Efficiency and Equity Issues in the Funding of Roading Expenditures

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INDEX

Efficiency and Equity Issues in the Funding of Roading Expenditures

This paper considers whether present systems for decision-making and charging in the roading sector are achieving transport efficiency goals and fair outcomes for the roading network funders.

About $2.5 billion is spent on roading and related services each year. The more than $1 billion of this that is spent on capital represents a significant part of New Zealand's annual capital expenditure and therefore of national savings. It is larger again when added to public and private capital expenditure being spent in associated and/or competing activities in the economy. As a result it is important to establish efficient prices and investment criteria for the sector.

The discussion comprises six broad sections and is preceded by a summary report, conclusions and recommendations:

Section 1 describes the current model used to allocate road expenditure between various vehicle-use characteristics and expenditures unrelated to vehicle-use. The description draws on the Cost Allocation Model (CAM) and data used by the Ministry of Transport both to "inform" the Government of the allocations and to determine petrol excise tax and road-user charges rates for the 2007-08 Land Transport budget.

Section 2 identifies specific cost relationships formulae used in the CAM that seem deficient and should be reviewed. In particular where recent research findings and empirically derived vehicle performance data have or should have been applied.

Section 3 debates whether or not the petrol excise tax and road-user charges for vehicle-use, as determined under the CAM, are economically efficient.

Section 4 discusses the treatment of residual costs (ie unrelated to vehicle-use) in the CAM and equity issues involved in recovering such costs.

Section 5 addresses efficiency and equity issues arising from using Local Authority funding

Section 6 identifies other matters affecting the efficiency of the roading network.

Summary, Conclusions and Recommendations

Summary Report

Section 1. The Present Cost Allocation and Recovery Regime

Expenditure associated with the provision of roads and the enforcement of road-use regulations totals close to $2.5 billion per annum. The payment for these services comes from user charges, an annual licensing fee and local authority rates.

In order to determine user-costs roading expenditure is broken down into four use-related measures:

Road Amenities (road markings etc.) are related to Powered Vehicle (PV) kilometres. Under this measure a car and truck are treated equally.

Road Space such as four-laning or passing lanes is related to Per Car Equivalent (PCE) kilometres. Under this measure a 44-tonne truck has the same impact as 6.4 cars.

Road Strength is related to Gross Vehicle Weight (GVW) kilometres. Under this measure a 44-tonne truck has the same impact as 26 cars.

Road Pavement Wear is related to Equivalent Standard Axle (ESA) weight kilometres. Under this measure a 44-tonne truck has the same impact as about 8,300 cars.

The following table sets out the current annual costs attracted by light vehicles (up to 10 tonnes) and heavy vehicles (over 10 tonnes).

		PV	PCE	GVW	ESA	Total
Total Expenditure		597	549	182	443	1,771
Up to 10 tonnes	**$ m**	570	462	113	31	1,176
	%	95%	84%	62%	7%	66%
Over 10 tonnes	**$ m**	27	87	69	412	595
	%	5%	16%	38%	93%	34%

Under the cost allocation model (CAM) used by the Crown, use-related costs are recovered from user charges. These charges are a petrol excise tax (PET) and, for all vehicles licensed over 3.5 tonnes and all light diesel-powered vehicles, a road-user charges fee (RUC). The RUC rates are calibrated to take into account the impact that the operational weight of a vehicle has on roading expenditures.

The remaining costs of $725 million are unrelated to vehicle-use and are treated as residual costs to be recovered in a way that minimises their impact on road usage. These costs are currently met by the Motor Vehicle Licensing fee (about $235 million), a local authority rates contribution to local roading (about $475 million) and miscellaneous income and reserves.

Section 2. Improvements to the CAM

There are three immediate areas where the relationship formulae between costs and vehicle-use used in the CAM warrant further review:

1. The 4^{th} Power Rule For Pavement Wear

The appropriateness of the 4^{th} power has been questioned for some time, both internationally and locally. Research conducted in New Zealand and in Australia using New Zealand-type gravels concluded that a lower exponent than the current one should be used. In one case results were in a range between 1-3 with a typical value of 1.5 and in the other case between 1.8 and 3.2.

A change in the exponent to 1.5 would reduce the wear-related allocation to vehicles over 10 tonnes from $412 million to $223 million. Alternatively an exponent of 2.25 (the average of the ranges) would mean the wear-related allocation to vehicles over 10 tonnes would be $321 million. The difference would be met by cars and other vehicles with weights up to 10 tonnes.

Since two thirds of the current RUCs for vehicles over 10 tonnes come from this ESA expenditure category (and a higher proportion for the heaviest vehicles) any reduction in the exponent would have a major bearing on both the level and structure of RUC rates. There would be a flattening of the rates structure, with lighter vehicles paying more and heavier vehicles paying less, and with the progression in rates going to a third or a half of the previous progression.

Obviously for the CAM to operate effectively a single best estimate for the exponent is required. However, since the roading network is made up of a number of different road substrata and binding materials, there is a range of exponents across the network and these exponents need to be understood when considering the economic merits of the prices generated in the CAM. However with an expected reduction in the exponent it would be appropriate to review the net deadweight costs of the present RUC system compared to alternate cost recovery systems against the potential roading and land-use benefits of the CAM generated prices.

2. Average Vehicle Operating Weight

The CAM uses average vehicle operating weights for the GVW and ESA measures. However because the same factor relationship to licensed weight is

used for over 99.5 % of both GVW kilometres and ESA kilometres, any suggested concession to particularly heavy vehicle operators is meaningless as it does not alter charges.

While RUC licence weights for similarly configured vehicles are consistently spread over a 20 to 30% weight range there is no provision made for different operating practices. For example:

- Logging trucks and tankers that are configured for a single commodity with zero backhaul prospects,
- Vehicles engaged in round trip collection and distribution services where maximum weights are achieved for less than half the journey
- Vehicles with full backloads
- Normally lighter vehicles that operate at a constant loading all the time because there is little difference between the tare (or tare plus machinery) and maximum weight.

Failure to recognise these different operational practices or dealing with them on the basis of national averages introduces another source of cross-subsidy into the CAM and undermines the efficiency of vehicle configuration decision making as well as the overall integrity of the user-pays system.

The extent of these cross-subsidisations in the system and its effect on efficient decision-making should be understood and, if substantial, needs to be managed by introducing additional vehicle classes that take into account characteristics beyond configuration and maximum licence weight.

3. Congestion Related Expenditure

The $549 million allocated to the PCE characteristic is applied to vehicles, according to their PCE weighting, as follows:

Licence Weight	PV km %	PCE km %	PCE $ mil
1 to 10 tonnes	95%	84%	462
Over 10 tonnes	5%	16%	87

The heavier vehicles do only 5% of vehicle kilometres nationally but are allocated over 16% of the space-related expenditure.

Over 90% of PCE expenditures are associated with new capital projects and therefore incurred on a very small part of the network. less than 500 kilometres of road have traffic levels that meet Transit's threshold for double laning and while some passing or crawler lanes may be required in other areas the majority of

programmed PCE expenditure is limited to a small part of the network (less than 1%) with most being made in the Auckland region.

Survey data from the Auckland motorway suggests heavy vehicles comprise only 2.3% of traffic during congested periods rather than the 6 - 7% of average daily movements nationally. This data would be in line with the expectation that heavy commercial vehicle operators would want to avoid the down-time experienced on congested routes and that such operators generally have operating discretions that are not available to business commuters.

The issues that arise for pricing are simply whether Auckland's ongoing congestion relief solutions should be funded by road-users across the country (and if so in what use related proportions) rather than by the road-users that actually give rise to the expenditure?

Allocating PCE expenditures in proportion to the vehicle fleet causing the expenditure would result in at least half the expenditure currently allocated to vehicles over 10 tonnes being allocated to cars and light trucks. Such an allocation would reduce heavy vehicle RUC rates by about 10%. Of course if such costs were left to be recovered where they fell, the RUC rates for heavy vehicles not operating on the Auckland arterials at peak times would fall by close to 20%.

These are further examples of the fact that the averaging process in the CAM results in significant cross-subsidies between road-users.

Section 3 Road-user Prices and Economic Efficiency

The CAM is clearly an attempt to blend economic principles into a paygo cost recovery system. It links a series of road-cost relationships to vehicle operating characteristics. Where links are not possible, costs are deemed unrelated to vehicle-use and therefore need to be collected in a manner that has the minimum impact on vehicle-use.

Road users face a number of other charges unrelated to road-use and the government plans to introduce more in the form of tolls and additional fuel taxes.

In economic terms, prices are generally considered to be efficient when they are equal to the Marginal Cost of production. In this instance the Marginal Cost of production equals the present and future costs incurred by the road provider in accommodating one more kilometre of travel by a vehicle. If a vehicle owner meets this cost then he or she should value the journey at least as highly (and probably more highly) than the resources he or she consumes.

When the CAM was reviewed by officials in 2001 the economic advisor to the Working Party concluded that average use-related costs were a reasonable proxy for Marginal Cost.

However the advisor described the average use-related costs for a vehicle as a combination of both the incremental costs and the average use-related costs including long-run capital costs incurred as a result of vehicle-use. This methodology was followed by the group of roading engineers who determined the apportioning of each expenditure category to vehicle performance characteristics.

Notwithstanding the use of a Marginal Cost methodology, the economic value of the prices is dependent on whether the average prices generated in the CAM are reasonable proxies for the individual Marginal Costs that make up the whole network (ie pavement types, terrain, traffic volumes, and so on). For example:

Pavement types	**Vehicle per Day Counts**	**Total Kilometres**
Unsealed		32,811
Urban Sealed	< 200	5,080
	200 – 5,000	9,931
	> 5,000	2,820
Rural Sealed	< 200	18,585
	200 – 1,000	13,592
	> 1,000	10,723
Total		93,542

Less than 500 kilometres of roads carry more than 15,000 vehicles per day. As the trigger volume at which dual-carriage ways are considered appropriate is 20,000 vehicles per day, most capital is spent in expanding or duplicating what is actually less than 0.5% of the network.

The Extent of Cross-Subsidisation under Average Pricing

There are numerous examples of cross-subsidisation arising from averaging prices across the network. Three were identified in the previous section:

1. a single average exponent for pavement-wear when it is likely that the exponent will vary with pavement source materials and traffic volumes;
2. a constant average weight relationship for RUC licences when it is readily apparent that vehicle operational practice varies;
3. the spreading of localised congestion relief expenditure across the whole network and different subsets of vehicles.

A comparison between expenditures on the State Highway network and local road network further highlights cross-subsidies and therefore potential inefficiencies that are hidden within the CAM.

Extent of Cross-Subsidies between State Highways and Local Roads				
Percentage %, $ million	**PV km**	**PCE km**	**GVW km**	**ESA km**
State Highway km %	44%	44%	47%	52%
Local Roads km %	56%	56%	53%	48%
Use-Related Expenditure	$597	$549	$182	$443
State Highway Expenditure	$257	$457	$103	$155
State Highway Income	$263	$241	$86	$230
	+$6	-$216	-$17	+$75
Local Roads Expenditure	$340	$91	$79	$288
Local Roads Income	$334	$308	$96	$213
	-$6	+$216	+$17	-$75

Using the PCE measure $216 million more is spent on the State Highway network than is recovered from users. Conversely using the ESA measure $75 million less is spent on the State Highway network than is recovered from users.

The impact of these differences on network vehicle use costs is:

Vehicle Use Characteristic (price $ per 1,000 kilometres)			
Characteristic	**State Highway**	**Local Roads**	**Difference**
PV kilometre	$12.67	$16.04	-$3.38
PCE kilometre	$19.01	$3.15	+$15.86
GVW kilometre	$1.89	$1.25	+$0.64
ESA kilometre	$177.96	$324.15	-$146.19

Since the paygo system of road payments requires recovery of capital in the year it is spent the above prices do not hold for the networks unless continuing capital expenditures are likely. The current 10 year Transit plan does have a continuing real capital expenditure requirement at the same level so the differential in the main capital expenditure area of PCE congestion relief (where 95% of expenditure is for capital) is expected to continue for some time. To correct these differences light vehicle charges on local roads would be reduced to just over 60% of their State Highway charges. Heavy vehicle charges on local roads would be about 40% more than their State Highway charges.

These percentage variations across the two big networks are already very large and would be exceeded if other sub-networks were subjected to the same scrutiny. Again where capital is a major part of the expenditure (e.g., PCE) care would need to be made to either annualise route capital expenditure or make comparisons across a subset of the network where PCE expenditures would continue into the future.

The cross-subsidies identified certainly suggest that the average use-related PET and RUC rates generated in the CAM are not the most efficient proxies for the Marginal Cost of road-use.

Improving the Pricing of Roads

The deficiencies identified in current road-user pricing can only be overcome by reducing the amount of cross-subsidy inherent in the current national average prices.

In an ideal world, pricing would reflect time-of-day usage, as well as route-specific expenditures, weather conditions, and accurate vehicle operating characteristics for each piece of road to be traversed on a particular journey.

Such initiatives for reducing cross-subsidy would require increasing the complexity of the pricing and revenue collection process ultimately resulting in major deadweight management, compliance and enforcement costs that would almost certainly outweigh the benefits of having a more efficient pricing signal.

Road-users as a Source of Government Revenue

The government has for many years collected more revenue from PET than is required for roading and enforcement purposes.

The government has recently announced its intention to hypothecate that excess PET revenue for use in the subsidizing of other transport services and infrastructure. This move appears to formalize a process that already occurs, as the Crown is currently using the Consolidated Fund to subsidise rail and bus passenger services and their infrastructure. Such a move clearly identifies vehicle-users as paying excess tax for the purpose of supporting competing services.

If the road-use prices determined in the CAM were actually equal to Marginal Cost prices or if the average cost price was higher than the Marginal Cost price for a region (this would depend on the direction of the cross-subsidies in the region) then there would be no grounds for subsidising alternate services. A subsidy in such circumstances would result in efficiency losses.

The government has also announced plans to introduce regional fuel taxes for both petrol and diesel fuels with the stipulation that at least half of the tax must be used on alternative passenger transport services. The rest can be used for regional roading expenditure.

The scheme clearly suffers from the same cross-subsidy issues that occur at a national level. Even at a regional level the public passenger commuters will be subsidised by both competing and non-competing road-users.

While the part of the fuel tax dedicated to roading might be directed towards special local needs this would be a significant break with past practice and would require a re-thinking of the CAM.

Properly, it would require breaking down the CAM into regional models with those regions with the highest user-related unit costs being required to seek additional local funding. Those with lower roading cost structures could have the benefit of a lower assessed regional average Marginal Cost provided the discretionary local fuel tax included part of the current Petrol Excise Tax and RUC rates.

Ultimately regional petrol and diesel excise taxes reflecting regional use-related expenditure differences could be determined.

