billion then this leaves $8.19 billion in uncompensated costs (see Table A5.2). There are other crash costs that are internalised to private motorists as a group, such as the $0.87 billion in lost labour within households ($1.06 billion in 2004/05 values) and the $1.77 billion pain and suffering ($2.16 billion in 2004/05 values). If these are subtracted from the uncompensated costs, then the external cost of road crashes becomes $4.97 billion, or 32% of total crash costs. This is similar to the 25% of total crash costs determined in Cox and Meyrick (1997) and an OECD figure of 30% quoted in NZMOT (1996).

Table A5.2: External Australian Crash Costs, 2004/05

			2002	1996	
Comprehensive & Third Party Premiums			1.98	1.53	
Commercial Motor Vehicles			1.12	0.90	
Domestic Motor Vehicles			3.71	2.95	
		Totals 2002	6.81	5.38	0.24 per year
		Increase to 2004	**7.28**		
Balance of crash costs less premiums			**8.19**	This is the uncompensated costs of road crashes	
Less internalised costs	labor in the household		1.06		
	quality of life/pain & suffering		2.16	Internalised by road users	
			4.97		
	less charges on speeding and alcohol		**1.99**	40% charged to speeding and drink drivers	
Equals	**remaining externality crash cost**		**2.98**	60% charged to road users	

Martin (2005) has analysed what percentage of total crash costs should be considered as externalities and comes to the following conclusion

"*Ultimately it is the definition of external accident costs that is adopted that determines both the total value and the variation. Commonly used definitions of external accidents range widely and still appear to be in the 'state of flux' that Cox identified more than a decade ago (Cox 1994, p.189)*"

Not all of these external crash costs should be attributed or charged to ordinary road users but should be targeted, for maximum effect, on those that are causing many of these crashes, namely drunk and speeding drivers. Alcohol is a major factor in about 30% of all road fatalities (ATC 2003, FORS 1996) and speeding is a major factor in 14% of crashes (Fildes and Lee 1993). There may be some double counting in adding these two figures together and it will be assumed that 40% of crash costs should be charged to these groups of drivers in the form of a charge on alcohol and in speeding fines. This leaves $2.98 billion to be charged to motorists through a fuel charge.

Greene and Jones (1997) also argue that there is no point in adding an externality charge to cover the costs caused by drunk drivers as their behaviour is irrational and will not be influenced by any pricing signals. They state "Internalising any external costs they (*drunk drivers*) generate would not necessarily lead to an efficient transportation system".

The present externality cost for road crashes of $2.98 billion is very similar to the $3.08 billion estimated in Cox (2001a) and higher than the previous figure of $2.49 billion in Cox and Meyrick (1997).

Accident costs were allocated to vehicle types and both metropolitan and regional areas in Cox and Meyrick (1997) and this distribution will be assumed in this project[2]. The allocation of external crash costs to both light and heavy vehicles are given at the bottom of Table A5.3.

[2] Note that this distribution used in the previous analysis differs from the rural and urban split used in other categories of this report. However, there should not be that much of an error in assuming that this metropolitan and regional split is applicable to urban and rural areas.

