



An Independent Review of the New Zealand Road User Charging System

An examination of land transport cost allocations, options for improving the current road user charging system and the merits of alternative methods of collecting revenue from diesel vehicles

31 March 2009



To: The Hon Steven Joyce, Minister of Transport

The Road User Charges Review Group is pleased to present our report on the New Zealand road user charging system as requested in the terms of reference released on 19 August 2008.

Dated: **31 March 2009**

A handwritten signature in black ink, appearing to read 'James Hill'.

James Hill (Chair)

A handwritten signature in black ink, appearing to read 'Tony Gibson'.

Tony Gibson (Member)

A handwritten signature in black ink, appearing to read 'Warren Young'.

Warren Young (Member)

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FOREWORD

The independent Road User Charges Review Group (the Review Group) carried out its task from August 2008 to the end of March 2009 in accordance with its terms of reference. Our approach was to research existing material, consult with stakeholders, gather and analyse evidence, test conclusions and present recommendations.

We commissioned research on international road costs and charges, engineering assumptions in the cost allocation model (CAM), inputs to the CAM, compliance activities, costs associated with the road user charges (RUC) system, available technology and economic advice on both cost allocation and alternative charging options.

The Review Group consulted with a wide range of stakeholders. We received 87 written submissions from interested parties including private motorists, businesses, private organisations and government agencies. Oral submissions were heard in Auckland, Hamilton and Wellington.

In evaluating options, the Review Group has used both qualitative and quantitative analysis tools to assess the various options before making informed judgements in developing our recommendations.

In the review we have noted that several 'trade-offs' are required. One of these is simplification versus accuracy. For example, a better level of accuracy in cost allocation would create an overly complicated model. This would also imply a higher degree of accuracy than can be obtained in any allocation basis. Accordingly, a degree of averaging has to apply. To quote from work carried out for us by Infometrics:

"A good charging system should not be discarded in the pursuit of a perfect system. The policy aim should be for a system that accomplishes as many and as much of the objectives as possible at low cost and, from a dynamic perspective, is not so complicated that different parties are constantly tempted to chip away at various components and undermine it" (2008, p. 2).

We consider that the costs to be allocated are those incurred by the road user rather than the value of benefits received or costs avoided. We also consider the roading network to be just that, a network. The system is a linked structure and we have not, therefore, recommended pricing component parts of the network differently.

Our recommendations will deliver some short-term changes, but the recommendations have been developed with longer-term solutions in mind. With the use of modern technology, current distance measurement could be improved and would also give future opportunities for more sophisticated charging options, including road pricing and tolling.

Our international literature search identified that many countries have either existing systems in place, or policies set for the use of modern technology to enable revised forms of road charging. Most of these will base

their charging on a distance travelled basis. Besides the European countries already operating such systems, those that are now planning for such changes include The Netherlands, Sweden, Australia and The United States of America (USA).

The Review Group thanks the Ministry of Transport (MOT) the New Zealand Transport Agency (NZTA), New Zealand Police, industry organisations and the many individuals who contributed to the findings of this report. We received a very high level of co-operation and assistance.

The report represents the views of all the members and the opinions arrived at are based on the objectives set by the terms of reference.

We appreciated the opportunity to contribute to this important review and trust that our recommendations will assist in improving the road charging system and give a way forward that is efficient, effective, fair and sustainable.

James Hill

Chair

Road User Charges Review Group

EXECUTIVE SUMMARY

OVERVIEW OF KEY FINDINGS

The Review Group found that New Zealand has a relatively unique approach to allocating and charging diesel vehicles for roading costs. Distinguishing features of the New Zealand approach include charges based on operator nominated weights and having measured distance-based charges, as opposed to maximum laden weights and fuel excise duty (FED) and/or other charges that serve as a proxy for distance.

There are positive aspects to the New Zealand approach. In particular, vehicles are charged according to their overall use of the roading network and the associated costs they impose. While compliance costs are quite high, they fall predominantly on road users rather than other sectors of the economy.

The developed world is now clearly moving towards technology-facilitated, direct road charging based on weight, distance travelled and the time and location of travel. New Zealand's history of weight and distance-based charging means that it is well placed to adopt this developing international approach.

Transitioning in full to the inevitable technological solutions most suitable for New Zealand will take some time. Perhaps less than 5 years for heavy vehicles and, depending on incentives or requirements to install appropriate technology in vehicles, somewhat longer for most of the light vehicle fleet. The transition will necessarily involve monitoring of international developments and careful planning and trialling under New Zealand operating conditions.

For the interim, we have identified ample scope to improve the basis upon which roading costs and other costs of the National Land Transport Programme (NLTP) are allocated; and to ensure that the charging system is fair, efficient and based on up-to-date information. We have identified these 'opportunities for improvement' through discussions with transport operators, enforcement staff and other informed stakeholders, surveying road users about their most recent experiences, analysing public submissions and commissioning expert reports.

PRIMARY CONSIDERATIONS IN FORMULATING RECOMMENDATIONS

In developing our recommendations we have maintained a strong focus on the review objectives of economic efficiency, cost recovery and equity. To help ensure that our recommendations contribute to achieving these objectives we also:

- took account of opportunities to make compliance easier and to increase transparency, including by way of price signals to road users
- adopted a view that all New Zealand roads should, for the time being, continue to be regarded as an aggregated network

- accepted that, while a degree of precision is desirable when determining the allocation of costs and setting of charges, absolute precision is not possible or practicable.

As per our terms of reference, we also concerned ourselves with matters such as the costs of change, future-proofing, checking for consistency with the New Zealand Transport Strategy (NZTS) 2008 and effectively managing any significant transitional effects.

RECOMMENDATIONS

COST ALLOCATION

With respect to the MOT's CAM we recommend that:

1. The Government investigates alternative funding for non-road related costs in light of our conclusion that costs recovered through the road user charging system should, in general, be confined to the costs associated with road use only.
2. Local authority revenue be applied within the CAM to offset those costs to which it directly relates, rather than the existing practice of deducting the revenue from the total non-use related costs.
3. The allocation of space-related costs in the CAM is based on an appropriate standard motor car equivalent factor rather than using the current, largely weight-based proxy.
4. The NZTA undertakes an empirical study into the actual pavement conditions throughout the New Zealand road network and evaluates the impact of axle reference loads on road wear, the consequential cost of maintenance, and the resultant changes to the CAM.
5. No change be made to the current assumption in the CAM regarding distribution of weight across axles (taking into account future charging on the basis of the maximum (permissible) gross laden weight of a vehicle and having regard to axle configuration).
6. The fourth power rule continues to be used in calculating the road wear component of RUC (as we did not find sufficiently robust evidence to justify changes in the road damage law exponent or to select a different single exponent for road user charging).
7. The average loading assumption inherent in the CAM and RUC rates be amended to use a factor of 45 percent for trailers (as that is what recent empirical evidence indicates is appropriate).
8. No explicit allowance be made for air suspension and wide tyres in the CAM calculations (as such additions would add complexity, bring no material benefit, and would lead to yet further compliance and enforcement costs).
9. The allocation of costs between use related parameters in the CAM be re-examined by the MOT to ensure that the equivalent standard axle (ESA) measure appropriately reflects the uncertainties involved in attributing the effects of road wear to heavy vehicles.

10. The Government considers an alternative to pay-as-you-go (PAYGO) which recognises the creation of a road asset and amortises the asset over the expected useful life (as annual roading expenditure patterns are escalating and becoming more 'lumpy' over time).
11. In future, the charges set for cost recovery purposes are consistent with the rates calculated by CAM (because, assuming CAM reflects the relationship between use and expenditure, it should, on equity grounds, dictate what is charged).

REVENUE COLLECTION

With respect to the system for applying the charges derived from the CAM for revenue collection purposes we recommend that:

12. The outdated annual motor vehicle licence fee, the basis for which is unknown, be replaced with a new annual road network access fee¹.
13. The new network access fee be set in a more transparent way to recover a defined set of costs in the CAM.
14. The new network access fee should aim to recover the non-use related elements of road related expenditure².
15. The current allowance for transport operators to nominate operating weight is replaced with charging on the basis of the maximum (permissible) gross laden weight of a vehicle, having regard to axle configuration.
16. Supplementary licences be removed from the RUC regime.
17. The time licence system for revenue collection be discontinued and vehicles currently subject to the time licence regime, in future, be required to pay a flat rate network access fee similar to all other road vehicles.
18. Should a diesel excise duty be implemented, a refund system operates in conjunction with the GST return.
19. The NZTA gives priority to investigating and implementing a modern, internet-based RUC purchase channel.

¹ The current annual license fee of \$43.50 (GST exclusive) has not changed since 1992 when it was increased by just \$1.00. The estimated revenue from the fee in 2007/08 was \$187 million.

² If the recommended network access fee approach had applied in 2007/08 the access fee would have been \$123.50 (GST exclusive) for that year. Coincidentally this amount is very close to what the current annual fee would be if it had been adjusted in line with the Consumer Price Index since 1984 (the last year there was any significant increase in the level of the fee).

20. The NZTA discontinues all the other current RUC purchase channels, except for an over the counter option, once the new internet purchase channel is available.
21. The NZTA devotes further resources to improving RUC customer service delivery.
22. The RUC rates are reviewed annually and changes implemented at the same time each year.
23. A minimum of 6 weeks' notice be provided of any RUC rate changes that are to occur.
24. The Government legislates to:
 - a) provide for more stringent regulations around odometer tampering;
 - b) impose a duty on vehicle inspectors to report odometer readings to the NZTA as part of the vehicle warrant of fitness and certificate of fitness inspection processes to provide the NZTA with information that will assist with recovery of outstanding RUC;
 - c) impose a duty on relevant road users to keep books and records and give the Government access and assessment powers similar to those available under the income tax system;
 - d) institute proper safeguards and appeal rights and to carefully prescribe the powers and duties of government officials; and
 - e) decriminalise enforcement of RUC for vehicles under 3.5 tonnes as part of a process of moving light vehicle RUC to a civil collection system.
25. The NZTA develops and implements, in association with selected user groups and others as appropriate, a "proof of concept" trial to test the feasibility of the systems architecture outlined in this report and generate data that is essential to inform decision-making in New Zealand about whether and how to proceed with an eRUC system.
26. In light of all the previous recommendations, the Government implements a revenue collection approach generally in accordance with one or other of the following two options:

Option A – Enhanced RUC system for all vehicles: Substantial enhancement of the current revenue collection approach.

Option B – Diesel excise duty plus RUC system for heavy vehicles: Major changes to the revenue collection approach including eliminating RUC for vehicles weighing less than 8 tonnes and introducing excise duty on diesel.
27. Preference is given to Option A, an enhancement of the current system which retains weight and distance-based RUC for all vehicles, because Option A:
 - a) enables, subject to our transitional recommendations below, most of the critical enhancements to be implemented almost immediately, or within a relatively short timeframe

- b) maintains the many positive aspects of the current system which is well understood and has served New Zealand well for the last 30 years
- c) avoids the need to establish a new diesel excise duty system which would (due to technology developments) probably only be maintained for a limited period of time
- d) avoids the imposition of the diesel excise refund regime on a large number of non-road diesel users; and the corresponding imposition on the government in establishing and operating the new refund system.

OTHER CONSIDERATIONS

The Review Group also recommends that:

- 28. No attempt be made, at this stage, to modify CAM or the RUC system to better recognise the operating practices of defined industries (on the grounds that the anomalies identified could only be properly addressed by full road pricing which appropriately acknowledges time, weight, distance and location factors).

TRANSITIONAL RECOMMENDATIONS

To lessen the impact on any road users that might face substantial RUC rate increases and to help ensure a smooth and timely transition to the new, improved charging regime we recommend that:

- 29. Changes to the CAM are fully implemented on the next occasion CAM is applied so that the most appropriate allocation of costs related to road use is available to inform the setting of new RUC rates and FED.
- 30. Introduction of the new network access fee is phased in over two years so that in the first year the new fee does not exceed \$85 in total (GST exclusive).
- 31. Introduction of changes to RUC rates arising from the updated CAM are also phased in over time so that no RUC rate increases by more than 20 percent in any one financial year.
- 32. Introduction of the first phase of RUC rate and access fee changes proceeds as soon as possible during the 2009/10 financial year subject to completion of any necessary legislative changes, our other transitional recommendations, and the giving of public notice as we have also recommended.
- 33. The change process is supported by an appropriate communication strategy to ensure that stakeholders are well informed about the short-term changes, the longer-term direction and the reasons for the overall approach being taken.

IMPACT OF RECOMMENDATIONS ON RUC RATES

Dependent upon what is included in the NLTP for future years, implementation of our recommendations will result in some significant changes to RUC that different individuals and road user groups must pay. As the total revenue to be collected remains essentially the same, redistributive consequences of the changes mean that charges will increase for some, reduce for some and stay around the same for other road users.

With reference to the 2007/08 NLTP expenditure we have been able to estimate which road user groups will be most affected by our recommended changes (ie implementation of Option A). The table below summarises our estimate of the scale of the change to the 2007/08 RUC rates for a range of different vehicles.

Table 1: Illustrative estimates of changes to 2007/08 RUC rates due to Review Group recommendations

	Changes under Option A		Additional annual cost or saving, based on 15,000km per annum
Small & large diesel car (2 & 3t)	-8%	+\$80	+\$125
Small trucks (5t)	+43%	+\$80	+\$348
Medium truck (10t)	-11%	+\$80	-\$134
City Bus (12t)	-20%	+\$80	-\$538
3 axle truck (20t)	-24%	+\$80	-\$1,148
7 axle B train	-28%	+\$80	-\$2,211
8 axle B train	-25%	+\$80	-\$1,524
Petrol (FED)	-20%	+\$80	-\$51

THE ROAD USER CHARGES REVIEW GROUP

Review Group members were chosen for their combined expertise and knowledge of economics, business principles and the transport sector. Appointments were made after consultation with major stakeholders.

The members of the Review Group are: James Hill (Chair), Warren Young and Tony Gibson.

James Hill is a Chartered Accountant. He is currently self-employed as a professional director and consultant. Previously, he was the Managing Partner at KPMG Auckland. He is currently the Chairman of Manukau Water Limited, Seafood Processors Limited, the CDP Group Limited and Sealegs Corporation Limited. He was also a member of the Transit New Zealand Board until July 2008 and served as a director of The Yellow Bus Company in Auckland for 8 years.

Warren Young is a Fellow Chartered Accountant and a qualified Cost and Management accountant. He is also a Fellow of the Institute of Directors, a Fellow of the Institute of Management, and a Fellow of the Chartered Institute of Secretaries. Warren was previously a senior member and partner of an international firm of chartered accountants, and continues to act in an advisory capacity to various national and international organisations. He has held a range of directorships over the years including Capital Power Limited, Wellington Electricity Management Limited, Timberlands West Coast Limited, New Zealand Blood Service, Capital and Coast District Health Board, MetService of New Zealand, and Hutt Valley District Health Board. He has also assisted the New Zealand Government with a wide range of briefs.

Tony Gibson is a transport professional with extensive national and international experience in senior management roles within shipping and logistics. He has previously been Managing Director of Maersk Line New Zealand, Director of Maersk Logistics and Managing Director of P&O Nedlloyd for New Zealand and the Pacific Islands.

Wayne Donnelly, previously the Chief Executive of the former Crown entity Land Transport New Zealand, was also appointed as the review adviser to assist with links to the Government sector.

The Review Group was supported by an independent project manager, **Henry Dowler**. Additional support was also provided by seconded staff from the MOT.

TERMS OF REFERENCE

The Review Group was appointed in August 2008 by the previous Minister of Transport “to consider the basis on which roading costs and other costs of the National Land Transport Programme should be allocated and to ensure that the charging system is fair, efficient and based on up-to-date information”.³

The Review Group’s terms of reference (attached as Appendix 1) required the Review Group to consider the following issues:

- The MOT’s CAM: Determine the appropriateness of the allocation of the various components of roading costs and other costs of the NLTP.
- Alternative charging regimes: Identify the merits of any alternative charging mechanism or regime (including, without limitation, diesel taxes).
- Associated costs: Ascertain the nature and extent of the costs associated with the current systems for setting and administering RUC, together with any improvements that might be made to reduce those costs. Compare the costs associated with the current system against the costs associated with any alternative charging regime considered by the Review Group.
- Process for changing levels of charges: Assess the process for reviewing and adjusting charges, including consultation and notice of changes.

The Review Group was also asked to provide “recommendations for possible changes to policy, processes, or legislation”.

³ Road User Charges Review Group, Terms of Reference, August 2008.

REVIEW OBJECTIVES AND PRINCIPLES

In undertaking this task the Review Group was asked to ensure that the CAM and mechanisms for charging for road use meet the objectives of economic efficiency, cost recovery and equity. The Review Group has adopted the following definitions of these 3 objectives:

ECONOMIC EFFICIENCY

- **Cost-effective** – the charging method delivers the expected outcomes while also providing value for money.
- **Efficient** – the charging method meets operational and wider transport goals using the minimum of resources required and encourages efficient use of the roading network.
- **Sustainable** – the charging method is operationally sustainable for the medium term.

COST RECOVERY

- **Cost recovery** – Payments recover the actual costs that road users impose on the roading network.

EQUITY

- **Equitable** – as far as practicable, all payments are fair, reasonable and impartial; and people who use more should pay more.
- **Transparent** – the charging method and associated responsibilities are clear and easily understood.

In the course of interacting with stakeholders and considering submissions, the Review Group identified the following as important guiding principles when considering the RUC system:

- **Simplicity** – complexities are kept to a minimum so that there is a wide understanding among road users of how the charging system operates, and compliance is easy.
- **Long run marginal social cost (LRMSC)** – with the exception of short term issues relating to congestion, decisions around road use involve long-life capital assets and the concept of LRMSC should therefore ultimately provide the most suitable basis for network costing and pricing.
- **Efficient pricing** – involves charging road users with the long run marginal social cost of road use and in a way that allows the operator to be broadly aware of the costs they incur in using the road network.
- **Roads versus a network** – the national road network should be viewed as a whole until such time as separate charging becomes possible through separate road pricing.

- ***Averaging*** – while precision is desirable when determining the allocation of costs and the setting of charges, it is not possible or practicable hence a degree of averaging must be accepted for both CAM and RUC.

INTRODUCTION

LAND TRANSPORT FUNDING IN NEW ZEALAND

Public sector expenditure on land transport is currently funded from 4 national sources and 2 local authority sources⁴. The national sources consist of:

- Dedicated FED on petrol, compressed natural gas (CNG) and liquid petroleum gas (LPG) collected at a wholesale level by the New Zealand Customs Service. FED is a proxy for the distance travelled for the predominantly light vehicles that use these fuels. (\$809 million in 2007/08)⁵.
- RUC on diesel road vehicles collected by the NZTA. RUC is directly linked to the actual distance travelled and weight of the vehicle (\$881 million in 2007/08).
- Motor vehicle registration (including annual vehicle licence fees) on road vehicles collected by the NZTA (\$291 million in 2007/08).
- The balance is made up of Crown appropriations and other funding⁶.

There are small scale refund systems for commercial non-road FED. RUC refunds are also payable on kilometres travelled off road.

These sources contributed to total National Land Transport Fund revenue of around \$2.4 billion in 2007/08. The level of income to the National Land Transport Fund varies with petrol consumption, the distance travelled, and the weight of the diesel vehicle fleet. The Land Transport Management Amendment Act 2008 requires that these revenue sources be reviewed every 3 years in line with the Government Policy Statement on Land Transport Funding.

The local roads component of the national network is owned and managed by local authorities who gather a majority of their revenue from rates (55-60 percent). Local authority rates are based on a combination of fixed charges and a rating based on either un-improved land values (popular in rural areas), capital values (popular in urban areas), or rental/annual values which represent an estimate of the likely return of the property. In some instances a differential rating of 2 or 3 times the normal rate may apply where the land is used for commercial purposes (eg forestry).

⁴ Several sundry items also exist such as rental income, sale of land and interest. These are grouped together under the heading "other" but have a very minimal contribution to revenue and are not discussed in this report.

⁵ All figures represent actual revenue.

⁶ The introduction of full hypothecation (dedication of transport revenues to the National Land Transport Fund) from 1 July 2008 means that FED revenue previously retained by the Crown and given back through Crown appropriations will now be fully committed to transport from 2008/09.

Every 3 years local authorities in a region identify a number of transport projects that they consider to be priorities for their area and develop a Regional Land Transport Programme. These programmes detail local authority contributions and financial assistance from the Crown and are forwarded to the NZTA for approval. Projects put forward will receive approval if they meet the NZTA's funding evaluation criteria. Once a project has received funding approval it forms part of the NLTP. In this sense the NLTP is an aggregation of the Regional Land Transport Programmes and what the NZTA itself spends. Local authorities are free to fund works outside the NLTP but this would require them to fully fund such a project. Local authority revenue for NLTP works amounted to \$652 million in 2007/08.

The level of local contributions varies according to the willingness of local authorities to allocate resources to land transport activities in their area.

Provision is also made in legislation for funding of land transport through road tolls applied on a project-by-project basis. Low New Zealand traffic volumes combined with the tendency for motorists to use free alternatives mean that road tolling is only ever likely to make a very modest net contribution to land transport revenue.

BACKGROUND TO ROAD USER CHARGES

The initial RUC system was introduced in New Zealand more than 30 years ago with the passage of the Road User Charges Act 1977.

Key drivers for the introduction of the RUC system were:

- To establish more economic price relativities between road and rail transport.
- More accurate roading costs to provide an economic incentive to all road operators to economise on the use of roads.
- The ability to adjust revenue from road taxation to match roading expenditure attributable to heavy vehicles.
- Ensuring that each type of vehicle is taxed according to the costs it imposes on the roading system, thus making the user-pays principle more evident in the financing of road construction and road maintenance.⁷

Multiple reviews of RUC over the intervening years have looked at many issues including administration costs, enforcement inequities, desirability of an alternative system, CAM, operational aspects of the system, and the

⁷ Introduction Road User Charges Bill [NZPD 1977 p4802].

impact of 'averaging.' The reviews have not always been able to satisfactorily reconcile opposing views on these and various other key issues.

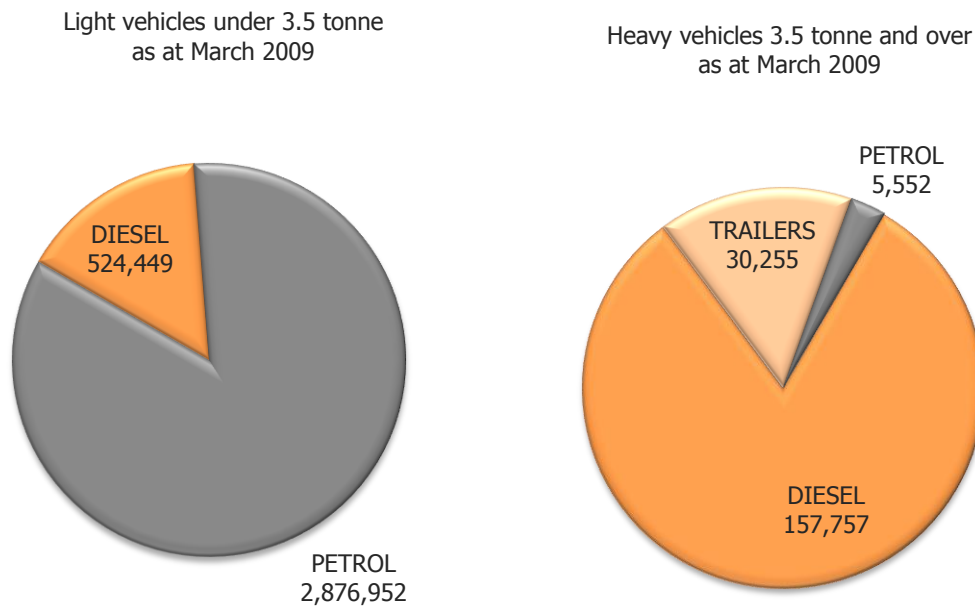
THE NEW ZEALAND VEHICLE FLEET

The total vehicle fleet is currently made up of 3,594,965 vehicles and heavy trailers, 95 percent of which are light vehicles with heavy vehicles and heavy trailers making up the remaining 5 percent.

As shown by Figure 1 below, petrol is the dominant source of motive power, representing 81 percent of the powered vehicle fleet⁸. This is largely due to the considerable number of petrol private motor vehicles.

Diesel vehicles represent 19 percent of the powered vehicle fleet. Diesel is used by almost all of the heavy fleet which is virtually entirely made up of commercial vehicles.

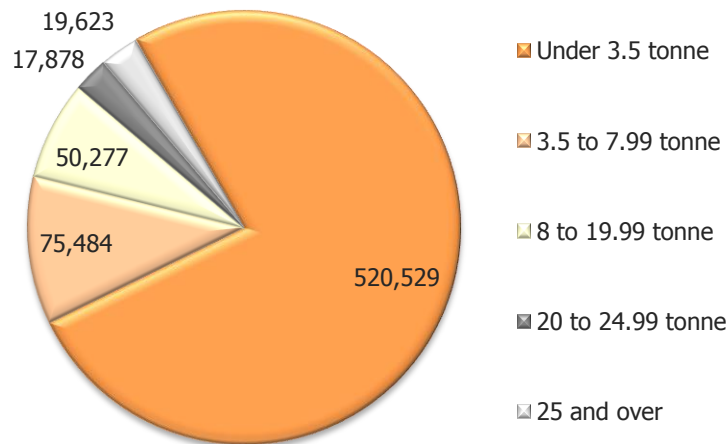
Figure 1: The total New Zealand vehicle fleet



⁸ CNG, LPG, electric and other represent 0.1 percent of the powered vehicle fleet.

Figure 2 below illustrates the composition of the diesel vehicle fleet by weight. Light diesel vehicles make up a large portion of the total, however, a significant number are likely to be used for commercial purposes (such as courier vans) rather than private passenger use.

Figure 2: Diesel vehicles and trailers by selected GVM weight categories as at March 2009



COSTS AND CHARGING

The current land transport revenue collection system is based on a costing allocation method (ie CAM) and a charging method (ie RUC). These 2 important component parts are the primary focus of much of this report. By way of introduction, we also outline the concept of averaging which we have recognised as an unavoidable aspect of both CAM and RUC.

CONCEPT OF AVERAGING

The CAM essentially views the road system as a network rather than as a combination of separate and distinct roads. In the allocation of expenditures there is no recognition of the very divergent quality of pavement source materials and standards of construction. A single wear exponent is applied regardless of the pavement strength and durability. Rates of investment and maintenance vary markedly across the whole network.

Traffic volumes and weather impacts are not distinguished between (and even within) geographic boundaries. Localised congestion related expenditure is spread across vehicle users nationally.

In short, CAM is a tool which allocates costs according to broad weight and distance criteria. It does not purport, nor can it be expected, to recognise those costs where the incidence changes according to time and place of network use. This degree of precision can only be achieved with a more sophisticated CAM.

There is also some averaging in the context of RUC pricing. In particular, no regard is given to the quite diverse operating practices and conditions in setting the allowance for 'backloads' in the heavy vehicle diesel fleet. Light vehicles tend to be grouped together for common treatment irrespective of weight disparity, and whether they are used for business or private use. To do otherwise would significantly complicate the charging mechanisms and would contribute further to the overall cost of compliance and enforcement.

THE COST ALLOCATION MODEL

CAM is a mechanism designed to calculate the RUC rates and FED necessary to fund the NLTP in any given year. The primary purpose of CAM is to allocate costs on the most equitable and efficient basis possible⁹. CAM also seeks to ensure that users pay according to the cost they impose, albeit with significant averaging in the distribution of costs.

"The marginal infrastructure cost associated with the use of a vehicle depends on several factors including the design of the vehicle, how it is maintained, how heavily laden it is, how the weight is distributed between the axles, how strong the road is and other factors connected with road deterioration"(Transport Research Laboratory Limited, 2009).

The CAM allocates all costs to either use-related costs or residual costs.