If new regional Petrol Excise Tax, Diesel Excise Tax and RUC rates that were much closer to actual regional Marginal Costs were applied then the need for subsidies for competing services would be difficult to justify. Passenger services would need to rely more on the fare box rather than cross-subsidies from regional road-users or central government funding. It is only the view that road users are not paying their way that rationalizes the need for passenger services to be subsidized.

The linking of a fuel tax to non-road services with an opportunity for some of the funds to be used on roading without taking into account the efficiency of current pricing (or necessarily the relative efficiency in benefit-to-cost ratio terms of the alternatives) is bound to have unfortunate economic consequences.

The Use of Tolls for Cost Recovery

Plans have also been announced for tolling certain routes. These routes include the State Highways under construction in Auckland and are proposed for the main road north of Wellington.

The value of tolling new routes will be determined by its impact on road use and any deadweight costs involved in revenue collection. Income would presumably be allocated for expenditure on other projects or in paying off loans on the new facilities.

The tolls will be a surcharge for users as they must continue to pay their PET and RUC rates while they use the facilities. On a new route, which would normally not require further expenditure for many years and carry a large number of vehicles, the income from users is likely to be well in excess of the short run Marginal Cost of using the new road.

The immediate effect of the toll surcharge would be a rationing of space on the new road. Any diversion of traffic would be inefficient as it would occur at a time when capacity was not an issue. The end result would be an under-utilisation of the increased capacity.

The economic justification for tolling is to both ration scarce capacity to those who benefit most and test the market value of increasing capacity. Thus it should be used on main access arterials before they become seriously congested.

The use of tolls during peak times on Auckland Harbour Bridge, which is coming up for expansion, would be preferable to their introduction on new routes.

Section 4 The Recovery of Residual Costs

Roading expenditures allocated as residual cost amounted to about $725 million and were recovered from Motor Vehicle Licensing fees ($235 million) and from local authority rates ($475 million).

As the costs are unrelated to vehicle-use of roads they should be set for recovery in a way that causes the least distortion both in road demand (when collected from road-users) and in general demand (when collected from non-road-user sources).

Ramsey Pricing Theory dictates recovery from activities that have a low price elasticity of demand. The alternatives for recovery would seem to be one or more of the following mechanisms:

Motor Vehicle Licensing Fees

This is an annual fixed fee paid by vehicle-users. As the fee is currently used for other purposes, the deadweight costs associated with its use are minimal.

The fee could be considered as a road access charge. If the entire residual expenditure was recovered in this way the current net fee would need to treble and this could have some vehicle ownership implications for those vehicle-users with intermittent use of their vehicles. To the extent that that occurred it would reduce efficient road-use.

Recovery from a fixed vehicle fee brings with it the implication that the income should be shared across the network and not restricted to meeting, say, only those residual costs associated with the State Highway network as it would appear to do currently.

Local Authority Rates

The road rate is an annually determined charge applied as a fixed charge. To be consistent with Ramsey Pricing rules its application should be independent of the ratepayer's network use.

Currently the local authority's contribution is based on funding a proportion of each regional road expenditure category. Contributions are not related to residual costs but road use in the region As a result local authorities often attempt to recover costs from land users in particular areas.

If local authority rates are to be used then they should be set to recover the proportion of each roading expenditure category that is allocated in the CAM as residual costs and collected from rates in a manner that will not alter road-use (e.g., industry viability).

Mark-up on User Charges

If there are no public good arguments for recovering residual costs from anyone other than users, then a mark-up on one or more of the use-related characteristics would be possibilities.

The Officials Working Party considered this issue in 2001 and recommended recovery could be on the basis of a PV kilometre charge. This option was chosen ahead of the other characteristics since it involved spreading the charge more widely than other options and because, unlike a fixed fee that they also considered, it did not penalise those who made little use of the network.

The fact a part of the Petrol Excise Tax has been diverted to the Consolidated Fund for many years indicates, for petrol-powered cars at least, that the government does not consider there are elasticity arguments for recovering roading costs from third parties.

A mark-up of the PV component is also consistent with Margaret Starrs' review of the earlier CAM model. Starrs concluded that the general mark-up which had been applied to variable costs to fund State Highway fixed costs unfairly targeted heavy vehicles.

Section 5 Local Authority Funding

Local authority rates are treated in the CAM as recovering part of the residual component of costs, which is the component unrelated to vehicle-use. However currently a significant proportion (about a third) of contributions are required to fund road use-related costs. As a result of this anomaly some shippers will end

up paying twice for their use of local roads, once in road-user charges and then again in rates.

This inconsistency between the CAM and current funding arrangements needs to be corrected. However prior to considering the use of local authority rates as a source of recovering residual costs it is necessary to consider how the government plans to fund the State Highway residual costs.

If cost recovery from user charges is taken into account, the net funding position for the two networks becomes:

$ million	Use-related Allocation	Residual Allocation	Total	User Charges	Deficit
Total	1,771	725	2,496	1,771	725
State Highway	972	240	1,212	820	392
		33%			54%
Local Roads	799	485	1,284	951	333
		67%			46%

The residual costs of $725 million are split between the State Highway network ($240 million) and local roads ($485 million). However, if revenue is allowed to accrue where it is generated, the income deficit on the State Highway is $392 million compared to $333 million on the local road network.

If a use-related characteristic or the per vehicle fixed fee mechanism is chosen for the recovery of the State Highway networks residual costs, it could reasonably be argued that the such imposts are being generated by use of the vehicles on the local roads network. That being the case, about half of any revenue collected under the charge would be collected on the local roads network. More than the entirety of the deficit on local roads would be generated on that network before the deficit on the State Highways was generated.

These are strong equity arguments that payments being made by vehicle-users should be allocated first to costs incurred on their behalf, even if indirectly, prior to being allocated to third party activities. Thus even if hypothecation was ignored and the State Highway residual costs were funded directly from the Consolidated Fund, it would still be open for local authorities to argue that as the Consolidated Fund was receiving excess Petrol Excise Tax such income should be used to fund all vehicle-user impositions prior to being diverted to other causes. Local authorities and their ratepayers also have available the arguments that any regional fuel taxes should first be used to fund any residual costs leaving the region to collect and spend its rates income in line with regional priorities rather than by government fiat.

While user-pays with regard to roading costs can be achieved there are no equity arguments available to suggest that someone else such as the local authority should require residents to pay what is effectively a second time for the same service.

If the government wishes to fund other services then it can look to raising additional taxes to provide such services. It could even leave it to regional authorities to decide on the services they want in their own regions, and avoid the equity issue of providing clear cross-subsidies from revenues raised in other regions for such services that residents in other regions must forego or fund independent of similar central government support.

Section 6. Other Roading Efficiency Issues

While the earlier analyses suggest the prices derived in the CAM can really only be considered as revenue-generators and have little merit as economic pricing tools, there are other aspects of the roading delivery regime where processes based on economic efficiency criteria need to play a role.

Determining the Roading Programme

In the absence of a commercial risk to roading providers (because of the monopoly provision of the roading network) vehicle-users are reliant on local authorities and Transit for delivering an efficient network that meets both quality and capacity requirements.

Transit has sought to provide an efficient programme by using benefit-cost analysis to determine the merits of the many projects available across the country and the scheduling of them into a moving 10-year programme. These benefit-cost analyses take into account the value of human life as well as external benefits from the projects.

Economic efficiency is maximised if projects with the highest benefit-to-cost ratio are done first, and all projects with a benefit-to-cost ratio greater than 1 should be in the programme. However this has not been the case, with many projects proceeding out of ranking order.

For example the Northern Busway in Auckland costing a then estimated $203.5 million proceeded in 2005/06 on the basis of a benefit-to-cost ratio of 1.7 while the Kapiti Link road at a cost of $24 million was set to commence in 2012 even though it had a benefit-to-cost ratio of 6.9. (It was recently reported than the Busway project's actual cost was in excess of $300 million suggesting that the B/C ratio would now be around 1.2 presuming the same level of benefits)

In the 2005/06 plan the national net benefit from both these projects was projected to be about the same at $142 million and yet in the Busway case over eight times as much was being spent. (It appears over twelve times as much was spent.) The extra $180 million (now $280 million) presumably could have been spent on bringing forward other projects on the programme and probably some that have been excluded from the actual 10-year programme.

Besides this, a recent analysis showed some $6 billion worth of projects with benefit-to-cost ratios in excess of 1 have not been included in Transits latest 10-year programme.

This means one of two things: either the budgetary constraints are too restrictive or the shadow prices of many of the benefits brought into the analysis (eg value of life at over $3 million) are too high. It is important, from a national perspective, that any shadow prices used to value social benefits in transport are used across all sectors in the economy and it could be because of this that transport has such high investment opportunities. To programme effectively either the budgetary constraint needs to be relaxed, or the shadow prices reduced or they both need to be jointly resolved so the programme is internally consistent with a benefit-to-cost ratio cut-off close to 1. Then all projects on that programme should be subject to a strict analysis and review process (including ex post audits to reduce bias and optimism) and prioritised on their benefit-to-cost ratio ranking.

An unfortunate aspect of the existing situation is that design standard can become excessive or value can be eroded by the inclusion of enhancements. The potential for designers and/or approving authorities to erode optimal economic outcomes for road-users should be carefully monitored. Both quality standards and any add-on amelioration works should also be tested under economic efficiency criteria using the same cut-off ratio as for the entire programme.

Under this proposal the marginal cost of higher building standards and /or of enhancements would be compared to the marginal benefits derived rather than bundling them with the whole project.

It is possible that a lowering of design standards would be closer to user expectations particularly when only short sections of new road are available and the full design standards of the new section is not permitted to be used (eg through speed restrictions).

A review of the impact of design standards constrained by expected operating practice on benefits and costs at the margin may identify some scope for carrying out additional projects within the budget thereby increasing aggregate benefits.

Level Playing Field for Inter-modal Competition

The principal competitive market in the transport sector is the long haul freight market where limited competition between the rail and road does occur.

That market is generally characterised by the long haul cartage of bulk goods. The rail operates over approximately 4,000 kilometres of track and the competing road network is somewhat less than the 11,000 kilometre State Highway network.

In 2006 the Ministry of Transport carried out a study (Surface Transport Costs and Charges) aimed at determining whether, and to what extent, trucks met the costs they imposed on society (including environmental, safety, and other social costs) as compared to rail transport. Two reviews of the MOT report concluded that heavy vehicles met a substantially higher proportion of costs than did rail.

A number of factors were not included in that analysis. These included:

- the provision of government financial assistance to Ontrack;
- the possibility that the 4th power rule should be reduced in line with current research findings
- the impact of the heavily trafficked State Highway network's economies of scale (and thus lower ESA related costs than are included in RUC rates).

Had they been taken into account the reviews would have indicated that heavy vehicles were meeting an even higher share of costs and rail a lower share.

RUCs were introduced to create a level playing field. However the present arrangements would place road freight services at a significant financial disadvantage in comparison with rail.

More recently the Crown has purchased the rail assets from Toll Holdings for "strategic sustainability" purposes. In doing so government has indicated that it intends investing in both infrastructure and rolling stock yet acknowledging that rail will require ongoing subsidy.

The basis for these subsidies and their extent is unclear. The analysis identified above found that even when taking into account environmental costs road freight services are outperforming rail. In this operating environment subsidies do not make a mode viable, rather they crystallize taxpayer losses. In a commercial environment the purchase price should reflect the worth of a viable business to the owners. As Toll operates at commercial levels a viable Toll business would be a viable Crown owned business.

Having purchased rail any rail investment proposals supported by government funding should be subject to the same cost benefit criteria as the roading projects and should therefore return a profit. However if this criteria is actually used it is

unlikely that the government's stated intention of reducing heavy traffic movements on the roading network could be achieved. Thus as neither commercial nor economic criteria can be satisfied if the government's objectives are to be achieved railways would have to revert to operating as a department of state rather than as an SOE or Crown corporation at it would require guaranteed loans and receive direct Crown operating and/or capital grants,

It makes no sense to fund such grants from road users as the issue is not one of correcting for any unfair or inefficient competitive advantage for road.

The level of the necessary government grants for rail will depend on road freight charges. The widespread use of road freight services in non-competing services means that there are neither grounds for funding rail grants from road users or to have roading operations constrained by economic regulation as occurred in the past.

The Regulation of Heavy Vehicle-Use

A number of studies were carried out by Transit around 2000 looking at the efficiency of the restrictions put on vehicle weights and vehicle dimensions.

The research examined potential increases in road damage and therefore cost, as well as considering any safety implications that might arise if heavier vehicles were allowed on the roads. The studies concluded that increasing the weight limits would result in a net benefit in the efficiency of the road transport sector. The recommended relaxation in gross vehicle weight has yet to be accepted by government.

In Australia, where higher weights are permitted, cartage rates for bulk goods are substantially less than the comparative rates in New Zealand. An analysis of the difference in freight rates in Australia compared to those in New Zealand showed the benefits of higher loadings were quickly passed on to consumers. The per tonne cartage rates for bulk goods in Australia were lower than those in New Zealand by almost exactly the proportion of additional payload trucks are allowed to carry there.

Following further industry submissions on the recommended relaxations the New Zealand government recently approved a pilot study into the implications.

Conclusions/Findings

The following conclusions and findings can be drawn from this report and supporting analyses:

1. The widespread use of averaged data inputs in the Cost Allocation Model fails to take into account traffic volume and pavement variations across the network. The result is the average Petrol Excise Tax and RUC rates that apply involve substantial cross-subsidies between vehicles operating on different parts of the network.

2. The clearest examples of those cross-subsidies are that heavy vehicles on the State Highway network pay $75 million more than the costs they impose on that network, in effect subsidising heavy vehicles operating on the local road network by that amount, while light vehicles operating on the local roads network pay $213 million more than their costs on that network, effectively subsidising by a similar amount those light vehicles operating on the State Highway network.

3. The extent of the cross-subsidies and the lack of any analysis of the resource use choices they affect means that the prices determined in the model could not be accepted as valid Marginal Costs for resource-use allocation purposes. Having said that, an analysis of current charges does indicate that light vehicles on the local roads network are paying more than their Marginal Cost while heavy vehicles on the state highway network are similarly paying more than their Marginal Cost.

4. The deadweight costs of making prices align with Marginal Cost using current technology are likely to far exceed the benefits that might arise.

5. The road-wear relationship that is used in the Cost Allocation Model is under threat from both research findings as to the exponential factor and from its application as a single-point estimate for all roads.

6. As the road-wear relationship underpins the use of the current Road User Charges regime for charging heavy vehicles, any significant reduction in the weight relationship (as proposed) brings into question the value of applying and enforcing the current weight distance licensing regime.

7. The current regime for funding local roads, and in particular the method for determining the level of local authority funding, is inconsistent with the Cost Allocation Model and vehicle-use-related pricing. The present system involves both the vehicle user and the ratepayer paying for use related expenditures.

8. The use of a Petrol Excise Tax as a general government revenue source undermines the use of local authority rates for roading purposes as there are no grounds for the recovery of non-use-related costs from third parties.