Table A5.3: Distribution of External Crash Costs

Revised Estimate Based on $2.98 billion (multiply by 2.98/2.49 =				1.20					
	NSW	VIC	QLD	WA	SA	TAS	NT	ACT	AUST.
Total External cost by Vehicle Type ($'000)									
Passenger vehicles	584.3	606.9	458.2	224.8	150.5	51.0	23.7	20.6	2119.9
Motor cycles	4.2	4.4	3.3	1.6	1.1	0.4	0.2	0.1	15.3
Light commercial vel	122.6	117.3	120.5	56.5	29.7	13.8	11.7	3.0	475.1
Rigid & Other trucks	32.7	27.3	23.2	11.5	6.1	2.3	1.9	0.6	105.6
Articulated trucks	66.7	78.8	53.2	28.4	17.1	7.6	6.5	0.8	259.1
Buses	6.5	5.8	5.6	3.3	1.8	0.7	1.6	0.3	25.6
0.00	817.1	840.4	664.1	326.1	206.3	75.8	45.5	25.4	3000.7
Note: 10% of road toll is motorcyclists. 11% of road toll is in accidents involving artic. truck (www.atsb.gov.au)									
External Costs by Metro and Rural Regions ($'000)									
Metro									
Passenger vehicles	366.6	387.8	181.5	150.5	105.7	21.2	13.9	20.6	1247.7
Motor cycles	2.6	2.8	1.3	1.1	0.8	0.2	0.1	0.1	9.0
Light commercial vel	55.7	67.2	42.1	29.8	16.3	4.8	5.6	3.0	224.4
Rigid & Other trucks	20.1	18.9	10.2	6.8	4.0	1.0	1.0	0.6	62.7
Articulated trucks	31.3	40.4	18.3	10.7	4.9	2.1	1.4	0.8	110.0
Buses	3.7	3.5	1.8	1.7	1.2	0.3	0.4	0.3	12.8
0.00	480.0	520.6	255.2	200.6	132.7	29.6	22.4	25.4	1666.7
Rural									
Passenger vehicles	217.6	219.1	276.8	74.3	44.8	29.8	9.7	0.0	872.2
Motor cycles	1.6	1.6	2.0	0.5	0.3	0.2	0.1	0.0	6.3
Light commercial vel	67.0	50.1	78.4	26.7	13.5	9.0	6.1	0.0	250.7
Rigid & Other trucks	12.7	8.4	13.0	4.6	2.2	1.3	0.8	0.0	42.9
Articulated trucks	35.4	38.4	34.9	17.7	12.2	5.4	5.1	0.0	149.1
Buses	2.8	2.3	3.8	1.5	0.7	0.4	1.3	0.0	12.8
0.00	337.1	319.8	408.9	125.4	73.5	46.1	23.1	0.0	1334.0

	Metro	Regional	Total	
Light Vehicles	**1399.3**	**1191.9**	**2591.2**	87%
Heavy Vehicles	**114.4**	**277.7**	**392.0**	13%
All Vehicles	**1513.6**	**1469.6**	**2983.2**	

A6. SUMMARY OF ROAD USER AND EXTERNALITY COSTS, 2004/05

The distribution of road use and externality costs are given in Table A6.1 where total costs amount to $10.2 billion in the year 2004/05.

Table A6.1: The Costs of Road Transport Use and Externalities, 2004/05

	Light Vehicles			Heavy Vehicles			All Vehicles		
	Urban	Rural	Totals	Urban	Rural	Totals	Urban	Rural	Totals
Air Pollution	1809	0	1809	891	0	891	2700	0	2700
Noise	545	0	545	565	0	565	1110	0	1110
Crash	1399	1192	2591	114	278	392	1514	1470	2983
Road Use less Registration	1651	663	2314	538	554	1092	2189	1217	3406
Totals	**5404**	**1855**	**7258**	**2109**	**832**	**2941**	**7512**	**2687**	**10199**