Use-related costs are allocated against relevant vehicle characteristics. These are as follows:

- Powered vehicle (PV). Driver imposed costs resulting from the need to provide resources for motorists themselves. These include signs, road markings and landscaping.
- Passenger car equivalent (PCE). Capacity-related costs resulting from the space requirements of vehicles.
- Gross vehicle weight (GVW). Strength imposed costs resulting from the gross weight of vehicles such as bridge strength, but expressed as a function of weight.

⁹ Externalities are not taken into consideration by the CAM. They are often very difficult to quantify and in some cases are captured through other mechanisms (eg ACC, or the proposed emissions trading scheme).

- Equivalent standard axle (ESA). Durability costs resulting from axle weights (to the fourth power) such as pavement wear.

Use-related costs are assigned between vehicle categories on the basis of the percentages of wear, strength and vehicle driver related costs generated by each vehicle category.

Residual costs are costs that cannot be attributed to a vehicle cost characteristic, such as the damage caused to roads by the weather or public transport costs. These are allocated across all vehicle categories on the basis of vehicle kilometres of travel.

The total of use-related costs and net residual costs assigned to each vehicle grouping is then used as an input to setting the level of RUC or FED appropriate for each category of vehicle.

THE CURRENT ROAD USER CHARGING SYSTEM

The current RUC system is governed by several pieces of legislation. The Road User Charges Act 1977 sets out who is required to pay RUC, what the charges are, the basis for charging (ie actual weight carried on road and distance), licence requirements, vehicle requirements (eg vehicles must have a distance recorder) and administrative details, such as who may issue licences and refunds for off road use.

Other Acts of importance include the Customs and Excise Act 1996 which sets the rates of FED relating to petrol, LPG and CNG; and the Land Transport Act 1998 which provides the authority to prescribe motor vehicle registration and licensing fees. Land transport funding is governed by the Land Transport Management Act 2003, and revenue raised under the aforementioned Acts is distributed in accordance with this Act.

Statutory responsibility for the application of the RUC system rests with the Chief Executive of the MOT. The Chief Executive has delegated responsibility for administration of the system to the NZTA. This includes collection of fees, recovery of unpaid RUC and management of refunds. Enforcement of the offences regime relating to RUC is carried out by the New Zealand Police while the MOT administers RUC policy and has overall revenue management responsibility.

The end result is a requirement for 2 groups of vehicles to pay RUC; all diesel powered vehicles and other vehicles powered by a fuel not taxed at source¹⁰ regardless of weight. All vehicles that travel on road must also pay an annual license fee which can be paid annually, half yearly or quarterly and is quite separate from the RUC distance licences.

Distance RUC licences are purchased in units of 1,000 kilometres or multiples thereof. Vehicles must be RUC licensed for a continuous distance so that when the finish distance is reached a new RUC licence is required.

¹⁰ Fuels taxed at source are petrol, CNG and LPG.

Distance RUC licensed vehicles are classified according to:

- whether the vehicle is powered or unpowered
- the number of axles on the vehicle
- the number of tyres per axle, either single tyred or twin tyred.

Different RUC rates apply to different vehicle configurations, depending on the number of axles and tyres. This is intended to reflect the different degrees of wear and tear on roads caused by different axle configurations. Appendix 2 shows the different RUC vehicle types.

In all cases the expected vehicle load should be added to the unladen weight to establish the RUC licence weight. This weight is then rounded up to the nearest tonne for the licence weight to be purchased.

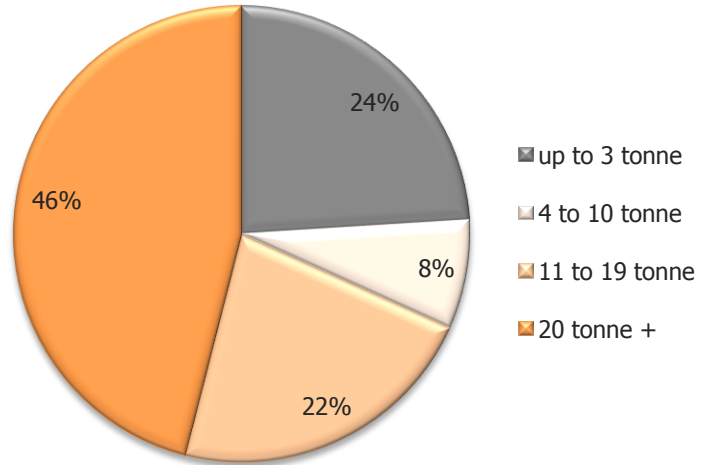
All vehicles that operate with distance RUC licences must be fitted with a distance recorder that is of a type and accuracy sufficient to provide a reliable record of distance travelled. Every motor vehicle requiring a distance RUC licence where the manufacturer's gross laden weight is more than 3.5 tonnes must be fitted with an approved hubodometer.

Operators may increase the nominated maximum weight of a current distance RUC licence by purchasing either:

- a new distance RUC licence at an increased total weight to replace the existing licence; or
- a supplementary RUC licence at an increased total weight which will supersede a portion of the current distance RUC licence.

Figure 3 below represents estimated RUC revenue as in the CAM in respect of 2007/08. While light diesel vehicles are large in numbers the majority of RUC revenue is actually collected from the heaviest vehicles which represent only 5.4 percent of the diesel vehicle fleet.

Figure 3: Estimated RUC revenue by weight



INTERNATIONAL APPROACHES TO ROAD COST ALLOCATION AND CHARGING

The Review Group commissioned the New Zealand Institute of Economic Research (NZIER) to undertake a review of international literature on road cost allocation and charging for road use. The Review Group has also located and read a wide range of government reports and other written information on these matters. In addition we have considered all other material provided by submitters and spoken directly with overseas experts.

Developing an understanding of international systems, and their distinct differences and approaches used for particular problems, has informed our thinking about what will work best in the unique New Zealand operating environment. For example, New Zealand's isolation means that it does not have to deal with complex border management and other issues caused by heavy vehicles being able to readily transit through multiple national jurisdictions.

The following outlines key NZIER findings and what we also noted from our own investigation and examination of international information. Appendix 3 provides further detail from the NZIER report on the approaches taken in a number of different countries.

COST ALLOCATION

There appears to be relatively little literature on road cost allocation – what was found came mostly from Australia and the USA which use road cost allocation models similar to New Zealand, but have some distinct differences in detail. These differences are outlined, where appropriate, in the 'Opportunities for improvement' section of this report.

There are also elements of similarity with some European systems, which utilise various axle load/road-wear power relationships and variously attribute different types of cost to vehicle axle loadings, gross weight and related measures.

REVENUE COLLECTION

Literature on road charging (revenue collection) mechanisms is more abundant. Much of this literature is technology-led and aimed at problems which are either less significant in New Zealand or outside the scope of the current NLTP, such as:

- congestion charging
- recovering revenue from foreign heavy vehicles in transit
- reducing the environmental impact of heavy vehicles
- inter-operability of proprietary technologies.

Internationally there has historically been a large dependence on fuel taxes plus a vehicle excise tax or registration fee (differentiated by characteristics of the vehicle as the basis for charging). This is quite different from New Zealand's rather unique approach which includes operator nominated weight and distance-based charges. International approaches can lead to overcharging of road users as they are largely driven off schemes designed to collect 'taxes' rather than purely as cost recovery mechanisms. Often such taxes are applied to fund other transport modes. Accordingly, the New Zealand system, which is clearly designed to recover only NLTP costs, is likely to be more equitable.

More recently, international jurisdictions have introduced special charges on heavy vehicles using electronic location and fee collection systems. These have been implemented in Switzerland, Austria, Germany and the Czech Republic, with others planned in Sweden, the Netherlands, Hungary and Slovakia. Further detail is provided in Appendix 3.

There have also been numerous approaches to urban congestion charging, ranging from revenue-raising toll rings in Norway to the use-detering congestion charges in London and Singapore. There have also been congestion-related charging trials in cities ranging from Stockholm to Portland, Oregon.

EXAMPLES OF CURRENT INTERNATIONAL SYSTEMS AND WHERE THE WORLD IS MOVING

As technologies with the ability to electronically monitor and charge for road use evolve, more countries are considering direct road charging and transport pricing reforms. This is illustrated by the following snapshot of some very recent international proposals and perspectives.

AUSTRALIA

Australia currently uses a hybrid PAYGO approach to road charging, in which the National Transport Commission (NTC) estimates the annual cost of road service provision from the average of road expenditure in the current budget year and the 6 previous years. It gathers expenditure data for the whole road network, including capital and maintenance expenditure at all levels of government, so that capital and maintenance expenditure is recovered in full in the period in which it is spent (Productivity Commission, 2006). The averaging over a 7 year period with increasing annual costs causes an under-recovery of current year costs. As these charges are a form of tax without hypothecation, this is not considered to be a problem.

The Australian cost allocation model's broad components are:

- Total costs to be allocated are based on the average level of road expenditure over 7 years (in real dollars) minus 39 percent deducted as "amenity costs".
- Costs that can be associated with use of different vehicle types are attributed to the different classes of vehicle.

- The remaining costs are allocated to different vehicle classes by way of a broad measure of road use (vehicle kilometres travelled, or 'vkt').

The Australian charging model aims to recover expenditures allocated to each vehicle class through a combination of a fuel charge and fixed annual charges. An 'access charge' and a diesel fuel charge are 'selected' and revenues from these are deducted from the expenditures allocated to each vehicle class. The remaining expenditures become the basis for setting 'mass distance charges' which, combined with the access charge, are wrapped up in the annual vehicle registration charge.

The Australian national heavy vehicle charging regime was introduced in 1992, but the diesel fuel excise was introduced in 1957 with the express purpose of contributing to road costs. Registration fees have also been in place since well before the introduction of the road use charging regime.

We have noted a clear indication from the NTC that its preferred charging model is direct mass-distance-location-based pricing of heavy vehicles. The NTC goal is to move from a highly averaged charging system to one with charges that more accurately reflect the costs of using the road network.

As part of a broad reform agenda for road infrastructure and investment NTC is carrying out a feasibility study on incremental pricing for heavy vehicles (National Transport Commission, 2009). Incremental pricing allows transport operators to carry additional mass above national regulated limits on specific roads by paying the road agencies or councils for the extra road wear and tear. This initiative is about increasing productivity and greater targeted road spending. The Council of Australian Government's timetable would see the feasibility study completed by 2011 and the initiative implemented in 2014.

Incremental pricing for heavy vehicles is seen by the Australians as an important first step towards the development of a comprehensive mass-distance-location-based charging scheme. Such a scheme would replace existing registration and fuel charges with a charge for road use based on the mass of the vehicle as it travels, the distance travelled and the location of the road use.

THE UNITED KINGDOM

Road charges in the UK have 2 principal components, a vehicle excise duty (VED), also known as road fund tax, which is a tax on ownership of vehicles for use on public roads, and FED, which is a tax on use of those vehicles. VED accounts for around 16 percent of road-related revenues collected, with fuel duty making up the remainder. Road diesel taxes in the UK are now the highest in the European Union (EU), about 83 percent above the all-EU average (Butcher L, 2008). Most of these revenues are not returned to fund roading and transport, and a growing gap between revenues recovered from road users and expenditures on roads over the past 20 years in particular has been a matter of some concern.

VED was first introduced for 4 wheeled motor vehicles in 1889, but although historically it was considered a road fund tax to pay for the building and maintenance of the road network, this has not been the case since

1937. The UK Treasury is strongly opposed to hypothecated taxes, and revenue from both VED and fuel taxes go into the government's consolidated fund from which appropriations for roading and other purposes are made. The UK's VED does differentiate between vehicles on the basis of gross weight and number of axles, but the linkage between cost allocation and road charge setting appears tenuous, as VED is a fixed charge per vehicle irrespective of the amount of use made of the road network, and bears no relation to each vehicle's contribution to road-wear.

The United Kingdom Department for Transport has also cited time, distance and location based charging as its goal. To help realise this, the UK Government has proposed a national road user charging scheme for all vehicles by 2030 with technology that can charge by time, distance and place to target costs, including environmental costs. The goal is to introduce variable charges per kilometre to change social attitudes and promote public transportation. It is felt that at present the fixed costs of motoring (road tax, insurance, vehicle depreciation) dominate the variable costs (fuel, wear and tear) in the total cost equation so that the average driver has little incentive to be practical in their use of the road (NZIER, 2008).

THE UNITED STATES OF AMERICA

The USA uses cost allocation and PAYGO charging through vehicle registration fees, fuel taxes and diverse other charges (eg tax on large tyres), but the overall charge structure is complicated by the overlay of Federal, State and local charges.

Their road-related revenue is derived from different sources:

- Federal level: 90 percent from fuel tax, plus excise tax on truck sales, graduated tax on large tyres, and less than 3 percent of revenue from a heavy vehicle tax on trucks greater than 24.9 tonnes laden weight.
- State level: 50 percent from fuel tax, 33 percent from vehicle registrations, the balance from other assorted charges.
- Local level: 40 percent from vehicle registrations, the balance mainly from property taxes.

A recent report by the USA National Surface Transport Infrastructure Financing (NSTIF) Commission to Congress on transport finance recommends a major shift from the current funding approaches (based largely on indirect user fees in the form of federal motor fuel taxes) toward a new system built around more direct user charges in the form of fees for miles driven. This recommendation is based on an assessment that "...all too often the prices paid by transportation system users are markedly less than the costs of providing the transportation services they use (including pavement repair)—much less the total social costs (including traffic congestion and pollution). This underpayment contributes to less efficient use of the system, increased pavement damage, capacity shortages, and congestion" (National Surface Transport Infrastructure Financing Commission, 2009, p. 4).

The NSTIF report also notes that, in the USA, current revenues are insufficient to cover investment needs and the cumulative gap 2010-2015 is forecast to be US\$400 billion if nothing is done.

THE NETHERLANDS

A recent announcement by the Government of The Netherlands is a further example of an intention to implement a road user charging scheme whereby all users will be charged a fee per kilometre driven differentiated by time, place and environmental characteristics. The first phase will be for heavy goods vehicles (over 3.5 tonnes) with implementation completed by the beginning of 2012.

From 2012 to 2016 inclusive, road pricing will be implemented for all other vehicles. The proposed collection system will be based on the most up to date satellite technology, with a requirement for all vehicles to install an On-board unit (OBU). A point of note is an indicated financial limit on operating costs amounting to a maximum of 5 percent of revenue (Ministry of Transport, Public Works and Water Management, 2008).

The objective of the scheme is to mitigate congestion by making the user more aware of the cost of using the road network and to provide incentives for modal shift or to avoid use of the network during peak periods. On average the cost impact to the user is expected to be neutral because the implementation of a road user charging scheme will replace taxes on car ownership and car purchases (Hyder Consulting (NZ) Limited, 2008).

In planning for the implementation of the new approach, The Netherlands has placed considerable emphasis on the importance of effective communication with road users and the general public. They clearly see a well informed public as a critical success factor for rolling out the new approach.

OPPORTUNITIES FOR IMPROVEMENT

For more than 30 years RUC charges, informed by CAM calculations, have contributed to the diesel vehicle share of the revenue needed to fund the roading works included in the NLTP and its previous incarnations. The Review Group has noted many positive aspects of both the CAM and the RUC system and do not consider either of these to be 'broken'.

New Zealand is one of only a few countries to have successfully introduced road user charging by weight and distance. One of the system's main advantages is that it goes some way to assigning charges to vehicles according to their overall use of the network and the general associated maintenance costs incurred due to that use. Compliance costs also fall predominantly on road users rather than other sectors of the economy that use diesel.

The Review Group has, however, identified a wide range of issues and opportunities to address those. We have identified these "opportunities for improvement" through discussions with operators and enforcement staff about the difficulties they face, surveying users about their most recent experiences, analysing public submissions and commissioning and reading expert reports.

For consistency with preceding sections of this report, we have summarised in this section our key findings and consequent recommendations under the broad headings of "cost allocation" and "revenue collection".

COST ALLOCATION

The Review Group considers that, in principle, the CAM provides the framework for a fair and equitable allocation of costs between the various classes of road users. Although there are clearly imperfections in certain areas of the current model, and we are suggesting adjustments to address those aspects, we believe it would be unwise to discard a fundamentally good and well understood system in pursuit of an improved but untested substitute.

"A constantly changing model reduces confidence and leads to suboptimal investment" (Infometrics 2008 p.2).

In general, the existing model deals only with those costs actually incurred. It does not attempt to account for expenditures designed to avoid road wear, or the benefits enjoyed by other than drivers of motor vehicles. The purpose of CAM is simply to recover costs from those who contribute to the physical wear and deterioration of the network.

Furthermore, the CAM does not seek to recognise the group of costs which are customarily referred to as "externalities". These would typically include costs associated with such matters as road related accidents and adverse environmental impacts. The ultimate and ideal cost recovery mechanism would be that which recoups from all road users the long run marginal social cost of maintaining the network.

In the following sections we address those areas of the CAM which require further consideration and/or amendment.

INCREASING THE PURITY AND TRANSPARENCY OF THE CAM

Non-road expenditure

The CAM currently includes some expenditure on rail and public transport which is un-related to road use. Road users contribute to these outlays through FED, RUC and annual vehicle re-licensing. Heavy vehicle operators are in direct competition with rail and are naturally uncomfortable at the prospect of subsidising their competitors. Furthermore, the need for public transport is contended to arise from congestion in urban areas which is caused primarily by private passenger vehicles. Heavy vehicle operators assert that they should not be liable for costs that they do not impose.

"...it would be inefficient and inequitable to charge heavy vehicles for passenger transport subsidies. Charging heavy vehicles for passenger transport subsidies would constitute a tax on the productive sector of the economy, including exports, to subsidise social expenditure" (Road Transport Forum New Zealand Inc, 2008).

Non-road related expenditure in the CAM comprises costs that are not generated by road use and road users do not benefit from the expenditure in any direct way. The majority of these non-road costs relate to public transport subsidies. Although those subsidies can provide indirect benefits to road users through congestion relief, the Review Group does not consider that recovering the related costs through RUC and excise duty is either equitable or efficient. Advice to the Review from Infometrics was that "FED and RUC should not be used as revenue sources for non-road related expenditure" (2008, p. 14). Similarly, the Review Group does not consider that taxes or charges on road use are the most appropriate way to fund subsidies to other transport modes such as rail and sea freight, or central government agency costs not directly related to road use.

In our view, the costs allocated through the CAM should be limited to direct costs of road provision and use. The CAM is not designed to charge users either for the benefits they receive from road use, or for costs that have been avoided as a result of spending on other activities. That would require a different, and much more sophisticated, charging model to be developed.

The Review Group has concluded that the costs to be recovered through RUC and FED should, in general, be confined to the costs associated with road use only, with all other land transport costs funded through an alternative mechanism.

Recommendation

That the Government investigates alternative funding for non-road related costs in light of our conclusion that costs recovered through the road user charging system should, in general, be confined to the costs associated with road use only.

Local authority revenue

The treatment of local authority revenue in the CAM has been the subject of some debate over the years and has been called into question by a number of commentators. At present the CAM recognises local authority revenue as a deduction from the non-use related costs in the CAM.

"Rates are treated in the CAM as recovering 'residual costs' (i.e. activities unrelated to road use), but in practice around a third of rates revenue is required to fund use-related costs. This means that many road users are paying twice for their use of local roads – through RUC/petrol tax and through rates. In effect ratepayers are subsidising the state network"(Local Government Forum, 2008).

The 1983/4 version of the CAM was the first time that local authority expenditure was recognised in the model and that related revenue was introduced by way of a deduction from aggregate costs before RUC and FED levels were calculated. This treatment remained in place for many years.

In 1996 an independent review by Margaret Starrs (cited in the 2001 working group report) argued that excluding local authority expenditure entirely from the CAM was more in keeping with international practice. If this was deemed not acceptable, then an alternative treatment was to deduct revenue from the costs in the CAM in a manner which was neutral as between the various classes of vehicle users.

A report prepared by Outcome Consultants (1999) reached a similar conclusion, and suggested that to include local authority expenditure was inconsistent with cost recovery principles and the way in which government had clearly decided to fund roads. It was also contended that the inclusion in the CAM of both local authority expenditure and the related revenue could have the effect of shifting a greater proportion of costs from the light to the heavy vehicles in the fleet.

The 2001 working group stated that it was "inconsistent to include third party expenditure in a cost recovery model only to net it out again" (p. 30). After considerable discussion however, they recommended that local authority expenditure remain in the model, so that all use related costs could be taken into account in setting charges. The 2001 group recognised that "this option does not match actual Crown expenditure with ... charges set by the Crown" and "would require reconsideration should stricter cost recovery principles ever be adopted for the collection of RUC" (p. 33).

Removing both the expenditure and revenue elements of local authority funding from the CAM arguably increases the risk of some vehicle classes being charged less than their average use related costs, and possibly lower than the incremental costs they impose on the network. As efficient pricing requires all users to meet at least their marginal costs, this fundamental principle could be compromised. But in accepting this possibility it must also be recognised that the CAM itself is inherently studded with averaging assumptions which cause imprecise measurement across the whole fleet nationally.

We also appreciate that the removal of certain expenditures relating to the local roads would mean that the CAM is then not accounting for the full cost of the roading network.

However, we believe that the central concern is to ensure that road users are not charged twice for the same costs. We also share the view that, in a model which is dealing principally with cost recovery, it is somewhat illogical to include those expenditures which have been fully recouped via revenue generating mechanisms which sit totally outside the CAM.

We therefore support the netting off of local authority expenditures against the attributable revenue and that none of the sums involved is included for CAM calculation and charging purposes.

Recommendation

That local authority revenue be applied within the CAM to offset those costs to which it directly relates, rather than the existing practice of deducting the revenue from the total non-use related costs.

ALLOCATING SPACE RELATED COSTS BY USING A SPACE RELATED MEASURE

The current approach to distributing space related costs (the PCE factor in the CAM) applies a formula that is based largely on vehicle weight. PCE values do not differ according to vehicle type, except for trailers which are rated lower than for powered vehicles of equivalent weights.

The formula for powered vehicles is $PCE = 0.875 + \text{gross vehicle weight divided by } 8$. For trailers it is simply gross weight divided by 8. This formula was recommended in the report of the 2001 Review of the CAM. It is intended to produce a PCE that appropriately captures the space requirements of the average heavy vehicle.

The current formula is unrealistic in that it produces a PCE factor for each vehicle that rises steadily as a function of weight. Vehicles of the same size are thus assigned a different share of space related costs depending on their weight, irrespective of their length and other factors that can directly affect space requirements. For example, at present a 10 tonne truck is allocated space related costs equivalent to 2 small cars, while a truck of similar length that can carry a load of 20 tonnes is allocated the space costs of 3 cars.

Transport Research Laboratory (TRL), in their report to the Review Group commented that *"there is little justification for using weight as a proxy for space"*. TRL considers that *"...it would be more appropriate to use a value related to length, perhaps having standard values for a prime mover and trailer"* (2009, p. 25).

The Review Group has identified 2 international jurisdictions that adopt this approach, both of which could provide the basis for adapting the New Zealand method in dealing with the attribution of cost in the PCE calculations¹¹.

The effect of moving to a length-based value for PCE would be a re-distribution of costs in the model from heavier vehicles to those that are lighter but of similar external dimensions. That is, the 10 tonne truck referred to above would pay slightly more and the 20 tonne truck slightly less. The effect on charges is greatest for vehicles at the low end of the definition of heavy vehicle, where RUC rates could increase by up to 20 percent.

The change in approach recommended would not have a significant effect on charges for light vehicles up to 3.5 tonnes.

Recommendation

That the allocation of space-related costs in the CAM is based on an appropriate standard motor car equivalent factor rather than using the current, largely weight-based proxy.

ENSURING FAIR ALLOCATION OF ROAD WEAR COSTS

Road wear costs are allocated in the CAM via the principle of equivalent standard axle (ESA). The ESA is an important component within the CAM and has a significant influence in the calculation of RUC.

"The core point about the ESA factor is that for heavy vehicles it dominates everything else in the allocation of costs. This follows unavoidability from the 4th power rule"(Infometrics, 2008, p. 6).

ESA calculation

The ESA or 'wear effect' of a vehicle is based on a range of considerations including the number of axles on the vehicle, the number and configuration of the tyres on each axle, the spacing of the axles, and the gross weight of the vehicle itself. The CAM seeks to reflect these elements through the ESA parameter by calculating the impact of the different vehicle characteristics across the range of RUC licences available.

The stress impact on pavement structures has been determined by roading engineers to approximate the following formula:

$$\text{Wear} = (\text{maximum gross weight/sum of axle reference loads})^4 \times \text{number of axles} \times 0.55$$

¹¹ See for example the Australian approach in table 47 of Third Heavy Vehicle Road Pricing Determination, Technical report, National Transport Commission, Melbourne, October 2005

The first part of this formula incorporates assumptions regarding variations in wear attributable to axle and tyre configuration by assigning a different combination of axle reference loads to each vehicle type.

The reference load for an axle is that which causes 1 unit of pavement wear. In general, axles with dual tyres have higher reference loads than axles with single tyres and axles that are grouped in sets of 2 or more have higher reference loads than axles that are widely spaced. The higher the reference load, the less impact a given weight carried by an axle has in terms of road wear.

The sum of the separate axle reference loads for a given vehicle type is described in the CAM as the 'axle factor' for that vehicle. For example, a vehicle with 2 axles, the rear of which has dual tyres, has an axle factor of 14.9 tonnes. A 3 axle vehicle with 2 dual tyred axles in tandem has an axle factor of 23.8 tonnes, reflecting that its configuration distributes load in a way that is less damaging to the road.

The axle factors in the current CAM range from 8.2 for a single axle trailer to 34.5 for a trailer that has 4 axles, all with dual tyres.

The ESA formula in the CAM divides the gross weight of the vehicle by the total axle factor; to represent the way that vehicle configuration mitigates the wear impact of weight.

The result of that sum is then multiplied to the fourth power, reflecting the assumption that road wear increases by that exponent as weight increases. The final steps in the formula are to multiply by the number of axles (averaging the axle factor) and apply an average loading assumption of 0.55. This assumes that vehicles cover half of their distance fully laden and half in an empty state, and that when empty the ESA is 10 percent of the value when fully laden. In the current model this factor is the same for all vehicles over one tonne and therefore has no influence on the level of charges.

Determining appropriate axle reference loads

It has been suggested to the Review Group that the axle reference loads used in the CAM do not accurately reflect current road design practice and that, accordingly, it may be preferable to adopt those recommended in the Australian 'Austroads Pavement Design Guide'.

Compared to the Austroads approach, the reference loads used in the CAM incorporate different assumptions about the relative road wear impacts of different axle configurations. In brief, the Austroads reference loads result in axles fitted with single tyres generating substantially higher ESA values compared to axles with twin tyres than they do under the New Zealand CAM model.

If the CAM were amended to reflect the Austroads recommendations the greatest benefit would fall on operators using trailers with twin tired axles. There would be no significant implications in the redistribution of costs elsewhere in the fleet, or as between heavy and light vehicles.

The Review Group accepts that there have been developments of consequence in pavement design theory since the CAM reference loads were determined in 1977 and believe it is appropriate to review the reference loads used in the calculation of RUC.

"These reference loads are presumably what was used for pavement design when the RUC system was first developed but they are substantially different from the reference loads used in the Austroads Pavement Design Guide which are the basis of current New Zealand design practise" (TERNZ Ltd, Covec Limited , 2008, p. 59).

However, we are also aware that Austroads is undertaking further research to re-assess pavement damage caused by multiple axle loads and that care should be exercised in adopting a regime which might be subject to material change in the short term. There is also some question as to the significance of any difference between the axle reference loads presently employed in the CAM and those suggested by Austroads.

If the ESA reference loads in the CAM are to change then it would be more appropriate to base these on studies relating to the New Zealand pavement conditions and not simply adopt the current or revised position from Austroads.

"...more information on the actual performance of the different classes of road network and the types and timings of maintenance on the network is needed to evaluate the impact of changes in ESAs on road wear and costs" (Transport Research Laboratory Limited, 2009, p. 10).

Recommendation

That NZTA undertakes an empirical study into the actual pavement conditions throughout the New Zealand road network and evaluates the impact of axle reference loads on road wear, the consequential cost of maintenance, and the resultant changes to the CAM.