9. The generation of additional Petrol Excise Tax revenue regionally as currently planned as well as local roads use costs being less than the revenue collected on local roads all suggest that a PV charge mark-up for the recovery of residual costs would be consistent with Ramsey Pricing rules and preferable to the use of local authority rates.

10. The current and planned use of additional fuel taxes as a source for additional tax for other than roading purposes impacts on the efficiency of road-use. This is doubly the case for local arterial roads which seem to be more than covering their Marginal Costs as subsidies to competing bus or rail services can only be justified where road use payments are less than the Marginal Cost of their road use.

11. Further the use of such funds to subsidise alternatives to roading projects that do not meet the benefit-to-cost ratio of roading projects foregone reduces the efficiency of the transport sector.

12. The extension of the CBA criteria for roading into matters requiring subjective judgment appears to have had the effect of over-riding without analysis the CBA priority for most projects included in the 10 year roading programme. Accordingly there is a need to identify as part of any analysis the inherent price (society cost) being put on those areas where subjective judgment has influenced the priority.

13. Either inputs to the CBA analysis are inconsistent with the real value that society places on the various shadow prices included in the analysis or the roading budget is under-funded. There is a need to resolve this position.

14. The use of tolls as a source of additional user charges from new roads will almost certainly raise charges above the short run Marginal Cost of their use and may reduce their effectiveness in reducing congestion.

15. The provision of subsidies for rail freight services is inconsistent with the analysis underlying the government's studies on the degree to which heavy vehicles and rail freight are meeting the costs of their operations. Those analyses ignored the fact the present heavy vehicle RUC rates exceed the costs imposed by heavy vehicles operating on the routes where the modes compete by about 50%, reducing further the case for rail subsidies. In effect this means that in the rail corridors heavy road vehicles are more than paying their way while railways do not.

16. The government purchase of the rail assets and its stated intention to transfer freight from road to rail using ongoing subsidies is contrary to level playing field criteria for competition. The lack of commercial criteria for intermodal competition removes efficiency drivers for rail and introduces uncertainty into the long haul freight market that will adversely affect current producers and transport operators.

17. The current restrictions on heavy vehicle weights are inconsistent with the conclusions of government studies on the implications for roading costs and vehicle safety when relaxing such limits.

Efficiency and Equity Issues in the Funding of Roading Expenditures

Annual expenditure on roading maintenance capital and enforcement each year is about two and a half billion dollars. Thus the pricing of roads and allied services can have a significant impact on the economy. For example charges for road use will have an impact on: modal choices such as road freight or rail freight: travel options such as car, bus or commuter train; residential and business location choices; and heavy vehicle configuration choices, With over one billion dollars of New Zealand's pool of investment funds going into capital expenditure on roads each year and with hundreds of millions also being spent by government on allied services and facilities it is important to have a system of revenue collection and expenditure decision making in the roading sector that is economically robust.

Background

The origin of the present system of user payments for road use was in the transport policy studies that were carried out in the mid 1970s. The main land transport changes to come from those studies were: the removal of the economic licensing of road transport with its restricted entry provisions and price control in favour of a qualitative licensing system; and the removal of the competitive restrictions on competition between the rail and road modes. Those restrictions had (with few exceptions) limited the distance that road freight could compete with rail to 64 kilometres. (The limit originally put in place as a 48 kilometre limit).

The research carried out at the time concluded that there would inevitably be some increase in road transport freight services at the expense of rail and that this would also lead to an increase in roading expenditures. Supplementary analyses in the reports at the time highlighted the results of studies that had been carried out in the United States on the relationship between road use and road damage to the effect that road wear on flexible pavement increased exponentially by the 4^{th} power of vehicle axle weights and that such a relationship could not be implemented using the then government charging regime for heavy vehicle. Charges at the time included a vehicle sales tax, an annual license fee and a diesel fuel excise tax.

As a result of the then research, and with the objective of providing a "level playing field" for the expected competition for freight traffic, the government introduced a new pay as you go system of charging heavy vehicle users for their use of the roading network. The view at the time was that just as rail had to cover the maintenance and capital costs associated with its track a similar charging system for roads would result in heavy vehicle users paying for the maintenance and capital costs of their road use.

Since its introduction in 1978 the system has been subject to review and refinement on several occasions, the most recent resulting from a peer review done by Margaret Starrs, an Australian economist with expertise in the roading sector. Her methodology was recommended in the Cost Allocation Model Review carried out by a Working Group of Officials in 2000/01. The Working Group concluded that a set of average prices based on recovering use-related expenditures from the vehicles causing the expenditures would be a reasonable proxy for the marginal cost of road use and therefore meet efficient pricing criteria. They accepted that any shortfall between marginal costs and total costs (ie. those expenditures not directly related to vehicle use) could be recovered in a manner that would cause the least impact for vehicle use. Local authority rates, vehicle licence fees and vehicle use charges were seen as options. The Working Party considered that if a use-related charge was to be used it should be uniform across all vehicles on a vehicle kilometre basis.

Section 1. The Current Cost Allocation Model and Road User Charges

The Government links the following broad expenditure categories and funding sources under its land transport policy portfolio (2007 data):

Expenditure Categories	($million)	Revenue Sources	($ million)
State Highway	1,064	LA Rates (roading)	475
Local Roads	1,102	LA Rates (passenger)	233
Passenger (Crown)	282	Motor Vehicle Registration	234
Passenger (LA)	233	Other Government	548
Regional Development	20	LTNZ Reserves	32
Walking and Cycling	18	Misc. (LPG, ACC, etc)	10
Rail and Sea Freight	21	RUC and Petrol excise tax	1,556
NZ Police	224		
MOT	65		
LTNZ	58		
	3,087		3,087

In the latest Ministry of Transport analysis Road User Charges (RUC) and Petrol excise Tax (PET) recoveries were treated as a residual cost to be recovered from vehicle users after payment of registration fees, local authority rates as well as other government funding. However in setting the current user charges that were to apply from April 2007 the RUC and PET rates were calibrated to recover approximately $200 million more than the $1,556 million used in the cost allocation analysis. The following analysis assumes user related cost recoveries of $1,771 million which are in fact the level of vehicle use-related costs determined in the CAM and that charges would be in line with those allocations.

However as can be seen from the table the government programme covered in the model is wide-ranging, going well beyond just road related enforcement and operating and capital expenditures. It now includes a number of government and local authority subsidized services (eg rail and bus passenger services) on the expenditure side and additional sources of funding on the income side.

If the CAM is restricted to road related expenditure categories including enforcement it is apparent that the main sources for the current expenditures on roading maintenance, capital, and enforcement are PET, RUCs, the Motor Vehicle Licence fees and local authority rates. It should be noted that vehicle users also make a number of other payments to the Crown the most important being the further petrol excise taxes that are paid by users of petrol powered cars and that accrue to the consolidated fund for general government expenditure. Recently the Government indicated plans to hypothecate this additional petrol excise tax to meet some of its wider land transport related costs (eg passenger transport subsidies). It also announced legislation in the 2007 budget (yet to be

passed) to allow regional authorities to introduce special regional petrol and diesel excise taxes to be used to fund additional roads and passenger transport services and infrastructure on the proviso that at least 50% of any funds must be used for additional bus and rail passenger infrastructure and services.

As noted above in the narrow confines of user payments of road related expenditures the current regime includes essentially three revenue sources, the PET linked to roading, RUCs and the MVL fee. Both the PET (which applies to petrol powered vehicles up to 3.5 tonnes) and RUCs (which apply to vehicles over 3.5 tonnes (including trailers) as well as light diesel powered vehicles. The rates for light diesel powered vehicles are calibrated as per kilometre charges that are approximately equivalent to the PET cost per kilometre for petrol vehicles. At higher weights only RUCs apply. Since the RUC rates are calibrated to include a number of weight related operating characteristics the per kilometre charges increase substantially as the overall operating weights for a particular vehicle configuration increase. As a result the heavier vehicles pay approximately 20 times more per kilometre than cars. The MVL fee is a fixed charge unrelated to vehicle use.

The other major source of road funding is Local Authority rates with payments unrelated to vehicle use yet collected from Local Authorities as a variable financial ratio (that averages about 44%) of the various categories of roading expenditure that are being undertaken in the region.

The appropriateness of the current regime for sourcing and allocating funds for roading depends very largely on whether the Cost Allocation Model (CAM) determines accurate economic relationships between road use and roading expenditure. This necessarily includes consideration of the degree to which a national average pricing mechanism accurately reflects user costs at the regional and route specific level.

The Cost Allocation Model (CAM)

The current cost allocation section of the model is based on a breakdown into use-related and non use-related components of 54 categories of roading expenditures (26 for State Highways, 28 for Local Roads), a further 21 categories covering passenger transport, regional development, walking and cycling, and rail and sea freight, then 10 covering road related police enforcement services, and 9 covering departmental and other road related administrative expenditures. The use-related components are driver, space/ congestion, strength, and wear related cost relationships. As would be expected there are many categories in the CAM model that cannot be considered vehicle use-related and these have been allocated as residual costs unrelated to road use. As well some parts of the various road expenditure categories are not directly related to vehicle movements being weather or age related damage and these are also treated as residual costs.

The use-related components of the expenditure categories were identified as either costs that were incurred directly as a result of vehicle use (e.g., maintenance from vehicles damaging the road) or as costs that are brought forward by vehicle use (e.g., rehabilitation or expansion to cater for increased traffic). In the latter case virtually all capital expenditure is considered to be use-related with an incremental cost approach being used to determine the share of expenditure to be allocated to each vehicle use characteristic. The vehicle characteristics are powered vehicles (PVs), the car equivalent performance of different vehicle configurations (PCEs), the overall weight of the vehicle (GVWs), and the weights on the individual axles that make up the vehicle (ESAs) respectively.

All the vehicle characteristics other than the Powered Vehicle kilometre characteristic reflect the fact that different vehicles and/or vehicles operating under different load characteristics will exhibit quite different impacts on the roading network. The impacts generally increase as vehicle configurations and their operating weights increase and the characteristics are intended to represent a measurable factor for the greater damage done by the heavy vehicles.

The importance of these characteristics in allocating costs between light and heavy vehicles should not be underestimated as for other than driver related costs which are the same for all powered vehicles the impact of heavy vehicles will usually be many times greater than the impact of light vehicle. (The following tables are for illustrative purposes only but do demonstrate the relative impacts recorded by vehicles or vehicle types operating at different weights.)

The Passenger Car Equivalent measure of spatial requirements is based on the formula 0.875 + GVW / 8. For a range of weights the relative damages of heavy vehicles compared to cars are:

Vehicle operating weight	**Car**	**15 tonne**	**30 tonne**	**44 tonne**
Passenger Car Equivalent	1	2.8	4.6	6.4

The heaviest vehicles have a spatial impact that is about 6 times that of a car.

The Gross Vehicle Weight measure of strength requirements is pro rata with the operating weight of the vehicles.

Vehicle operating weight	**Car**	**15 tonne**	**30 tonne**	**44 tonne**
Gross Vehicle Weight (Average)	1	9	18	26

The heaviest vehicles have a strength impact that is about 26 times that of an average car.

The Equivalent Standard Axle measure of wear is related to the 4th power of the weight on each standard axle on the vehicle.

Vehicle operating weight	**Car**	**10 tonne**	**20 tonne**	**30 tonne**	**44 tonne**
2 axles	1	1,193			
2 axles, 1 twin tyred		780			
3 axles, 2 twin tyred		213	3,415		
4 axles, 3 twin tyred			1,273	6,442	
5 axles, 4 twin tyred				2,756	
6 axles, 5 twin tyred					8,315

In this case a truck and trailer operating at a maximum weight of 44 tonnes with 6 axles is given the same pavement wear rating as approximately 8,300 cars. It should be pointed out that while feasible virtually no vehicles with 6 axles are licensed to carry 44 tonnes because of the cost penalties involved and most combinations operating at this weight have seven axles even though this limits payload capacity.

The reasonableness of these relationships is discussed in more detail later in the report. The full range of expenditure categories and their allocation between vehicle use-related activities and non-use that are included in the CAM are set out in the following tables. The tables also identify the 2007 expenditures and how those amounts would be allocated between each of the vehicle use relationships as well as to the non vehicle use category.

State Highway Costs						
Work Categories	Vehicle Use-related (%)				Residual (%)	Exp
	PV km	PCE km	GVW km	ESA km		$million
Pavement Maintenance	2		1	46	51	**$54**
Area Wide Pavement Treatment			25	65	10	**$43**
Major Drainage Control				20	80	**$6**
Chip Seal Maintenance			51	33	16	**$49**
Thin Asphaltic Surfacing			51	33	16	**$37**
Seal Widening Maintenance	40			40	20	**$0**
Bridge Maintenance	17		70		70	**$20**
Amenity/Safety Maintenance	32				68	**$34**
Street Cleaning	20				80	**$1**
Traffic Services	72				28	**$40**
Carriageway Lighting					100	**$8**
Professional Services	13		11	25	51	**$55**
Property Management		95			5	**$13**
Preventative Maintenance					100	**$5**
Emergency Reinstatement					100	**$32**
Bridge Renewals/ New Bridges	64		22	3	11	**$19**
New Roads	11	68	9	12		**$324**
Road Reconstruction	72	6	5	17		**$35**
Traffic Management		100				**$78**
Rehabilitation	19			72	9	**$0**
Seal Extension	60			40		**$0**
Transportation Studies	19	68	6	7		**$0**
Strategy Studies	19	68	6	7		**$0**
Property Purchase	10	90				**$138**
Minor Safety Projects	100					**$27**
Total	16	43	10	14	17	
Total Expenditure	**$165**	**$437**	**$99**	**$141**	**$176**	**$1,018**

Local Road Costs						
Work Categories 2007 Expenditures	Vehicle Use-related Percentages (%)				Residual	Expend
	PV km	PCE km	GVW km	ESA km		$million
Pavement Maintenance	8		2	27	63	**$189**
Area Wide Pavement Treatment			25	65	10	**$97**
Major Drainage Control				20	80	**$128**
Chip Seal Maintenance	2		28	31	39	**$97**
Thin Asphaltic Surfacing	2		28	31	39	**$33**
Seal Widening Maintenance	20	20		40	20	**$4**
Bridge Maintenance	17		13		70	**$24**
Amenity/Safety Maintenance	37		63		63	**$28**
Street Cleaning	20				80	**$6**
Traffic Services	64				36	**$49**
Carriageway Lighting					100	**$41**
Cycleway Maintenance					100	**$1**
Railway Level Crossings				50	50	**$1**
Professional Services	12		8	21	59	**$65**
Preventative Maintenance					100	**$5**
Emergency Reinstatement					100	**$65**
Bridge Renewals/ New Bridges	51		27	3	19	**$17**
New Roads	15	70		15		**$101**
Road Reconstruction	76			24		**$102**
Traffic Management		100				**$0**
Rehabilitation	10			80	10	**$49**
Seal Extension	28			72		**$23**
Transportation Studies	43	26	1	27	3	**$2**
Strategy Studies	43	26	1	27	3	**$3**
Property Purchase	50	50				**$0**
Advance Property Purchase	50	50				**$4**
Minor Safety Projects	70	30				**$52**
Crash Reduction Studies	70	30				**$0**
Total	21	8	7	25	39	
Total Expenditure	**$228**	**$91**	**$78**	**$273**	**$418**	**$1,088**

Other Expenditures included in the CAM						
Work Categories	Vehicle Use-related (%)				Residual	Expend
	PV	PCE	GVW	ESA		$million
Administration State Highway	16	42	10	14	18	**$47**
Administration Local Roads	21	8	7	25	39	**$14**
Administration Other					100	**$19**
NZ Police	80			6	14	**$224**
MOT					100	**$65**
Land Transport NZ					100	**$41**
Regional Development	76			24		**$20**
Passenger Transport					100	**$512**
Walking and Cycling					100	**$18**
Rail and Sea Freight					100	**$21**
Total	21	2	1	3	73	
Total Expenditure	**$204**	**$21**	**$6**	**$29**	**$721**	**$981**
Grand Total	19	18	6	14	43	
Grand Total Expenditure	**$597**	**$549**	**$182**	**$443**	**$1,315**	**$3,086**

The allocation shares were determined by a group of engineers with backgrounds in road building and maintenance with knowledge of the State Highway and/or the local roads sectors. The group was briefed on the economic issues to be taken into account when allocating costs and was aware of the review carried out by Margaret Starrs and of her findings. The group used the Delphi Method to reach a consensus on the allocation shares. The method involves having each expert provide its own estimate of the cost relationships to be followed by group discussion on the reasons for any variances. After some rounds of estimating and discussing an average of the final estimates is taken as the consensus of the group.