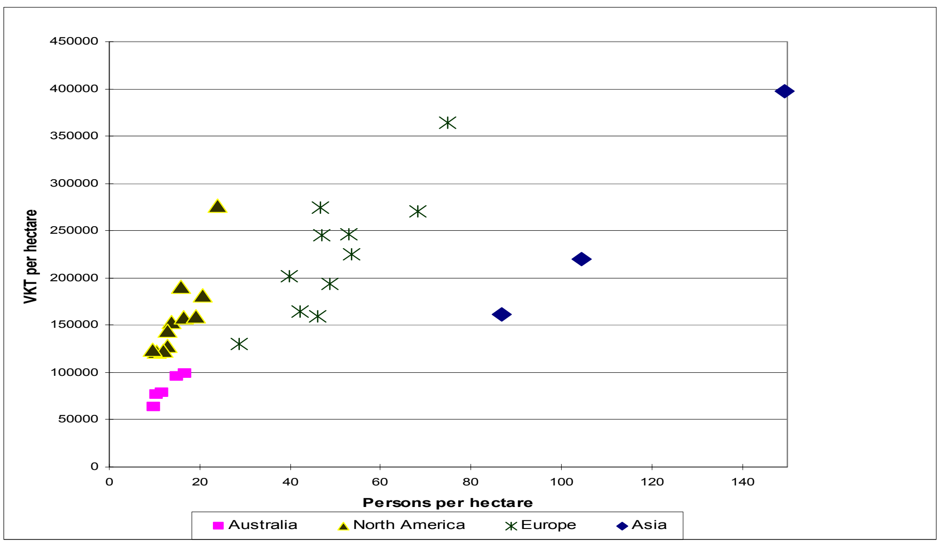
This $10.2 billion of costs can be compared with registration and fuel charge revenue totalling $12.3 billion in 2002/03 (BTRE 2005a), although this revenue figure does not include any rates revenue that is raised by Local government for local roads expenditure.

There is little change in the 2004/05 costs ($10.2 billion) with those in 1999 of $10.1 billion (Cox 2001a). As these are in current costs there has, in fact, been a small reduction. Environmental costs of air pollution and noise have increased from $1.6 billion in 1999 to $3.8 billion in 2004/05 but external crash costs are down from $3.7 billion to $3.0 billion because of a reduction in fatalities and an increase in insurance costs from $5.4 billion to $7.3 billion. Road use costs are also down from $4.6 billion to $3.4 billion, mainly due to an increase in registration charges from $2.3 billion to $3.4 billion.

The sum of air, noise and crash cost externalities comes to $6.9 billion, or 0.9% of the present GDP for Australia. These values are low compared to the values quoted in the European literature (2.1% in EC 1995).

This emphasises that Australian road transport externalities are markedly different from European road transport externalities where most of the externality studies have been carried out. The following graph shows that vehicle intrusiveness in Australian urban areas (as measured in vehicle-km of travel/sq km) are one third of the values in European cities and even half of those in the USA.

Figure A6.1 Vehicle Intrusiveness in Australian, European and US Cities



Source: Kenworthy et al 1997

The same is true of travel outside of the major cities because Australian population densities (2 persons/sq km) are much lower than those in European countries (an average of 114 persons/sq km for all European Union countries). The transfer of European road transport externality results to Australia will therefore be very misleading unless there are major adjustments, as was carried out in the AUSTROADS (2003) study.

Lastly, it should be recognised that many of the external costs of road transport are controlled by government intervention in the form of regulatory measures for vehicle design (safety and air pollution) and fuel standards, which then become internalised in the private costs of motoring. What we are considering in this report are the externalities that are remaining.

A7. FUEL CONSUMPTION IN URBAN AND RURAL AREAS

The Australian Bureau of Statistics (ABS 2005) gives an estimate of fuel consumption in 2004 by vehicle type but not by area of operation. The fuel consumption by light and heavy vehicles is given in the right hand column of Table A7.1 and includes petrol, diesel and LPG/CNG.

ABS (2005) do, however, give estimates of travel by vehicle type in these two geographical areas, as shown in the table below. Light vehicle travel figures are taken as the sum for cars motor cycles and light commercial vehicles and heavy vehicle travel figures are taken as the sum of rigid trucks, other trucks, articulated trucks and buses.

Table A7.1: Travel and Fuel Consumption by Light and Heavy Vehicles, 2004 by Urban and Rural Regions

	Urban Travel (billion veh-km)	Rural Travel (billion veh-km)	Total Travel (billion veh-km)	Fuel Consumption (mill. Litres)
Light Vehicles	130.73	52.48	183.21	21,408
Heavy Vehicles	7.80	8.04	15.84	6,009
All Vehicles	138.53	60.52	199.05	27,417

Source: ABS (2005)

The fuel consumed is divided into petrol, diesel and LPG/CNG but no distinction will be made in this study between fuel types. That is, any fuel charges determined in this study will be applicable to all fuel types.