Axle factors and weight distribution

For simplicity, the CAM assumes that the licensed gross weight is distributed across axles in proportion to the reference loads, and that weight distribution is unaffected by changes in licensed weight. It has been suggested that this is not realistic for all vehicles and that different assumptions should be made for vehicles that have combinations of different types of axles, in particular, type 6 and 14 heavy vehicles. .

The alternative assumption suggested by TERNZ and Covec (2008) was that, for any given level of load, payload is distributed across axles in the same proportion as for a vehicle carrying the maximum permissible weight. This has relatively little effect on the calculation of ESA for vehicles at or near the maximum weight, but increases the ESA for vehicles with gross weights significantly lower than the maximum.

TRL, in its advice to the Review Group, agreed that the current assumptions are unrealistic:

"In practice, the weight distribution between axles will depend on the vehicle's unladen weight, dimensions, load carried and position of the load" (Transport Research Laboratory Limited, 2009, p. 16).

Application of the approach suggested by TERNZ/Covec would require a more complex ESA formula, incorporating assumptions about the typical unladen weights of vehicles. It is not clear to the Review Group that this added complexity would be justified, or indeed that the resulting ESA values would necessarily be more realistic than the current ones for all vehicles. Other advice received by the Review Group questioned whether the assumptions suggested by TERNZ/Covec about unladen weight would be realistic for lower licensed weights (Allan Kennaird Consulting, 2009).

As noted elsewhere, the Review Group is recommending that all vehicles be charged on the assumption that they are loaded at their legal maximum. In this context, the question of how rates should be set for vehicles carrying less than a full payload loses relevance.

Recommendation

That no change be made to the current assumption in the CAM regarding distribution of weight across axles (taking into account future charging on the basis of the maximum (permissible) gross laden weight of a vehicle and having regard to axle configuration).

The fourth power rule

The so called 'fourth power rule', reflected in the ESA formula, is a key determinant in assessing the relationship between axle loads and pavement wear. It has its origins in the American Association of State Highway Officials (AASHO) studies carried out between October 1958 and November 1960.

One of the major achievements arising from those studies was the development of 'load equivalency factors' (LEFs). The basic concept of the LEF is that when an axle of a particular load and configuration passes over pavement it generates some element of pavement wear. The extent of the damage caused by that load will depend not only on the characteristics of the vehicle concerned but also on the type and strength of the underlying pavement. The stronger and more durable the surface, the better will be its ability to resist pressure and weight.

The tabulation of the AASHO findings determined that a power factor of 4.15 was appropriate to express the impact of varying weight on a standard axle, and for simplicity reasons this factor was rounded to 4. It should however be noted that the AASHO tests involved only single and tandem axles, and were conducted on

pavements and in conditions that are not necessarily applicable to the network of roads in New Zealand. We also note the following comment on the way in which the fourth power rule operates:

"It is important to understand that the power rule relationship does not describe the strength of the pavement, it only describes its sensitivity to changes in axle loadings" (TERNZ Ltd, 2008, p. 5).¹²

Nevertheless, the concept of LEFs and the use of the fourth power relationship are still applied in this country and elsewhere, particularly for pavement design purposes. It is also used for cost allocation, but as noted by TRL:

"The 4th power rule (or other exponent) is primarily used when designing new roads... [and is] more difficult to justify when used to calculate road user charges" (Transport Research Laboratory Limited, 2009, p. 9).

While there is on-going debate on what the value of the exponent should be, most technical experts seem to agree with the principle that beyond a certain tonnage road damage rises nonlinearly (if not always smoothly) with weight.

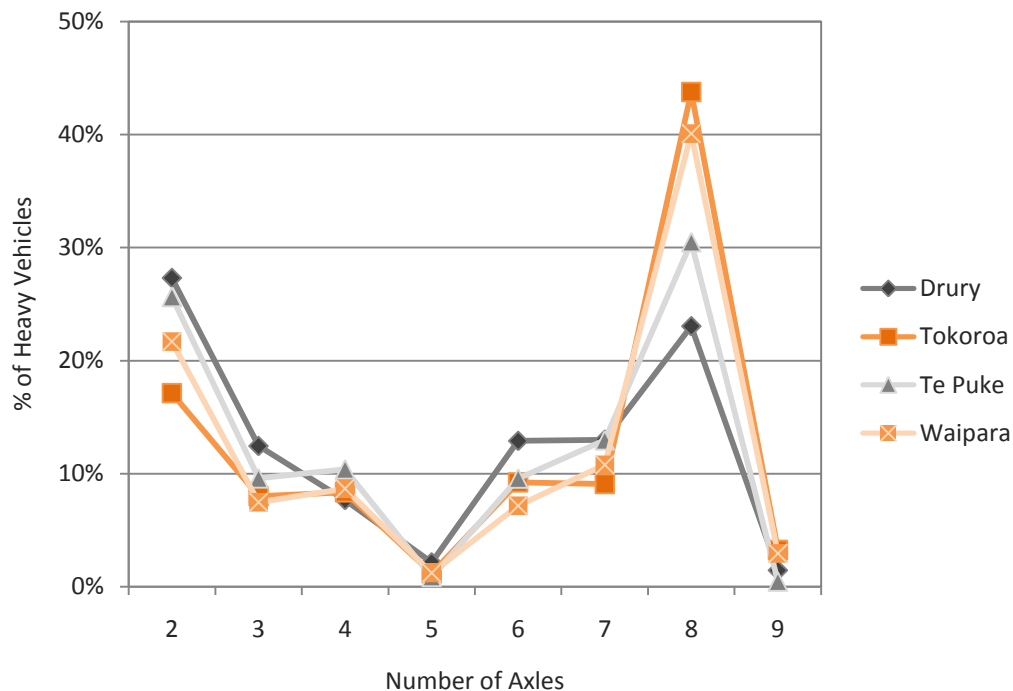
Many submitters consider that the fourth power rule is too high for New Zealand conditions and its use results in the unfair allocation of road-wear costs to heavy vehicles. Also that the nature of the exponential relationship between road wear and weight and resultant RUC rates could act as a disincentive to operating at higher weights.

This is a particular concern for operators currently participating in the heavy vehicle productivity trial. The current RUC rates could considerably reduce the economic incentive to move to a higher gross vehicle mass. In addition, application of the fourth power rule promotes the use of more axles on heavy vehicles, which results in higher capital costs with little overall economic advantage.

"Under the current fourth power relationship, the scale of RUCs leads road transport operators to choose vehicle types with more axles than is common internationally, thereby significantly increasing heavy vehicle operating costs. For vehicles operating at their maximum weight limit, the additional axle(s) also require a reduction in payload" (Road Transport Forum New Zealand Inc, 2008).

Figure 4 below shows the extent to which New Zealand operators concentrate on 8 axle vehicles rather than 7 solely because the RUC licence rates are cheaper.

¹² Attachment to Appendix B, submission of the Road Transport Forum

Figure 4: New Zealand (2007) 'weigh in motion' data from four locations

Source: TRL

One of the strongest criticisms of the use of the fourth power rule is in an attachment to the Road Transport Forum's submission, prepared by Transport Engineering Research New Zealand Limited (TERNZ). Drawing on research carried out at the Canterbury Accelerated Pavement Testing Indoor Facility (CAPTIF) laboratory in Christchurch, TERNZ has suggested that *"the effect of axle load can be modelled by a power rule with an exponent in the range 1.3-1.8"* (TERNZ Ltd, 2008).

Other submissions received by the Review Group maintain that the fourth power rule remains the best average assumption for the New Zealand roading network. The Automobile Association (AA) is representative of this viewpoint, stating in its submission: *"there is insufficient evidence to definitively replace the fourth power rule with any other exponent"*.

Information and advice received by the Review Group has not persuaded us that there is sufficient evidence to support a move away from the fourth power rule. As concluded by TRL and Sinclair Knight Merz in their advice to the Review Group:

"The evidence so far produced from the CAPTIF study (and other studies worldwide) is insufficiently robust to justify changes in the damage law exponent or to select a different single exponent for road user charging purposes" (Transport Research Laboratory Limited, 2009, p. 15).

"...there is insufficient robust and clear evidence to change the RUC model for road wear by changing the fourth power rule" (Sinclair Knight Merz, 2009, p. 26).

Advice received from TRL did, however, cause the Review Group to question whether the current allocations of costs to ESA in the CAM are appropriate. This is discussed below.

Recommendation

That the fourth power rule continues to be used in calculating the road wear component of RUC (as we did not find sufficiently robust evidence to justify changes in the road damage law exponent or to select a different single exponent for road user charging).

Average loading assumptions

The current assumption in the CAM is that all vehicles are 55 percent laden on average. It has been suggested that this assumption reduces the ability of the CAM to set efficient prices and results in cross subsidisation between operators.

"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 (e.g. livestock, logging truck, and aggregate operations) and others that operate on pick up or put down round trips and are at maximum weight for much less than half the trip (e.g. 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" (McKenzie Podmore Limited, 2008, p. 42).

The Review Group acknowledges that the current assumption is not realistic for all operators, but does not consider it practical to distinguish between the different operational practices when considering the charging regime.

A different issue, however, is whether the current assumption is equally reasonable across all of the existing vehicle categories.

Weigh in motion data has been used to challenge this assumption with TERNZ and Covec (2008) commenting that a 55 percent loading is *"appropriate for the powered vehicles, but the trailers should probably have a utilisation factor of about 0.44"* (p. 67). Assuming that the weigh in motion data is representative of the fleet, the Review Group accepts this reasoning. A lower load factor for trailers will result in less emphasis being placed on durability costs (eg, pavement wear) for trailers as compared to powered vehicles.

Recommendation

That the average loading assumption inherent in the CAM and RUC rates be amended to use a factor of 45 percent for trailers (as that is what recent empirical evidence indicates is appropriate).

Road friendly suspensions and wide tyres

Air bag suspensions and wide tyres, when used correctly, have been shown to reduce pavement damage. For several years now many operators have been recommending a concession in the RUC scale for these road friendly additions.

The feasibility and appropriateness of recognising road-friendly suspensions has been a consideration in several past reviews of the CAM. Although there appears to be agreement amongst roading engineers that air bag suspensions and wide tyres do indeed lead to reduced pavement wear, the Review Group understands that the adoption rate of these suspensions in particular is very high (and increasing) for new vehicles.

Accordingly, there seems little benefit in introducing explicit allowances in CAM or RUC rates to encourage further uptake as this would require a scheme of rating and certifying suspensions and inspection of tyres at the roadside. This would not only add to the complexity of the RUC system but also create significant compliance costs in its own right.

Recommendation

That no explicit allowance be made for air suspension and wide tyres in the CAM calculations (as such additions would add complexity, bring no material benefit, and would lead to yet further compliance and enforcement costs).

Allocation of costs to the road wear parameter in the CAM

As previously discussed, the calculation of ESA values relies on assumptions about reference loads, weight distribution across axle groups and payload distribution. The CAM apportions a large proportion of use related costs to ESA. Given the debate surrounding some of these elements it has been suggested that a more conservative approach could be adopted in the allocation of costs to the ESA parameter in the CAM.

"There is considerable uncertainty about the calculation of ESAs. While the uncertainty has limited effect on road design, it is more difficult to justify its use for road user charging" (Transport Research Laboratory Limited, 2009, p. 15).

As noted above, the Review Group found no good grounds for moving away from the fourth power exponent in calculating the effect of vehicle weight on road wear. At the same time, however, the Review Group was

concerned to find that there is a considerable level of uncertainty around both the power rule and other aspects of the ESA calculation in the model.

We note, in particular, TRL's conclusion that *"the ESA values [in the model] are unlikely to be representative of real vehicles"* (2009, p. 3).

This conclusion was based on TRL's assessment of the assumptions that the model makes about weight distribution, average loadings and axle reference loads, as well as the use of the fourth power exponent. Each of these assumptions is justifiable as a reasonable approximation of average vehicle characteristics. Taken together, however, the cumulative effect limits the robustness of the ESA values in the model.

Bearing in mind the uncertainties around the ESA calculation, TRL questioned whether it was appropriate for the ESA value to play such a dominant role in setting the RUC rates for the heaviest vehicles. They concluded that:

"A high proportion of the Road User Charges (RUC) paid by the heaviest vehicles is based on the calculation of Equivalent Standard Axles (ESA). There is considerable uncertainty about the calculation of ESAs. While the uncertainty has limited effect on road design, it is more difficult to justify its use for road user charging. ... It may be appropriate to reflect this uncertainty by reducing the relative importance of the ESA component of RUC" (2009, p. 3).

In response to this conclusion the Review Group asked TRL for a view on how the dominance of ESA in setting charges might be reduced. TRL's response pointed to a number of elements in the costs allocated to ESA in the model that appeared open to question. In particular, TRL notes that by international standards the model allocates a relatively high proportion of pavement maintenance costs to ESA.

The Review Group also notes that the Australian cost allocation practice appears to place much less emphasis than the New Zealand CAM on ESA relative to other allocation parameters¹³.

Determination of the proportion of costs that might be re-allocated from ESA to other cost parameters in the model would require a relatively detailed examination of the expenditure categories in the CAM, based on in depth knowledge of New Zealand road conditions. Such an examination was not thought to be required for the current review, given that the CAM cost allocations were last reviewed in 2001 and the concerns raised in submissions did not highlight this particular issue. Notwithstanding, and recognising the concerns now held by the Review Group in connection with this matter, we believe that the allocation of costs between work categories in the CAM must now be examined by the MOT to determine their accuracy and continuing relevance.

¹³ See table 17 in Third Heavy Vehicle Road Pricing Determination, Technical report, National Transport Commission, Melbourne, October 2005.

Recommendation

That the allocation of costs between use related parameters in the CAM be re-examined by the MOT to ensure that the equivalent standard axle (ESA) measure appropriately reflects the uncertainties involved in attributing the effects of road wear to heavy vehicles.

CONSIDERING ALTERNATIVES TO THE PAYGO APPROACH

The PAYGO system in which costs of a capital nature are written off in the year in which they are incurred has come under scrutiny as a result of the Review Group's investigations and may not be the most appropriate way of dealing with expenditures of enduring benefit.

The PAYGO funding model as applied in New Zealand and various other countries (including Australia, Germany, United Kingdom and USA) relies on expenditure for the construction and maintenance of roads being recovered in the same year it is incurred. This means that those who use the roads in that particular year fund the full amount of the investment made during that period. This is in contrast to spreading the capital costs over a period of years by:

- amortising the asset over the effective useful life of the asset
- deferring a portion of the initial cost for recovery over a defined number of subsequent years
- averaging over a period of years.

Annual expenditures on the road network can really only be considered appropriate for full recovery in the year of outlay if:

- the network is neither expanding nor contracting, and the pavement and bridge conditions essentially remain constant
- annual expenditures in connection with the network do not vary in any significant way over time
- traffic volumes are relatively steady, and the rate of investment in the network is not unduly impacted from year to year by capacity and congestion considerations
- the level of maintenance and renewal spend closely approximates the depreciation charge on the assessed replacement cost of the asset.

The Review Group suggests that the principles of PAYGO will be satisfied only if these 4 conditions are met and the existing network is efficiently maintained. In New Zealand there is evidence to suggest that the annual expenditure patterns are escalating and becoming more 'lumpy'. Accordingly, in respect to capital expenditure which has an enduring benefit over time, some alternative method to PAYGO may be more appropriate.

Recommendation

That the Government considers an alternative to pay-as-you-go (PAYGO) which recognises the creation of a road asset and amortises the asset over the expected useful life (as annual roading expenditure patterns are escalating and becoming more 'lumpy' over time).

ENSURING CONSISTENCY BETWEEN CAM CALCULATIONS AND ACTUAL RUC RATES

The CAM has no legislative authority. It is simply an input that the government uses in determining how to set charges. In the past, considerations other than the calculations of the model have been factored into the decision making process. This goes against the principle of transparency and has resulted in most vehicles less than 10 tonnes paying RUC rates below what the CAM outputs suggest are appropriate.

For vehicles over 10 tonnes, rates are either the same or very similar to those calculated by CAM. At lower weights there is considerable divergence, with the rates for light diesels being about 20 percent lower, on average, than indicated by CAM.

Conversely, the CAM calculations indicate that the current rate of petrol excise duty over-recovers the costs allocated to light petrol vehicles.

This reflects that, for a number of years, RUC rates were either not adjusted or were amended on a flat percentage basis without reference to the CAM.

If CAM is correct and accurately reflects the relationship between use and expenditure then it should (on equity grounds) dictate what is charged. This does not mean that all RUC rates should move immediately to a level that absolutely reflects the levels indicated by the model, but the Review Group considers that there should be adjustments over time to bring charges into alignment with CAM calculations.

Recommendation

That, in future, the charges set for cost recovery purposes are consistent with the rates calculated by CAM (because, assuming CAM reflects the relationship between use and expenditure, it should, on equity grounds, dictate what is charged).

REVENUE COLLECTION

IMPROVING THE BASIS FOR RECOVERING NON-ROAD USE RELATED EXPENDITURE

Revenue is currently collected from vehicles when first registered and through annual re-licensing. In the 2007/2008 year \$217.6 million was collected from these sources. This motor vehicle registration (MVR) revenue is then paid into the National Land Transport Fund. For the purposes of the CAM, MVR revenue is used to reduce the amount of 'residual' (non-use related) costs to be recovered from users through FED and RUC.

Most MVR revenue (an estimated \$187 million in 2007/08) comes from the annual licence fee. This fee is arguably a user charge but the policy rationale behind it is not clear and there is no explicit link between the revenue and any specific element of costs. Unlike FED and RUC, the CAM does not generate a suggested level for the licence fee. This has previously been identified as a shortcoming of the revenue system and the CAM.

At present, the largest component of the annual fee paid by motorists is the ACC levy. The transport component (the actual licence fee) is only \$43.50. Apart from a \$1 increase in 1992 the fee has not changed since 1984.

If the purchasing power of the fee had been retained by regular consumer price index (CPI) adjustments since 1984 the licence fee would currently be in the order of \$120. For a number of years an expanding vehicle fleet caused the proportional contribution of MVR revenue to remain stable. As a result, no need was seen to review its level and no regular process established for that purpose.

The Review Group has come to the conclusion that it is equitable for all road users to pay an access fee for use of the road network, regardless of the level of their use. Furthermore, to increase the transparency of CAM, this charge should be recognised as a revenue source for defined costs within the CAM (ie rather than an element of revenue determined externally that simply goes to offset residual costs generally).

The Review Group considers that the costs that can be attributed to the annual licence fee are the non-use related elements of road related expenditure. These can be regarded as indirect costs of road use, in that they are required in order to operate the road network at its current extent, but do not vary with the amount or type of traffic.

The total amount of such costs in the 2007/08 CAM is approximately \$563 million. If all these costs were to be recovered from MVR revenue, the annual network access charge for most vehicles would have to be about three times the current \$43.50 licence fee¹⁴.

This would be a substantial increase and we therefore address the impact of the increase, later in this report, by way of transitional recommendations.

Recommendations

- That the outdated annual motor vehicle licence fee, the basis for which is unknown, be replaced with a new annual road network access fee.
- That the new network access fee be set in a more transparent way to recover a defined set of costs in the CAM.
- That the new network access fee should aim to recover the non-use related elements of road related expenditure.

REDUCING COMPLEXITY OF THE RUC SYSTEM TO MAKE IT EASIER TO COMPLY

The complexity of the current RUC system leads to some confusion and dissatisfaction. The system is also costly to administer and not supported by good technology.

"Simplicity of collection should be favoured for collecting dues from large numbers making small contributions where precision should be favoured for small numbers making large contributions" (New Zealand Automobile Association Incorporated, 2008).

A comprehensive user survey undertaken for us by Research New Zealand confirmed a number of difficulties. Given the generally negative tenor of submissions we received directly, the survey results revealed a surprisingly high overall satisfaction level with the current system among those who pay RUC. Case studies undertaken by Research New Zealand also revealed that some road users' experiences of the system (actual or perceived) are far from positive.

Removing the need for operator nominated weights and supplementary licences

A good deal of the difficulty and confusion associated with the current system is related to weight and distance measurement. The current RUC system is based on an operator nominating the actual weight they will carry. The Review Group received a number of submissions pointing out the difficulties of this aspect of the RUC system. It can be difficult for an operator to know in advance what their precise weight requirement will be

¹⁴ \$43.50 is the fee for relicensing a car or heavy vehicle. Other vehicles such as motor cycles and light trailers pay smaller fees.

and accurately weighing loads is problematic as onboard scales are often inaccurate. Some operators insist that they can only accurately weigh their loads at the point of destination.

"The requirement to pre-purchase RUCs means that the operator is expected to correctly estimate the weight and distance necessary in advance. In the forest industry, estimating the weight correctly is very difficult, yet legislation requires that the minimum purchase is 1000 kms and that the licence weight should exceed the heaviest load. No allowance is made to average the actual weight carried" (Williams and Wilshire Ltd, 2008).

The Review Group is convinced that actual weight measurement is unnecessarily complex and difficult to manage. We consider that the best approach to this issue is to replace the requirement to buy licences for the actual weight carried with a more simple weight-based approach. That is, purchasing distance licences based on a vehicle's maximum (permissible) gross laden weight and particular axle configuration.

There is an economic argument for charging each vehicle according to its maximum gross laden weight for all kilometres travelled. This would encourage more efficient use of the heavy vehicle fleet and completely eliminate the opportunity for 'double-dipping' that occurs when supplementary RUC licences are purchased.¹⁵

The supplementary licence regime provides for an increase in the weight limit of a licence to allow for the occasional cartage of heavier loads. A supplementary licence replaces the original licence for this distance, but once it has expired the provisions of the original licence will again be in force. With a move to maximum (permissible) gross laden weight for all kilometres travelled, supplementary licences will no longer be necessary¹⁶.

Recommendations

- That the current allowance for transport operators to nominate operating weight is replaced with charging on the basis of the maximum (permissible) gross laden weight of a vehicle, having regard to axle configuration.
- That supplementary licences be removed from the RUC regime.

Removing the need for time licences

The time licence system is costly to administer, serves only a small fraction of eligible diesel vehicles, and adds unnecessarily to the complexity of the system.

¹⁵ Double dipping arises from the lower backload weight having already been factored into the CAM calculations.

¹⁶ For special transport needs the over-weight permit system would remain unchanged.

Time licences are applicable to vehicles which are essentially off-road vehicles but do make some limited use of the road network. The vehicles are listed in the legislation and comprise categories such as bulldozers, mobile cranes and various construction, forestry and road maintenance related heavy machinery.

Time licences are purchased in periods of one month and may be purchased for a single month or up to 12 months. The charges for time licences are based upon vehicle type and weight and determined by the length of period for which the owner intends to purchase the licence.

Time licences cannot be purchased online or through BP using a RUC card. An analysis of revenue received from this source as compared to the cost of running the system indicates that time licences are relatively expensive to administer and adds to the compliance cost to industry.

The Review Group believes that these vehicles should continue to make a contribution to roading costs. We consider that a better approach would be to simply replace time licences with the new network access fee as per our recommendation earlier in this report. As time licences are influenced by the weight of the vehicle some averaging of costs would arise from the move to the flat rate access fee. The Review Group feels that this is an acceptable trade-off in light of the significant cost savings and reduced complexity.

Recommendation

That the time licence system for revenue collection be discontinued and vehicles currently subject to the time licence regime, in future, be required to pay a flat rate network access fee similar to all other road vehicles.

DIESEL EXCISE DUTY AND REFUND SYSTEMS

The submitters' most popular alternative to the RUC system is an excise duty (also referred to as a tax) on diesel with a graduated network charge for heavy vehicles. Typical statements from submitters are:

"The Forum believes that a diesel fuel excise tax and annual vehicle licence system similar to that operating in Australia and other similar countries would be much better than the existing RUC system"
(Road Transport Forum New Zealand Inc, 2008).

"Our preferred option is the inclusion of a tax on diesel at the pump to substantially replace RUC"
(Motor Trade Association, 2008)

To many submitters diesel excise duty represented a fair, equitable and simple way of collecting revenue from road users.

"The most practical alternative to the current system would be to have a fuel tax on diesel and a registration charge based on vehicle weight" (Smith & Davies Ltd, 2008).

Taxing diesel is a common form of road charging in overseas jurisdictions; however, it is almost universally used as a general tax rather than a tied tax. New Zealand is unusual in that it dedicates all land transport revenue to a transport fund.

A diesel excise duty has advantages over RUC in its simplicity of administration and security of collection. It is also able to offer a cash flow benefit to transport operators in that it is pay as you go rather than payment in advance.

FED is often referred to as being "paid at the pump". This represents what appears to be a common misunderstanding of how FED actually works in New Zealand (ie, the duty is actually applied at the point the fuel enters the country, namely the shipping terminal or refinery). Due to the complexity of fuel distribution channels, the only practicable way to impose excise duty on diesel would be for New Zealand Customs to place excise duty on all diesel fuel as it enters New Zealand or leaves the refinery. However, imposing a diesel excise duty in this manner would adversely impact on a large number of off-road users who would be required to keep records and apply for refunds, effectively shifting compliance costs on to a new class of user.

"Claiming a fuel tax refund involves the keeping of receipts and the filling out of forms and can consume considerable hours of work which would otherwise be spent on productive activity" (Federated Farmers of New Zealand Inc, 2008)

Recent estimates prepared for the Ministry of Economic Development suggest that 36 percent¹⁷ of diesel used in New Zealand is for off-road purposes such as generators or stationary machinery (Outcome Management Services Ltd, 2008).

¹⁷ 36 percent is derived by dividing off-road petajoules by total petajoules.

Table 2: Off-road use of diesel by sector

Diesel Use by Sector	Off-road percent	Off-road litres (millions)	On-road litres (millions)
Agriculture	91%	277.16	28.86
Fishing	100%	75.4	-
Other Primary Industry	100%	146.9	0.26
Industry (including construction)	92%	323.7	26.78
Commercial	100%	82.94	-
Transport Industry	-	86.84	627.9
Household off-road	-	38.22	-
Retail network	1%	11.44	1155.96
Total	-	1042.08	1839.5

The Review Group considered that we should only recommend a diesel excise duty if a satisfactory and cost effective method of refund could be found. We identified the current Australian approach as a potentially satisfactory refund method. In Australia, fuel excise refunds are netted off against GST payable through a business activity statement.

Taking the Australian approach as a starting point, the Review Group developed a framework for refunding off-road diesel excise through a GST return. The refund would only be available to GST registered off road users which we estimate would involve around 123,000 businesses¹⁸. The refund amount would be based on a tax-payer self- assessment. Users of diesel who wished to claim refunds would need to keep adequate records to support any investigation by the Inland Revenue Department (IRD).

While the Review Group has verified that a diesel excise duty refund system works well through the Australian GST system, the IRD in New Zealand does not consider that it could readily take on an equivalent role. The IRD has advised us that the refund system does not fit with their business of revenue collection and there is no linkage with tax concepts or tax compliance.

In response to an outline proposal put forward by the Review Group, IRD commented that their computer system is not suitable for the purpose of administration of both core tax and other programmes (such as the refund system in our proposal); and that their staff and management resources are under significant pressure.

¹⁸ Based on Statistics New Zealand figures.

The IRD also pointed out that under the proposed refund system, many taxpayers would need to change to monthly GST returns (from 2 monthly or 6 monthly) or suffer negative cash-flow effects.

While the Review Group has noted these concerns we still believe that combining diesel refunds with the GST return would provide the most efficient process. Any stand alone refund system is likely to be substantially more expensive to establish and operate.

Recommendation

That, should a diesel excise duty be implemented, a refund system operates in conjunction with the GST return.

In addition to shifting the compliance burden to non-road users (currently exempt vehicles such as farm tractors would be brought into the diesel excise duty regime) a dedicated diesel excise duty has several other points of weakness. Fuel excise duties cannot easily extend to the inclusion of electric and hybrid vehicles. Increasing fuel efficiency of the vehicle fleet means that, over time, fuel excise duties will cease to be a reliable collection method.

For the reasons below some submitters do not favour the introduction of a diesel excise duty.