The 2007 CAM produced the following cost allocations:

Allocation Summary						
Work Group	**Vehicle Use-related $ million**				**Residual**	**Total**
$ million	**PV**	**PCE**	**GVW**	**ESA**		
State Highway	$165	$437	$99	$141	$176	$1,018
Local Authority Roads	$228	$91	$78	$273	$418	$1,088
Administration State Highway	$7	$20	$4	$7	$9	$47
Administration Local Roads	$3	$1	$1	$3	$6	$14
Administration part MOT/LT					$85	$85
NZ Police	$179			$14	$31	$224
Regional Development	$15			$5		$20
Total Road Related Exp.	$597	$549	$182	$443	$725	$2,496
Total Other Expenditures	$0	$0	$0	$0	$590	$590
Total CAM Expenditures	**$597**	**$549**	**$1,315**	**$443**	**$1,315**	**$3,086**

Vehicle Use Statistics

As noted above the various vehicle and vehicle combinations in operation on the road network exhibit different road damage characteristics at different operating weights. Vehicle performance statistics have been generated from historic road user charges and licence information as well as from past petrol excise payments and statistics on light vehicle use. This data has enabled national aggregate vehicle use statistics to be generated for each of the vehicle use-related categories used for allocating expenditures.

Statistics were generated for 15 vehicle types including cars and trailers and performance relationships were generated for each licence weight that the vehicles operate under. The different types of vehicle together with the annual distance traveled each year are set out in the following table. The reference weight is determined by whether the axles are single or twin tyred and on the spacing of the axles.

Vehicle Type No	No of Axles	Reference Weight (tonnes)	Annual Distance (million km)
Petrol Vehicles			
1	2	13.4	31,391
RUC Vehicles			
Powered			
1	2	13.4	6,608
2	2	14.9	1,403
5	3	22.8	74
6	3	23.8	888
14	4	31.4	643
19	5	41.0	1
Trailers			
24	1	8.2	8
27	2	13.4	2
28	2	14.1	5
29	2	17.2	208
30	2	16.4	18
33	3	26.3	299
37	3	25.0	125
43	4	34.5	549

About 90% of vehicle kilometres are done by type one vehicles which are almost entirely made up of petrol and diesel cars, light vans and utility vehicles. The main heavy vehicles used are the type 6 and 14 trucks and the type 33 and 44 trailers. (These are used later in the report where examples are required.)

The following table sets out the performance characteristics for a type 14 vehicle. This is a 4 axle truck that can operate up to 31 tonnes on its own or higher if towing a trailer. Because of the level of RUC rates for vehicles operating at maximum weights most type 14 vehicles are licensed to operate at 21 to 26 tonnes. The table identifies the damage factors that occur at each license weight.

Vehicle Performance Factors for a Type 14 Truck

RUC Licensed Weight	PV	PCE	GVW	ESA	Licences Purchased
11	1	2.250	8.8	0.03	0.2%
12	1	2.375	9.6	0.05	0.3%
13	1	2.500	10.4	0.06	0.3%
14	1	2.625	11.2	0.09	0.8%
15	1	2.750	12.0	0.12	1.1%
16	1	2.875	12.8	0.15	1.0%
17	1	3.000	13.6	0.19	1.5%
18	1	3.125	14.4	0.24	3.4%
19	1	3.250	15.2	0.30	2.3%
20	1	3.375	16.0	0.36	4.4%
21	1	3.500	16.8	0.44	5.5%
22	1	3.625	17.6	0.53	25.6%
23	1	3.750	18.4	0.64	30.5%
24	1	3.875	19.2	0.75	15.0%
25	1	4.000	20.0	0.89	3.7%
26	1	4.125	20.8	1.04	3.5%
27	1	4.250	21.6	1.21	0.7%
28	1	4.375	22.4	1.40	0.1%
29	1	4.500	23.2	1.61	0.0%
30	1	4.625	24.0	1.84	0.1%
31	1	4.750	24.8	2.10	0.0%

The use-related damage factors generated for each vehicle type are multiplied by the distance licensed at each weight and these are then combined to determine the aggregate performance characteristic kilometres traveled by the whole fleet in a year.

A summary of the vehicle kilometre characteristics generated at each licensed weight forecast to be purchased in 2007 by all vehicles in the fleet are as follows;

Licensed Weight	PV kilometres (millions)	PCE kilometres (millions)	GVW kilometres (millions)	ESA kilometres (millions)
1	637.4	637.4	637.4	0.0
2	30,604.9	34,430.6	48,968	16.7
3	6,534.5	8,168.2	15,683.2	17.9
4	565.8	779.3	1,818.9	45
5	246.7	373.0	1,005.3	3.8
6	144.4	242.0	739.7	4.7
7	98.8	181.6	608.8	6.0
8	98.7	202.0	739.9	10.4
9	116.5	264.9	1,043.0	19.1
10	110.6	343.8	1,581.4	34.0
11	92.9	262.9	1,162.7	35.4
12	87.4	261.5	1,184.5	42.1
13	58.1	181.5	836.3	35.8
14	85.6	290.3	1,378.1	60.4
15	62.9	263.5	1,334.4	40.5
16	69.7	309.0	1,587.2	40.9
17	111.1	492.3	2,528.7	68.9
18	147.1	650.5	3,339.3	104.3
19	80.6	459.3	2,488.2	84.6
20	262.9	1,054.2	5,275.0	232.3
21	245.1	1,073.7	5,499.4	266.9
22	195.7	1,165.4	6,362.2	195.0
23	197.4	1,147.4	6,237.7	190.4
24	97.5	625.4	3,456.4	117.6
25	24.6	198.2	1,130.7	42.0
26	22.9	102.2	525.5	27.0
27	4.4	19.1	97.7	5.6
28	0.7	4.1	25.0	1.3
29	0.4	2.9	16.5	0.9
30	0.4	2.6	14.1	1.2
31 to 40	0.4	3.4	19.6	2.7
Over 40	0.4	2.6	14.7	3.2
Total	**41,006.5**	**54,195.1**	**117,339.7**	**1,716.2**

When the costs allocated to the vehicle use characteristics are averaged across the kilometres of use the following unit costs are generated:

Rate per Powered Vehicle kilometre	$14.56 per 1,000 kilometres
Rate per Passenger Care Equivalent kilometre	$10.13 per 1,000 kilometres
Rate per Gross Vehicle Weight kilometre	$1.55 per 1,000 kilometres
Rate per Equivalent Standard Axle kilometre	$258.13 per 1,000 kilometres

These rates are then reallocated back across the vehicle type factors for each licensed weight to generate the appropriate RUC rate for a vehicle. In the example of the type 14 vehicle (set out above) the following use-related costs would be attributable for particular operating weights:

Composition of RUC Rates					
Type 14 Vehicle (4 axle, 31 tonne reference weight)					
RUC Licensed Weight	PV	PCE	GVW	ESA	Use-related Cost/1,000 km
20	1	3.375	16.0	0.36	
	$14.56	$34.19	$24.82	$92.93	$166.50
22	1	3.625	17.6	0.53	
	$14.56	$36.72	$27.30	$136.81	$215.39
24	1	3.875	19.2	0.75	
	$14.56	$39.25	$29.78	$193.60	$277.19
26	1	4.125	20.8	1.04	
	$14.56	$41.79	$32.26	$268.46	$357.07

These use-related charges highlight the impact that weight has on charges and in particular for the wear component of road damage that is measured by ESA. A 30 % increase in licensed weight increases the overall rate by more than 110% with the ESA cost component increasing by about 200%.

Allocation of Vehicle Use-related Costs by Licence Weight						
$ million	**Licence**	**PV km**	**PCE km**	**GVW km**	**ESA km**	**Total**
	Weight	**Amenities**	**Space**	**Strength**	**Wear**	
Expenditure		597	549	182	443	1,771
Petrol Vehicles	1 to 4	457	362	82	7	908
RUC Vehicles	1 to 5	105	88	24	5	222
	6 to 10	8	12	7	19	46
	11 to 15	6	13	9	55	83
	16 to 20	10	30	24	137	201
	Over 20	11	44	36	220	311

Percentage %	**Licence**	**PV km**	**PCE km**	**GVW km**	**ESA km**	**Total**
	Weight	**Amenities**	**Space**	**Strength**	**Wear**	
Petrol Vehicles	1 to 4	76%	66%	45%	2%	51%
RUC Vehicles	1 to 5	18%	16%	13%	1%	12%
	6 to 10	1%	2%	4%	4%	3%
	11 to 15	1%	2%	5%	13%	5%
	16 to 20	2%	6%	13%	30%	11%
	Over 20	2%	8%	20%	50%	18%
		100%	100%	100%	100%	100%

With PET and RUC prices calibrated to recover only use-related costs there is a deficit of about $725 million in residual costs to be funded. Currently this is being broadly funded from Motor Vehicle Licensing fees and Local Authority Rates. These were forecast to be about $235 million and $475 million respectively for the 2007 year. These have been used as the source of residual cost funding since RUCs were first introduced. Their continued use is no doubt in part because the government excluded examining the use of local authority funding as a revenue source from the terms of reference of the 2001 Working Party review of the CAM.

Section 2. Improvements to the CAM

A review of the CAM has identified three particular areas where the vehicle-use roading expenditure relationships would need to be revised to improve the accuracy and integrity of the resulting RUC rates.

As noted above one element defining the robustness of the inter-vehicle cost relationships derived from the CAM is the quality of the link between vehicle use characteristics and vehicle use weight. The PCE, GVW and ESA vehicle use characteristics are all related to the weight at which vehicles operate and are therefore instrumental in setting the level of the differences between light and heavy vehicles charges. There are reasonable grounds for the relationships used in the model for each of these characteristics to be disputed. The particular issues are:

- the continued use of a 4th power axle weight relationship for road wear;
- the use of national average PCE usage statistics for allocating congestion relief expenditure; and
- the ineffective use of average weight measures to manage backhaul variances.

<u>The ESA vehicle use relationship - Using of the 4th power rule to allocate road wear expenditures.</u>

The 4th power relationship between axle weights and pavement wear that has been used to allocate the wear component of roading expenditure came from tests conducted by the American Association of State Highway Officials (AASHO) that were completed in 1960. This rule ensures that virtually all wear related expenditures (The ESA characteristic) are allocated to the heaviest vehicles in the fleet. The 5% of vehicles kilometres traveled on RUC license weights over 10 tonnes are allocated 93% of ESA related expenditures.

$ million	**Licence**	**PV km**	**ESA km**	
	Weight	**%**	**Expenditure**	**%**
Petrol Vehicles	1 to 4	76%	7	2%
RUC Vehicles	1 to 5	18%	5	1%
	6 to 10	1%	19	4%
	11 to 15	1%	55	13%
	16 to 20	2%	137	30%
	Over 20	2%	220	50%

Over time the results of the 1960 tests have been increasingly questioned by roading experts. A re-analysis of the AASHO test data in 1989 found that the damage functions were in most cases between the 2nd and 3rd power rather than the 4th power. The fact that the climatic conditions in which the AASHO tests

were held were far more severe than normal operating conditions in New Zealand (much of the pavement wear that occurred in the tests occurred during the spring thaw cycle) also raises doubts about the transferability of the results to the whole New Zealand roading network.

In 2001, as part of a review into the potential impacts of relaxing heavy vehicle axle weight restrictions from 8.2 tonnes to 10 tonnes a number of accelerated pavement tests were actually undertaken for Transit NZ at Canterbury University. These were carried out on thin surface granular pavements made from roading materials commonly used in New Zealand. These tests consistently found "load damage exponents between 1 and 3 with the typical value being around 1.5". At about the same time similar tests using New Zealand materials that were carried out in Australia and found "a load damage exponent of between 1.8 and 3.2". While the research findings were made available to Transit in 2001 it was not until 2006 that at the request of the Road Transport Forum TERNZ (Transport Engineering Research New Zealand Limited) published a report on the research written by Dr John Du Pont of TERNZ and peer reviewed by David Cebon of the University of Cambridge Engineering Department.

A reduction in the exponent to, say, a 2.25th power relationship (the average of the outliers) or the 1.5th power relationship determined in the New Zealand studies does two things to the cost allocations. Firstly it reduces the share of costs borne by the vehicles operating with the heaviest axle loads and equally importantly it reduces the difference in RUC rates between one license weight and the next.

The following tables highlight these two effects. The first shows a respreading of the allocation to lighter vehicles.

Respreading of ESA Expenditures by Vehicle Licence Weight

$ million	**Licence**	**4th power**		**2.25th power**		**1.5th power**	
	Weight	ESA	%	ESA	%	ESA	%
Petrol Vehicles	1 to 4	7	2%	69	16%	150	34%
RUC Vehicles	1 to 5	5	1%	28	6%	49	11%
	6 to 10	19	4%	25	6%	21	5%
	11 to 15	55	13%	42	10%	30	7%
	16 to 20	137	30%	109	24%	76	17%
	Over 20	220	50%	170	38%	117	26%

Reducing the 4th power relationship to a 2.25th power would move approximately $90 million of the expenditures that are currently allocated to the heaviest

vehicles (the vehicles operating at weights in excess of 10 tonnes) on to cars and light commercial vehicles. At a 1.5^{th} power the movement is approximately $190 million or about 40% of the current allocations.