To determine the fuel consumed in urban and rural areas from the above travel and fuel consumption data, it is necessary to assume how much more fuel is consumed in urban areas because of stop-start driving than travelling at more or less constant speeds in regional areas. From a review of the literature (as discussed in Cox and Meyrick 1997) it will be assumed that light and heavy vehicles will consume 20% and 40% more fuel respectively in urban areas. The heavier vehicles give a higher percentage increase in fuel consumption for driving in urban areas because of the greater energy needed for stopping and starting. This provides the fuel used in urban and rural areas, as shown in Table A7.2.

Table A7.2: Fuel Consumption in Urban and Rural Areas

	Urban	Rural	Total
Light Vehicles	16042	5,366	21,408
Heavy Vehicles	3,461	2,548	6,009
All Vehicles	19,502	7,915	27,417

A8. SUMMARY OF FUEL CHARGES

If actual registration charges are taken as an offset to reduce road use charges and all costs (as per Table A6.1) are divided by the fuel consumed by light and heavy vehicles in both urban and rural areas then fuel charges for each of these costs can be estimated, as shown in Table A8.1.

Table A8.1: Estimation of Fuel Charges by Area and Light and Heavy Vehicles, 2004/05 (cents/litre)

	Light Vehicles			Heavy Vehicles			All Vehicles		
	Urban	Rural	Totals	Urban	Rural	Totals	Urban	Rural	Totals
Air Pollution	11.28	0.00	8.45	25.75	0.00	14.83	13.85	0.00	9.85
Noise	3.39	0.00	2.54	16.34	0.00	9.41	5.69	0.00	4.05
Crash	8.72	22.21	12.10	3.30	10.90	6.52	7.76	18.57	10.88
Road Use less Registration	10.29	12.35	10.81	15.54	21.75	18.17	11.22	15.38	12.42
Totals	**33.69**	**34.56**	**33.90**	**60.93**	**32.65**	**48.94**	**38.52**	**33.94**	**37.20**

Note: The average fuel charge is the total externality cost for light and heavy vehicles divided by the total Australian vehicle – km of these vehicles. This national average would be used if it was not possible to separate charges into urban and rural categories.

These charges can be compared to the fuel charges estimated for 2001/02 in Cox (2001a) in Table A8.2 following. Although some of the differences may be due to the separation of charges from capital and regional areas in the previous study to urban and rural regions in the new determination, it is evident that major increases of about 30% have occurred in the light vehicle charges. The main reasons for this are because of a larger estimate for air pollution costs for light vehicles and a greater proportion of road use costs in the NTC (2005) road user charges determination being allocated to light vehicles compared to heavy vehicles.

Table A8.2: Previous Estimation of Fuel Charges by Area and Light and Heavy Vehicles, 2001/02 (cents/litre)

	Light Vehicles			Heavy Vehicles			All Vehicles		
Fuel Charge (c/l)	Capitals	Regional	Totals	Capitals	Regional	Totals	Capitals	Regional	Totals
Air Pollution	6.0	0.0	3.6	21.6	0.0	8.8	8.4	0.0	4.7
Noise	1.3	0.5	1.0	12.3	2.7	6.6	2.9	1.1	2.1
Crash	13.8	17.4	15.2	6.4	10.6	8.9	12.7	15.5	13.9
Road Use -Registration	5.2	8.4	6.5	15.5	23.8	20.4	6.7	12.7	9.4
	26.3	26.3	26.3	55.7	37.1	44.6	30.7	29.3	30.1

The new light vehicle fuel charge of about 34 c/l in Table A8.1 can be compared with the present excise charge of 38.1 c/l and shows that there is currently a slight amount of overcharging of all light vehicles. It should be noted that under the NTC full cost recovery methodology this road user charge includes an allowance for capital expenditure recovery and therefore the application of a further congestion charge would be a form of double counting. The alternative would be to only include marginal road use costs (the additional maintenance cost from road use) and to apply a congestion charge on top of these lower fuel charges.