"A diesel tax can act as a proxy for road use but only to a limited extent as it would not take account of the vehicle's fuel efficiency, while an escalating scale of licence fees would take account of vehicle weight but not take account of road use" (Local Government Forum, 2008).

"Automotive technology is entering a phase of electrification which will ultimately render fuel taxes redundant. No fuel tax system will be sustainable in the medium to long term" (New Zealand Automobile Association Incorporated, 2008).

It is a widely recognised fact that fuel burn bears no close relationship with the road wear caused by heavy vehicles. A necessary adjunct to any diesel excise duty regime, therefore, is a supplementary charging mechanism that accurately accounts for the weight of a vehicle. This was confirmed by Infometrics who, in their report to the Review Group stated that *"...fuel excise duties can be a reasonable proxy for all RUC allocation variables except ESA"* (2008, p. 9). Several submitters recommended that such a supplementary mechanism should be a graduated scale of flat, annual, weight-based fees to replace RUC for heavy vehicles.

The Review Group does not favour this graduated fee approach. The introduction of flat fees, which could involve very significant amounts of money, would favour those who operate over long distances to the detriment of those who operate over shorter distances. Accordingly, in the absence of any distance component, the fee calculations would need to be greatly averaged.

Furthermore, introduction of this approach would not help to advance technology-based charging systems. As discussed in detail below, the Review Group believes that enhanced technology should form an integral part of New Zealand's future road charging arrangements.

REDUCING ADMINISTRATION COSTS AND BETTER ALIGNMENT WITH BUSINESS NEEDS

Submitters' concerns

A number of submitters consider the RUC system a burden on the transport industry and the country as a whole, due largely to the cost and time associated with compliance. For example, the Road Transport Forum commented in its submission that "*...small operators, in particular, face constant problems complying with the RUC system's administrative requirements*".

The Review Group has some sympathy with such observations and with the following additional points raised by submitters:

- Many different applications make the RUC system time consuming and costly. The length of time it takes the NZTA to process applications results in dissatisfaction (eg change of hubodometer applications or off road refunds).
- The requirement to display a licence means that occasionally licences need to be transmitted (faxed) to drivers while on the road, which is also time consuming and inconvenient.
- 'Over purchasing' where transport operators obtain licenses for the weight they 'could use', rather than what they 'actually' use (ie operators are forced to estimate haulage weights in advance, which may be incorrect on the day).
- It can be difficult for a transport operator to source information required to inform RUC purchasing decisions.
- The requirement to prepay RUC places a strain on cash flow as refunds or economic benefits from the outlay come much later; and pre-payment also requires forward prediction which adds to the compliance burden.

Compliance and administration cost data

Data gathered for us by Research NZ indicates that road users spend about 1 million hours per annum completing RUC transactions. The wages cost alone to business of these transactions would be approximately \$19 million¹⁹.

¹⁹ Wage costs are based on average industry wage as supplied by Statistics NZ. It is assumed that 100 percent of phone/fax, Direct Connect and RUC card transactions are carried out by businesses. The online option is predominantly used by private

Other information we have received indicates that government administration and enforcement costs for the RUC system in 2008/09 year will be approximately \$23 million. A little less than 80 percent of this (\$18 million) relates to NZTA administration with most of the remaining 20 percent being for Police enforcement. As discussed further under the 'RUC purchase channels' subheading below, around \$15 million of the NZTA costs are recovered from RUC purchasers through 'administration fees' prescribed by regulation.

Many of our recommendations will contribute to reducing both government administration and business compliance costs. For example, encouraging the adoption of new technology to enable internet-based post-payment and charging according to maximum laden weight rather than operator nominated weight.

As outlined in the following discussion, however, there are other improvements and cost reductions that should be made. In particular by simplifying and modernising RUC purchase channels to reduce administration overheads and consequent transaction costs.

RUC purchase channels and transaction fees

RUC users are currently able to purchase a RUC license through 6 different channels including:

- over the counter at NZTA agencies (Automobile Association, Post Shop, VTNZ and VINZ centres)
- by telephone through the BP Customer Service Centre
- by fax through the BP Customer Service Centre
- using a RUC card at authorised service stations and truck stops (for distance and supplementary RUC licenses only)
- by Direct Connect with the Motor Vehicle Registry
- online via the NZTA Transaction Centre²⁰.

While the recent Research NZ survey indicated that 78 percent of respondents were satisfied with the quality of the service they received at the time of their most recent RUC transaction, the Review Group considers that there is much scope for improvement in customer service delivery.

Notably, it is not always possible to use some of the more convenient, modern payment options (such as credit card or direct credit) for all of the above alternatives. For example, it is not possible to use a credit card

users (due to restrictions on types of eligible bank accounts and use of credit cards), so 10 percent is estimated to be business users. Assumed 80 percent of counter transactions are carried out by businesses.

²⁰ The online option is for a maximum purchase of \$400 and is not a real time transaction. Processing is still completed manually and the licence takes up to 7 days to arrive via post. This is essentially a means of placing an online order for RUC.

to purchase RUC (or make any other transaction) at a Post Shop. Similarly, a RUC card cannot be used at the NZTA agents or petrol stations other than those operated by BP.

The \$400 limit that applies to purchasing RUC online was a source of frustration for a number of heavy transport submitters as it reduces their ability to purchase sufficient RUC to meet their needs. Submitters also stated that processes need to be more reliable to increase efficiency. We note that the call centre has limited availability, there is no set up support for Direct Connect (and it is sometimes difficult to connect) and the BP machines are often hard to access or are out of order (Research New Zealand , 2009).

The RUC system and associated processes are particularly unfriendly to private motorists with many light diesel vehicle operators viewing the system as simple but generally inconvenient. At present there no customer focus groups or any other regular customer engagement on service delivery and how this might be improved. Light vehicle owners are provided with a single factsheet (approximately 2 pages) to describe the system and its requirements. Furthermore, some customer service agents are not fully informed and in a position to help motorists with their queries.

In each case manual entry of relevant details is required by an NZTA customer service agent, data entry operator, or staff member. The transaction costs to businesses associated with RUC processes must therefore be relatively high when purchasing takes place on a regular basis.

"Frequent payments can add significantly to the total RUC cost (up to 10 percent)" (Bus and Coach Association New Zealand Inc, 2008).

In addition the RUC charges, prescribed transaction fees apply to every RUC purchase regardless of the type of licence purchased. The table below shows the fees and number of transactions for each of the payment channels for 2007-08.

Table 3: RUC transactions and payment channels

Purchase channel	Prescribed transaction fee (GST inclusive)	No of transactions	Total cost of fees to RUC purchasers
Over the counter	9.56	1,142,483	\$10.92 million
Direct Connect	3.38	548,302	\$1.85 million
Phone or fax	6.98	206,313	\$1.44 million
Auto Teller	5.06	82,129	\$0.42 million
Industry	3.38	66,820	\$0.23 million
Online orders	9.56	14,209	\$0.14 million
Total	-	2,060,256	\$15 million

The transaction fees have not been reviewed for many years and the relationship between individual fees and the actual costs of each payment channel are uncertain. We note that the Direct Connect channel currently has the lowest prescribed fee. This is based on a system that uses outdated technology and computer programmes. This has its own hidden costs and the technology will shortly become obsolete.

To reduce administration overheads and business compliance costs we consider that investigation and implementation of a modern, internet-based 'real time' electronic purchase channel should be a priority for the NZTA. We would expect the fee for this largely automated option to be substantially less than all the current prescribed fees which all relate to channels that involve manual processing.²¹

When a modern internet purchase channel is available, all of the current purchase channels (other than over the counter) should be discontinued. We see the maintenance of over the counter options throughout New Zealand as an essential adjunct to the internet option to meet the varying needs of RUC purchasers.

It seems possible that the total cost of fees to RUC purchasers and the corresponding government administration costs could, in future, be reduced by a substantial amount. Based on the following illustrative assumptions the total, annual cost of fees to RUC purchasers could be reduced from \$15 million to around \$10.4 million (ie an annual saving of around \$4.6 million).

- a continuation of around 2 million RUC purchase transactions each year

²¹ While not directly comparable, we note that a number of banks typically charge around \$0.50 for electronic transactions and around \$3.00 for the same transactions where they are carried out manually.

- 40 percent of the purchases occurring via an over the counter channel at a cost of \$10 per transaction (\$8 million in fees – GST inclusive)
- 60 percent of the purchases occurring via an automated internet channel at a cost of \$2.00 per transaction (\$2.4 million in fees – GST inclusive).

Clearly the lower cost of the internet transactions would also, over time, encourage RUC purchasers to move away from the over the counter option.

Recommendations

- That the NZTA gives priority to investigating and implementing a modern, internet-based RUC purchase channel.
- That the NZTA discontinues all the other current RUC purchase channels, except for an over the counter option, once the new internet purchase channel is available.
- That the NZTA devotes further resources to improving RUC customer service delivery.

Process for RUC rate changes

Businesses reported that it is essential to have advance notice of RUC increases in order to budget and allow for better management of their business. One month was considered to be the minimum required as standard industry contracts do not allow for the immediate recovery of cost increases.

"Unexpected increases in RUC cause cost problems for negotiated bus contracts with operators bearing cost increases for typically 6 months" (Bus and Coach Association New Zealand Inc, 2008).

The July 2008 increase of RUC was the catalyst to the establishment of the Road User Charges Review Group. The transport industry objects to increases in rates without notice, citing fixed contracts as the major impediment to passing on these cost increases.

Legislation changes in 2002 allowing transport operators to purchase large amounts of RUC in advance (at the lower rate) resulted in government viewing increases without notice as necessary to protect Crown revenue flows.

After much consultation with industry the Review Group is convinced that this is a real problem that goes beyond the advance purchase issue. It is the opinion of the Review Group that the majority of operators are not in a position to spend large amounts of money on advance purchases of RUC.

A history of ad-hoc (and sometimes sizeable) increases in RUC have not been helpful for industry. Long periods of no change have meant that industry contracts are not responsive to un-notified changes in RUC.

The Review Group considers that rates should be changed on a “no surprises” basis with a minimum of 6 weeks’ notice to enable industry to adjust prices for their customers.

The adoption of the proposals outlined above means that industry would be able to manage their contracts and prices more effectively.

Some industry representatives are also calling for the government to consult when reviewing charges. The Review Group believes that if RUC rates applied are consistent with the charges calculated by the CAM (as recommended previously) and the process of annual adjustments adhered to (as outlined above), then greater transparency will be achieved and the need for consultation will become redundant.

Recommendations

- That RUC rates are reviewed annually and changes implemented at the same time each year.
- That a minimum of 6 weeks’ notice be provided of any RUC rate changes that are to occur.

EVASION AND ENFORCEMENT

The Review Group heard that the level of RUC evasion²² by both light and heavy vehicle operators is a major concern.

“Evasion and enforcement difficulties have led to the RUC system being held in widespread disrepute within the road transport industry” (Road Transport Forum New Zealand Inc, 2008).

Evasion methods usually relate to either weight carried or distance travelled. With weight-based evasion, RUC licences are purchased for a lesser weight than actually carried. Distance-based evasion consists of either licences not being purchased or tampering with distance recorders so that they under-record actual distance travelled. False or overstated RUC refund claims are also considered to be evasion.

The precise amount of unpaid RUC is difficult to accurately assess. The best estimate available from the MOT is that RUC evasion is in the order of \$43 million annually. This is comprised of \$30 million from heavy vehicles and \$13 million from light vehicles. Information received by the Review Group would suggest that the MOT estimate is conservative (ie lower than actual).

The New Zealand Police enforce RUC offences at the roadside and are empowered to issue traffic and infringement offence notices. Advice from the Police and others we consulted with suggests that a high

²² Evasion refers to the practice of unlawful behaviour designed to avoid taxation.

percentage of RUC payers do engage in some form of evasion. We noted also the view of senior Police officers that some aspects of the system make it difficult for even the most positively motivated road user to comply all the time. This Police view about compliance difficulties related particularly to weight-related aspects of the system and a lack of readily available information and advice for road users.

The NZTA Economic Compliance Unit (ECU) is tasked with countering RUC evasion. ECU staff explained to us how difficult their task is as they operate without adequate legal powers. The ECU investigates RUC evasion through civil processes and recovers in excess of \$8 million of evaded RUC every year. Recovery of unpaid RUC is achieved either by voluntary agreement or by placing evidence before a District Court Judge under section 18A of the Road User Charges Act 1977 for a formal assessment of debt.

The process of applying and proving an assessment through the court process is costly and can sometimes take several years to reach a conclusion. The practical effect is that the parties to any RUC related dispute attempt to negotiate settlement in preference to seeking resolution through the courts.

At the end of the day, evasion results in compliant road users subsidising the use of the roads by evaders.

"[Evasion] has a significant effect on competition within the road transport industry with operators who evade their road user charges being able to undercut operators who comply" (Road Transport Forum New Zealand Inc, 2008).

"RUC evasion leads to decrease in expenses and permits increased profit and undercutting the rates of operators who elect to pay the correct RUC. With every increase in RUC rates the commercial incentive to evade the RUC regime is increased. Every case of evasion contributes to further increases in costs for those who comply" (Hyder Consulting (NZ) Limited, 2008, p. 32).

Evasion opportunities arise from:

- a lack of legislated record keeping requirements or penalties for failing to supply records
- the inability of the NZTA ECU to issue binding assessments²³
- much negotiation and compromise involved in the settlement of unpaid RUC
- the practical difficulties faced by enforcement officers attempting to check hubodometers on the road-side
- the location of weighing sites being well known and easily avoided
- tampering with odometers not being under surveillance.

²³ Currently assessments are undertaken by a judge under section 18A of the Road User Charges Act 1977. The ECU process of collecting evidence for these assessments is known in the industry as 18A Audits.

On the other hand we also heard criticisms of enforcement action along the following lines:

- the process around audits undertaken under section 18A of the Road User Charges Act 1977 is not well documented or understood by transport operators
- NZTA ECU practices are inconsistent
- the level of fines for roadside offences are seen as extreme for what operators perceive to be minor infringements
- the system is generally confusing²⁴.

Our earlier recommendation that RUC be based on maximum (permissible) laden weight will eliminate much of the aggravation associated with assessing unpaid RUC and could largely eliminate weight-based evasion.

The Review Group was given information about odometer tampering and considers that the government should make more stringent regulations to deal with this, including increased penalties. For light vehicles we also favour decriminalising simple non-payment of RUC. If the surveillance measures we recommend are implemented, RUC should be able to be recovered as a civil debt.

Recommendation

That the Government legislates to:

- a) provide for more stringent regulations around odometer tampering;
- b) impose a duty on vehicle inspectors to report odometer readings to the NZTA as part of the vehicle warrant of fitness and certificate of fitness inspection processes to provide the NZTA with information that will assist with recovery of outstanding RUC;
- c) impose a duty on relevant road users to keep books and records and give the Government access and assessment powers similar to those available under the income tax system;
- d) institute proper safeguards and appeal rights and to carefully prescribe the powers and duties of government officials; and
- e) decriminalise enforcement of RUC for vehicles under 3.5 tonnes as part of a process of moving light vehicle RUC to a civil collection system.

²⁴ See our discussion on tolerances and system complexity which serve to compound confusion.

WEIGHT TOLERANCE AND ITS RELATION TO RUC ENFORCEMENT

The Review Group received many submissions about legislated tolerances for roadside enforcement purposes and lack of such a tolerance in the investigation, under section 18A of the Road User Charges Act 1997, of RUC payments by the NZTA ECU. It is clear to us that there is a fundamental confusion about these matters that needs to be resolved. The reason for the confusion is that there are 2 different tolerances under 2 different legislative systems and no tolerance at all in a third system.

Firstly, the 5 percent tolerance commonly referred to by operators is a tool for calculating RUC infringement fees at the roadside. This tolerance is set out in the Second Schedule (Part 4) to the Transport Act 1962. Before calculating an infringement fee for violation of the RUC licence weight, the gross measured weight of the vehicle is reduced by an amount equal to 5 percent of the licence weight. If the vehicle has exceeded the RUC weight but is within the 5 percent tolerance an infringement offence notice cannot be issued.

The second tolerance applies to the regulatory offences regime relating to overloading of vehicles. The Vehicle Mass and Dimensions Rule 2002 provides that the maximum allowable weight for a vehicle on New Zealand roads is 44 tonnes. Infringement offence notices for non-compliance with these safety regulations are not issued if the measured weight of the vehicle is less than 45.5 tonnes (ie, allowing operators a 1.5 tonne tolerance).

There is, however, no provision in the Road User Charges Act 1977 or the Road User Charges Regulation 1978 which allows a tolerance to be applied in the calculation of RUC rates or the amount of debt owed for underpayment of RUC. The following quote illustrates the confusion experienced in this regard by one road user who had recently been the subject of an ECU audit.

"...the one issue that was agreed to verbally and accepted for 25 years was that there would be a 1.5 tonne overloading tolerance for both weight and was factored into the Road User Charges....I ask you and any other fair minded person how a tolerance that was factored in for 25 years can suddenly be removed..." (Jonhson, 2009).

If the Review Group's recommendation that operator nominated weights are replaced with maximum (permissible) gross laden weight is adopted much of the confusion should end. That is because the question of a tolerance relating to RUC will no longer arise.

TECHNOLOGY-BASED SOLUTIONS

HUBODOMETERS ARE OUTDATED TECHNOLOGY

Hubodometers are currently used as the legally required distance recorder for heavy vehicles. Vehicle kilometres travelled are measured by the hubodometer counting the wheel revolutions for an individual axle to which that hubodometer is fitted. When RUC was introduced, hubodometers were considered more reliable than the vehicle odometer and more tamper resistant or tamper evident.

Despite having advantages over odometers, hubodometers have their fair share of operational issues. Many submitters questioned the durability and accuracy of hubodometers currently available in New Zealand, citing occasions of early mechanical failure. Due to the mounting position in the hub of a moving vehicle, hubodometers are prone to damage (particularly when used in off-road environments – a point that we heard repeatedly, for example from logging truck operators). This can also affect readability at the roadside (Hyder Consulting (NZ) Limited, 2008).

We have been advised that retail prices for hubodometers in New Zealand range approximately between \$120 and \$170 per unit (Hyder Consulting (NZ) Limited, 2008). Data we received from NZTA indicates that, on average, hubodometers are replaced after around 180,000km of use. NZTA receive 10,432 applications each year for hubodometer changes (Research New Zealand , 2009). As noted above however very different operating environments mean that some transport businesses are faced with having to replace damaged or faulty hubodometers much more frequently than others. The initial installation and subsequent replacement processes also creates additional costs for the transport business (ie, payments to installers and some likely lost earnings while the vehicle is not available for business purposes).

The cost associated with hubodometer changes is not insignificant with approximately \$3.4 million spent in the year ending June 2008²⁵. While the sealed hubodometer unit can be considered reasonably tamper resistant, it is by no means tamper proof. We received information confirming that manipulation of hubodometers is a leading cause of distance-based RUC evasion.

Both the odometer and hubodometer are open to abuse. Common methods include unplugging or switching off the speedometer cable, hubodometer tampering that result in the device measuring less (or no) distance per wheel revolution, and owning several hubodometers and switching them on a frequent basis so that RUC payments are minimised.

²⁵ This figure does not include an assessment of the cost of down-time for the vehicle and driver concerned.

Faulty and unreliable hubodometers result in replacement costs and the administrative burden of re-licensing these to the prime mover or trailer. There are also potential penalties for incorrect readings or discrepancies between odometer and hubodometer readings when checked at warrant of fitness time.

As outlined below, use of modern technology could provide the opportunity to increase the accuracy and security of distance measurement devices.

OVERVIEW: DEVELOPMENT, COST AND USE OF TECHNOLOGY SYSTEMS

The Review Group notes that electronic location and fee collection systems for heavy vehicles are already employed in a number of countries. NZIER (2008) advised us that international literature indicates that technologies will become more cost effective in future for a range of potential uses, including:

- vehicle mounted tachometers for measuring distance-only travelled
- gantry mounted terrestrial detectors recording and identifying vehicles using or entering a defined area
- wide area tracking systems employing satellite global positioning systems (GPS) or cellular technologies, with potential to measure distance, weight and other parameters.

With these positive indications and many submitters' clear dissatisfaction with the current odometer and mechanical hubodometer-based distance measurement systems in mind, the Review Group commissioned specialist advice from Hyder Consulting. We also consulted directly with a number of New Zealand and international transport industry technology users and service providers to determine the feasibility of:

- facilitating and regulating the establishment in New Zealand of cost-effective technology-based road charging infrastructure (including undertaking trials to test the technology under New Zealand specific operating conditions)
- introducing the ability for vehicle owners to use on-board electronic distance measurement units (OBUs) as an alternative to the odometer for light vehicles or the hubodometer for heavy vehicles (ie with the aim of increasing the accuracy, security and broader utility of distance measurement devices).

COST OF AN ON-BOARD UNIT

The retail cost of a GNSS OBU is around \$500 per unit. There is also the option for an operator to have an all inclusive package with a service provider for approximately \$100 per month per vehicle.

It is reasonable to assume that, in the relatively near future, increased on-board technology, including GNSS devices will be fitted to every new vehicle. Currently 30,000 New Zealand vehicles are fitted with mobile data

communication facilities. This is increasing at the rate of 500 vehicles per month (Hyder Consulting (NZ) Limited, 2008).

DISTANCE, LOCATION AND TIME MEASUREMENT

From the information we have seen, we are satisfied that global navigation satellite systems (GNSS) technology can, in the short to medium-term, deliver cost-effective positioning information that accurately describes on and off-road usage, whether the vehicle is operating on a highway or local road and any other type of location and time-based information.²⁶

An important issue that would need to be addressed in relation to a GNSS solution is the required degree of accuracy and security for charging purposes. From the information we have reviewed it seems clear that if a GNSS based solution is considered, it should include augmentation with electronic wheel revolution and movement sensor information. It must also be coupled with strong physical and electronic security and strategically placed fixed, automated audit sites to mitigate the risk of evasion. This view was endorsed by all the key informants we consulted.

Although outside the scope of our review, we have also noted the additional potential of high quality positioning information, when used with temporal information and on board communication devices, to assist with congestion management.

WEIGHT MEASUREMENT

While there are a range of modern technologies available for weighing vehicles and their payloads (eg weigh in motion and on-board scales) we are not satisfied that this technology can be practicably deployed to continuously provide weight information that is sufficiently reliable for RUC purposes. Many of the transport operators we spoke to were adamant that weighing technology was inherently unreliable and will always be prone to problems similar to those they currently encounter with mechanical hubodometers. Accordingly our focus has been on the much more highly regarded option of using technology for measuring distances travelled and location (ie on and off road use).

HOW ELECTRONIC CHARGING CAN WORK FOR HEAVY TRAILERS

We noted concerns about ensuring an equitable and reliable technology-based charging system for heavy trailers and that this issue has been the subject of some debate internationally. Clearly a prime mover towing a heavy trailer should be charged more than a similar prime mover not towing a trailer. The challenge is

²⁶ All future (currently planned) European systems are being designed as GNSS based, covering all roads. None of the European jurisdictions provide refunds for off road use because a technology based solution does not charge for off road use in the first instance (Hyder 2009).

establishing joint and severable electronic tracking systems for different and often-changing prime mover and trailer combinations.

We have identified the following as possible ways to overcome this issue.

- Electronically linking and identifying trailers when the electrical system is coupled to a towing vehicle (tractor unit). However it is recognised internationally that it is equally feasible (and somewhat less safe) to tow a trailer without connecting the electrical system in order to evade RUC.
- Electronic declaration by the driver that a trailer is being towed relying on honesty and a combination of automated and random manual enforcement checks. This can be verified by the back office system recording where trailers are last electronically uncoupled and providing an exception report if the trailer is next electronically coupled at a different location.
- Separate OBUs mounted to each trailer. This dictates ultra-low power usage and long battery life to cater for occasions when the trailer is not being towed. This also relies on at least occasional connection of the tractor electrical system to recharge the battery. There is one system under development in New Zealand that offers this potential and others that rely on more frequent electrical connection.
- An enhancement on this business model would have for example a green LED for normal operation, and an orange LED low-battery warning with a very substantial minimum penalty (or infringement) for operating a trailer with a unit not showing a green or orange LED on a road.
- Continued use of mechanical hubodometers on trailers as a backup to either of the above systems.
- A combination of the above.

WHAT AN ELECTRONIC RUC SYSTEM COULD DELIVER FOR NEW ZEALAND

In summary, international experience suggests that an eRUC system could deliver:

- a stable revenue stream
- cost reductions and easier administration for road users and government agencies
- the ability to charge more equitably for road use and road damage regardless of fuel type
- low RUC evasion through sound architecture of the system, appropriate laws and ease of enforcement (see below for more comment on monitoring and enforcement concepts)
- provision for future congestion, location and time based charging
- compatibility with other fleet, logistics, traffic demand management and traffic management systems
- the degree of privacy required by New Zealand law

- promotion of efficient road freight services
- fair conditions for competition
- 24x7x365 internet access for RUC purchasing with electronic proof of purchase
- digital tachygraph linked to a standardised electronic driver licence (or smartcard)
- tracking and management augmentation options (eg in relation to hazardous goods in heavy vehicles).

New Zealand is well placed and would not be alone in the world in proceeding to develop eRUC systems for commercial vehicles. In heading down that path we conclude that it would be reasonable to consider the longer-term application of such technology in all road vehicles.

New Zealand also has the advantages that:

- border control issues are few (restricted to temporary imports of overseas registered vehicles)
- our transport industry is already accustomed to a distance-based charging system
- there is a good awareness and application within the industry of cost-effective, advanced technology solutions.

A TECHNICAL INFRASTRUCTURE CONCEPT FOR ERUC IN NEW ZEALAND

The sample systems architecture proposed by the Review Group (Diagram 1) is a strategic picture of the base components that are required to achieve a workable and reliable electronic user charging system. We expect that the proposed infrastructure will simplify business processes and reduce overhead costs.

USE OF EXISTING INDEPENDENT COMMERCIAL TRACKING SERVICES

The most cost effective means of achieving an eRUC revenue collection system is to use existing, independent commercial tracking services. There are currently a range of providers who use OBUs to monitor vehicle movements of their clients' fleets for various commercial purposes such as claiming off-road rebates, driver management, speed monitoring, logistics and assessing travel time and distance data. The commercial tracking service providers have told us that they could easily facilitate the payment of RUC to the NZTA on behalf of their clients.

The small number of large firms in New Zealand who use OBUs and their own systems platform to monitor their own fleets could also use their systems for payment of RUC.

The OBU, via a mobile data network, would become the primary information stream to the NZTA web server (see below). This will require security protocols to be agreed and developed by the NZTA and users.

DEVELOPMENT OF A WEB SERVER INTERFACE AT THE NZTA

This is a standardised pool of data and is populated by the commercial tracking service provider at agreed intervals for the principle purpose of RUC payments. The web server could also be made continuously accessible (eg through secure, password protected, log-on arrangements) to the transport sector for their individual legitimate purposes. For example, reviewing information on their fleet, RUC administration, certificates of fitness and other licensing information.

Standards for interfacing to and from the web server will need to be defined but there are already common standards available (eg "XML" which stands for "extensible markup language", the World Wide Web Consortium's recommended standard for creating formats and sharing data on the Web).

OTHER COMPONENTS: AUDITING AND ENFORCEMENT

The proposed systems architecture provides the opportunity for the NZTA to audit the service provider for RUC compliance rather than the commercial transport operator. This would reduce compliance costs for the transport operator.

As we noted in the discussion above about monitoring and enforcement concepts, current RUC evasion can be substantially reduced by the introduction of the OBU and layers of monitoring and enforcement sites and that roadside infrastructure would be the highest capital cost element of technology falling on the public sector. Whilst we support the concept of automated enforcement systems, in principle, it is not an essential component of any initial eRUC system.

FACILITATING A USER TRIAL OF AN ELECTRONIC REVENUE COLLECTION SYSTEM

The Review Group considers that the electronic systems architecture outlined above should be used as the basis for conducting an initial 'proof of concept' trial. The idea of such a trial has been welcomed by those with whom we tested the idea.