The following tables compare the road user charges rates under a 2.25^{th} power and then a 1.5^{th} power with those applying under the current 4^{th} power used for allocating pavement wear expenditures for the four most commonly used heavy vehicles. The rate comparison covers the spread of rates at which over 70% of licenses are currently purchased in each group.

Impact on RUC Rates of a 2.25^{th} Power Axle Weight Relationship

	Trucks				Trailers			
Vehicle Type	6		14		33		43	
No Axles	3		4		3		4	
Max. Weight	21		26		22		28	
License Weight	4^{th}	2.25^{th}	4^{th}	2.25^{th}	4^{th}	2.25^{th}	4^{th}	2.25^{th}
15					$117	$96		
16					$139	$107		
17	$177	$162			$164	$120		
18	$208	$178			$192	$133		
19	$244	$195			$226	$146		
20	$286	$213			$264	$161		
21	$334	$231	$190	$187			$170	$142
22			$216	$202			$193	$155
23			$246	$217			$219	$168
24			$279	$234			$248	$181
RUC Range	89%	43%	46%	25%	125%	68%	46%	27%
Average per tonne Change	22%	10%	15%	8%	25%	14%	15%	9%

The table indicates that not only is there a significant reduction in RUC rates at different weights but there is also a halving of the rate at which charges increase as licensed weight is increased. Thus the influence that RUC rates may have on vehicle configuration choice will be significantly reduced. Operators are less likely to see a net benefit from making a trade-off between more axles and a lesser payload to get a lower RUC rate. If this is the case operators are more likely to buy licences and operate at weights that are closer to the maximum axle weight limits.

Impact on RUC Rates of a 1.5th Power Axle Weight Relationship								
	Trucks				Trailers			
Vehicle Type	6		14		33		43	
No Axles	3		4		3		4	
Max. Weight	21		26		22		28	
License Weight	4th	1.5th	4th	1.5th	4th	1.5th	4th	1.5th
15					$117	$87		
16					$139	$94		
17	$177	$126			$164	$102		
18	$208	$135			$192	$110		
19	$244	$144			$226	$118		
20	$286	$152			$264	$126		
21	$334	$161	$190	$159			$170	$125
22			$216	$168			$193	$132
23			$246	$177			$219	$140
24			$279	$185			$248	$148
RUC Range	89%	28%	46%	16%	125%	45%	46%	18%
Average per tonne Change	22%	7%	15%	5%	25%	9%	15%	5%

Besides a further $100 million of costs being spread back to the lighter vehicles the RUC scales have been further flattened. The overall RUC rates are one half to two thirds of current rates and the difference per 1 tonne change in licensed weight is now one third that of the current differences.

In this case the size of the changes would indicate that a review of the merits of the present system of RUC with its deadweight operating, administrative and enforcement costs should be examined rather than just making a change in the axle weight exponent used in the CAM.

Given the importance of the power factor to both the level of heavy vehicle charges and the rate at which those charges increase with vehicle weight on one hand and its current influence on both vehicle purchase and operating decisions and roading design on the other there is a need to urgently consider the TERNZ study findings with a view to deciding on a best estimate for the axle weight exponent appropriate for New Zealand roads.

<u>The Average Vehicle Operating Weights used in the CAM</u>

In recognition that most vehicles operate at different weights for their primary as opposed to their backhaul travel the CAM includes the assumption that with the

exception of 1 tonne vehicles all other vehicles will on average operate at 80% of their RUC licensed weight for the strength related expenditures (GVW) and on average 55% of their RUC licensed weight wear related expenditures (ESA). The latter 55% is consistent with a licensed weight loading for the primary haul and a 60% backload for a 4^{th} power axle weight relationship, ie an average overall weight of 80% of licensed weight.

However since the ratio is the same for all vehicle type license weights except the 1 tonne weight it is a meaningless concession as it makes almost no difference to the RUC rates. This is the outcome because vehicles licensed at 1 tonne account for 0.5% of GVW kilometres, and only 0.002% of ESA kilometres with the result that the 80% weight concession reduces the GVW per kilometre charge by 0.1% (about 0.2 cents of the $1.55 per 1,000 GVW km), and the 55% ESA per kilometre charge by less than 0.0004% (around 0.1 cents but this time of the $282 per 1,000 ESA km).

The setting of a common average would be alright if average vehicle weight to licensed weight was in fact constantly at a factor equivalent to the 80% for GVW and at the same time constantly at 55% for ESA purposes. In reality this would only occur with a full journey one way and a backhaul at 60% of licensed weight. Any differences will impact on GVW costs and ESA costs quite differently. However on the downside if the backhaul was empty (at a tare weight of say 30% of licensed weight) the GVW average would reduce to 65% (-20%) while the ESA average would reduce to about 51% (- 9%). On the upside a backhaul at 90% of licensed weight would require a GVW average of 95% (+ 20%) but an ESA average of 83% (+50%). Obviously there are a myriad of vehicle operations that fit somewhere in between often depending on route and product characteristics. For example in some cases the licensed weight may only be achieved for less than half the journey. In the case where the primary haul had effectively been at 90% of licensed weight (for ESA purposes) and the backhaul at 70%, still a GVW average of 60%, the appropriate ESA average would have been 45%, a 20% reduction.

In reality differences in the averages will occur between broad vehicle groups and within vehicle types. For example at the lighter end of the fleet it is likely that vehicles such as cars, vans and light trucks will operate at close to the same weight all the time rather than with a gross vehicle weight backhaul that is 60% of the primary trip. This in part because the tare weight of the vehicle is the major part of any load.

Then there will be differences within the same vehicle types. For example notwithstanding the same tare weight the same vehicle types are licensed across several different weights. If backhaul prospects for these types of vehicle are the same they would not be at a constant ratio to licensed weight. The current averaging process would automatically penalize the more heavily licensed vehicle.

There are well known vehicle operations which would involve significant differences between costs attributed at average rates to the actual operations and those attributed under the CAM. For example the fleet is made up of some vehicle operations that have no backloads (eg livestock, logging truck, and aggregate operations} and others that operate on pick up or put down roundtrips and are at maximum weight for much less than half the trip (eg milk collection and oil tanker distribution operations). Of course then again there will be the lucky few that operate with full loads in each direction.

The lack of variability in loading averages is a source of concern for in particular those operators and industries that cannot fully utilize their RUC license payments. The suggested recognition of these factors by the use of a single averaging factor related to license weights is an attempt to hide the continuing over and under payments. The practicality of increasing the range of road user charges vehicles to not only include vehicle axle configurations but also to include other vehicle characteristics that may signal differences in achievable average load factors should be examined. This coupled with survey data on actual average operating prime haul and backhaul weights compared to licensed weights and maximum vehicle weights should result in a formulation of weight relationships across the range of vehicle types and license weights that is more meaningful and improves the integrity of the CAM by reducing the amount of cross subsidization from this source. This data should also be used to determine vehicle use relationships for the PCE characteristic since that characteristic is also currently related to licensed weight but assumed to operate at the full licensed weight at all times.

Using National Vehicle Use Data to Allocate Congestion Related Expenditures.

As with all usage related expenditure categories the $549 million allocated to the PCE characteristic is applied to all vehicles according to the PCE weighting they receive. The CAM allocates the amount across all vehicles in the fleet as follows:

$ million	**Licence**	**PV km**	**PCE km**	
	Weight	**%**	**Expenditure**	**%**
Petrol Vehicles	1 to 4	76%	362	66%
RUC Vehicles	1 to 5	18%	88	16%
	6 to 10	1%	12	2%
	11 to 15	1%	13	2%
	16 to 20	2%	30	6%
	Over 20	2%	44	8%

About $460 million is allocated to cars and light commercial vehicles and about $90 million of this amount to heavy vehicles operating at licence weights in excess of 10 tonnes. The latter group of vehicles makes up only 5% of vehicle

kilometres across the country but because of their size are allocated over 16% of the space related expenditure.

This relationship would be reasonable if the make-up of the particular traffic that gave rise to the expenditure was identical to that for the whole of the country. However this does not appear to be the case as most of the expenditure is for congestion relieving new road projects in the Auckland area.

A Transit research paper dated 1997 that specifically modelled the "Congested Auckland Freeway" included the results of a traffic survey. That survey indicated that the heavy vehicle share of traffic on a 10 km section of the southern motorway (from Mt Wellington to Spaghetti Junction) during congested times was just 2.3%. This survey defined heavy vehicles as being vehicles weighing more than 3.5 tonnes and being over 11 metres long. Other categories were cars and light commercial vehicles, the latter being defined as vehicles weighing less than 3.5 tonnes and being between 5.5 and 11 metres long. As these are not mutually exclusive categories (for example some vehicles weighing more than 3.5 tonnes would be less than 11 metres long) it is not possible to make a direct comparison with the above table.

That the heavy vehicle traffic numbers during congested times on Auckland arterial roads are about half the national average would not seem an unreasonable expectation. The pattern of heavy vehicle use (spread as it is across the full working day rather than just peak times), the desire of commercial operators to maximise their productivity by avoiding the dead time costs of operating in congested areas at peak times, and the limited flexibility for commuters to travel outside of normal business start and end times all suggest that the heavy vehicle share of peak traffic is likely to be less than their average share of traffic across the whole of the day.

If that is the case then had the congestion relieving expenditure been allocated under its causal relationship rather than on the basis of national average vehicle kilometre and vehicle space characteristics the amount of the expenditure allocated for recovery from heavy vehicles would have been half the near $90 million currently allocated under the CAM.

To ensure such an outcome that is fair to heavy vehicles the cost allocation relationship used in the CAM for the main work categories involving congestion relief would need to change. This could be achieved by changing the PCE relationship with weight from 0.875 + GVW / 8 to say 0.95 + GVW / 20.

Introducing this new causal effect relationship difference between light and heavy vehicles into the CAM transfers costs to light vehicle users with most of the extra cost falling on light vehicles that do not use the congested route. Since only a small part of the cost falls on users of the congested route all that has been achieved is the replacement of one inequity by creating another.

Section 3. Current Road User Prices and Economic Efficiency

The present road pricing regime is an attempt to blend economic principles into a Paygo cost recovery system. The CAM produces a series of average road cost relationships to vehicle operating characteristics and identifies a further amount of roading expenditure that is considered to be unrelated to vehicle use of the network.

However road user pricing does not end with the CAM and roading expenditures as the government currently recovers additional taxes from vehicle use. The government is also promoting the use of additional fuel taxes as measures for raising funds for roading and for wider transport purposes.

In economic terms prices are generally considered to be efficient when they are equal to the Marginal Cost of production. In a roading situation the Marginal Cost for a particular vehicle (eg car, 40 tonne 6 axle truck and trailer unit) would be defined as the present and future costs incurred by the road provider in accommodating one more kilometre of travel by that particular vehicle. If the user chooses to travel and pay that price then he will value the journey at least as highly and probably more highly than the resources he consumes.

The questions to be considered are whether the prices determined in the CAM and the government's other road-user pricing measures coincide with the above view of an efficient price, and probably just as importantly, whether those prices are likely to result in a more efficient use of roading resources?

The economic advisor to the Working Party of Officials reviewing the CAM in 2001 had concluded that the average use-related costs would provide a reasonable proxy for Marginal Cost. In their view this meant that vehicles classes should be charged at least their incremental costs plus their average use-related costs (including long run capital costs incurred as a result of vehicle use) with any remaining common or joint costs recovered in the least distortionary manner possible. It does seem that the group of roading engineering experts followed this methodology when determining the proportions of the various expenditure categories that would be assigned to the various vehicle performance characteristics. For example those allocations assigned 99% of capital to vehicle use characteristics in line with the view that capital should only be spent if the benefits to users exceed the cost. However for average use-related prices to be considered efficient prices it is necessary for all roads to behave equivalently irrespective of pavement type, terrain, traffic volumes, and so on across the whole country.

The following analysis is in three parts. It looks firstly at whether the CAM produces an average cost that could be considered a useful economic tool for modifying road use behaviour; then examines the extent to which the current collection of residual costs has adverse efficiency consequences; and finally how

the additional charges the government is proposing for road use might impact on the efficient use of the roading network.

CAM Prices and Economic Efficiency

The current CAM vehicle use characteristic per kilometre unit costs are generated at a national aggregate expenditure level and become nation wide prices effectively ignoring any regional or route and network differences. As a result there are immediately a number of deficiencies in the CAM's use as an effective economic pricing tool for promoting the efficient allocation of resources. Whether the deficiencies are sufficient to undermine the value of the present allocation process will depend on the impact the level of the inevitable cross subsidies could be assessed as having on: modal choices such as road freight or rail freight: travel options such as car, bus or commuter train; residential and business location choices; and heavy vehicle configuration choices, (To the extent that such choices are also being impacted by other decision making [eg rail and bus passenger subsidies] a similar scrutiny is required.)

Road Types and Volumes

The following variations in traffic density across the State Highway and Local Roads networks are identified in the CAM.

Pavements	**Vehicle per Day Counts**	**State Highway Kilometres**	**Local Roads kilometres**	**Total kilometres**
Unsealed		57	32,754	32,811
Urban Sealed	< 200	11	5,069	5,080
	200 – 5,000	409	9,522	9,931
	> 5,000	652	2,168	2,820
Rural Sealed	< 200	103	18,482	18,585
	200 – 1,000	2,228	11,364	13,592
	> 1,000	7,888	2,835	10,723
Total		**11,348**	**82,194**	**93,542**

A further analysis of State Highway statistics on traffic counts indicated that less than 3,000 kilometres of the rural sealed road category carried more than 5,000 vehicles a day, of which less than 500 kilometres of road were carrying more than 15,000 vehicles per day. Taking these differences in traffic volumes across the 93,000 kilometres of roads in New Zealand together with differences in terrain, sub-strata and climate any average road use price is bound to have

difficulties in satisfying both economic and equity objectives as it will invariably involve substantial cross-subsidies from one group of road users to another.

The Extent of Cross Subsidisation under Average Pricing

There are numerous examples of the cross subsidisation inherent in the CAM modeling.

One example is the application of average prices to the PCE (or congestion) related expenditure. In recent times the amount of expenditure related to congestion relief has increased substantially. In 2001 the CAM allocation to the PCE vehicle characteristic made up just 4.5% of total roading related expenditures. It now is over 20%. Much, if not virtually all of this expenditure now and in the near future will be spent on the near 500 kilometres of State Highway roads that currently carry more than 15,000 vehicles per day. The Transit trigger for promoting additional lanes is about 20,000 vehicles per day although a number of roads still carry many more vehicles per day on single carriage ways.