Table A8.3: Comparison of Full Cost Recovery Heavy Vehicle Fuel Charges with Existing Charges

Vehicle/ Area of Operation	Existing Fuel Excise	Fuel Charge This Study
Light vehicles - rural	38.1	33.7
Light vehicles – urban	38.1	34.6
Rigid Trucks (4.5 – 20 t) - rural	19.6	32.6
Rigid Trucks (4.5 – 20 t) – urban	38.1 (1)	60.9
Articulated Trucks – rural	19.6	32.6
Articulated Trucks - urban	19.6	60.9

Note: 1. This will revert back to 19.6 c/l on July 1, 2006
2. These diesel costs are for ultra low sulphur diesel. Regular diesel excise is 1 c/l higher.

The Energy Grants Credit Scheme presently gives a rebate of 18.51 c/l for articulated trucks in rural and urban areas and for rigid trucks between 4.5 and 20 tonnes in rural areas only. After July 1, 2006 all trucks in both rural and urban areas will receive this 18.51 c/l rebate. Table A8.3 shows that there is a significant undercharging of heavy vehicles of 32.6 – 19.6 = 13.0 c/l in rural areas and an even greater undercharging after July 1, 2006 of 60.9 – 19.6 = 41.3 c/l for trucks in urban areas.

The Terms of Reference for the Inquiry stress the effects of externalities on the efficient allocation of resources. The undercharging of heavy vehicles, particularly in metropolitan areas, will lead to significant resource allocation decisions which will favour economic and transport growth in urban areas at the expense of rural areas.

Similarly the existence of no fuel charge on CNG and LPG, despite the contribution of these vehicles to road use, crash and noise costs will lead to an inefficient transfer of vehicles to these fuel types and an under recovery of costs. It would be better to keep a constant fuel charge and reduce registration fees to take account of the better environmental performance of these fuel types, as suggested in BIC (2001). Differential registration fees are very effective in moving vehicle fleets towards more fuel-efficient and environmentally friendly vehicle types (Cox 1994).

It should also be noted that a significant fall in excise revenue is anticipated over the next 20 years if the status quo continues because of the diffusion of excise free fuels (LPG, CNG, electricity, fuel cells) into the present vehicle fleet. Removing the undercharging of heavy vehicles and excise free vehicles would help keep fuel charge revenue from falling and being insufficient to finance growing road expenditures.

There could also be a reduction in costs and charges in the future due to better technology. This is occurring in the reduction of emissions and air pollution costs but could also occur with crash costs and road use costs. The Australian road transport sector is maturing as demand slows (Cox 2002) so that after several major urban road projects are completed there may be a slowing of road expenditure increases also.

It must be pointed out that externalities are not the only kind of flaws that prevent markets from allocating resources efficiently. Institutional factors are another major flaw in that most road investments are controlled in a “command economy” fashion that predominantly considers roads as a public good. Commonwealth government expenditure, for example, has generally been directed towards rural roads and this has been a major reason for the high road transport externalities in urban area that has been estimated in this report. Some analysts are sceptical of pricing for full social costs when roads are still considered to be a public good and vehicles are not working in a fully operating market (Greene and Jones 1997). This is even more apparent in the provision and pricing of public transport.

This is the reason why many economists have recommended that there be greater market mechanisms in road transport. A connection between road user charges and road expenditures would mean that when the costs of air pollution, crashes or road congestion goes up then there will be more revenue that can be used to reduce these costs. Conversely if road transport costs decline then there will be less need for this revenue.

This also raises the question of where the revenue from these various road use, environment and crash costs should be directed. The present system of charges/excise being directed to the Commonwealth government while the States have responsibility for most of the road use and expenditure is contrary to microeconomic reform in other government utilities where there is a linkage through user charges between revenue and responsibility. It is fairly clear that road use costs and some crash cost charges should be directed to road management agencies at both Federal and State levels so as to reduce these road transport costs. Some crash and environmental charges should probably be directed to State health services.