A primary purpose of the trial will be to provide preliminary, indicative data around the level of accuracy of a technology based system, albeit one that is not yet proven to be 'secure'. The results of the trial's electronic measurements can be compared with the current hubodometer system.²⁷

The proposed trial will help with determining:

- device accuracy levels against traditional hubodometer and odometer readings and known distances

²⁷ Although there is no current legislative authority to substitute alternatives to hubodometers in any capacity for on road RUC in New Zealand, this does not preclude the trial of GNSS based or alternative electronic hubodometer devices *in addition to* the hubodometers required for payment of RUC.

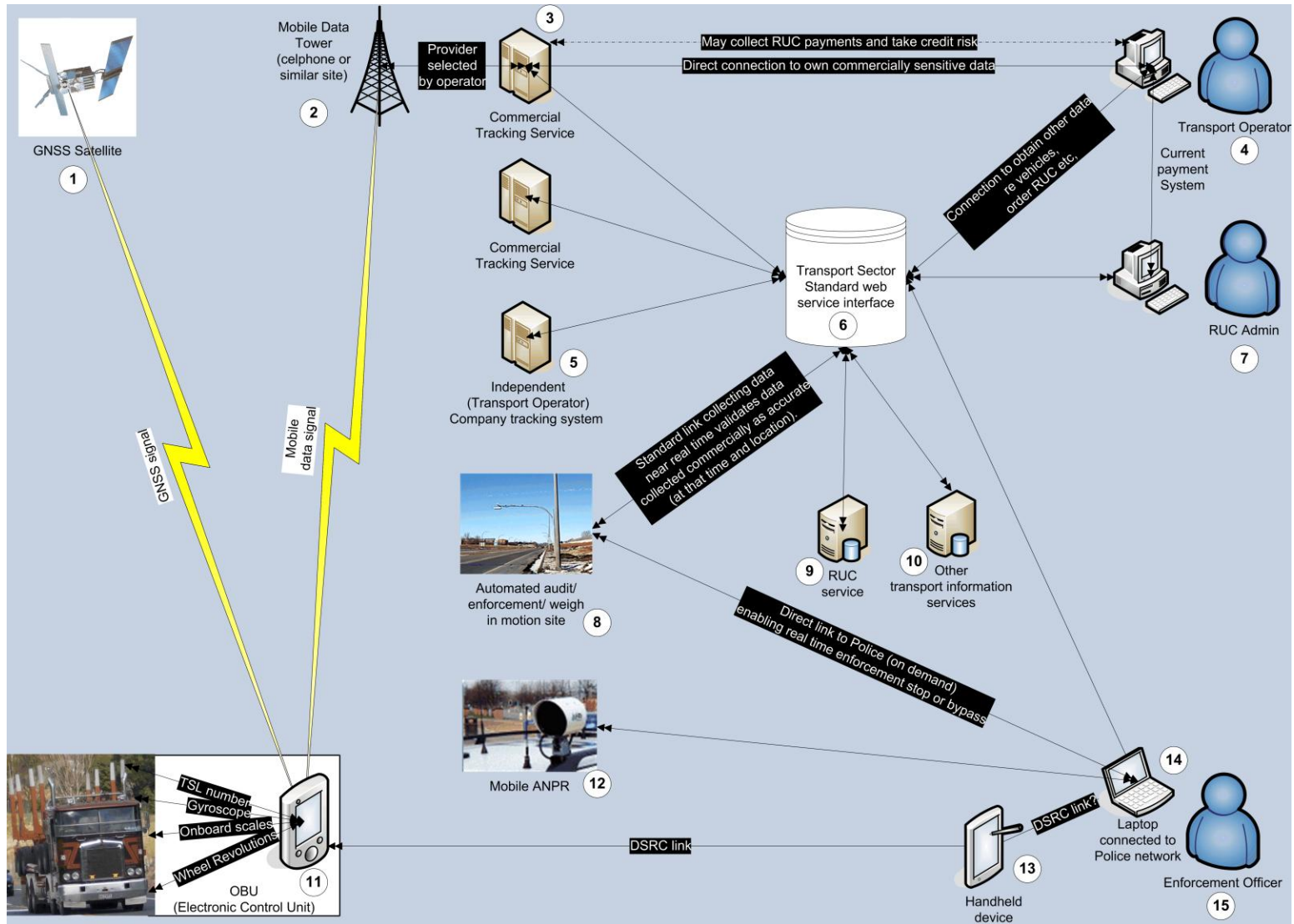
- whether GNSS is accurate enough to identify when vehicles are on private roads parallel to the highway (ie as a number of logging roads run alongside state highways)
- the effect of urban and rural landscape forms (including tunnels) on accuracy of current GNSS devices (ie consideration of the materiality of 'canyoning' and 'canopy' effects)
- the effect of known evasion methods that potentially reduce the measured distance and the ability of security mechanisms to indicate evasion
- the 3 dimensional (triangulation or x,y,z coordinates) effect of altitude variation between actual road distance recorded by a wheel revolution based system and the 2 dimensional (x,y coordinates) distance recorded by GNSS systems
- significant differences (if any) between underlying GIS base maps and projections
- standards required for the trial and post trial, including security protocols for the OBU's
- costs and benefits of an automated RUC system
- the business drivers and business requirements of the various RUC 'players' (including RUC administrators, transport operators, Police and commercial tracking providers)
- an appropriate foundation for a move to full eRUC.

More detailed information on technology-related matters, such as monitoring and enforcement concepts and a suggested approach to the recommended technology trial are set out in Appendix 4.

Recommendation

That the NZTA develops and implements, in association with selected user groups and others as appropriate, a "proof of concept" trial to test the feasibility of the systems architecture outlined in this report and generate data that is essential to inform decision-making in New Zealand about whether and how to proceed with an eRUC system.

Diagram 1: Sample architecture



The sample architecture (Diagram 1) is a strategic picture of the basic components that are required or are strongly recommended to achieve a workable and reliable road user charging system. The strategic picture is highly simplified; there are many layers of complexity below each of the components in the diagram. Explanatory notes corresponding with each of the numbers in Diagram 1 may be seen in Appendix 4.

ALTERNATIVE REVENUE COLLECTION OPTIONS

The Review Group saw the development of distinct revenue collection options, encompassing the range of identified solutions, as the logical first step towards an objective assessment of the relative merits of the options and their component parts. Therefore, taking into account the potential solutions discussed above and with the assistance of Deloitte, we developed several different revenue collection options that we thought could realistically be implemented in the short term (ie, within 2 to 3 years).

IMPORTANT CONTEXT FOR OPTIONS DEVELOPMENT

The Review Group developed the alternative revenue collection options with a clear expectation that, in the relatively near future, most heavy vehicles will be required to pay distance, weight and (possibly) location and time based RUC. We also expect that:

- the distance, location and time measurements will be made and reported via secure electronic means
- this eRUC regime will eventually expand, in some form, to also capture light vehicles.

Information we have received indicates that 7-10 years is a realistic timeframe for the expansion to capture the light vehicle fleet. In that timeframe it is likely that OBUs will be a standard option for all manufactured vehicles due to international demand.

As discussed previously, we also see trialling of potential technological solutions under New Zealand conditions as an essential pre-requisite to both voluntary and mandatory use of such solutions. Two of the options involve technology based systems on a trial basis and with voluntary uptake.

SUMMARY DESCRIPTION OF ALTERNATIVE REVENUE COLLECTION OPTIONS

The Review Group initially developed an option (original Option A) with a fixed annual charge for light vehicles to remove them from the RUC regime. This is the "Option A" referred to in the Deloitte Economic Advice (2009) (see extracts of the Deloitte report in Appendix 6). Stakeholder feedback indicated there would be strong objections to the idea of a fixed annual charge for light vehicles. Reasons for the objections were equity problems between light vehicle users and the likelihood that the charge would be a relatively large dollar amount. Accordingly, we amended the structure of the option to make light vehicles still subject to RUC. This amended option is referred to as Option A1 in the financial analysis (2009) carried out by Deloitte and as Option A in the following Review Group description and option assessment.

The Review Group also initially considered, but did not pursue, an option for a full eRUC system, referred to as Option D in the Deloitte reports. Option D, while a realistic consideration for a longer term solution to road charging, is clearly not able to be implemented immediately. A full eRUC system would provide operational

efficiencies for both government and industry, promote greater fairness, improve enforcement and provide options for more accurate charging. This view is supported by several key industry representatives such as the Local Government Forum.

"The Forum supports the investigation of electronic road pricing as a medium to longer term alternative to existing road charging mechanisms" (Local Government Forum, 2008).

Accordingly, while the other options are included in the Deloitte advice, the 3 options evaluated by the Review Group are summarised below (referred to hereafter as Options A, B and C):

- **Option A** – Enhanced RUC for all vehicles: An enhanced RUC system which includes several improvements over the status quo.
- **Option B** – Diesel excise plus RUC for heavy vehicles: Eliminating RUC for vehicles weighing 8 tonnes or less, introduction of excise duty on diesel and retaining RUC for heavy vehicles over 8 tonnes.
- **Option C** – Diesel excise plus graduated fees for heavy vehicles: Eliminating RUC for both light and heavy vehicles, introduction of excise duty on diesel and introduction of graduated fees for heavy vehicles over 8 tonnes.

The table below and further descriptive text about each option provide information about the structural aspects and consequential differences between the three options. Some information about assumptions that underpin the options and key implementation tasks is also provided. The detail of the various components that make up the options is provided in previous sections of this report.

Table 4: Summary of component parts of alternative charging options

	Potential component of alternative charging options	Option A	Option B	Option C
1	Network access fee payable by <i>all</i> vehicles using the road network (ie, replacing annual motor vehicle licence fees).	●	●	●
2	Graduated, fee for heavy vehicles over 8 tonnes based on maximum (permissible) gross laden weight and axle configuration.			●
3	Introduction of diesel excise duty and refund systems for off-road use of diesel.		●	●
4	Distance-based RUC, as calculated by the CAM, payable by <i>all</i> vehicles. Vehicle categories and charges based on maximum (permissible) gross laden weight and axle configuration.	●		
5	Distance-based RUC, as calculated by the CAM, payable by vehicles with a maximum (permissible) gross laden weight greater than 8 tonnes. Vehicle categories and charges based on maximum (permissible) gross laden weight and axle configuration.		●	
6	Option to use electronic distance measurement (OBU's) that comply with specific standards as an alternative to the odometer for light vehicles or the hubodometer for heavy vehicles.	●	●	
7	Option of payment in arrears net of off-road kilometres as an incentive to install compliant OBU's.	●	●	
8	No charge for off-road use to all vehicles fitted with compliant OBU's, otherwise RUC refunds available to heavy vehicles only.	●	●	

OPTION A: ENHANCED RUC FOR ALL VEHICLES

Option A recognises that the current RUC system is built on sound principles and, while it is not 'broken', there is considerable room for improvement. Administration and compliance are simplified by moving to charging based on maximum (permissible) gross laden weight rather than operator nominated weight.

Incorporating the ability to use technology-based distance measurement and low cost electronic RUC purchase channels offers further efficiency gains and helps to future-proof the model.

Some of the key implementation tasks for Option A would be:

- Completing technology trials.
- Redefining CAM based on the Review Group recommendations.
- Finalising standards, guidelines and other arrangements for matters such as:
 - interfacing to and from the NZTA web server and technology service providers

- OBU performance (eg, accuracy and security)
- protocols for service providers and operators to be approved by the NZTA
- credit arrangements for payment of RUC in arrears
- information technology infrastructure
- sector communications (information provision).

Given that tasks under this option would have been undertaken in parallel with the proposed technology trial, Option A could be fully implemented soon after completion of the trial. Some components of the option that are not reliant on technology could, however, be implemented sooner.

OPTION B: DIESEL EXCISE PLUS RUC FOR HEAVY VEHICLES

Option B differs from Option A in 3 major respects:

- Introduction of diesel excise duty and excise refund systems for off-road use of diesel.
- The consequent elimination of the need for distance-based RUC for vehicles with a maximum (permissible) gross laden weight of 8 tonnes or less.
- A partial shift of the compliance burden from road users to non-road users who would now be required to keep records of fuel use and apply for refunds.

Option B aims to ease the compliance burden on light-medium diesel vehicles while reducing evasion and achieving greater alignment of charges between diesel and petrol vehicles. This option also accounts for the facts that increasing weight and axle configuration has a significant bearing on road wear, and fuel excise duty is clearly unsuitable as the sole revenue collection method for vehicles over 8 tonnes²⁸. RUC charges applicable to vehicles over 8 tonnes would reduce from current levels as diesel excise acts as a proxy for some of the distance related costs. RUC is retained to recognise additional damage caused to the road by the weight of the vehicle.

This will result in a reduction of about 80 percent of the number of vehicles subject to RUC.

Key implementation tasks for Option B additional to those described for Option A above would be:

- Legislating for the new excise duty and refund processes (proposed to be linked to GST return).

²⁸ Technical experts agree that fuel excise duties can be a reasonable proxy for all RUC allocation variables except ESA. The point at which the ESA component becomes a significant proportion of the charge and some other collection mechanism must apply will vary between vehicle types, but in general will be beyond 8 tonne.

- Oil companies aligning processes for collection of excise duty for petrol and diesel.
- Closing off redundant RUC administrative arrangements and establishing new arrangements for managing the revised RUC regime, and the new excise duty and refund systems (including IRD set-up to align diesel refund with the GST process).

OPTION C: DIESEL EXCISE PLUS GRADUATED FEES FOR HEAVY VEHICLES

Option C involves the introduction of excise duty on diesel for similar reasons to Option B. This is similar to the option most often promoted by heavy transport operators and most similar to existing overseas models.

Key differences between Option C and the other 2 options are:

- the graduated fee component for vehicles over 8 tonnes, which increases according to increasing weight, while taking account of axle configuration
- elimination of RUC and the corresponding need for distance measurement
- reduced incentives for the installation of OBUs and probability that a large proportion of refund applications would be paper based; consequently it would be necessary to improve the automation of the paper based refund process.

ASSESSMENT CRITERIA

In accordance with the Review terms of reference the Review Group used 3 principle criteria to assess the relative merits of the alternative revenue collection options, namely:

- economic efficiency
- cost recovery
- equity.

These criteria are defined in the earlier 'Review objectives and principles' section of this report.

In completing our assessment of the options we also took account of the guiding principles referred to earlier in this report and other matters included in the Review Group's terms of reference such as 'future-proofing' and consistency with the NZTS 2008.

We commissioned an economic assessment of the revenue collection options and a financial analysis of the costs of the options from Deloitte (see Appendix 6). We also developed our own tabular assessment of the features in each of the options and arrived at similar conclusions to those of Deloitte about the relative merits of the options.

OPTIONS ASSESSMENT

OPTION A: ENHANCED RUC FOR ALL VEHICLES

Economic efficiency

Option A contributes to economic efficiency by providing the most accurate pricing signals for all vehicles in relation to other options. There is no weight differential up to 3.5 tonnes so the price for that group is averaged; however, this has only a minor effect. There are cost savings over the status quo due to simplification of the system, but Option A still retains a relatively complex system for light vehicles.

Cost recovery

Retaining the RUC system maintains a reasonable basis of cost recovery from different road user groups. As covered under efficiency (above), however, there is more averaging for light vehicles as there would be no weight differentiation up to 3.5 tonnes. Improvements we have recommended to the system should enhance recovery by reducing opportunities for evasion.

Equity

This option makes it difficult to determine equity between diesel and petrol light vehicles by virtue of the different revenue collection regimes.

Other considerations

Option A is future proofed by including incentives for road users to pursue a technology-based approach to RUC.

Through new technologies, Option A could make a strong contribution to the achievement of some of the government's objectives for transport as set out in the New Zealand Transport Strategy 2008. Enhancing RUC through using new technologies would provide a valuable tool to develop an integrated and sustainable transport system. In particular, eRUC could provide "*a more targeted, efficient and fair way to reflect the actual costs to society of using vehicles, while raising sufficient revenue for transport investment*" (p. 9)

Advantages and disadvantages of Option A in relation to status quo

Option A, as an enhanced RUC system, largely maintains the advantages of the status quo. It is equitable between diesel users, appropriate for cost recovery and builds upon a system that, despite its complexities, has stood the test of time and is largely well understood.

Option A facilitates what we see as an inevitable and necessary move to modern technology and lays a foundation for eRUC and potentially full road pricing. This is consistent with where the world is moving to.

Option A replaces the outdated annual licence fee, the basis for which is unknown, with a new road network access fee. The new fee has a clear basis in cost recovery and contributes to a sustainable revenue stream.

Option A also addresses some of the disadvantages of the status quo through our recommended refinements of CAM and using maximum (permissible) laden weight rather than operator nominated weights. This will deliver cost savings over the status quo. The maximum weight proposal should also reduce evasion.

Heavy vehicle charging is simplified by the maximum (permissible) weight recommendation and the CAM changes in the charging regime. We expect more efficient utilisation of the fleet would follow. Most of the complexities of RUC remain.

OPTION B: DIESEL EXCISE PLUS RUC FOR HEAVY VEHICLES

Economic efficiency

Option B applies direct pricing signals for vehicles over 8 tonnes. For the vehicles up to that weight, fuel consumption is a reasonable proxy for the relationship between the distance a vehicle travels and the consequent road wear. Fuel efficiency differences between vehicles do, however, distort the effect of fuel consumption as a proxy.

The collection method is simple but there is a major additional administrative burden for refunds to those who use diesel for non road use. Approximately 36 percent of all diesel use in New Zealand is for non-road activities.

Cost recovery

The averaging associated with using fuel consumption as a proxy for the relationship between the distance a vehicle travels and the consequent road wear for vehicles weighing less than 8 tonnes is a limitation on the accuracy of cost recovery from individual road users.

Equity

This option reduces the inequities between diesel and petrol powered vehicles. Having the fuel excise duty apply to all vehicles under 8 tonnes creates some inequity between those vehicles because fuel consumption is not an exact proxy for road wear.

Other considerations

Option B is future proofed by including incentives for road users to pursue a technology-based approach to RUC.

Advantages and disadvantages of Option B in relation to status quo

The primary advantage of this proposal is that it removes around 80 percent of the current diesel fleet (ie, light diesel vehicles) from RUC payment to indirect payment via a diesel excise duty. The compliance costs for that group of road users are substantially reduced as is evasion. Many of the advantages of Option A are also relevant for vehicles that weigh more than 8 tonnes.

A fundamental requirement of this proposal is the need for the government to institute a new excise duty and excise refund regimes.

The imposition of a diesel excise duty would have the advantage of efficiency of collection for both users and government. The collection advantages of the excise duty have to be weighed against the disadvantage of having to establish a new administration regime to deal with refunds for a large number of non-road users of diesel. These non-road diesel users may also need additional working capital as the value of their fuel stock purchases will be inflated by the diesel excise duty element pending the refund.

The option has the capacity to pave the way for the adoption of modern technology. There is some disadvantage in that the diesel excise duty might be introduced for a limited period of time and then removed when all vehicles became subject to electronic payment.

As with Option A, Option B also replaces the outdated annual licence fee, the basis for which is unknown, with a new road network access fee.

For light vehicles this option is better than the status quo in terms of equity with petrol vehicles and ease of use. Over time, increases in fuel efficiency may distort the use of fuel as a proxy for road use and wear.

The advantages for heavy vehicles are similar to Option A in that the maximum laden weight proposals and refinements of CAM are all advantages over the status quo. For heavy vehicles that are used both on and off-road there will be increased administration of refunds because vehicles over 8 tonnes without OBUs will be liable to pay RUC as well as the diesel excise duty.

OPTION C: DIESEL EXCISE PLUS GRADUATED FEES FOR HEAVY VEHICLES***Economic efficiency***

This option has no direct pricing signals for weight (and reduced signals for distance) as it comprises diesel excise duty and graduated weight-based, averaged flat fees. Fuel efficiency may distort the effect of fuel being a proxy for use.

Like Option B, it includes a simple collection method, but there is the major administrative burden of refunds.

Cost recovery

Again, as with Option B, using fuel consumption as a proxy for vehicles weighing less than 8 tonnes is a limitation on the accuracy of cost recovery because of the averaging involved.

Equity

This option reduces the inequities between diesel and petrol powered vehicles. With the excise duty being the only charge applying to all vehicles under 8 tonnes, there will be some inequity between those vehicles as fuel consumption is an inexact proxy for road wear. The graduated flat fees above 8 tonnes will benefit those vehicles that travel longer distances and penalise those running shorter distances. Inequities will arise in this averaging effect.

Other considerations

Option C provides no future proofing as there are no incentives for road users to pursue a technology-based approach.

Advantages and disadvantages of Option C in relation to status quo

This option has the same advantages and disadvantages of a diesel excise duty as discussed under Option B. Instead of a RUC component for heavy vehicles it has a weight based graduated licence fee. It has the advantage of providing equity for the lighter vehicles. The imposition of a graduated weight based licence fee would be inequitable for low kilometre users. This option would have no scope for future technology and would not be in accord with modern international practice and trends

This option again has the advantages and disadvantages of a diesel excise duty in terms of collection and refund management.

A variable weight-based annual licence fee would be paid by vehicles over 8 tonnes. This would be easy to collect and difficult to evade. It would not provide equity for low distance users and longer distance users would be advantaged.

Light vehicles would be more equitably treated than under the status quo.

COSTS OF OPTIONS

The Review Group commissioned Deloitte to undertake financial modelling of the costs of the 3 chosen options. Deloitte used figures that in most cases were provided by third parties and based on broad assumptions. All options showed a net economic benefit compared against the status quo and because the upfront costs are relatively low the payback periods are all less than a year.

The Review Group concluded that the financial modelling of the costs was useful guidance for our option assessment but, in view of the comparatively short payback period for all options and the proviso that the modelling was based on subjective assumptions and subject to material inaccuracies, the costing findings could not be a primary consideration for option choice. Deloitte also commented in a similar fashion.

NEW ZEALAND TRANSPORT STRATEGY

The objectives of the Review Group's terms of reference require our findings to be consistent with the New Zealand Transport Strategy 2008.

We are satisfied that, overall, our recommendations are consistent with the Strategy, particularly in terms of assisting economic development (eg, through reduced complexity and administration costs, less evasion, and reduced operating costs for the transport sector). Our technology-based proposals and other recommended improvements will encourage appropriate behaviors and ensure an economically efficient, sustainable means of generating revenue for investment in the road network.

The recommended changes to CAM and consequent reduction in RUC to be paid by the heavy vehicle fleet are, however, potentially unhelpful with the Strategy's focus on mode shift.

OVERALL CONCLUSION ON PREFERRED OPTIONS

The Review Group considers that Option A offers significant improvements over the current system; and the most practicable way forward to an almost inevitable, future technology-based road charging system. It is marginally our preferred option.

The Review Group considers that Option B, while entirely feasible, is the second best option. Even though Option B is very different to Option A, our assessment is that Option B scores almost equally with Option A, in aggregate, against the assessment criteria.

While Option C is certainly viable in the short to medium term, and clearly favoured by some submitters, the Review Group considers that it should be the least preferred of the 3 options. Compared to Options A and B, Option C's key disadvantages are in terms of economic efficiency, the greater (possibly unacceptable) use of averaging, and absence of any incentives to support the inevitable, future technology-based road charging system.

As outlined above, Option A and Option B both have their advantages and disadvantages. Both of these options provide incentives for the uptake of technology consistent with where the world is moving to. The costs of Option A are greater than those of Option B, but not significantly so.

Option B requires the introduction of a new excise duty system and a viable means of managing refunds to a large number of non-road users of diesel. This has been a significant matter in our considerations.

Wider policy issues may lead others to a different conclusion, but the Review Group prefers Option A over Option B for the following reasons.

Option A:

- enables, subject to our transitional recommendations, most of the critical enhancements to be implemented almost immediately, or within a relatively short timeframe
- maintains the many positive aspects of the current system which is well understood and has served New Zealand well for the last 30 years
- avoids the need to establish a new diesel excise duty system which would (due to technology developments) probably only be maintained for a limited period of time
- avoids the imposition of the diesel excise refund regime on a large number of non-road diesel users; and the corresponding imposition on the government in establishing and operating the new refund system.

Option C is the least preferred option because it does not incentivise the adoption of modern technology and the degree of averaging under the system means that it does not fulfil the criteria for efficiency and cost recovery as well as the other two options. Option C is not as equitable for heavy vehicles as regards the averaging involved in a fixed annual fee for weight irrespective of kilometres driven. Although Option C is less costly than Options A and B, we consider that the cost difference is not sufficient to outweigh the disadvantages of Option C.

Recommendations

- That, in light of all the previous recommendations, the Government implements a revenue collection approach generally in accordance with one or other of the following two options:

Option A – Enhanced RUC system for all vehicles: Substantial enhancement of the current revenue collection approach.

Option B – Diesel excise duty plus RUC system for heavy vehicles: Major changes to the revenue collection approach including eliminating RUC for vehicles weighing less than 8 tonnes and introducing excise duty on diesel.

- That preference is given to Option A, an enhancement of the current system which retains weight and distance-based RUC for all vehicles, because Option A:
 - a) enables, subject to our transitional recommendations below, most of the critical enhancements to be implemented almost immediately, or within a relatively short timeframe
 - b) maintains the many positive aspects of the current system which is well understood and has served New Zealand well for the last 30 years
 - c) avoids the need to establish a new diesel excise duty system which would (due to technology developments) probably only be maintained for a limited period of time
 - d) avoids the imposition of the diesel excise refund regime on a large number of non-road diesel users; and the corresponding imposition on the government in establishing and operating the new refund system.

OTHER CONSIDERATIONS

THE LIGHT VEHICLE FLEET

Light vehicles are currently charged differently according to whether they are powered by petrol, LPG or CNG (FED payers) or whether they have another source of motive power (RUC payers). When RUC was introduced it was not expected that it would apply to large numbers of light vehicles. Changes in the light vehicle fleet composition, however, have resulted in around 80 percent of the diesel fleet being light vehicles²⁹. Light diesel vehicles deliver about 24 percent of RUC revenue.

Submitters were clear that many motorists buy diesel vehicles because they are believed to be more efficient and environmentally friendly. Accordingly, the RUC system is criticised for failing to recognise these benefits and submitters wish the Government to be more proactive in encouraging people to purchase diesel rather than petrol powered cars (in particular smaller diesel cars).

RUC only takes account of the actual costs associated with road use. As RUC does not include any charge for environmental externalities, in particular carbon emissions, there is no basis for providing a discount for environmentally friendly vehicles. The issue of externalities, a key feature of most charging systems offshore, has not been the focus of our deliberations as it is outside the Review Group's terms of reference.

Having a differential charging system based on motive power can create inequities between petrol and light diesel vehicles. The pricing relativities are masked by the different bases of revenue collection, an approach that disregards the principle of transparency.

"The AA believes in principle that the framework for charging for the cost allocation components of: road damage by weight; space; user information and residuals should be consistent and equitable regardless of vehicle motive technology"(New Zealand Automobile Association Incorporated, 2008).

The CAM is designed to achieve, on average, equitable charging between light petrol and light diesel vehicles. The current charges, which differ from those indicated by CAM calculations, do not achieve this equitable outcome. On average light diesel vehicles are paying too little and light petrol vehicles too much.

It is impossible to achieve perfect equity between such road user groups while the basis for charging remains fundamentally different. Adjustment of the RUC rates to align with CAM calculations, which we do recommend, could still not deliver equity between specific vehicles.

²⁹ Assuming that all vehicles of unknown GVM are light vehicles.

The Review Group did consider a variation of Option A which included completely removing all light vehicles from the RUC system. This variation would have required a distance-based RUC to be replaced with an annual fixed licence fee. However, the gross averaging and consequential inequities caused us to abandon further consideration of that option. This variant of Option A would also still not provide a similar charging platform for light petrol and diesel vehicles.

Ways of eliminating these inequities would be to replace RUC with a diesel excise duty for light vehicles or to move all petrol vehicles onto a RUC system. It would not be practicable to bring the much larger number of petrol vehicles into the RUC system while it remains paper-based. This was one of the motives for considering Option B, which would see the introduction of diesel excise duty, despite it being a useful revenue collection method in the short run only. While not discounting Option B, our reasons for preferring Option A are explained earlier in this report.