As over 95% of the PCE expenditure category included in the CAM is for capital it is in effect linked to the congestion relief expenditure that is being carried out for the most part as motorway construction in the Auckland area. With capital being fully allocated to vehicle use in the CAM the PCE component now represents over 30% of use-related expenditures and therefore of use-related charges. Thus under the PCE allocation characteristic the present average pricing mechanism involves a substantial subsidy to peak users of the previously congested routes from both non-peak users of those routes and from vehicle users on the other 99% of the roading network.

It needs to be noted that as the paygo system of road payments requires recovery of capital in the year it is spent, any route prices would necessarily involve annualising the capital expenditure over many years. The alternative is to consider a wider subgroup of the network where similar expenditures are planned over the next few years. The current 10 year Transit plan does have a continuing capital expenditure requirement in the Auckland region for planning period.

Besides failing any equity test the way the CAM treats congestion expenditure does not fit with how marginal cost pricing should deal with network expansion issues. The initial economic issue in this situation is how best to ration scarce capacity during peaks with the aim of: spreading the peak; diverting traffic on to underutilized roads; changing to public transport; and/or changing location. Then should additional capacity be valued highly enough to warrant expansion of the facility, the issue post expansion becomes how best to recover such congestion relief expenditures so that the recovery itself has minimal impact on both the use of the new facility and on the efficient use of any other facilities over which the recovery may be made.

(It could be argued that legislation before the House allowing the application of regional petrol and diesel fuel taxes could reduce pricing errors for congestion relief at the regional level. However these additional pricing options still suffer from intra-regional as opposed to inter regional expenditure and use differences added to which there is the further requirement in the legislation that at least half of the funds from the extra fuel taxes would have to be used to subsidise non-roading activities. This requirement would clearly frustrate the use of this additional vehicle user revenue source as an efficient road pricing tool.)

Other use-related characteristics behave quite differently from those associated with space and congestion (PCE) expenditures. While congestion is a cost associated with heavily trafficked roads, those heavily trafficked roads themselves benefit from the economies of scale that exist in the generation of driver facilities and in carrying out rehabilitation and repair work on the strength and particularly the wear components of roading expenditure. The current average pricing of the wear (ESA) expenditure category does not reflect these economies and so the users of heavily trafficked roads end up cross-subsidising those users on lightly trafficked roads for these expenditure categories.

Sub-Network Cross-Subsidies

Both the cross-subsidies that occur under the PCE and ESA characteristics in the CAM can be further highlighted by a comparison of the expenditures on the state highway and the local roads networks that are caused by vehicle use and of the user revenues generated on each of the networks from the use based PET and RUC payments. The table uses network data from the national roads database survey conducted by Transit in the 1990s.

Extent of Cross-subsidies between State Highways and Local Roads				
	PV km	PCE km	GVW km	ESA km
State Highway km %	44%	44%	47%	52%
Local Roads km %	56%	56%	53%	48%
Use-related Expenditure	$597	$549	$182	$443
State Highway Expenditure	$257	$457	$103	$155
State Highway Income	$263	$241	$86	$230
Difference		-$216		+$75
Local Roads Expenditure	$340	$91	$79	$288
Local Roads Income	$334	$308	$96	$213
Difference		+$216		-$75

Under the PCE characteristic use-related expenditure category $216 million more is spent on the State Highway network than is recovered under average charges from vehicles using that network. The reverse is true on the local roads network. Then the ESA characteristic use-related expenditure category $75 million less is spent on the State highway network than is recovered under average charges from vehicles using that network. The reverse is true on the local roads network. These differences suggest that had RUC prices been calibrated separately for the two networks there would have been significant differences in user charges.

The following tables compare the vehicle use characteristic cost that apply under national pricing with those that would apply under the State Highway network and under the Local Roads network.

Vehicle Use Characteristic (price per 1,000 kilometres)				
Characteristic	National Network	State Highway	Local Roads	Difference SH - LR
PV kilometre	$14.56	$12.67	$16.04	-$3.37
PCE kilometre	$10.13	$19.01	$3.15	+$15.86
GVW kilometre	$1.55	$1.89	$1.25	+$0.64
ESA kilometre	$258.13	$177.96	$324.15	-$146.19

The differences in RUC rates calibrated at the national average and the State Highway average for a range of vehicle types would be:

	Light vehicles				**Truck**		**Trailers**			
Vehicle Type	Car		2		6		43		SH - LR	SH - LR
No Axles	2		2		3		4			
Weight	Nat	SH	Nat	SH	Nat	SH	Nat	SH	$	%
1	$26	$34							+$8	31%
2	$29	$37							+$8	28%
3	$32	$41							+$9	28%
4	$36	$46							+$10	28%
6			$46	$58					+$12	26%
7			$55	$66					+$11	20%
8			$67	$77					+$10	15%
9			$84	$90					+$6	7%
10			$106	$108					+$2	2%
17					$177	$172			-$5	-3%
18					$208	$195			-$13	-6%
19					$244	$223			-$21	-9%
20					$286	$254			-$32	-11%
21							$170	$135	-$35	-21%
22							$193	$150	-$43	-22%
23							$219	$167	-$52	-24%
24							$248	$185	-$63	-25%

As expected the lower ESA unit costs for State Highways has a beneficial effect on the heavy vehicle rates while the higher PCE unit costs have an adverse impact on light vehicle rates. Local roads pricing differences would be similar (since the volumes of traffic on both networks are roughly the same) but in the opposite direction with lighter vehicles paying less and heavier vehicles more. The differences between rates for each network would range over a spectrum from plus 50% to minus 50% depending on vehicle type and operating weights.

If these ranges can occur between the largest two network groups any further breakdown of the networks into regional networks or by specific route would no doubt produce larger pricing variability.

Review of Network Differences

A review of the cost allocation schedules for each network identified the following reasons for the variances between the two networks.

The Powered Vehicle (PV) Use Characteristic

The difference of 23% of the national average factor between the two networks is the result of the allocation of almost 70% of the PV related enforcement costs to the local roads network compared to only 56% of actual vehicle use. The $205 million is split $140 million to local roads and $65 million to State Highways rather than $115 million to $90 million on vehicle use. This is in line with the Police's allocation of their traffic resources. Excluding this cost item the difference in unit rate between the two networks would be around 10%.

Unlike other roading expenditure, the influence of enforcement is likely to go beyond network boundaries and thus not too much can be drawn from this allocation difference. If that cause is ignored then the national average could be accepted as rough justice given the imperfect mechanisms that are available. This view is reinforced by the view of the 2001 Working Party that recommended that residual costs should be recovered through this factor, no doubt considering that such recovery would have minimal impact on vehicle use and therefore little adverse economic impact.

The Per Car Equivalent (PCE) Use Characteristic

The difference of 157% of the national average factor between the two networks is almost entirely due to the congestion relief capital investments that are being undertaken, much in the Auckland area. The difference in Capital Expenditures allocated to the PCE characteristic on State Highways ($424 million) and local roads ($90 million) is $334 million. Being associated with relieving congestion,

outside of the capital expenditure categories the PCE allocated costs are negligible. Only $13 million of a total of $530 million in PCE allocated costs are included in the maintenance expenditure categories.

Besides the difference between the two networks it is easy to see that the appropriate allocation would have a few routes bearing all the costs and almost the entire network no costs at all. To do this would require that a further route specific or regional pricing tool be introduced. Any such pricing tool would be required to manage the fact that PCE expenditure is essentially capital and thus any route pricing would need to manage cost recovery over a number of years. As the current 10 year Transit programme includes ongoing expenditures at similar levels it is expected that the differential for the two big networks will remain.

As noted earlier the differential in the main capital expenditure area of PCE congestion relief (where 95% of expenditure is for capital) is likely to continue for some time. To correct these differences light vehicle charges on local roads would be reduced to just over 60% of their State Highway charges. Heavy vehicle charges on local roads would be about 40% more than their State Highway charges.

PCE is a significant budgetary item, being over 30% of all use related expenditure, and represents about 40% of car allocated costs and a 16% share of heavy vehicle costs. Since the capital expenditure is specific to only a few areas/routes the appropriate charges on those routes would be many times existing charges, As a result an average network cost cannot be seen as representing a reasonable proxy for Marginal Cost. A full analysis of cost recovery from peak users of the new Auckland and the Wellington Transmission Gully routes would bear this out.

The Gross Vehicle Weight (GVW) Use Characteristic

The difference of 40% of the national average factor between the two networks is entirely due to the difference in the New Roads expenditure category. About $30 million of expenditure was allocated to State Highways under this category compared to nil for the local roads New Roads category. This is equivalent to just under 60 cents of the 64 cent difference.

Since capital expenditure is specific to a very small part of the network with most of the network unlikely to have any GVW related capital spent on it for many decades it seems likely that the average vehicle related costs for the Local Roads part of the network might be a reasonable proxy for the Marginal Costs. Ideally should some route specific charging mechanism (that adequately takes into account capital cost recovery over time) be added to the cost recovery

regime for PCE cost recovery it could be extended to recover GVW capital costs also.

The Eqivalent Standard Axle (ESA) Use Characteristic

The difference of 57% of the national average factor between the two networks would seem to be related to the difference in traffic movements on the two networks and the likelihood of there being significant economies of scale in the pavement repair and rehabilitation work categories. As the work is undertaken on a cyclical basis it involves the building back into the road sufficient ESA capacity to last until the next cycle.

The ESAs per kilometre on the State Highway average 8 times those on the whole local roads network (11,300 kilometres doing about 52% of ESAs compared to 82,200 kilometres doing 48%) and still 5 times if only the 48,000 kilometres of sealed local roads are used for comparative purposes. If there are economies of scale in producing ESA capacity and the cost curves for both networks are the same then the actual marginal costs of the last ESAs on both networks are likely to be less than the average for the State Highway network. This would be less than the $178. If the cost curve was linear after an initial set up cost the maximum Marginal Cost for ESAs would be $157.

However it is unlikely that the cost curves for all roads will be similar as the actual design and build/repair methods might be dependent on terrain, base course and substrata materials, available aggregates, expected weather extremes, existing structure, traffic forecasts, etc. For example. the management of unsealed roads (32,800 kilometres) and those sealed roads with less than 200 vehicles per day (23,500 kilometres) is likely to be very different to managing those sealed roads with more than 5,000 vehicles per day (6,000 kilometres).

If there are two or more cost curves then, rather than employing an averaging process to the cost component that has the greatest impact on the RUC rates for heavy vehicles, attention should be turned to determining the price that maximises the economic benefits from the market choices that are available to operators and shippers. The averaging process used in the CAM raises charges above the cost being imposed on the State Highway network by in particular heavy vehicles adversely affecting their competitiveness with rail. As there are no competitors to road freight in the local roads network, rail not being an option, it would be preferable to align charges with the State Highway network than either to adopt an average ESA use related charge or the local roads ESA cost.

Conclusion

The above review of the differences generated by looking at just two of the possible subsets of the network shows how fragile the CAM is as a mechanism for promoting economic efficiency in road use and in related vehicle use and

modal choices. Further breakdowns of the network would result in bigger variations in cost from this source. The addition of other averaged measures into the CAM such as the weight factor and that a single power factor may not reflect the true ESA relationship serves only to increase the problems as they involve a further set of cross –subsidies both between light and heavy vehicles and within vehicle types. While any system of network pricing will have imperfections the level identified here appears high and it makes it impossible to identify where the most efficient of the myriad of pricing options might lie.

The introduction of additional pricing tools that could be applied at a route or regional level would assist in providing the pricing flexibility that is necessary to make the current system credible. However the introduction of additional pricing mechanisms bring their own problems, not the least being the treatment of capital and the additional deadweight management, compliance and enforcement costs.

However on the above analysis it could be concluded that the current average use-related PET and RUC rates that are generated under the CAM do not appear to be the most efficient of the pricing options that are available.

Improving the Pricing of Roads.

The deficiencies identified above can only be overcome by reducing the amount of cross subsidy inherent in the current average prices. Unfortunately this seems only achievable by increasing the complexity of the pricing and revenue collection process. In an ideal world time of day usage, as well as specific route expenditures, weather conditions, and accurate vehicle operating characteristics would need to be taken into account in order to determine an efficient price for each piece of road to be traversed on a particular journey. (Then it would also be necessary for the user to have the capacity to assimilate the same information including forecasts of the likely long term impact it would have on his location and other investment choices in order to decide whether better options are available.)

With the number of variables to be considered in order to determine the appropriate price signal new charging mechanisms would have to be implemented and it is difficult to see these being put in place without major deadweight cost losses. For example for the current fleet the cost of:

- retrofitting transponders for satellite tracking,
- the widespread provision of in motion weighing,
- the recording of the movements of each of the 2.5 million vehicles in the fleet over the 93,000 kilometres of network,
- the breaking down of use-related expenditures across relatively small parts of that same 93,000 kilometres of network
- then associating the movements with the expenditures, and
- then managing the billing of and the collection of revenue from each of the 2.5 million vehicles in the fleet

would far outweigh any economic benefits arising from the more efficient prices that would become available. RTF have suggested that the deadweight costs of the present RUC system could be as high as $100 million per annum. This is already a high price to pay for a system that is in reality attempting to extract fair prices of less than $600 million from the heavier vehicles in the fleet.

Without the introduction of the further complexities the current PET and RUC rates generated under the CAM should be considered only as cost recovery mechanism rather than as an efficient road pricing tool leading of itself to a better allocation of resources in the transport sector. As a result the current regime with its high deadweight administrative, compliance and enforcement losses should be compared alongside other cost recovery mechanisms and their associated losses.

Road Users as a Source of Government Revenue

The Use of the Petrol Excise Tax Surplus

The government has for many years collected more revenue from Petrol Excise Tax than it has used for roading purposes. This has been diverted directly into the consolidated fund for general use.

The present cost recovery programme under the CAM includes not just expenditure on roads but also provides funding for a range of additional services including passenger services, regional development, walking and cycling, rail and sea freight, bus lane infrastructure and rail infrastructure. On the other hand it also includes revenue sources beyond road users including Local Authority support for both roading and passenger services as well as direct government subsidy from the consolidated fund.

The government has recently announced that it intends hypothecating all the fuel excise tax (some of which currently goes to the consolidated fund) as well as RUCs to cover not just roading expenditures but also subsidies for the additional transport services and facilities listed above. In effect requiring road users to subsidise road and rail urban area passenger services and rail infrastructure as well as meeting the costs that they impose on the roading network.

Formally hypothecating such taxes to non road use is formalizing a process that is occurring at present as an amount similar to the excess petrol excise tax already goes from the consolidated fund to subsidise bus and rail passenger services and infrastructure. The new arrangement clearly shows the double hit that is being imposed on the road transport industry. On the one hand their own costs are driven up and on the other their competitors are being subsidized.

If the road use prices determined in the CAM did actually equal Marginal Cost prices or if the Average Cost price is higher than the Marginal Cost price for a region (this will depend on the direction of the cross-subsidies in the region) then there is no need to subsidise alternate services. A subsidy in such circumstances would result in efficiency losses. That loss would be greater if road users were to fund the subsidization of their competitors.