A9. MARGINAL COST PRICING

It is often argued that social equity is the main reason for using the full social cost recovery method employed above, in that all road users are charged for their fair share of road expenditures as well as the costs that they inflict on other members of society.

One of the problems in this recovery method, however, is that it does not lead to strong price signals for an efficient allocation of resources in the road transport sector (see Box 6.3 in Cox 1994). The consensus of the road pricing literature is that short run marginal social cost pricing, where prices equal marginal costs, is the first best pricing principle as it provides better signals for both road use and investment in infrastructure.

Short run marginal costing is based on the road user paying the cost of an additional trip at the current level of infrastructure provision while long run marginal costing allows for the cost of infrastructure being optimally adjusted to the level of demand.

These charges, particularly for congestion, will have more effect on demand and efficient resource allocation, as studies have indicated that congestion costs could be of the order of $1 per km in central city areas and even 14 c/km in other metropolitan areas (BTCE 1996) compared to the 4 c/km in the full social cost recovery method.

The question is often raised whether short run marginal costs will provide sufficient revenues to support road expenditures (Box 6.4 in Cox 1994). From the various case studies around the world sufficient revenue appears to be provided by short run marginal costs if there are large urban areas where congestion charges are generated. Cox and Meyrick (1997) found that short run marginal costs in Australia from efficient road user charges of $9.1 billion were more than sufficient to cover the $5.7 billion being spent on the road system at that time, and even would cover a higher estimated optimal level of road expenditure of $7.5 billion.

Although the means to convert average externality costs into marginal costs are generally unclear, there are a few references that conclude "*Constant average cost may characterise some transportation externalities reasonably well*" (Greene and Jones 1997). There are some, however, that argue that if there is no increase in the number and severity of crashes with increasing traffic then the marginal cost of accidents should be zero. The average externality costs in the main report will be considered to be marginal costs in this section.

In the case of road use, the only costs that are due to additional traffic are pavement maintenance and rehabilitation costs and NTC (2005) gives the following figures for these expenditures.

Table A9.1: Maintenance Costs, 2004/05

Routine Maintenance	$560 million
Periodic Maintenance of Sealed Roads	$402 million
Road Rehabilitation	$654 million
Total	$1,616 million

Source: NTC (2005)

Not all of these costs are due to road use, though, as pavement maintenance would still be required due to climatic damage even if there was no traffic. For example, the majority of sealed roads in Australia have a surface seal that has to be resealed every 7 years or so because the bitumen in the seal oxidises, becomes brittle and cracks irrespective of traffic levels. In the case of heavier pavements, a conservative pavement design process often leads to overdesign of the pavement and this also limits the effects of vehicle loading on pavement damage and subsequent maintenance costs.

The NTC second heavy vehicle charges determination assumed, for example, that 50% of maintenance costs were attributable to climate and 50% were due to AGM-km, where AGM is the average gross mass of a laden vehicle.

The third heavy vehicle charges determination discusses the attempts to relate these pavement expenditures to road use (NTC 2005) and found that only one of the four analyses found any relationship that was statistically significant. They also found that road maintenance expenditures were related to the passage of lighter vehicles, or PCU-km, where PCU is Passenger Car Units. The allocation in the third heavy vehicle charges study was as follows.

Table A9.2: Allocation Parameters Used to Apportion Maintenance and Rehabilitation Expenditures (Per cent)

Expenditure Category	AGM-km	PCU-km	ESA-km	Non Attributable Costs
Routine Maintenance	37	37		26
Periodic Maintenance	60	10		30
Rehabilitation			45	55

Source: NTC 2005

The distribution of the costs in Table A9.1 in accordance with the allocation parameters given in Table A9.2 gave the following split for the marginal cost of road use for both urban and rural areas as well as for light and heavy vehicles (NTC 2006).