The Review Group considers that, ultimately, charging all vehicles on a rate per kilometre basis for use of the road network is the best option to solve these issues (including externalities). The aspects of moving to such a charging regime that would necessarily be technology-based are also discussed elsewhere in this report.

RECOGNISING DIFFERENT INDUSTRY PRACTICES

Road transport is diverse in terms of the range of the vehicles and the varying business activities they carry out in different parts of New Zealand. The CAM, by its very nature, averages the costs of roading over the whole fleet. CAM cannot recognise the specific circumstances of individual road users. This gives rise to the contention that there is a large measure of subsidy between individual users of the road network.

"Failure to recognise the different operating practices or dealing with them on the basis of national averages introduces another source of cross subsidy" (McKenzie Podmore Limited, 2008, p. 6).

Some sections of the transport industry, which generally have some form of operational loading constraint, see themselves as disadvantaged by the present system and have sought special consideration.

"The BCA would like to see a separate charging scale for buses to recognise the different characteristics of the roads on which buses operate primarily and also the lower load factors achieved by bus operators in relation to vehicle tare weights" (Bus and Coach Association New Zealand Inc, 2008).

"A proportionally higher funding burden, compared to road impact, is placed on users who are unable to backload and/or run fully loaded on the major part of their route" (Fonterra Co-operative Group Limited, 2008).

Submitters maintain that the degree of averaging in the system significantly downgrades the accuracy of the CAM and therefore the equity of the RUC system as between vehicle classes and even within the same class.

"The CAM uses average vehicle operating weights, making no provision for actual operating practices and is therefore a source of cross subsidies and inefficiencies" (Local Government Forum, 2008).

The Review Group appreciates the points made. We conclude, however, that the complexity involved in attempting to accommodate particular vehicle or industry practices would far outweigh the advantages or equity achieved in developing such accommodations. In our view, the anomalies identified can really only be addressed with the introduction of full road pricing which appropriately acknowledges time of travel, weight of the vehicle, distance travelled and the route of travel (location).

Recommendation

That no attempt be made, at this stage, to modify CAM or the RUC system to better recognise the operating practices of defined industries (on the grounds that the anomalies identified could only be properly addressed by full road pricing which appropriately acknowledges time, weight, distance and location factors).

THE IMPACT ON ROAD USERS OF OUR RECOMMENDATIONS

The changes in the RUC rates that could apply, resulting from our proposed changes, need to be viewed in light of the fact that the current charges are not always set as calculated by the CAM. Accordingly the following indicative examples are expressed both in relation to the current RUC rates and the rates that would result if the current CAM were fully applied.

It is important to note that the illustration in the tables below uses 2007/08 costs. The actual costs for subsequent years will depend, among other things, on what is included in the NLTP. Note also that the additional \$80 is over and above the current \$43.50 annual vehicle licence fee.

The annual change in costs has been calculated on the basis of the average annual kilometres travelled for the light vehicle fleet (15,000km). The annual change in costs for petrol powered vehicles is based on the average fleet fuel consumption of about 10 litres per 100 km.

Table 5: Illustrative estimates of changes from current CAM due to Review Group recommendations

	CAM changes under Option A		Additional annual cost or saving, based on 15,000km per annum
Small diesel car (2t)	-9%	+\$80	+\$34
Large car/SUV (3t)	-9%	+\$80	+\$4
Small trucks (5t)	+7%	+\$80	+\$142
Medium truck (10t)	-15%	+\$80	-\$223
City Bus (12t)	-20%	+\$80	-\$538
3 axle truck (20t)	-24%	+\$80	-\$1,148
7 axle B train	-29%	+\$80	-\$2,269
8 axle B train	-26%	+\$80	-\$1,687
Petrol (FED)	-8%	+\$80	+\$38

Table 6: Illustrative estimates of changes to 2007/08 RUC rates due to Review Group recommendations

	Changes under Option A		Additional annual cost or saving, based on 15,000km per annum
Small & large diesel car (2 & 3 t)	-8%	+\$80	+\$125
Small trucks (5t)	+43%	+\$80	+\$348
Medium truck (10t)	-11%	+\$80	-\$134
City Bus (12t)	-20%	+\$80	-\$538
3 axle truck (20t)	-24%	+\$80	-\$1,148
7 axle B train	-28%	+\$80	-\$2,211
8 axle B train	-25%	+\$80	-\$1,524
Petrol (FED)	-20%	+\$80	-\$51

The major driver for the savings illustrated above for vehicles weighing 8 tonnes and over is our recommendation to change how local authority revenue/expenditure is treated in the CAM. The savings to the heavier vehicles from this change are met by a transfer of costs to lighter vehicles (including small trucks).

TRANSITIONAL RECOMMENDATIONS

As noted in the previous section, implementation of our recommendations may result in some significant changes to the RUC rates that different individuals and road user groups must pay. Redistributive consequences of the recommended changes mean that RUC rates will likely increase for some, reduce for some and stay around the same for other road users.

With reference to the 2007/08 NLTP expenditure, we have been able to estimate how different road user groups will be affected by our recommended changes (ie implementation of Option A). With those effects and the requirements of our Terms of Reference in mind, we have formulated the following transitional recommendations to lessen the impact on any road users that might face substantial rate increases.

We consider that these recommendations will help ensure a smooth and timely transition to the new, improved charging regime.

Recommendations

- That changes to the CAM are fully implemented on the next occasion CAM is applied so that the most appropriate allocation of costs related to road use is available to inform the setting of new RUC rates and FED.
- That introduction of the new network access fee is phased in over two years so that in the first year the new fee does not exceed \$85 in total (GST exclusive).
- That introduction of changes to RUC rates arising from the updated CAM are also phased in over time so that no RUC rate increases by more than 20 percent in any one financial year.
- That introduction of the first phase of RUC rate and access fee changes proceeds as soon as possible during the 2009/10 financial year subject to completion of any necessary legislative changes, our other transitional recommendations, and the giving of public notice as we have also recommended.
- That the change process is supported by an appropriate communication strategy to ensure that stakeholders are well informed about the short-term changes, the longer-term direction and the reasons for the overall approach being taken.

For the sake of completeness, Appendix 5 provides further summary information on:

- implementation tasks for our recommended technology trial and for both Options A and B
- legislative implications of our recommendations.

GLOSSARY

Axle reference loads: the load at which an axle with given characteristics generates a standard unit of road wear. Provides a measure of the effects that variables such as axle spacing and numbers of tyres per axle have on the road wear generated by a vehicle.

Cost allocation model (CAM): a tool used by the MOT to apportion costs associated with the land transport network to road users via FED or RUC.

Electronic road user charges (eRUC): the administration and collection of RUC by electronic means, rather than current paper-based processes.

Equivalent standard axle (ESA): a component of the cost allocation model which assigns durability costs resulting from axle weights (to the fourth power) such as pavement wear.

Externalities: costs or benefits arising from any activity which does not accrue to the person or organisation carrying on the activity and for which payment cannot be sought.

Fourth power rule: the assumption that structural road wear is related to the fourth power of a vehicle's axle weight. A component of the ESA calculation, resulting in steep increases in RUC charges at higher axle loadings.

Full hypothecation: the dedication of transport taxes to the National Land Transport Fund to be spent on land transport activities.

Global positioning system (GPS): a global navigation satellite system which allows receivers to determine their current location, velocity and the time.

Heavy vehicles: all vehicles over 3.5 tonnes gross laden weight. These vehicles are currently required to fit a hubodometer for distance measurement purposes.

Light vehicles: vehicles with a manufacturer's gross laden weight of 3.5 tonnes or less.

Long run marginal social cost (LRMC): the total cost to society for producing one further unit, or taking one further action, in an economy. This includes not only private costs which fall directly on the person or firm conducting the activity but also external costs, which fall on other people, who are not able to gain compensation for them. All inputs are considered variable.

Maximum gross laden weight: the lower of either the manufacturers' specification of the gross laden weight or the Land Transport Rule: Vehicle Dimensions and Mass 2002.

Motor vehicle register (MVR): a term used to describe the collective revenue received from fees and charges relating to initial motor vehicle registration, annual licensing and change of ownership of a vehicle.

On board unit (OBU): a substitution for the mechanical hubodometer, which enables inputs from the cab and recording of accumulated distance travelled. Measurement of distance would be by matching a GPS position to a digital map with agreed distances of road segments, with the vehicle odometer pulse and a gyroscope as back up.

Passenger car equivalent (PCE): a component of the cost allocation model which assigns capacity-related costs resulting from the space requirements of vehicles.

Pay-as-you-go (PAYGO): the system where all costs, both capital and revenue, are fully funded in the year that they are incurred.

Road user charges (RUC): charges payable by individual road users as specified by the third schedule to the Road User Charges Act 1977. Charges are currently applicable to all vehicles over three and a half tonnes manufacturer's gross laden weight and all vehicles of three and a half tonnes or less powered by a fuel not taxed at source (e.g. diesel vehicles). All RUC licences are based on a vehicle's motive power, distance travelled, axle configuration and weight nominated in advance by the vehicle operator (at time of licence application)³⁰. Charges are paid in advance and each vehicle must be continuously licensed so that when a distance or time is complete a new licence is required.

The National Land Transport Programme (NLTP): details the allocation of funds to land transport activities in a given financial year, by listing the activities that have already been given funding approval and those activities that are being considered for funding approval. It also contains a 10-year forecast of anticipated transport revenues and expenditure.

³⁰ This weight refers to the maximum weight that will be carried by the vehicle over a particular licence period not a declaration of the weights that will be carried on particular parts of a trip or on particular roads.

APPENDIX 1: TERMS OF REFERENCE

PURPOSE

1. These terms of reference are for an independent review of the Road User Charges System that will:
 - examine the way in which the Ministry of Transport's cost allocation model apportions costs
 - consider the merits of collecting revenue from diesel vehicles by way of RUC as compared to potential alternative methods.
2. This review has been initiated to consider the basis on which roading costs and other costs of the National Land Transport Programme (NLTP) should be allocated and collected, and to ensure that the charging system is fair, efficient and based on up-to-date information.

REVIEW OBJECTIVES

3. The review will aim to ensure that the cost allocation model and charging mechanisms meet the following objectives:
 - economic efficiency
 - cost recovery
 - equity.
4. The findings of the review must be consistent with the New Zealand Transport Strategy 2008.

SCOPE

5. The review will provide recommendations for possible changes to policy, processes or legislation.
6. The review will look at the following issues.

MINISTRY OF TRANSPORT COST ALLOCATION MODEL

- the appropriateness of the allocation of the various components of roading costs and other costs of the NLTP including:
 - the relationship between vehicle use and NLTP expenditure and, in particular, the power relationship between axle weight and road wear and the relationship between various axle configurations and road wear
 - any other matter relevant to these costs.

ALTERNATIVE CHARGING REGIMES

- the merits of any alternative charging mechanism or regime (including diesel taxes) with no limitation.

ASSOCIATED COSTS

- the nature and extent of the costs associated with the current systems for setting and administering RUC (including matters relating to the impacts of the RUC scale on the efficiency of vehicles, enforcement, avoidance and evasion, administrative and compliance costs) together with any improvements that might be made to reduce those costs
- compare the costs associated with the current system against the costs associated with any alternative charging regime considered by the review group.

PROCESS FOR CHANGING LEVELS OF CHARGES

- the process for reviewing and adjusting charges including consultation and notice of changes.

TRANSITION REGIME

7. Where the Review Group makes recommendations for change to the way that costs are allocated across different road users, it will also comment on an equitable and efficient way to transition to a different allocation or charging mechanism. Transition should consider the merits of a gradual adjustment to new cost allocations to reduce the impact on road users and allow time for changes to be factored into their planning and road use decision-making.

MATTERS EXCLUDED FROM REVIEW

8. This review is about methods of raising revenue to fund roading costs and other costs of the NLTP. It inevitably has links to the way in which land transport activities are funded, but wider questions about transport funding will be addressed through a separate review. In particular, the following matters are not within the scope of this review:
 - the activities that are funded by the NLTP
 - financial assistance rates for local authorities in respect of the land transport activities that they undertake
 - alternatives to rating as a source of land transport funding
 - matters relating to other costs not currently charged for through the NLTP (eg externalities).

FUTURE TRANSPORT DEVELOPMENTS

9. Although it is not considering the issues in paragraph 8 above, the Review Group should consider likely future developments in areas such as technologies enabling new charging mechanisms, trends in use of transport fuels and transport technology generally.

REVIEW GROUP

10. The review will be undertaken by an independent group appointed to advise the Minister of Transport. Members will be appointed by the Minister on the basis of their skills, knowledge and experience, rather than as representatives of sector groups.
11. It is envisaged that the Review Group will comprise between three and five members, with the following skills and experience between them:
 - knowledge and experience of the transport sector (particularly in relation to roads and funding systems)
 - knowledge and experience of the business sector
 - understanding of economics
 - experience in the development of government policy and knowledge of regulatory/legislative frameworks.

One member will be appointed as Chair, primarily on the basis of his/her proven skills in leading and facilitating the work of a review of this nature.

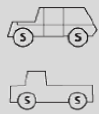
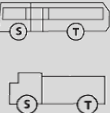
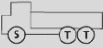
REVIEW PROCESS

12. The Review Group will determine its own procedures and approach to developing a report. It will be able to seek independent expert input, as well as canvass the views of key interest groups and stakeholders.
13. An independent contractor will be engaged as Project Manager, reporting to the group.
14. Wayne Donnelly will act as Review Adviser.
15. The MOT will provide general support to the review, including provision of accommodation.
16. The Review Group will have a budget for consultants to enable it to commission reports on the engineering, economic and other aspects of the cost allocation model and charging mechanisms.
17. The review will report to the Minister of Transport by the end of March 2009 with its findings regarding the current cost allocation and charging system, and any recommendations for possible changes to them.

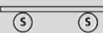

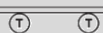

18. Final decisions about any changes will be determined by Cabinet on the recommendation of the Minister of Transport. The Minister may also take into consideration any other advice and material in making his or her recommendations.

APPENDIX 2: VEHICLE TYPES

Powered vehicle types (distance licence)

No. of axles	Types of axles	Example vehicles	Vehicle type no.
2	2 axles, single tyred		1
2	2 axles, 1 single tyred and 1 twin tyred		2
2	Any other configuration		1
3	3 axles, 1 single tyred and 2 twin tyred		6
3	Any other configuration		5
4	Any configuration		14
5 or more	Any configuration		19

Un-powered vehicle types (distance licence)

No. of axles	Types of axles	Example vehicles	Vehicle type no.
1	Any configuration		24
2	2 spaced axles, both single tyred		27
2	1 group of 2 close axles, both twin tyred		29
2	2 spaced axles, both twin tyred		30
2	Any other configuration		28
3	1 group of 3 close axles, all twin tyred		33
3	Any other configuration		37
4 or more	Any configuration		43

APPENDIX 3: FURTHER INFORMATION ON INTERNATIONAL APPROACHES

AUSTRALIA

The Australian road use charge system applies only to heavy vehicles in excess of 4.5 tonnes. Charges recommended by the National Transport Commission (NTC) are set so that the aggregate charge revenue will recover heavy vehicles' estimated share of road expenditure, as determined with the NTC's cost allocation model. This model separates costs into non-attributable (common) and attributable costs. Attributable costs are distributed across all vehicle classes (including passenger vehicles) according to various measures of road use such as vehicle kilometres travelled or share of passenger car-equivalent units (PCUs). The charges on heavy vehicles comprise a per litre diesel fuel excise and an annual registration charge which varies by vehicle class (and hence by weight). Light vehicles contribute to their costs through petrol tax and registration charges. The registration charge for each vehicle class is set to recover the difference between the cost allocated to the class and revenue recovered from the class through fuel excise. As heavier trucks impose higher costs, the fuel excise alone is not sufficient to recover the costs allocated to these vehicles, so their registration charges are greater.

In aggregate charges recover from heavy vehicles their attributed costs of road maintenance, repair and capital expenditure on strengthening roads and bridges against the wear effect their use imposes on the road network, plus their allocated share of the common costs of road provision. The petrol tax and registration charges on light vehicles recover from them their allocated share of common costs. The NTC removes a considerable proportion of road expenditure from the cost base prior to cost allocation, including expenditure recovered through other fees and charges, interest on borrowings, heavy vehicle enforcement expenditure and a proportion of expenditure considered to account for other services provided by these roads, such as local access and amenity. The amount of local road expenditure excluded from the calculation on grounds of local access and amenity has exceeded 40 percent in some years, raising criticisms that this amount is too high and provides cross-subsidy to heavy vehicle users. Similarly there has been debate on the magnitude of common costs in relation to pavement maintenance expenditure, for instance the amount of road-wear that is attributed to environmental factors, such as weather, and hence treated as a common cost spread across all vehicles rather than attributed to heavy vehicles with the greatest impact on road-wear.

Productivity Commission (2006) argues that even though heavy vehicles are currently allocated a relatively low share of common costs (7 percent), this would not imply a subsidy unless the costs borne by other parties (light vehicles and taxpayers) are higher as a result of heavy vehicles' use of the road network. In other words, if costs are truly common their allocation to different vehicle classes is purely a distributional matter of no significance for efficiency, and no real cross subsidies are created. There are various ways in which common costs could be allocated to different vehicle classes, but all are essentially arbitrary. If common costs are correctly estimated, the rule for efficient allocation is Ramsey pricing, in which common costs are distributed in inverse proportion to the price elasticity of the different vehicle classes – i.e. they are allocated

most heavily onto the least price sensitive vehicle classes. In this way the costs can be recovered with least distortion on road use, which is the most efficient outcome for full cost recovery.

Most independent studies of Australian road cost allocation attribute a greater proportion of costs to heavy vehicles than the current NTC model. In particular, in common with a number of other countries (e.g. New Zealand, Germany, UK, USA), most of these Australian studies attribute pavement maintenance costs on the basis of ESA-km, whereas the NTC uses AGM-km³¹, which results in a lower allocation to heavy vehicles. The Productivity Commission (2006) notes that while most of the assumptions made in the Australian cost allocation process are reasonable individually, their cumulative effect is to produce an allocation of costs to heavy vehicles at the lower end of the plausible range of values, and further work is required to verify the validity of these assumptions.

NTC (2007) proposes a method for calculating an incremental price that can be used to set a charge for allowing vehicles to exceed current regulated mass limits on particular roads. The aim of such incremental pricing would be to enable more efficient use of the road network by not letting a rigid standard on mass limits preclude the use of the most efficient vehicles available. This necessitates calculating the incremental cost specific to particular parts of the road network of exceeding current limits, and finding a way of setting charges for that cost that are compatible with the general road use charges based on network-wide averages. NTC compares PAYGO and Lifecycle cost approaches to determine incremental cost, and proposes a trial using approach, in line with one of the recommendations in the Productivity Commission's (2006) review. However, the Austroads Pavement Technology Review Panel (APTRP 2007) respond with some technical criticisms of the proposed trial approach, suggesting it may give the wrong incentives and result in lighter charges for vehicles which create the most damage. It illustrates the complexity of breaking down network-cost averages to facilitate location-based charging that more closely affects the marginal cost of road use.

NTC (2008) outlines a national transport policy framework which includes a number of other initiatives aimed at moving towards a preferred model for direct pricing of heavy and light vehicles to replace the current charges methodology. These include research and data collection to support direct pricing, developing the technology for fee collection systems, and investigating reforms to the institutional framework of road management to facilitate direct pricing.

UNITED STATES OF AMERICA

The Federal Highways Authority was responsible for constructing inter-state highways in the period after World War II, and since the Federal Highways Act in 1956 revenues from road charges have been passed into a Trust Fund for this purpose. But management of these roads once built passed to the relevant states, which still receive Federal assistance towards their upkeep. In 1991 the inter-state building programme was declared

³¹ Average gross mass kilometre

completed, since when these funds have been available to be diverted to other transportation applications. There have been calls to divert all revenues to roading and for Federal involvement in State-managed roads to cease.

Cost allocation models are run at both Federal and State level and used to assist the setting of charges. Federal level models were run in 1982 and again in 1997 and used to create ratios of user fee payments to allocated costs for different classes of vehicle (www.tfhr.gov/pubrds/janpr/cost.htm). As each level of government applies its allocation models and charge setting separately, the combined effect of the overlapping charge structures shows more variation in these ratios than looking at any one level.

Balducci and Stowers (2008) review 22 Highway Cost Allocation System reviews carried out during 1982-2007, identifying some variation between states. In most cases heavy vehicles were under charged with an equity ratio (ratio of total tax payment by a user class to its cost responsibility) less than 1, but in three cases, the ratio was more than 1 (Delaware 1992, Montana 1992 and Oregon 2007).

New charging approaches in the USA are prompted primarily by congestion management. High Occupancy Toll lanes have been operational in California and other states for several years. The state of Oregon has run a trial weight-distance charge to replace its fuel taxes – the Oregon Mileage Fee – which involves paying the distance fee as measured by an on board unit at petrol stations (Whitty 2007). While officially hailed as a success in proving the concept could be implemented, it has been criticised for having a small sample of drivers (less than 300) and only two participating gas stations, and for being oriented to testing acceptability of the charging concept with a generous provision of onboard units and rebates for petrol taxes paid that is unlikely to be realistic in a situation where such charges are required for revenue collection.

EUROPE

Relatively little English-language literature has been uncovered on road cost allocation processes in European countries, although most countries appear to use such an approach with respect to setting heavy vehicle charges. While their systems approximate to PAYGO, there is an entrenched tradition in European countries of using road use taxes for purposes other than road cost recovery, e.g. environmental charges and above all revenue collection. An aversion to hypothecating road-related revenues to roading expenditures, on grounds that this could lead to revenue-generated expenditure which is not the most efficient use of funds, means that there is a wide divergence between what road users pay and what is spent on the roads. That aversion may be weakening, however, as public acceptance of new road use charges appears to be dependent on at least a substantial portion of revenues being directed to improvements in transport systems.

Particular drivers for road charge innovation in Europe include:

- Recovering costs from foreign vehicles in transit across countries;
- Ensuring fair competition among hauliers from different countries;

- Moderating congestion and environmental externalities.

In an attempt to increase revenues collected from foreign vehicles that might otherwise cross countries without contributing to road revenues, several European countries have required heavy vehicles to purchase windscreen-mounted stickers or "vignettes" that permit use of certain infrastructure within specified time periods (e.g. month, year etc). In 1995 a "Eurovignette" was introduced which provided a common system for charging heavy vehicles for use of motorways in six participating countries. As the revenue generated by temporal fees has been insufficient to sustain road maintenance and expansion in several countries, and responding to EC policy documents that call for fees which better reflect actual road usage, some countries have been moving to implement distance-dependent fees on which the Eurovignette Directive allows higher tariffs to be collected.

The White Paper on *Transport Policy for 2010 – time to decide* (European Commission 2001) foreshadowed a gradual replacement of existing transport system taxes with more effective instruments for integrating infrastructure costs and external costs. The charge for using infrastructure must cover not only infrastructure costs but also external costs, e.g. those arising from transport related accidents, air pollution, noise and congestion. It should also be capable of being levied without restricting freedom of movement or reintroducing frontiers and barriers to trade and competition. This arises from the recognition that transport is heavily taxed and unequally taxed, with different taxation structures in different countries. For instance, the White Paper cites excise duty on diesel varying from €246 to €797 per 1000 litres in different countries.

Another motivation in Europe is the large differences in the cost structures of road freight between the longer-established member states of the former European Community and the new members from economies in transition in Eastern Europe. There is concern that freight hauliers in these new member states gain competitive advantage over those in the old member states not only from lower wages and associated labour costs, but also from less rigorous observance of environmental and safety regulation of vehicles, and the possibility that trucks from these countries can evade current payment systems when transiting other countries' road networks and thus avoid contributing to the costs they impose on those countries. Hence the White Paper's thrust towards more harmonised road charging across countries, and for the inclusion of a greater range of transport-related costs than has previously been the case, when road infrastructure costs have been the dominant, if not the only, cost components reflected in the charge structure.

The European Commission's principal intervention in the charging of road use is the Eurovignette Directive 99/62/EC which, although not requiring member states to charge tolls or other charges to road use, set upper and lower limits to such charges when they arise, in an attempt to improve the harmonisation of charges across the European Union. This has since been modified by a later Directive 2006/38/EC which sets common rules on distance-related tolls and time-based user charges for goods vehicles above 3.5 tonnes, for the use of certain infrastructure. The stated intent of these directives has been to improve the functioning of the internal market by reducing differences in toll systems and levels so as to improve competition in the transport sector,

and also to provide for greater differentiation of tolls and charges in line with costs associated with road use by different types of vehicle.

EUROVIGNETTE

The Eurovignette is an integrated system of user charges for heavy vehicles of 12 tonnes Gross Vehicle Weight or more using the motorways in six EU member states. It was introduced jointly by Belgium, Denmark, Germany, Luxembourg and the Netherlands in 1995, and Sweden joined the system in 1998.

Its practical effect is to require vehicles of the qualifying size to purchase pre-paid entitlements to use the motorways in the participating countries for a defined period of time (month, year etc). It has been predominantly a manual process, with enforcement by random inspection at border posts and wayside checkpoints. Its intention is to ensure that heavy vehicles from outside those countries contribute financially to the costs they impose on the motorway systems. The costs it covers are those related to construction, operation and development of infrastructure.

Directive 1999/62/EC on the charging of heavy goods vehicles (HGVs) regulates road tolls and user charges that Member States can apply to HGVs with GVW exceeding 12 tonnes. It defines a toll as a “payment of a specified amount for a vehicle travelling the distance between two points” and states that “the amount should be based on distance travelled and the type of vehicle”. It defines a user charge as a payment of specified amount conferring the right for a vehicle to use the specified infrastructure for a given period. Under this definition the Eurovignette is a user charge.

The Directive puts lower and upper limits on the amount of user charges, in an attempt to improve harmonisation of road charges across member states. It also states that tolls and user charges may not be applied at the same time for the same piece of road, but they may be applied concurrently across a network – e.g. on a motorway network subject to Eurovignette, additional tolls may apply to specific bridges or tunnels. It does not, however, prevent member states from applying parking fees or specific urban traffic charges intended to tackle congestion.

In July 2008 the European Commission adopted a “Greening Transport Package” which includes proposals to revise the Eurovignette Directive. If enacted, these would move to including more of the costs of externalities caused by heavy vehicles’ use of motorways into the road use charges, but the current proposals have been criticised for excluding coverage of CO₂ emissions and accidents. However, CO₂ is more directly charged for through fuel taxes, and accidents are problematic for converting to a meaningful charge per use of the motorways.

The dismantling of border posts under the EU’s Schengen arrangement, and developments in other road charging instruments (particularly in Germany) suggest the current Eurovignette needs to become more fully automated (to improve monitoring and enforcement) and to improve inter-operability with these other instruments. The Eurovignette had 5000 points of sale in Germany alone, but when Germany seceded from

the Eurovignette in favour of its own heavy vehicle charge (Maut) system, the economics of continuing with the existing vignette changed significantly. However, it has been suggested that a new electronic vignette with around 800 points of sale in the 5 remaining participating states and in some of the “belt states” surrounding them would be viable, using the technology to deliver additional services to users from telecommunications companies and oil companies.

AUSTRIA

In Austria, distance-based charging for heavy vehicles was introduced in 2004, in a system known as the LKW Maut. It was intended to attribute costs more fairly based on use, but there was also an urgent need to service debts on the road network and to gather greater revenues than were permissible under the EU’s Eurovignette Directive, which set limits on the charges that could be levied on purely time or distance-based charges. A microwave DSRC technology was rolled out across the country’s motorway system, with windscreen-mounted on-board units given away to ensure wide adoption. Distance travelled is calculated by microwave communication between OBUs and 430 toll portals along the road network, and fees are calculated on the basis of the weight and number of axles on the vehicle as entered by the driver prior to each trip. The system applies to trucks of 3.5 tonnes or greater and covers motorways and some expressways. It has reportedly operated efficiently with no insurmountable implementation issues, with operational costs consuming only around 10 percent of toll revenues (TCA 2007).