If roading cross-subsidies are already or would have to be made from other road users that benefit a region then there can be a case for subsidizing competing services. However given the efficiency issues involved both the competing and road solution should be subject to the same analytical criteria as other projects in the transport sector. (As discussed later project priorities should be determined by B/C cut-off rates, and the same shadow prices for safety and environmental costs should be applied equally to the non roading option.)

At present it appears that some of the new rail commuter services expect to operate with subsidies (often hidden) of about $20 to $30 per day for peak time travelers. These would be unsustainable levels if all commuters chose to make use of the subsidized services. For example these per person subsidies add up to several times the current rates bill for individual dwellings. Children who travel with the peak flows will have their travel subsidized by more than the cost of the public school education they receive. Such a price differential could not be justified on B/C grounds let alone the real differential if the service was to be funded by road users in the region or even road users nationally.

The Application and Use of Regional Fuel Taxes

The Government has also announced plans to introduce regional fuel taxes for both petrol and diesel fuels with the stipulation that at least half of the tax must be used on alternative passenger transport services. The rest can be used for regional roading expenditure. Clearly such a scheme undermines the intended use of the CAM and its determination of PET and RUC rates that equal a surrogate of average Marginal Cost (vehicle use-related roading expenditures). The justification for a higher regional fuel tax for roading expenditures would need to be based on analysis that concluded that for the particular region the basic PET and RUC rates were less than the actual Marginal Costs of providing roading in the region. Any alternative to roading use of such funds would as discussed above need to be justified not only on a region's higher Marginal Costs for roading in the region but also take into account the efficiency losses from funding the alternative service from road users.

The scheme clearly suffers from the same cross subsidy issues that occur at a national level. The public passenger commuters will be subsidized by both competing and non competing road users, the latter often having no options to car use or because they travel at times outside of or travel against the peak when

their existing charges for road use might reasonably be expected to be less than the average Marginal Cost.

While the part of the fuel tax dedicated to roading might be directed towards special local needs this would be a significant break with past practice and would require a rethinking of the CAM. Properly it would require a breaking down of the CAM into regional models with those regions with the highest user related unit costs being required to seek additional local funding so that those with lower roading cost structures could have the benefit of a lower assessed Marginal Cost. Carried to its appropriate outcome a CAM analysis would be carried out for most regions and different petrol and diesel excise taxes that took into account regional use-related expenditure differences would be struck for each region. Since the new regional PET, Diesel ET and RUC rates would be much closer to the regions actual Marginal Cost the need for subsidies for competing services would be difficult to justify and in such circumstances passenger services would need to rely on the fare box rather than cross-subsidies from road users by government fiat, central government funding or by ratepayers.

In such an environment the only non road projects that might succeed would be those that were probable route specific and therefore involve a clear subset of a regional network. Such services would need to first argue that the region prices were not high enough to justify a roading route solution and that therefore an amount equivalent to the per traveler difference between road charges and the route road cost could be made available to entice a non roading alternative to compete with roading. In such an environment it is unlikely that some of the current alternatives such as busways and railway would proceed, certainly the level of subsidy would be much less than currently provided.

The linking of a fuel tax to be used for non road services with an opportunity for some of the funds to be used on roading without taking into account the efficiency of current pricing is bound to have unfortunate economic consequences.

The Use of Tolls

Plans have also been announce for tolling certain routes, and in particular some of the congestion relieving state highways that are under construction in the Auckland region and proposed for the main road north of Wellington.

The value of such charges on new routes will depend on the impact that the charge has on the number of vehicles that use the road and on the deadweight costs involved in revenue collection. The toll income would presumably be allocated for expenditure on other projects or in paying off loans on the new facility.

It needs to be remembered that tolls are in fact a surcharge on users as those users continue to pay their PET or RUC rate while they use the facility. On a new route which would in normal circumstances not require further expenditure for many years and be carrying a large number of vehicles the combined income of users from the PET and RUC would be well in excess of the Marginal Cost.

The immediate effect of the toll surcharge would be a rationing of space on the new road. Any diversion of traffic would be inefficient as it would occur at a time when capacity was not an issue. The end result would be an underutilization of the increased capacity.

The economic justification for tolls is in rationing scarce capacity to those who benefit most and in testing the value that the market places on having incremental capacity provided on the route. Thus it should have been used on the main access arterials long before they became seriously congested. Once the new capacity is in place road space is a sunk cost of limited value until traffic grows. Ideally road users need to be aware that tolls are only in place until congestion is relieved. The aim of the toll during that time is for potential commuters over to do one or other of the following:

- pay for the privilege of using a slightly congested facility during peak times; or
- change modes by becoming passengers; or
- change to traveling in off peak times; or
- change jobs.

Those commuters should be able to return to using the facility or its replacement at its marginal operating cost once the capacity constraint is no longer needed. As noted above the average user charges across the network are likely to exceed the actual Marginal Cost of the new facility when first commissioned.

Section 4. The Recovery of Residual Costs

As noted above roading related costs allocated in the CAM as residual amounted to about $725 million with about $235 million being recovered as Motor Vehicle Licensing fees and $475 million from local authority rates.

In its 2001 review the Working Party of officials recommended that should the recovery of residual costs be restricted to vehicle use-related charges it should be recovered under the PV kilometre characteristic. If it is assumed that the CAM average use-related costs are equivalent to Marginal Costs then Ramsey Pricing theory proposes how any deficit (in this case residual costs) should be recovered. Under Ramsey Pricing such costs would be recovered in a way that leads to the least distortion in vehicle use (and in fact the least distortion in general demands if collected from non-road user sources).

The mechanisms identified by the Working Party of Officials as possible sources of residual cost funding were:

Motor Vehicle Licensing Fees

These are an annual fixed fee collected from vehicle users. Being fixed by vehicle type it is based on vehicle ownership and not on vehicle use. As the fee is currently used for purposes beyond cost recovery for roads such as the collection of ACC levies to cover road accident victims and for tracking vehicle ownership and debt the deadweight costs of additional recoveries are minimal.

Such a fee is in effect an access charge for having the network available irrespective of use. If a fixed fee related to vehicle ownership is used then a consideration is whether the revenue should be reallocated to pay for costs on only the State Highway network as is currently the case or whether it should be allocated across the entire network. On any equity consideration the revenue should be spread across the whole network rather than a subset of the network.

Local Authority Rates

The road rate is an annually determined charge that properly should be applied as a fixed charge unrelated to the actual use the particular ratepayer makes of the network.

As currently determined the local authority's contribution to the various expenditures in the region (the net cost of various works after taking account of the amount provided from central government under the Finance Assistance Ratio scheme) is made on a work category basis. As a result local authorities often attempt to recover payments from the land owners and industries located where their costs arise. The following table sets out the average Local Authority

share of expenditure under each Local Roads work category together with the residual cost share of the work category expenditure.

Local Authority Rate Contribution and Residual Costs			
Work Categories	Expenditure $ million	LA share percentage	Residual percentage
Pavement Maintenance1	$189	48	63
Area Wide Pavement Treatment	$97	48	10
Major Drainage Control	$128	52	80
Chip Seal Maintenance	$97	49	39
Thin Asphaltic Surfacing	$33	53	39
Seal Widening Maintenance	$4	50	20
Bridge Maintenance	$24	49	70
Amenity/Safety Maintenance	$28	48	63
Street Cleaning	$6	53	80
Traffic Services	$49	52	36
Carriageway Lighting	$41	53	100
Cycleway Maintenance	$1	54	100
Railway Level Crossings	$1	0	50
Professional Services	$65	49	59
Preventative Maintenance	$5	0	100
Emergency Reinstatement	$65	0	100
Bridge Renewals/ New Bridges	$17	39	19
New Roads	$101	45	0
Road Reconstruction	$102	40	0
Traffic Management	$0	44	0
Rehabilitation	$49	44	10
Seal Extension	$23	35	0
Transportation Studies	$2	42	3
Strategy Studies	$3	42	3
Property Purchase	$0	0	0
Advance Property Purchase	$4	43	0
Minor Safety Projects	$52	40	0
Crash Reduction Studies	$0	40	0
Total Expenditure	$1,088	44%	39%

The table highlights a number of anomalies between the contributions currently being made by local authorities and the user related charges.

The first is that these contributions do not reflect the availability and use of all roads in a region as the State Highway network through the area is in effect free to ratepayers. This raises its own equity issues. This aspect would be avoided if the residual costs associated with all roads in a region were funded by the local authorities in that region.

Then there is the problem that funding relationships imposed by central government are clearly inconsistent with the funding of the residual costs. For example local authorities contribute on average 44% of the roading expenditures in their regions whereas the total residual costs in their regions are only 39% of expenditure. This highlights that the FAR operates on an arbitrary bundling of costs without regard to the integrity of the wider cost recovery process under the CAM.

There are 16 separate work categories (most in the capital spend categories) where the local authority contribution exceeds the residual component of costs in that work category. For example a combination of the New Road, Road Reconstruction and Rehabilitation work categories for Local Roads shows that local authorities contribute $110 million of a total cost of $252 million. However under the CAM $247 million (98%) of the $252 million cost is included in the calculation of the amount to be recovered from use-related PET and RUC rates.

This inconsistent treatment of local road expenditures has inevitably lead to some local authorities applying rating charges based on where their costs fall and at the same time the on charging of the same costs to road users. While it may be desirable to sheet home any excessive road damage costs to those that cause the damage such an exercise should not result in an effective double charging of shippers through a land-use charge as well as a road user charge. To avoid this happening the governments FAR assistance ratios should be restricted to percentages that are consistent with the same use-related share of each work category that is used in the CAM and local authorities should be directed to recover the residual costs incurred in their regions from rates that are unrelated to any vehicle use characteristics.

<u>As a Mark-up on User Charges</u>

If it is considered that there are no public good arguments suggesting that the residual costs should not be recovered from those that use the roads recovery could be made from a fixed per vehicle fee or from the mark-up of one or more of the use-related characteristics included in the CAM. The fact that a part of the Petrol Excise Tax is diverted to the consolidated fund indicates that for petrol powered cars and light vehicles at least the government does not consider that

there are public good arguments (considering that the demand for petrol is relatively inelastic with price) for recovering roading costs from third parties. The Officials Working Party considered this issue in 2001 and recommended that recovery should be on the basis of a PV kilometre charge. This was chosen since it involved spreading the charge more widely than other options, and because it did not penalize those who made little use of the network. It was considered that this alternative better met the Ramsey Pricing criteria that users who were price inelastic to demand should pay for residual costs. This option is consistent with the Margaret Starrs review which had concluded that a general mark-up of variable costs across had in her view unfairly on-charged a high proportion of fixed costs on to heavy trucks notwithstanding that those costs were unrelated to vehicle use.

The allocation of such charges on a PV kilometre basis would more than double that component of user charges. However since a significant share of the PET collected is currently credited to the consolidated fund actual vehicle use need not be affected should this tax now be used for roading although there would be a need for such funds to be replaced by other government charges or taxes. On the other hand the amount of the road residual cost is currently being met through the Motor Vehicle License fee and local authority rates so depending on the extent to which recoveries would be made from a use-related charge some or all of those funds would be left with road users and ratepayers.

Section 5. Local Authority Funding

A substantial part of the local roads budget is funded by local authorities. In 2007 planned recoveries were close to $500 million.

As noted above this is being treated in the CAM as allocated against the residual component of costs, that is the component unrelated to vehicle use. However as currently funded a significant proportion (about a third) of the local authority contributions are generated because the Financial Assistance Ratios provided by the Crown are less than the shares of particular expenditures that are allocated to vehicle use under the CAM. As a result local authorities are contributing to use-related expenditures and therefore encouraged to rate on the basis that land use is directly related to vehicle use rather than that their contribution to roading should be non-use-related as all use-related costs are to be recovered under road user charges and excise tax fees.

As a result of this anomaly some rating will result in some industries paying twice for their use of local roads, once in road user charges and again in rates. This inconsistency between the CAM and current funding arrangements could be corrected by setting the FAR under each local road expenditure category at a level to meet the use-related share of the category leaving only the residual (non use-related) component of each expenditure category to be recovered through rates.

As noted in an earlier analysis reallocation of users revenues between local roads and state highways on the basis of where the road use income was generated would result in the following.

$ million	Use-related Allocation	Residual Allocation	Total	User Charges	Deficit
Total	$1,771	$725	$2,496	$1,771	$725
State Highway	$972	$240	$1,212	$820	$392
		33%			54%
Local Roads	$799	$485	$1,284	$951	$333
		67%			46%

The residual costs of $725 million are shared in the ratio of 33% related to State Highway expenditures and 67% to local roads expenditures. While recovery could be sought in those ratios equity considerations suggest any recovery should also take into account the fact that more revenue is generated on local roads than user costs incurred on those roads. If account is taken of this then an equitable split would require a mechanism whereby approximately 54% of recoveries came from State highway sources and 46% from local road sources.

Of course the more important economic rule is that the mechanism should have minimal impact on vehicle use.

As discussed above, there would appear to the prospect of using one or more of four sources of funds to collect the residual costs. These are vehicle owner charges such as a fixed annual per vehicle fee or a fixed per vehicle kilometre charge, or third party funding such as local authority rates of consolidated fund contributions.

Payment of the State Highway deficit or residual costs from the consolidated fund would leave available an equity argument that the payment of the local roads deficit or residual costs could be made from local authority rates. It would also suggest that the funds could not be recovered from users under Ramsey Pricing rules and this does not appear to be the case. The consolidated fund already receives road user payments in petrol excise taxes. Thus it could be argued that any consolidated fund contribution would in effect be a return of the excess funds generated as excise fuel taxes. The additional argument could also be raised that as such revenues were generated on both the local roads network as well as the State Highway network such funds should be allocated against the deficits or residual costs on both networks.

Further the government has announced plans to hypothecate that excess petrol excise tax for use in subsidizing current passenger transport services, and in supporting walking and cycling projects, and sea freight and rail infrastructure and services. As these are outside of roading expenditures there is clearly a case that such user charges should be used first to fully fund roading expenditures ahead of being put to other uses. Certainly there is not a strong case for reverting to use local authority rates ahead of returning the excise tax surplus to the networks on which it was generated.

This hypothecation together with the government's planned introduction of regional petrol and diesel excise taxes, (at least 50% of which is tied to subsidizing additional regional passenger service infrastructure and operations) indicates that the government at least sees no economic efficiency reason for the sourcing of residual cost funding from other than vehicle users. If there were any concerns that the price elasticity effect on vehicle use would adversely impact on the economy then the government should have desisted from using fuel pricing for consolidated fund purposes. The fact that it hasn't means that the funding of the residual costs should not come from third party sources but rather from vehicle ownership or vehicle use-related fees.