Table A9.3: Distribution of Marginal Costs to Regions and Vehicle Types

	Urban	Rural	Total	Light Veh	Heavy Veh	Total
Routine Maintenance	130	430	560	342	219	561
Periodic Maintenance	126	276	402	187	214	401
Road Rehabilitation	192	462	654	355	298	653
Totals	**448**	**1168**	**1616**	**884**	**731**	**1615**

Source: Tables 3 and 9 of NTC 2006

If urban and rural costs on the left hand side of the table are split according to the ratios for light and heavy vehicles on the right side of the above table, then the final distribution is given in the table below

Table A9.4: Distribution of Marginal Costs to Regions and Vehicle Types

	Light Veh Urban	Light Veh Rural	Heavy Veh Urban	Heavy Veh Rural
Routine Maintenance	79.3	262.1	50.7	167.9
Periodic Maintenance	58.8	128.7	67.2	147.3
Road Rehabilitation	104.4	251.2	87.6	210.8
Totals	**242.4**	**642.0**	**205.6**	**526.0**

Notes: The allocation between light and heavy vehicles for urban and rural expenditures in Table A9.3 is based on ratios of light and heavy vehicle expenditures to total expenditures for each maintenance category in Table A9.3.

Assuming that average externality costs are the marginal cost of externalities and adding the values for marginal cost road use gives the total marginal costs shown in Table A9.5.

Table A9.5: Summary of Total Marginal Cost of Road Use

	Light Vehicles			Heavy Vehicles			All Vehicles		
	Urban	Rural	Totals	Urban	Rural	Totals	Urban	Rural	Totals
Air Pollution	1809	0	1809	891	0	891	2700	0	2700
Noise	545	0	545	565	0	565	1110	0	1110
Crash	1399	1192	2591	114	278	392	1514	1470	2983
Marginal Road Use	242	642	884	206	526	732	448	1168	1616
Totals	**3995**	**1834**	**5829**	**1776**	**804**	**2580**	**5772**	**2638**	**8409**
Fuel Consumption (million litres)	16042	5366	21408	3461	2548	6009	19502	7915	27417

Dividing these marginal costs by the fuel consumption figures in the above table gives the total marginal social costs of road transport in Australia (excluding the major marginal cost of congestion) in cents/litre.

Table A9.6: Estimate of Full Marginal Social Cost of Road Transport in Australia (c/l)

	Light Vehicles			Heavy Vehicles			All Vehicles		
	Urban	Rural	Totals	Urban	Rural	Totals	Urban	Rural	Totals
Air Pollution	11.28	0.00	8.45	25.75	0.00	14.83	13.85	0.00	9.85
Noise	3.39	0.00	2.54	16.34	0.00	9.41	5.69	0.00	4.05
Crash	8.72	22.21	12.10	3.30	10.90	6.52	7.76	18.57	10.88
Marginal Road Use	1.51	11.96	4.13	5.94	20.64	12.18	2.30	14.76	5.89
Totals	**24.91**	**34.17**	**27.23**	**51.33**	**31.54**	**42.94**	**29.60**	**33.33**	**30.67**

Note: The average marginal fuel charge is the total externality cost for light and heavy vehicles divided by the total Australian vehicle – km of these vehicles. This national average would be used if it was not possible to separate charges into urban and rural categories.

Comparing this table with Table A8.1 for average full recovery costs gives the following comparison.

Table A9.7: Comparison of Average Full Recovery Costs with Marginal Costs (excluding congestion)

	Light Vehicles			Heavy Vehicles			All Vehicles		
	Urban	Rural	Totals	Urban	Rural	Totals	Urban	Rural	Totals
Average Full Recovery Cost	33.69	34.56	33.90	60.93	32.65	48.94	38.52	33.94	37.20
Marginal Costs	24.91	34.17	27.23	51.33	31.54	42.94	29.60	33.33	30.67

It is seen that marginal costs are lower, particularly for light vehicles in urban areas. The undercharging of heavy vehicles in urban areas where charges are still only 19.6 c/l is still apparent, particularly if marginal congestion costs are added to these figures.

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