CZECH REPUBLIC

The Czech Republic has a motorway charge system apparently similar to that in Austria, with DSCR deployed across the country’s motorways and expressways. However, a second stage is intended to roll out the technology across a wider span of roads, for which DSCR appears a less suitable choice because of the mounting costs of acquiring sites and installing gantries across an increasing proportion of the road network. For this second stage a GPS-based OBU which requires no physical infrastructure at the road side would appear more appropriate (TCA 2007). When this became apparent the Czech government delayed implementation of the second stage indefinitely. TCA (2007) describe the Czech experience as a good example of the dangers of having no long term policy.

GERMANY

Germany introduced its own weight-distance charge on trucks larger than 12 tonnes laden weight in 2005, known as the “Maut” or toll. It applies to motorways and some expressways across the country.

Doll & Schaffer (2007) describe the principles for allocating the total road cost to individual vehicle categories, which involves 21 cost categories and 5 allocation steps, which are:

- Costs distributed in proportion to individual vehicle categories share of vehicle kilometres
- System-specific costs for cars and other vehicles below 12t gross weight

- System-specific costs for heavy goods vehicles above 12t gross weight
- Weight-dependent costs
- Capacity-dependent costs.

Allocation according to causality is only possible for weight-dependent cost and is achieved using third and fourth power of axle loads derived from updated results of the US AASHO road test. Capacity related costs are assigned according to each vehicle class's equivalency factor defined in passenger car units. This is an arbitrary allocation and could be improved by applying principles of co-operative game theory, but this appears not to have been done.

Both Prognos (2002) and Doll & Schaffer (2007) refer to co-operative game theory as a means of improving on the arbitrary current allocation of capacity-related costs in proportion to each vehicle class's share of passenger car units. Their descriptions of the approach are not detailed, but Doll and Schaffer identify it as involving a large number of calculations, and Prognos describes it as applying a fairness procedure to minimise the possible adverse effects on user classes, where a "fair" cost apportionment is one that minimises the incentive for classes to leave the partnership of all users. In short, it implies using game theory principles to find the distribution of capacity costs across vehicle classes where each class is least likely to be better off outside of the "partnership of user classes" - compared to distribution according to share of PCUs, in which some vehicle classes could bear disproportionately higher costs than others, and hence be better off outside the notional partnership of users sharing costs of providing the road network. This approach to avoiding cost allocations which would result in classes paying more in the partnership than they would in a self-contained scheme is similar to the common approach to identifying and eliminating cross-subsidy, so as well as being arguably fairer it is also likely to be more efficient than alternative approaches in which costs are allocated without regard to the alternatives available to each class in the partnership.

Wieland (2005) identifies the purpose of the HGV toll as primarily to remedy financial problems by bringing more funding into the transport system off the government's budget, with 50 percent of the revenues available to cross-subsidise rail and inland waterways. A further goal was to influence modal choice in favour of rail and inland waterways and to create "fair" competition between modes. It was also expected to further environmental objectives, as the toll includes some differentiation according to vehicle emission class: however, under EU Directive 1999.62.EC total revenue is still constrained to equal infrastructure costs, so the environmental differentiation is simply a weighting factor that redistributes cost liability away from environmentally friendlier vehicles to more environmentally damaging ones (Prognos 2002). There is no environmental cost added to the costs to be recovered (unlike in the Swiss heavy vehicle charge). The HGV toll also provides incentive towards optimal route choice and fleet management as the flat fee by weight class encourages high load capacity utilisation. German road hauliers were generally in favour of the scheme for ensuring greater contributions collected from foreign trucks passing through Germany, and there was strong support from industrial interests in developing a complex satellite based tolling system and sticking with it despite technological problems during implementation, because of the opportunities for selling the technology

in other countries. A grand coalition of support built up which included environmentalists who welcomed the improvement of inter-modal competition, and private motorists who looked forward to reduced congestion on the road. But the German example also shows the importance for public acceptance of the toll being seen as not just another tax and that the revenues are used for purposes which the toll payers can see and gain some benefit from (e.g. cross-subsidy of other modes which reduce road vehicles).

According to first-best welfare theory user charges should be set equal to social marginal costs and the revenues should accrue entirely to the state. However, public acceptability and long-term-development considerations militate in favour of earmarking revenues to the transport sector. Current practice in the German HGV scheme falls short of economic optimality. The German HGV toll scheme is currently based on an average-cost pricing rule with charges varying according to axle loads and exhaust emission standards. After 20 percent of revenues are retained by the private operator, Toll Collect, of the remaining revenues 50 percent are allocated to road, 38 percent to rail and 12 percent to inland waterways. Modelling by Doll & Link (2007) shows that when earmarking revenues to transport in this way, it is generally welfare optimal to allocate revenues to the road sector.

The German motorway tolling system uses GPS/GSM technology with an EFC on-board unit. While this has proved feasible for tolling, additional roadside beacons are required to support charging and enforcement functions. This system applies to trucks of 12 tonnes weight or greater, and requires higher OBU costs than the DSRC systems, and extending the system to smaller vehicles is expected to increase the costs and worsen the efficiency of collection. There were technical problems with the implementation of the scheme, the logistics of fitting 300,000 trucks with an OBU and a steep learning curve for Toll Collect, the operator of the system. There were also difficulties in the contract between the Ministry and the contractor. Some of the potential of the OBU for time and distance specific charging remains unrealised, as non-discrimination rules that prevent time-dependent charging for trucks without an OBU prevent this refinement of the OBU charging structure as well. The objectives of the German scheme seem to have mixed improved charging with the prospect of developing innovative market leading technology that might have export potential, but it is a scheme that has had implementation problems and no export opportunities have yet been realised.

SWITZERLAND

The Swiss introduced a distance-based charge (LSVA) on heavy vehicles of 3.5 tonnes or larger in January 2001, to assist demand management and internalise external costs of heavy vehicles, with financing a secondary role. It is applied to all roads for distance travelled in Switzerland and is operated by the Swiss government Customs Authority, rather than out-sourced to private contractors. It employs several technologies, primarily a digital tachygraph, DSRC, and chip-cards for ascertaining distance for charging, and GPS used as a back-up system. As operator of the scheme, the Swiss Customs Authority tendered for separate parts of the system rather than a single packaged system, which reportedly gave it flexibility and control. Revenue is comparatively high as trucks are also charged for external costs of noise, pollutant emissions and accidents as well as road construction, maintenance and financing. The Swiss Heavy Vehicle Fee is reportedly

technically successful, and has also been effective in achieving several objectives, including sustaining revenues and reducing some heavy vehicle traffic from more environmentally fragile mountain regions. According to Perkins (2004) heavy vehicle electronic kilometre charge payment is enforced through 'customs checks at borders, roadside checks and checks in the accounts of Swiss haulage companies'.

According to Austroads (2007), the objectives of the Swiss LSVA were to internalise external costs associated with road freight transport, facilitate a modal shift from road to rail for goods crossing the Alpine region, protect the Alpine region by limiting an expected traffic increase when the national mass limit for trucks in Switzerland rose from 28 tonnes to 40 tonnes, and to finance new railway tunnels. The basic principle of the scheme is that heavy vehicle transport through the Alpine regions costs more, with scheme charges varying per kilometre and per tonne and with the emission characteristics of the vehicle. Effects observed from the Swiss LVSA include fleet adaptation, with replacement of high emission trucks and migration to a more optimal size of vehicle, and organisation changes evident in mergers in the trucking industry and changes in freight and fleet management. There has been little observed effect on route choice (the scheme applies to all public roads) or on the prices passed on to consumer products. The successful implementation of the scheme can be attributed to Switzerland being a relatively small country with defined freight routes, and to the choice of well-developed technology with relatively few teething troubles. (Austroads 2007).

SWEDEN

Sweden is located on the periphery of the European Union, with a large surface area and relatively low and dispersed population. The current road tax system for heavy goods is based on fuel tax and vehicle tax. The vehicle tax is differentiated according to vehicle characteristics such as weight, number of axles and the environmental rating of the engine (i.e. emissions). In addition, Sweden has been one of the 6 participating countries in the Eurovignette, which requires heavy vehicles to buy time-limited licences for using specified motorways and other roads in those countries.

Because the Eurovignette tolls only cover a limited number of roads, they are not considered an adequate tool for internalisation of external costs, which is a goal of both Swedish and European transport policy. The Eurovignette is also beginning to unravel, with the withdrawal of Germany in 2005 on introduction of its own heavy vehicle charge. As of 1 October 2008 Sweden has abolished the vignette, the sticker in the window that signifies payment. A new system records toll payments electronically on a central on-line database, which is available for officials in other Eurovignette countries to search to confirm that a given vehicle has paid the appropriate toll (www.skatteverket.se).

Between 2002 and 2004 an investigation was carried out in Sweden that reviewed all road and vehicle taxes. It proposed the introduction of a kilometre tax that would apply to all heavy goods vehicles (both Swedish and foreign) with a gross weight over 3.5 tonnes that use the public road network. The Swedish parliament voted in May 2006 to proceed with a national kilometre tax for heavy goods vehicles, with the objective of internalising external costs (Sundberg 2007). This is currently being developed under a project known as ARENA, which aims to achieve a system that both meets Swedish requirements and conforms with Europe-

wide guidelines for road tolling that the EU commission is currently working on (ARENA 2008). The section that ARENA is focusing on is the collection of the kilometre tax, which involves measuring, calculating and supplying all information needed to pay the correct tax. The actual payment processes will be defined through the European Electronic Toll Service (EETS). The Swedish kilometre tax will apply only to road use within the boundaries of Sweden.

A control system based on physical installations throughout the entire taxed road network, as in Germany, Austria and the Czech Republic, is considered too expensive in relation to the anticipated income of a Swedish system. Instead, the focus of the control mechanisms is on more intelligence and less hardware, more control responsibility to the Toll Service Provider, and on a supervisory authority with powers to undertake roadside checks. ARENA's proposal for a kilometre tax will require a mandatory On Board Unit for all vehicles, which is expected to be a very simple OBU for the Swedish system, but the precise technology has not yet been determined. It is also proposed to apply the kilometre tax across the entire Swedish road network, even though some roads may not be subject to tax and carry a null tax rate.

The ARENA project is being progressed through a consortium of players, and the intention is to let out separate contracts to separate parts of the system (as in Switzerland) rather than seek a single-supplier solution (as in Germany), to increase competition among potential suppliers. Sweden has also just completed a trial of congestion charging in Stockholm, which is about to be implemented as a full time operation.

UNITED KINGDOM

A Lorry Road User Charge was proposed in the 2002 Budget for introduction in 2006, to ensure lorry operators from overseas paid towards using UK roads. This would have required foreign-registered hauliers to pay around 15p per kilometre travelled in the UK, assuming they bought their fuel outside the country, as most currently do. It would require all 430,000 lorries registered in the UK with gross weights over 3.5 tonnes to pay the same charge, with offsetting tax cuts in fuel tax to ensure the UK haulage industry was not disadvantaged. This would require a rebate system to be established to return an equivalent amount of fuel duty to hauliers, in the region of £3 billion per year. The LRUC was estimated to raise an extra £139 million per year for the UK Treasury. However, as the LRUC plans progressed it looked like being a costly solution to a relatively minor problem (McKinnon 2004). Unlike heavy vehicle charge systems in continental European countries, the proportion of foreign transit vehicles in UK is relatively low, so the LRUC would impose unnecessary costs on the majority of domestic vehicles to capture a minority of foreign free-riders on the system. And whereas other countries dedicate at least some of the revenues to improvements in the road system, the UK's position on non-hypothecation and revenue neutrality offered no such prospect of offsetting improvements.

After rising opposition the LRUC proposal was dropped. Currently the government is proposing a nationwide road use charge system by 2030, in which all vehicles will have satellite-based tracking devices that allow them to be billed for the precise use they make of the public road system, differentiating by both time and place to price both road-wear and congestion.

Other road charging initiatives in the UK include:

- London's congestion charge;
- An entry charge into the central area of the city of Durham, to reduce traffic and protect the historic heritage sites in the area;
- Trials on congestion charging in other cities, such as Edinburgh and Cambridge, none of which have yet become fully operative.

These schemes have proved the technical feasibility of charging over restricted areas, but there remains doubt about their overall success in economic terms.

ICELAND

Iceland lies just below the Arctic Circle in the middle of the Atlantic Ocean, with an area similar to that of the North Island, and population is similar in size to that of Greater Wellington or Christchurch City. About three quarters of the population lives in the south-west around the capital, Reykjavik, with the rest dispersed in smaller towns and villages, mostly around the coast, as lava fields, volcanic sand deserts or permanent ice sheets cover much of the interior.

The public roads are managed by the Icelandic Road Administration (ICERA) which supervises road construction, services and maintenance. Although in the past ICERA undertook most construction work, now it is almost entirely tendered out to private contractors in each region of the country.

There have been moves in recent years to increase the revenue recovered from road users, in face of traffic growth and increasing heavy-truck traffic that has caused a noticeable increase in road-wear. No details have been found of the cost allocation process used in setting charges, other than that Iceland uses the fourth power rule in relating axle weight to road-wear.

Funding for ICERA is determined by earmarked sources of income determined by the Icelandic Parliament, i.e. a share of revenues collected from taxes on diesel and petrol and a kilometre tax on vehicles weighing more than 10 tonnes. In 2005, revenues from such taxes totalled 47 billion Icelandic Krona, of which ISK13.4 billion were allocated to ICERA (ICERA 2007)³².

Road use charges in Iceland comprise (OECD 2006)³³:

- A weight tax on all motor vehicles regardless of fuel source;

³² ICERA (2007) "Our roads" Vegagerdin

³³ OECD (2006) "Consumption tax trends"; OECD, Paris

- A weight distance tax on vehicles greater than 10 tonnes only, based on the weight of vehicle and kilometres driven;
- A tax on sales of petrol;
- A tax on sales of diesel, effective from 1 July 2005 and replacing a previous flat tax on diesel powered vehicles;
- Licence fees for commercial transport operators and taxi operators;
- A disposal tax at a flat rate per vehicle paid every 6 months up to age 25, to assist in disposing and recycling of discarded motor vehicles;
- Excise duty and VAT on importing of vehicles into the country.³⁴

The all vehicle weight tax operates much like a vehicle licensing or registration fee, differentiated by vehicle weight rather than other measures (like engine cc rating). The weight distance tax is variable with road use and differentiates between heavy vehicles according to their expected share of road damage. Taxes on sales of petrol and diesel bear some relation to road use, but also significantly over-recover expenditures on roads and contribute to the national exchequer.

Iceland's roads have no cross-border traffic and it has a practically closed vehicle fleet. Its government has sponsored research into developing alternative fuels to reduce its dependence on imported oil, such as hydrogen vehicles and electric cars, both of which would utilise the nation's abundant hydro-electric and geothermal resources for creating stored energy. While this could make it a contender for developing purpose-designed road charge instruments, its fleet of 214,885 registered vehicles, of which 187,442 are automobiles, is small and its road network dispersed, and it would have few economies of scale in doing so. There have also been recent proposals to review and reform its road charge system, transferring more of the taxation from vehicle charges to fuel charges to more explicitly reflect greenhouse emissions and encourage the uptake of alternative fuels for transport use (Svanbjornsson 2008).

The recent world financial crisis has hit Iceland particularly hard, and is likely to increase the price of imported petroleum fuels. It is likely to halt the recent rise in vehicle registrations (which grew by 63 percent between 1995 and 2005) and slow the development of alternative charge mechanisms.

NORWAY

Norway is a long mountainous country on the periphery of Western Europe, with a lower proportion of vehicles from outside the country compared to those closer to the core regions. Congestion became a significant problem in the larger cities and at bottlenecks caused by topographical constraints around the country.

³⁴ Icelandic Ministry of Finance: www.ministryoffinance.is/customs-and-taxes/nr/1764

There is little literature (in English) about the cost allocation processes used in Norway. As in other countries, there is an attempt to attribute costs of road-wear to heavy vehicles and reflect these in the charges for those vehicles. Norway uses a power relationship of 2.5 rather than the usual 4 to relate road-wear to axle weights (Eriksen 2000). Given its northern location, environmental factors such as freeze-thaw action, snow cover and melt water may be expected to account for a higher proportion of repairs and maintenance than in more temperate countries.

Road related revenues in Norway predominantly come from fuel taxes (43 percent), vehicle purchase taxes (28 percent), ownership (annual registration) taxes (17 percent), tolls (9 percent) and other sources (3 percent). These revenues do not go into a dedicated road fund and only about half of them are returned to road funding uses. Distance charging is predominantly achieved via the fuel tax, while weight is charged with differentiation of vehicle licensing fees.

Norway's contribution to road use charging is its extensive experience of tolls, which have been used to fund public roads since the 1930s. In 1986 the tradition of tolls on link roads, tunnels and bridges was extended with the first cordon toll ring implemented on existing streets in the city of Bergen. This was followed in 1990 by a similar scheme in the capital Oslo, and in 1991 in Trondheim, and others have since been used in smaller cities. In all cases the purpose of the tolls was primarily to raise revenue to accelerate implementation of road improvement projects that were already planned, but which would take up to 30 years to complete in the absence of the alternative funding provided by the cordon toll scheme. All schemes were for a finite period only, usually around 15 years, and required agreement of the local councils and dispensation from the national government. The Trondheim scheme was terminated in 2005. The schemes in Oslo and Bergen were granted extension to raise funds for further work (including public transport improvements) and debate is still on-going on whether to change the schemes to time-differentiated congestion pricing.

The significance for road use charge development is the integration of toll financed roads, tunnels and bridges into the overall road network, and the practical implementation of electronic charging systems to facilitate the toll collection schemes. While early toll plazas involved manual collection of tolls, most tolls now use an Autopass system with prepaid tickets, with coin operated booths only for infrequent users (such as foreign tourists). Toll generally differentiate between private cars and heavy commercial vehicles, although the differential is generally more related to space requirements than its wear effects on the roads.

Braethen & Odeck (2006) examine the experience of private toll companies in the funding of road construction in Norway, where around 25 percent³⁵ of highway funds come from road toll revenues. Although toll financing has been used in Norway since the 1920s, its proportional contribution to funding was consistently around 5 percent, until it started rising about 30 years ago. Reasons for the increase in toll funding include increasing

³⁵ This refers to toll revenue as a share of spending on roads, in contrast to the 9 percent mentioned earlier which is the share of tolls in total road-related revenues, including fuel taxes and sales taxes diverted to other uses.

maintenance costs for expensive road projects, greater focus on traffic safety and political constraints on funding for transport projects, combined with constantly increasing traffic creating pressure for new roads. The political funding constraint is not due to scarcity in Norway, which is generously endowed with revenues from exploitation of its oil and gas resources, but from the risk of distorting the Norwegian economy from large tax-funded infrastructure investments. Although tolling is well established in Norway, the average Norwegian motorist is not in favour of road tolling. While public acceptance of the urban toll rings has increased since they have resulted in visible improvements in transport networks, with new roads, tunnels and public transport interchanges built, there remains widespread opposition to their spread.

OTHER COUNTRIES

The literature survey uncovered several other countries associated with innovative road charging instruments, but limited details have emerged. Conventional link tolls are commonly employed in many countries, particularly in France, Italy and Spain where substantial portions of the motorway network are provided on this basis. Also in Europe:

- The Dutch government is reported to be planning a satellite-based charge on all roads in the Netherlands in 2011, differentiating charges according to time, place and environmental factors;
- Slovakia is planning to introduce a satellite based heavy vehicle toll system, to replace the coupon-based system currently in place, from 2009;
- The Hungarian Transport Ministry has called a public procurement tender for creating and operating a national electronic toll payment system based on a GPS platform for heavy vehicles, to commence operation in 2009.

Further details, such as they are, are to be found on www.eroad.co.nz . Another source of information on road pricing is the UN Commission for Integrated Transport (CFIT), found on www.cfit.gov.uk . Both these sites appear to be enthusiastic advocates for electronic road charging in all its forms, and provide little basis for comparing the costs and benefits of the different options or why they have developed as they have.

Appel and Jordi (2005) provide an overview of the system in Europe and in Finland where the road budget is determined as part of the state budget. Taxes are collected for general use and are not related to 'costs of road keeping or social costs of transport'. Their road related taxes are:

- Automobile tax: it is a vehicle registration fee
- Vehicle tax: it is an annual fee paid by cars and vans
- Fuel tax: a levy is included in the retail fuel price
- Propulsion tax: levied on diesel vehicles, electric and gas driven vehicles based on weight. The vehicle and propulsion taxes are calculated on per calendar day basis.

Beyond Europe, literature on road pricing usually starts on Singapore, which since 1975 has had a system of urban road pricing, along with other high taxes on vehicle ownership intended to reduce congestion in the city. Elsewhere in Asia, Japan has a long history of tolls to finance link roads.

In Chile, Santiago has variably priced toll roads, introduced with manual fee collection in 2004 and with electronic charging based on Dedicated Short Range Communications technology since 2007.

APPENDIX 4: FURTHER TECHNOLOGY INFORMATION

HOW NEW ZEALAND MIGHT PURSUE TECHNOLOGY-BASED SOLUTIONS

Hyder Consulting advised us that:

- currently there are over 10 commercial providers of vehicle tracking systems operating in New Zealand (purely commercial and voluntary, generally for fleet management and logistics purposes)
- these New Zealand systems are all based on GNSS devices; and some are augmented for various purposes (at least one provider also uses the same information to generate accurate near real time traffic information)
- around 30 000 New Zealand vehicles are currently using on board technology to connect with some form of GNSS fleet tracking system, and this number is increasing by around 500 vehicles per month
- each system has been independently designed and implemented for a variety of purposes
- the indicative cost to an operator (per vehicle) for an all inclusive package is generally in the vicinity of \$100 per month, with some variation between providers, dependent on the services and equipment provided
- current GNSS OBUs retail for around \$500 each with a raw accuracy of 5-7 metres and are fitted with communications capability, in many cases include augmentation systems and a few include security and tamper reporting systems; and some commercial systems operators include the purchase price in their monthly charge
- security is not a focus for the majority of these systems
- vehicles connecting to the system are not all heavy vehicles
- a small number of companies with large fleets of trucks also operate their own tracking systems.

Hyder noted that: *"These facts set New Zealand apart from direct application of the European charging and enforcement models. However voluntary uptake of a complete, well architected secure technology system that is largely automated, simple and effective to operate may be a suitable way forward in providing long term benefits to all stakeholders"* (2008, p. 4); and, in doing so, also highlighted the following cautionary points.

- GNSS is prone to a number of weaknesses such as canyoning (bouncing signals) and loss of signal at certain locations (due to canopy cover) and times (poor satellite constellation reception).
- Adoption of technology will rely on building understanding and delivering sufficient benefits to each of the parties to gain their cooperation. A well thought out, strategic, cooperative approach to

application of technology offers significant long term cost, output and outcome benefits at a variety of levels. To achieve this will require sound strategic analysis; strategic business architecture; strong political will; appreciation of wider business drivers, government objectives and inclusion of associated business requirements.

The NZIER literature review also noted that issues remain over signal shadowing and canyon effects among urban high rise buildings, and risks of map matching not correctly identifying the road travelled on. A further concern with GPS noted by NZIER is the relative ease by which publicly available signals can be jammed by unintentional or deliberate interference by other transmission devices. NZIER, however, also found that the future is likely to rest with satellite navigation units.

The Review Group agrees with the view expressed by Hyder Consulting that *"...a technology based road user charges solution, including an automated enforcement system is a valuable strategic opportunity to address commercial profit objectives relating to fleet and driver management, freight logistics and automated business process to reduce administrative costs and time delays for compliant operators"* (2008, p. 56).

MONITORING AND ENFORCEMENT CONCEPTS

We have also noted and generally support the Hyder view that *"automated enforcement systems would strongly promote commercial equity by detecting, reporting and potentially automatically fining those who deliberately break the law to undercut rates of compliant operators"* (2008, p. 56). We emphasise, however, that we do not see automatic fining as an essential component of any initial eRUC system. We expect that would give rise to complex policy and legislative challenges that are beyond our ability to address in the course of this relatively short review.

Current RUC evasion techniques can be minimised by the introduction of the OBU and layers of monitoring and enforcement sites. Strategic monitoring and enforcement sites would require some roadside infrastructure, which would be the highest capital cost element of technology falling on the public sector.

Well designed and implemented automated audit and enforcement systems may readily and significantly reduce RUC evasion levels from the current New Zealand estimate of 5 – 10 percent. For example, the German LKW Maut system has reduced evasion to significantly below 2 percent.

The UK Vehicle and Operator Services Agency 'VIPER' automated number plate recognition/weigh in motion (ANPR/WIM) trials showed a 700 percent increase in the identification and prohibition of overweight vehicles. The German and UK systems are indicative of the inroads that strategic sites in addition to a GNSS based system could make to current New Zealand RUC evasion issues.

We have noted the following as potential social benefits associated with the development of a network of automated audit sites:

- The revenue gains from diminished RUC evasion practices. With increased perception that RUC evaders will be detected and penalised by automated electronic audit followed with targeted enforcement, evasion will decrease.
- Travel time savings for compliant truck operators. Operators who are recognised by the automated systems as compliant are unlikely to be stopped with a time saving for the driver and vehicle.
- More productivity from better targeted policing. Compliant operators will more often than not be able to pass weigh stations without being stopped for a traditional enforcement check. Police will have a sound and unbiased evidence base to focus on targeted enforcement of persistent offenders.
- Safety aspects with respect to entry and egress from inspection points. With a reduction in number of heavy vehicles entering and leaving weigh stations other drivers face a reduced collision risk.
- Wider aspects of network reliability and maintaining free-flow conditions: Drivers of compliant commercial vehicles are able to continue potentially at highway speed. With a potential reduction in number of heavy vehicles entering and leaving weigh stations delays to other drivers are minimised and the network becomes more reliable.
- Wider aspects of network monitoring and management: Significant benefits may be gained in terms of monitoring and managing the network.

SUGGESTED APPROACH TO THE RECOMMENDED TECHNOLOGY TRIAL

Assuming willingness to participate on the part of government agencies, transport operators, and technology service providers, the Review Group suggests an initial 6 month trial, commencing as soon as possible. We note that the operation of the trial would likely benefit from the assembly of a steering committee comprising of both government and private sector representatives.

Consideration should be given to selecting a reasonably wide mix of transport operators to participate in the trial. This would, we suggest, include businesses that operate collectively across a variety of sectors and who undertake both urban and rural transport activities. Such a mix of operators and variety of sector activities will provide data that is more broadly representative.

With this in mind we also suggest that, if possible, the trial include some fleet operators who currently believe that a paper based system is more effective (ie, to test whether their views might change if given the opportunity to use and become familiar with the alternative, electronic approach). Such truly representative data should inform future consultation and decision-making about any change to the current RUC system.

Finally, in respect of the trial, we suggest that the trial involves, as far as practicable, as many tracking system providers as are willing and able to participate.

The Review Group estimates that the cost of a trial would be between \$1- \$2 million, including the development of a web service interface and basic accreditation of service providers against standards and

security protocols adopted for the purposes of the trial. There would be no cost to government for provision of OBUs, as these are provided by and under contract between the service provider and the transport operator.

Very briefly, key tasks to be undertaken in the course of 12 months preparing for and completing the trial would include:

Phase 1: Establishment and planning (2 months)

- preparing a concept of operation
- establishing a steering group
- recruiting and briefing transport operators and service provider participants
- defining business drivers across government agencies, Police, transport operators and service providers
- procurement of any necessary specialist advisors.

Phase 2: Development (3 months)

- adopting or defining technology standards and security protocols for the trial
- designing and developing (interim) information technology infrastructure
- considering policy and legislative changes pending migration from the trial to actual implementation of eRUC (ie, in parallel with trial activities).

Phase 3: Testing and evaluation (6 months)

- undertaking trial activities
- evaluating trial data.

Phase 4: Reporting (1 month)

- reporting on trial findings and initiating steps for change if the trial proves the effectiveness of the approach.