If it is decided that the State Highway deficit is in part or whole to be collected through the application of a vehicle use-related charge then such a charge would be paid by vehicles when they were operating on the local roads network as well as when they were operating on the State Highway network. Accordingly the recoveries should be shared between both networks. In 2001 the Working Party

reviewing the CAM recommended that Powered Vehicle kilometres be the appropriate use measure as that measure would be more in line with Ramsey pricing rules than using PCE, GVW or ESA kilometres. As the PV kilometre characteristic is closely related to an additional PET the government should also see it as consistent with Ramsey pricing rules.

A PET or RUC rate set on a PV kilometre basis would accrue revenue in the ratio of about 56% from local roads use and 44% from State Highways use. As the deficit is in the proportion of 54% to State Highways and 46% to local roads any use-related charges would generate more than sufficient revenue on local roads use to cover the local roads deficit. The surplus generated on the local roads could be used with the revenue generated on the State Highway network to fully fund that networks deficit as well.

Recovery from any of the other use-related vehicle characteristics would have quite different impacts on vehicle use to the PV. For example if the residual costs were set for recovery under the ESA use-related characteristic the rate per 1000 kilometres for ESAs would increase from $258 to $680. Using the current CAM the RUC rate for a type 14 vehicle at 24 tonnes would increase from $279 to $595 per 1000 kilometres while the rate for a car would stay at $27. Compared to this the PV charge would increase the charges for each vehicle by about $17 per 1,000 kilometres. The bulk of such an increase in the ESA charge would be carried by between 20,000 and 30,000 truck and trailer units in the fleet rather than the near 2.5 million vehicles that share any PV increase. The increase in costs would be between $20,000 and $30,000 per annum for each heavy truck and trailer unit. The 2001 Working Party saw problems with such an allocation and also with pro rating across all use characteristics (as Margaret Starrs had found in her peer review of the CAM in the mid 1990s).

If a fixed vehicle fee was substituted for the PV per kilometre fee similar equity arguments between the networks would arise. This would be the case if the Motor Vehicle Licensing fee was used to fund the residual cost in part (as it currently does) or if it was increased to fund it in its entirety. Any equity based allocation of such a fee should result in the income being shared between the State Highway network and local roads network and probably on some network usage basis or a network size basis.

Thus there are neither public good arguments, nor Ramsey Pricing considerations that suggest there is a need for any third party funding of the residual costs. Rather than recover any of the costs through local authority rating it would be more appropriate for the residual costs for both the local roads and State Highway networks to be recovered by a combination of the Motor Vehicle Licensing fee and an increase in the amount to be recovered under the PV component of the CAM.

Section 6. Other Roading Efficiency Issues

While the foregoing suggests that the prices derived in the CAM can really only be considered as revenue generators and have little merit as economic pricing tools there are other aspects of the roading delivery regime where processes based on economic efficiency considerations can play a role. These include the process of decision making within the actual roading works programme, and the sourcing and allocation of other funds that are use for transport purposes (including the sourcing of funds from local authority rates, and the sourcing of funding for services that compete with road users).

Roading Works Programme

In the absence of commercial risk (because of the monopoly provision of different parts of the roading network through either local bodies or in the case of the State Highway network through Transit), vehicle users are reliant on local authorities and Transit for delivering an efficient network that meets both quality and capacity requirements. Transit has sought to provide an efficient programme by using benefit-cost analysis to determine the merits of the many projects available across the country and the scheduling of them into a moving 10-year programme. These benefit-cost analyses take into account value of life as well as externality benefits from the projects. Economic efficiency is maximized if those projects with the highest Benefit to Cost ratio are done first, and indeed all projects with a B/C greater than 1 should be in the programme. However this has not been the case as many projects have proceeded out of ranking order and while the cut-off for the approved programme has generally been at a B/C of 3 projects with higher ratios have not proceeded while a number with lesser ratios have proceeded. For example the Northern Busway in Auckland costing a then estimated $203.5 million proceeded in 2005/06 on the basis of a B/C ratio of 1.7 while the Kapiti Link road at a cost of $24 million was set to commence in 2012 even though it had a B/C ratio of 6.9. The national net benefit from both these projects is about the same at $142 million and yet in the Busway case over 8 times as much is being spent – the $180 million presumably could have been spent on bringing forward other projects on the programme and probably some that have been excluded from the actual 10 year programme. Other examples abound.

Approximately 140 large projects were listed in priority order in the 2006/07 10 year Transit plan. At priority 8th equal the Avondale Extension is listed as an $800 million project to start in 2009 with a B/C ratio of 1.1. Three other Auckland projects with a combined cost of $200 million are also listed at 8th with B/C ratios of 2. By comparison 21 of the projects ranked over 100 have higher B/Cs. The Kapiti Link road mentioned above is given a ranking of 42nd even though its B/C ratio is many times that of virtually all the 26 Auckland projects given higher priorities.

An independent analysis showed that some $6 billion worth of projects with B/C ratios considerably in excess of 1 have not been included in Transits latest 10 year programme..

This means one of two things: either the budgetary constraints are too restrictive or that the shadow prices of many of the benefits brought into the analysis (eg value of life at over $3 million) are too high. Further any shadow prices that are used to value social benefits in transport should also be used in all sectors in the economy. This would include for example using the same value of life used in roading and vehicle regulation in the wider health sector and applying the same value of carbon and other emissions to electricity generation, other fuel use and agriculture etc. Either the budgetary constraint needs to be relaxed or the shadow prices reduced or both should be resolved so that the programme is internally consistent with a B/C cut-off that is close to 1. Then all projects should be subject to a strict analysis and review process (including ex post reviews) and prioritized on their B/C ranking.

One unfortunate aspect of the existing analyses is that many of the B/C multiples are so high that there is scope for adopting unnecessarily high design standards for new projects and retain them on the programme. For example an increase in the cost of the Kapiti link project to $48 million would reduce the B/C of 3.5. Also the ability to breach the B/C priority ranking could lead to decisions being made on unidentified grounds where it appears that project cost is of little concern. The potential for designers and/or approving authorities to erode optimal economic outcomes for road users should be carefully monitored and both quality standards and any add-on amelioration works should also be tested under economic efficiency criteria whereby the marginal cost of higher building standards and /or enhancements is compared to the marginal benefits derived rather than considering them from a total project perspective. It is possible that a lowering of design standards may also be more consistent with user expectations which will be guided more by standards on the majority of any routes they traverse than on any single new section of road. This is particularly the case where it is clear that the full design standards of many new sections of the network are not permitted to be used (eg through speed restrictions). A review of the impact of design standards constrained by expected operating practice on benefits and costs at the margin may identify some scope for carrying out additional projects while at the same time increasing aggregate benefits from the programme.

The integrity of the user pays system requires that a tool such as a B/C ratio analysis be used for project evaluation else vehicle users are meeting costs that return less in the way of user benefits than would be available from other programmes. A clear example of this is the inclusion in the CAM of a regional development category of expenditure. This has been allocated under the PV and ESA road use characteristics and as such is recovered through the PET and RUC rates. As presumably the projects do not meet the B/C criteria the return to

users will be less than would occur if the funding had been put to other roading projects. As a result there is whether or to what degree such subsidies through roading should be paid by road users.

Level Playing Field for Inter-modal Competition

The principal competitive market in the transport sector is the long haul freight market where limited competition between the rail and road does occur.

That market is generally characterized as the long haul cartage of bulk goods. As rail operates over approximately 4,000 kilometres of track, the competing road network is substantially less than the 11,000 kilometres of road that comprises the State Highway network. Further a lot of freight traffic that currently travels on those parts of the State Highway network adjacent to the rail network would not be susceptible to competition either because of the type of freight or because a relatively short haul is involved.

Since the State Highway network is more heavily trafficked than the local roads network, with an average vehicle count per kilometre that is 8 times that of local roads the actual competing road network would be expected to exhibit better economies of scale and thus lower marginal costs for the main component of roading expenditures (wear related expenditures) that are allocated to heavy vehicles and represent about 70% of the RUC rates of vehicles over 10 tonnes. This improved efficiency is illustrated in the following comparison of the revenue generated under the ESA user charge on the State Highway network with the ESA related expenditures on that same network.

	ESA km
	Expenditures
State Highway km %	52%
Local Roads km %	48%
State Highway Expenditure	$155
State Highway Income	$230
	+$75

Under national average RUC pricing $75 million more is collected for ESA related costs from heavy vehicle users than actually allocated to them under that component of the CAM.

The differences in the RUC rates as calibrated in the CAM as national average prices and those calibrated on the basis of State Highway expenditures and usage for two of the common heavy vehicle types are:

	Truck		Trailer			
Vehicle Type	6		43		Difference	
No Axles	3		4			
Weight	Nat	SH	Nat	SH	$	%
17	$177	$172			-$5	-3%
18	$208	$195			-$13	-6%
19	$244	$223			-$21	-9%
20	$286	$254			-$32	-11%
21			$170	$135	-$35	-21%
22			$193	$150	-$43	-22%
23			$219	$167	-$52	-24%
24			$248	$185	-$63	-25%

Heavy vehicle users are paying significantly more under RUC rates than the user costs incurred by the same vehicles operating on the State Highway network. Even if the residual cost was allocated as a PV user charge this would only increase RUC rates by $12 per 1,000 kilometres and the conclusion would still hold.

In 2006 the Ministry of Transport carried out study (Surface Transport Costs and Charges) aimed at determining whether and to what extent trucks were meeting the full costs they imposed on society (extending the analysis to include environmental, safety, and other social costs) as compared to rail transport. While it concluded that trucks only met 56% of their social costs compared to 77% for rail those conclusions were subsequently found to be seriously flawed.

Two subsequent reviews of the MOT report identified a number of faults. Since the value of such a study is in creating a competitive level playing field ideally any study should have compared the average costs incurred on the relevant road network and the relevant characteristics of the vehicles types used to take freight similar to that carried on the rail network with the rail operations. This was not done with national road impacts being included and with the “truck” definition extending to all vehicles paying Road User Charges.

	Licence	Trucks	Trailers
RUC Vehicles	**Weight**	**Number**	**Number**
	1 to 3	300,000 est	
	4 to 5	29,000	500
	6 to 10	26,500	2,500
	11 to 15	14,500	5,000
	16 to 20	13,500	7,000
	Over 20	10,500	7,000
	Total	465,000	22,000
	Over 10	38,500	19,000

The RUC vehicle definition resulted in the inclusion of diesel-powered cars as well as utility vehicles, vans, and other light commercial vehicles (about 300,000 vehicles) and light trucks (about 55,000) with the genuinely heavy vehicles (about 40,000 trucks over 10 tonnes and around 20,000 trailers) in the subset. Excluding light vehicles from the "truck" analysis resulted in heavy vehicles meeting 84% of costs in one review and 100% in the other. These compared to the STCC report finding of 77% for rail. For commercial confidentiality reasons the analysis for rail was not available for review. The results of applying the STCC methodology to the genuinely heavy vehicles in the RUC paying fleet reversed the findings recorded in the actual STCC study.

As neither of the reviews included the difference between the RUC average rates as opposed to the State Highway only costs the findings in the reviews understate the percentage cost recovery of trucks. A number of other factors were also not considered in the analysis. These include:

- The provision of government financial assistance to Ontrack;
- The possibility that the 4^{th} power rule should be reduced in line with current research findings; and
- The probability that the PCE allocation of congestion relief expenditure on State Highways is unfairly being attributed to heavy vehicles.

Taking all these factors into account would reduce the share of the social costs that rail actually covers and further increase the share of social costs that heavy vehicles cover.

Thus in terms of the level playing field objective behind the introduction of RUCs the present arrangements and prices for road use would place heavy road vehicles at a significant financial disadvantage in comparison with rail.

Government Purchase of Rail

More recently the Crown has purchased the rail assets from Toll Holdings for "strategic sustainability" purposes. In doing so government has indicated that it

intends investing in both infrastructure and rolling stock yet acknowledging that rail will require ongoing subsidy.

The basis for these subsidies and their extent is unclear. The analysis identified above found that even when taking into account environmental costs road freight services are outperforming rail. Then again where costs are actually imposed on the transport modes (such as the carbon trading scheme) subsidies cannot be justified. (Of course on national efficiency grounds the use of any actual price imposts should, as with any shadow prices used in project benefit cost analysis, be applied equally across the transport modes and also to all other sectors of the economy.) Such pricing interventions would not change the relative positions of the modes from those in the studies.

Ideally as in the above section any rail investment proposals should be subject to the same cost benefit criteria as the roading projects. However if this is done it is unlikely that the government's stated intention of reducing heavy traffic movements on the roading network could be achieved. Thus as neither commercial nor economic criteria can be satisfied if the government's objectives are to be achieved railways would have to revert to operating as a department of state rather than as an SOE or Crown corporation. As such it would be government guaranteed and receive direct Crown operating and/or capital grants,

Such subsidies should not be funded from road users as the issue is not one of correcting for any unfair or inefficient competitive advantage for road.

The level of the necessary government grants will depend on road freight charges. The widespread use of road freight services in non-competing services mean that there would be a significant economic loss should roading operations be constrained by any unjustified economic regulation that restricted the application of efficiencies in the road transport sector.

The government purchase of the rail assets and its stated decision to ensure a transfer of freight from road to rail means that the level playing field criteria used in the STCC has been abandoned. The lack of any commercial criteria for competition introduces uncertainty into the long haul freight market that will adversely affect current producers and transport operators as they plan for the new conditions.

The Regulation of Heavy Vehicle Use

A number of studies were carried out by Transit around 2000 looking at the efficiency of the restrictions put on vehicle weights and vehicle dimensions. The main concern of Transit was the cost of meeting the expected increase in roading costs that might arise if the then existing regulations were relaxed. This concern was based on whether putting 50 tonne plus vehicles as opposed to the current

44 tonnes and possibly raising the axle weight limits from 8.2 to 10 tonnes would lead to major roading failures not covered in current RUC rates. The studies also looked at the safety aspects of allowing heavier vehicles on the network.

The studies concluded that there was scope for increasing these limits for a net benefit in the efficiency of the road transport sector. The studies effectively concluded that the trade off between the increased load weights that would be achievable would more than recover the additional road wear/strength costs (if any) from the heavier vehicles since fewer vehicle movements would be necessary to carry out the transport task.

The recommended relaxation in gross vehicle weights have yet to be accepted and implemented by government even though it has been demonstrated that such changes would be beneficial both environmentally through the reduction in heavy vehicle kilometres and in road transport charges. In Australia where higher weights are permitted cartage rates for bulk goods are substantially less than the comparative rates in New Zealand. An analysis of the difference in freight rates per tonne kilometre in Australia compared to those in New Zealand indicated that bulk rates were almost exactly lower in Australia by the proportion of additional payload that trucks are allowed to carry there. This indicates that in a competitive market such as transport the benefits from productivity improvements flow over time into reduced rates for shippers.

Following further industry submissions on the recommended relaxations the government recently approved a pilot study.