EXPLANATORY NOTES FOR DIAGRAM 1

1. **GNSS Satellite:** GNSS (global navigation satellite system) including (and often referred to as) the well known US NAVSTAR GPS system, the Russian Glonass system, the European Galileo system, the Chinese Beidou system and India's IRNSS system. Of these, the only fully operational system is GPS.

2. **Mobile tower:** This tower is representative of the requirement for wireless communications to ensure near real time tracking. Currently mobile data networks such as GSM or 3G are the most commonly used. There is potential in the future for other wireless communications protocols to be used. For example a specialised form of Wimax (wireless wide area broadband) is being developed for use with moving vehicles.
3. **Commercial tracking service:** There are currently a range of NZ Fleet tracking providers who use GNSS to monitor vehicle movements of their client's fleets for various commercial purposes such as claiming RUC off road rebates and management, driver management, speed monitoring, logistics, agricultural and travel times.
4. **Transport operator:** A transport operator is representative of a RUC customer. It is recognised that there are both light and heavy vehicle customers however the uptake of a technology based RUC system is more likely to have commercial advantage to a heavy vehicle operator that is already using or considering a fleet tracking system.
5. **Independent (Transport Operator) company tracking system:** There are currently a small number of large firms in NZ who use GNSS to monitor vehicle movements of their own fleets for various commercial purposes. This is an expensive option that may only suit large fleets. There is potentially an increased scope to tamper with data when compared to an independent tracking service.
6. **Transport Sector standard web service interface:** This is an extensible, standardised pool of real time, continuously available data relating to the transport sector. The principle is that each data set is collected once only, by one input device (creating simplicity and eliminating duplication of resources). The data is then available at various levels of legitimate use. For example RUC administrators might require access to vehicle and fleet routes taken and distance charged. Providers of traffic information for real time traffic broadcasts might require the number of vehicles and the average time taken to travel between points, crash, road works and weather information. Personal and vehicle information would be "anonymised" preventing identification to protect privacy. Transport operators might require all data relating to their own fleets and vehicles. This might include RUC, Certificate of Fitness (COF), licensing information (vehicle, operator and driver), location, speed etc. The data in the pool may technically be virtualised (not required to be physically stored in one database) although a database is another definite option. The exact nature of the interface will be subject to definition, by legislation, by private sector commercial forces (possibly guided by Government), and / or by lengthy negotiation and consultation process.
7. **RUC admin:** The RUC admin is the role currently provided by the NZTA ECU and agencies. This role is responsible for managing, auditing and debt recovery/ civil law enforcement of the RUC system.
8. **Automated audit/ enforcement / weigh in motion site:** Given that the primary stream of RUC data will be collected electronically without any physical means of inspection a possibility exists that the electronic data could be tampered with to evade RUC tax. The purpose of strategic

automated sites is to provide a physical verification of the primary electronic stream of data. If the verification fails an "exception report" may be generated for investigative or enforcement action. The sites may consist of standard technologies such as high resolution digital cameras with images processed by ANPR (automated number plate recognition) to recognise vehicles by number plate, DSRC (digital short range communication) to communicate with OBUs (11) of passing vehicles and weigh in motion equipment that weighs axle by axle at highway speed. The advantage of this system is that a large pool of accurate data is accumulated showing both consistent patterns of compliance with the law (permitting reduced enforcement stops and lost time) and highlighting consistent patterns of non compliance (enabling targeted enforcement of non compliant and evasive operators).

9. **RUC service:** In a service oriented architecture (SOA) each business process is carried out by a "service"
10. **Other Transport Information services:** In a SOA relating to vehicles other services may potentially include: Traffic management, travel demand management, driver monitoring systems, vehicle monitoring systems, vehicle safety and control systems, fleet services, public transport services and integrated ticketing, electronic payment services, ecall
11. **OBU (electronic control unit):** This unit collects one or more streams of electronic information. The fields below are indicative dependent on system requirements:
 - a) Positioning chipsets for general commercial use are currently accurate (at device level) to around 5-7 metres with older and less expensive devices having reduced accuracy. GNSS is prone to a number of weaknesses such as canyoning (bouncing signals) and loss of signal at certain locations (due to canopy cover) and times (poor satellite constellation reception). GNSS receivers form a part of the system with communications and back office systems supporting the receivers.
 - b) Transport Service Licence number is a key field to identify information about which licensed transport operator is operating the vehicle at a point in time.
 - c) Gyroscopes are essentially movement sensors that are capable of approximating position and either confirm GNSS signals or in their absence provide a degree of reliability to tracking.
 - d) Onboard scales are electronic methods of determining weight of the vehicle and its load. These technologies are currently claimed to be accurate to within 10 percent. Alternately some international examples require self declaration of weight by the driver, others rely on axle configuration and others rely on the specified gross laden weight of the vehicle (rather than the actual weight).
 - e) Wheel revolutions are an accurate indication of the physical distance travelled and may be obtained from a variety of points on a modern vehicle. This is the function of the current mechanical hubodometer.

12. Mobile ANPR: (automated number plate recognition) records images using high resolution digital cameras assisted by IR (infra red) or other technologies for night time detection. The images are automatically detected and processed, accurately and automatically reading the number plates of around 95 percent of vehicles, at highway speeds and forwarding images that cannot be recognised to operators for manual inspection. ANPR in this system positions a known vehicle at a given time and place for automated cross referencing with the position information obtained from the tracking service. Any significant difference in reported position (via the tracking service) and actual position (via the ANPR coupled with GPS) would result in an exception report, ideally within four seconds, enabling the enforcement officer to stop and check the vehicle if required.
13. **Handheld device:** A handheld device is essentially a hand held computer that may contain a number of features to simplify the enforcement task. It is not feasible to carry a laptop computer around a vehicle combination while performing an inspection however it is feasible to carry a hand held (PDA or XDA). The features required are likely to include:
- a) An imaging device (camera to scan 2D and 3D bar codes), this enables highly accurate electronic collection of vehicle, transport service licence (and for other purposes) drivers licence numbers as key reference fields.
 - b) Wireless communications including:
 - i) DSRC to obtain information from the OBUs,
 - ii) Wireless to a nearby computer (or directly through the mobile data network) to the NZTA or Police computer network or possibly directly to the transport sector standard web service interface.
 - c) GNSS receiver (to confirm electronic position).
 - d) Browser capability.

Health and safety considerations might suggest use of the slightly larger XDA rather than the smaller PDA.

14. **Laptop connected to Police network:** This indicates that an enforcement officer should have immediate access to a full size computer within the immediate vicinity of an enforcement check. The requirement is to minimise the time spent using the hand held devices for data entry and for ease of checking.
15. **Enforcement Officer:** This instance refers generally to Police CVIU as the predominant RUC enforcement group but does not exclude other Police or NZTA enforcement staff. Note: NZTA enforcement staff do not connect to the Police network.

DSRC (digital short range communication) generally between "RFID tags" or OBUs carried in vehicles, corresponding roadside infrastructure and handheld devices used by enforcement officers to collect vehicle specific identification data at highway speed. DSRC is widely used in tolling and

vehicle safety systems. The 5.9 GHz radio frequency band is widely used internationally for DSRC and the range is around 100 metres. This provides an effective communication time in excess of three seconds for a moving vehicle travelling at 100km per hour.

APPENDIX 5: KEY IMPLEMENTATION TASKS AND LEGISLATIVE IMPLICATIONS

Tasks	Trial	Option A	Option B	Key stakeholder
1. Prepare concept of operation	●			NZTA
2. Establish a user group	●			NZTA
3. Define business drivers across NZTA, Police, operators and service providers	●			NZTA, Police, operators, service providers
4. Define standards, security and accreditation protocols for trial	●			NZTA and user group
5. Design and develop information technology infrastructure	●			NZTA and user group
6. Prepare legislative changes	●			MOT
7. Undertake trial	●			NZTA and user group
8. Develop process for auditing service provider and enforcement procedures	●			NZTA, Police and user group
9. Re-define payment channels: <ul style="list-style-type: none"> - develop low cost internet option - decide service provider(s) for counter service - prepare for phasing out of other options (i.e. Direct Connect, phone-fax) 	●	●	●	NZTA
10. Re-define CAM in line with Review recommendations including: <ul style="list-style-type: none"> - allocate space related costs by using a space related measure - local authority revenue re-allocated - average loading assumption for trailers amended to 45 percent - incorporate network access fee - replace operator nominated weight with maximum (permissible) gross laden weight 		●	●	MOT

11. Finalise:				
- guidelines for standard interface with NZTA		●	●	NZTA and user group
- security and accreditation guidelines for OBU's		●	●	NZTA and user group
- protocols to be an approved operator by NZTA		●	●	NZTA
- credit arrangements for RUC payment		●	●	NZTA
- penalties for late payment		●	●	NZTA
12. Finalise information technology infrastructure		●	●	NZTA and user group
13. Commence phasing out of hubodometers		●	●	NZTA
14. Align/ incorporate diesel refund process with GST return system			●	IRD
15. Oil companies to collect excise duty for diesel at refinery			●	Oil companies
16. Develop communication plan		●	●	NZTA and MOT
17. Finalise legislative changes		●	●	MOT and IRD

Note: Tasks under Option A and B can be developed in parallel with the trial. This would facilitate full implementation of the chosen option upon completion of the trial. Pivotal to the implementation of Option B is the alignment of the GST process for refunds and the oil companies collecting excise duty on diesel.

LEGISLATIVE IMPLICATIONS

OPTION A

Many of the recommendations in this report have legislative implications. Changes to CAM can be made without legislation, but the resulting changes to RUC will need to be implemented by an Order in Council (a regulation) to amend the Third Schedule to the Road User Charges Act 1977. The Order in Council must then be confirmed by an Act of Parliament. If the Order in Council is made in the first half of the calendar year, it must be confirmed by the end of that year; and, if it is made in the second half of a calendar year, it must be confirmed by the end of the following year.

With a few exceptions, our 'revenue collection' recommendations will require amendments to the Road User Charges Act 1977. The exceptions include the following:

- Changes to the annual licence fee are implemented by way of an Order in Council under the Land Transport Act 1998. This would also be confirmed by Parliament with the same time constraints as for RUC changes. Depending on the policy a change to the empowering provisions of that Act may also be required. This is particularly relevant to recommendations related to recovering non-use related expenditure on the road network.
- Regulations may be made under the Road User Charges Act 1977 relating to hubodometers. A general modernising of this area of the law is desirable as modern technology becomes more feasible.
- The timing of reviews of RUC can be organised without the need to legislate. It is also possible to give prior notice of changes administratively, but, for certainty, this aspect should be included in legislation. Legislation would be required to give effect to our recommendations about the expiry of RUC for heavy vehicles after notice of a forthcoming change in RUC rates.
- Provisions relating to odometer tampering are contained in the Land Transport Act 1998. The Act would require amendment to address our recommendations.
- Regulations can be made under the Road User Charges 1977 to give effect to our recommendation that vehicle inspectors have a duty to report a vehicle's distance recording.
- The recommended trial of electronic technology can be implemented without legislation provided that participating vehicles continue to meet current legislative requirements.
- Recommended changes to the NZTA RUC purchasing channels can be implemented without legislation.
- Any changes to prescribed RUC purchase transaction fees (including revoking fees that would be no longer required as a result of removing some payment channels) would be made by way of regulations made under section 168 of the Land Transport Act 1998.

OPTION B

The legislative implications of Option B, as it still retains the RUC system, are similar to Option A with diesel excise duty additions. The setting of an excise duty on diesel would require straightforward amendments to the Customs and Excise Act 1996, but more complex legislation (in a statute we were not able to identify) would certainly be required to establish a refund system.

OPTION C

Like Option B, the setting of an excise duty on diesel would require straightforward amendments to the Customs and Excise Act 1996 and more complex legislation (in a statute yet to be identified) for a refund system.

All RUC legislation would be repealed. The new graduated weight based fees would be set by Order in Council under the Land Transport Act 1998 and confirmed by Parliament.

APPENDIX 6: DELOITTE EVALUATION INFORMATION

Deloitte were commissioned to provide an economic assessment and financial analysis of the revenue collection options, of which summary extracts are provided below.

It should be noted that for the economic assessment Deloitte were asked to assess a variant of Option A that included removing all light vehicles from the RUC system and replacing this with a fixed annual charge. While this represents a significant difference, it does not make any material variation to the conclusions reached.

Deloitte also undertook to assess the economic merits of an eRUC system for all vehicles, despite this proposal being seen as aspirational by the Review Group. This is referred to as Option D below.

CONCLUSIONS ON ECONOMIC ADVICE

Based upon the evaluation of each option, a scoring which compares the relative performances of each of the options against the status quo was undertaken. Each of the options were rated using a scale of 1 to 5 compared against the status quo current RUC system – where a 3 is neutral compared to the status quo and a 1 is poor performance and a 5 is good performance.

Criteria	Option A	Option B	Option C	Option D
Effectiveness	<p>Rated 4-5</p> <p>< 3.5 tonnes more effective, with reduced opportunity for non-compliance</p> <p>> 3.5 tonnes more effective, less room for weight non-compliance</p>	<p>Rated 4 short term but 3 long term</p> <p>Diesel excise is an effective way to raise revenues however over time this effectiveness may weaken with new vehicle technologies</p>	<p>Rated 4 short term but 3 long term</p> <p>Diesel excise is an effective way to raise revenues however over time this effectiveness may weaken with new vehicle technologies.</p> <p>Removal of RUC makes this option slightly more effective than Option B as there are fewer opportunities for non-compliance.</p>	<p>Rated 1-2 in the short term but 3-4 in the longer term as technology reliability improves.</p> <p>Currently significant uncertainty around implementability, compliance costs and reliability.</p> <p>However assuming these can ultimately be overcome this option allows for effective implementation of cost recovery principles as well as</p>

Criteria	Option A	Option B	Option C	Option D
				marginal pricing principles.
Efficiency	<p>Rated 4</p> <p>Simplifies administrative costs to both business and government, particularly in respect of weight measurement.</p> <p>Encourages HGVs to carry maximum loads and use of diesel vehicles generally where long distances travelled.</p> <p>Retains usage based charges in RUC system for all vehicles over 3.5 tonnes (compared against 6 tonnes for Option B). Direct price signals therefore retained for a large category of vehicles.</p> <p>However price signals absent for vehicles under 3.5 tonnes which may encourage higher road usage than is desirable.</p>	<p>Rated 1-2</p> <p>Introduction of diesel excise creates a new administrative burden, including systems for refunds in respect of off-road use of diesel and non-road users of diesel.</p> <p>Partially offset by similar cost reductions to Option A.</p> <p>RUC based on max gross laden weight encourages HGVs to carry maximum loads.</p> <p>Diesel usage is the primary means of sending price signals to all vehicles not paying RUC</p> <p>However diesel usage is only a proxy for distance and weight and this may tend to distort price signals – particularly over time.</p>	<p>Rated 3-4</p> <p>Introduction of diesel excise creates a new administrative burden, including systems for refunds in respect of off-road use of diesel and non-road users of diesel.</p> <p>However costs of compliance to operators will be significantly reduced – i.e. shifts costs from operators to government (noting that the deadweight burden of the collection costs will need to be incorporated into the CAM)</p> <p>Diesel usage as a proxy for distance and weight will tend to be less efficient as a means of sending price signals – notwithstanding the license fee “top-up” for HGVs based on weight.</p>	<p>Rated 4-5 short term, potentially 2-3 longer term</p> <p>It is currently unclear how significant would be the cost both to Government and road users of implementing an e-RUC system and the cost of enforcement and verification systems.</p> <p>More efficient than any of the other options in sending appropriate pricing signals, with the potential for even greater benefits should road pricing be implemented in future.</p>

Criteria	Option A	Option B	Option C	Option D
Cost recovery principles	<p>Rated a 4</p> <p>Option is expected to improve the simplicity and transparency of the system. There will however be increased averaging for light vehicles in respect of distance.</p> <p>However, overall the trade-off between simplicity and accuracy of cost allocation is expected to deliver cost savings to the economy.</p>	<p>Rated a 2</p> <p>Option is expected to improve simplicity of the system for road users, but create complexities for road users with high off-road use, non-road diesel users and diesel suppliers.</p> <p>It is also expected to reduce the transparency of cost allocations through a three-tiered structure for heavy vehicles.</p> <p>It is not clear whether the trade-off between simplicity and accuracy of cost allocations will deliver overall cost savings.</p>	<p>Rated a 3</p> <p>Use of a fuel excise duty is expected to simplify the system for road users, but place complexities on road users with high off-road use, non-road diesel users and fuel suppliers.</p> <p>It is also expected that the transparency will be improved although this will be at the cost of significantly increased averaging through use of fuel excise and MVR license fees differentiated based on weight alone (no distance component).</p> <p>The trade-off between simplicity and accuracy of cost allocations may be warranted based upon expected cost savings (it is likely that the cost savings will be greater than under Option B).</p>	<p>Rated 4-5</p> <p>The option simplifies the charging structure around weight. It is unclear whether the option would improve transparency or not, given the potential 'black box' nature of using an on board unit.</p> <p>Trade-off between simplicity and accuracy of cost allocations is unlikely to be justified given possible high costs of implementation, but these are essentially sunk costs, so could deliver benefits over the longer term.</p>

Criteria	Option A	Option B	Option C	Option D
Equity	<p>Rated 2</p> <p>Creates inequities around distance based charging (for light vehicles) and greater averaging of weight for heavy vehicles.</p> <p>To an extent these are offset by the perception at least of reduced opportunities for non-compliance (i.e. enhanced effectiveness).</p> <p>Retains inequities between diesel and petrol powered vehicles.</p>	<p>Rated 3</p> <p>Introduction of diesel excise duty as a proxy for distance and weight mutes impacts noted in Option A.</p> <p>However of itself the diesel excise introduces inequities around fuel consumption and in relation to refunds for off-road use of diesel.</p> <p>Reduces inequities as between diesel and petrol powered light vehicles.</p>	<p>Rated 2</p> <p>Similar to Option B.</p> <p>However complete replacement of RUC with a combination of diesel excise and license fees substantially increases the use of averages and proxies and inevitably this introduces inequities.</p> <p>For HGVs this will mostly relate to distance, for light vehicles to fuel efficiency.</p>	<p>Rated 3</p> <p>e-RUC is effectively a replacement of the current paper system.</p>
Broader policy objectives	<p>Rated a 4</p> <p>This option may encourage long distance light vehicle road users to purchase diesel vehicles</p>	<p>Rated a 4</p> <p>Implementation of diesel excise duty could be beneficial in signalling pricing of environmental externalities.</p>	<p>Rated a 4</p> <p>As for Option B</p>	<p>Rated a 3 in the short term but 5 in the long term</p> <p>e-RUC does not signal a significant change from the current environment. However, the potential for implementing a range of price signals such as in relation to congestion is huge for this option over the longer term.</p>

Criteria	Option A	Option B	Option C	Option D
Future proofed	<p>Rated a 4</p> <p>Strong incentives for the voluntary installation of OBUs into HGVs – which is the first step towards enabling road pricing more generally.</p> <p>Option A does not create any barriers to progressing towards road pricing and is unaffected by changes in vehicle technology impacting on the validity of fuel usage as a good proxy for distance and weight.</p>	<p>Rated a 3</p> <p>Some incentives for the voluntary installation of OBUs into HGVs, but weaker than in Option A as RUC charges will be lower.</p> <p>Introduction of diesel excise could create barriers for a transition to road pricing and over time the validity of fuel usage as a good proxy for distance and weight is likely to weaken.</p>	<p>Rated a 2</p> <p>Incentives for voluntary installation of OBUs restricted to vehicles with high off-road usage only.</p> <p>Similar issues to Option B in respect of diesel excise duty.</p>	<p>Rated a 5</p> <p>This option makes the installation of OBUs mandatory across the entire vehicle fleet which would be a huge step forward towards road pricing.</p> <p>At the same time it does not introduce diesel excise duty and indeed seeks to remove petrol excise duty over time.</p>

In carrying out this analysis the Review Group requested that a conclusion was not reached as to a specific option to be implemented or used as a replacement for the existing RUC system. The purpose of the evaluation is to assess the relative merits of a range of potential alternatives to the current RUC system to help inform the recommendations of the Review Group to Government on what, if any, changes should be made.

Both the current system and each of the options evaluated represents a trade off between competing objectives. On the one hand the current scheme has been conceived as a means of tying back charges as closely as possible to the costs each user imposes on the system. On the other hand, for the system to be workable it has to be sufficiently simple to be understandable to users and those charged with its enforcement and administration. This inevitably leads to averaging of charges across user groups and the associated inequities and cross subsidies this causes.

In developing the options for assessment we have taken a longer term view of what may be achievable with developing technology. Option D represents a possible initial step towards a “price per kilometre” charge for all road users using tracking and enforcement technology which is becoming available. In assessing the existing

RUC system and options A to C we considered the extent to which they facilitated or hindered an eventual move to such a system. Consideration of whether this is an important criteria or not depends upon whether Option D provides a better compromise between the competing criteria which the current system is trying to balance than the existing RUC regime.

We hold the view that road pricing has the potential to be a more effective and equitable road charging mechanism with higher costs offset by its much greater flexibility to charge based on location and time of day in the future making it a much more powerful tool for the implementation of Governments policy aims and objectives. As such it was considered to be one of the high priority evaluation criteria.

Option A provides some useful simplifications to the existing RUC system, improving its efficiency whilst remaining effective in collecting charges for road use. It remains based on the principles of weight and distance and provides incentives to adopt technology which would eventually assist a transition to road pricing. It is the most attractive of the options analysed and an improvement on the status quo although simplicity is achieved at the expense of equity.

Option B is a somewhat unsatisfactory compromise, adding a new collection mechanism without wholly eliminating any of the existing ones. Never the less it remains effective although its efficiency is compromised by the need to develop a new collection mechanism whilst retaining significant parts of the existing ones, and by its use of diesel excise duty as a somewhat unsatisfactory proxy measure for distance and weight for a large category of vehicles. It also requires an entire new category of businesses to interact with government with respect to refunds on diesel excise used entirely for non road purposes. Without a full financial analysis it is not possible to identify the extent of overall savings versus the status quo but it is likely to be a less efficient option than A. It goes some way to solving the inequities created in Option A, but introduces other complications in relation to refunds.

Option C is simple in concept but potentially costly to implement initially. It is also the least equitable option analysed and creates the most difficulty in transition to a road pricing regime. It essentially largely abandons the principles of cost allocation and recovery on which both the existing RUC system and road pricing are based on and lacks the flexibility to readily accommodate alternative fuelled and electric vehicles. Like Option B it also requires an entire new category of businesses to interact with government with respect to refunds on diesel excise used entirely for non road purposes.

The standing of Option D in the analysis is largely due to the cost of establishment and the fact that it is initially used only as a distance based charging mechanism. This option is not deemed cost-effective or economically viable in the short term due to the need make it mandatory across the entire diesel fleet.

As technology develops further Option D has the potential to provide the best balance between the competing objectives of a road user charging system being effective, efficient and equitable whilst providing the capability for both location and time based charging.

SUMMARY OF FINANCIAL MODELLING

To supplement the economic advice the Review Group requested financial modelling to provide comparative analysis of the key cost drivers of implementing and operating the alternative charging options – both to Government (admin costs) and to operators (compliance costs).

For this supplementary report the Review Group requested that Option D not be costed as the costs are too uncertain at this time. It further requested that a variation to Option A be costed which was not considered in the Economic Advice – this is Option A1.

It is important to note that the figures described below are based on indicative input assumptions which in many cases are highly subjective and therefore potentially subject to material inaccuracies.

Whilst every attempt has been made within the time available to gather data which enables reasonable estimates to be derived, it is appropriate to consider the analysis from an indicative comparative perspective only as the absolute figures could vary significantly at the point of implementation and operation.

All figures are in \$2008 and are rounded to the nearest hundred thousand dollars.

Costs	Option A	Option A1	Option B	Option C
Upfront Govt	\$7.2m	\$6.8m	\$10.1m	\$9.8m
Ongoing Govt	\$55.9m	\$57.3m	\$49.2m	\$42.0m
Operator costs	\$31.3m	\$36.6m	\$31.2m	\$22.4m
Total Ongoing	\$87.2m	\$93.9m	\$80.4m	\$64.4m
Benefit vs status quo	\$14.4m	\$7.7m	\$21.2m	\$37.2m
Payback period	0.5 yrs	0.9 yrs	0.5 yrs	0.3 yrs

The implementation costs are relatively low compared to annual administration / compliance costs and furthermore relatively similar across the options so this is not a material differentiating factor. Options B & C are higher due to the cost of implementing a system around diesel excise payments (and refunds).

Option C has lower ongoing costs than the other options and is also significantly less costly to operate than the current system (status quo). Indeed, this is the key reason why Option C has been included in the overall economic analysis.

Option C sees the removal of the current RUC system completely and replacement with increased MVR license fees for HGVs, with minimal cost as the MVR license fee system is already well established, and a new diesel excise regime. Whilst implementing a diesel excise regime entails some new costs – particularly relating to

processing applications for refunds – these are likely to be substantially lower than the costs of administering a RUC system.

Furthermore Option C has the lowest use of technology and lowest incentives to adopt it since while it allows for the possibility of operators installing OBUs to provide evidence for off-road refunds, it would be expected that the actual level of take-up would be low.

Options A and B are both likely to be somewhat less expensive for the Government to operate than the current system due to the simplification of the RUC system which reduces costs. This is partially offset by increased MVR licence fee transaction costs under Option A and diesel excise refund application processing and compliance costs under Option B. There is significant uncertainty about the costs of operating an efficient system for the processing of diesel excise refunds. Assuming that an approach piggy-backing on the current GST collection framework is feasible, it is considered likely that this would entail lower costs (under Option B) than the uplift in MVR costs (under Option A). For this reason Option A is assessed as more expensive to operate than Option B.

Uptake of OBUs under Options A, A1 and B is assumed to be 20% of the RUC-paying fleet under all options and is assumed to deliver savings in admin costs to both the Government and to operators. These savings are expected to manifest in reduced time to administer RUC licence renewals, and to process RUC refunds for off road use. These savings have been included notwithstanding that there is a monthly lease cost associated with installation of OBUs which is not included here on the basis that OBU installation decisions would be primarily based on broader fleet management benefits.

Although operator costs for Options A and B have been assessed as relatively similar, a key differentiating factor is the deadweight burden to operators required to apply for diesel excise refunds under Option B which does not currently exist – particularly relating to businesses who currently have no interface with the RUC system as their use of diesel is restricted to off-road use (e.g. as an industrial manufacturing component). i.e. under Option A, the operator costs are largely borne by road users, while under Option B a portion of compliance costs shifts to consumers of diesel outside of the road transport sector and who are not the target of the tax.

Option C also bears these higher deadweight diesel refund costs but these are offset at a whole of economy level by reduced RUC admin costs – thus further shifting the compliance burden from road users to non road diesel consumers.

Option A1 represents the least change from the status quo and thus retains most of the current costs – in particular administration of RUC for the entire diesel fleet.

EVASION AND REVENUE LEAKAGE

Since evasion/leakage expectations are built into the CAM and the CAM calculates RUC based on expected revenues net of evasion, this is not a true 'cost' to the economy, it is merely a transfer in cost burden from those who evade payment to those who do not. For this reason it is not included in the summary cost analysis above.

The table below provides an estimate of the value of evasion and how these costs might compare across the options.

All figures are lower than the status quo through the universal removal of actual weight specification within the RUC charging system.

Cost Type	Option A	Option A1	Option B	Option C
RUC evasion	\$6m	\$16.4m	\$1.9m	\$0m
MVR licence fees	\$12.4m	\$2.9m	\$2.9m	\$5.9m
Diesel evasion	\$0m	\$0m	\$8.3m	\$8.3m
OBU revenue leakage	\$3.3m	\$4.4m	\$1.0m	\$0m
Total evasion	\$21.6m	\$23.6m	\$14.1m	\$14.3m

A key assumption under Option A is that there will be increased rates of non-payment of MVR licence fees annually by light diesel vehicles, due to the substantial increased cost of licensing. Note, that persistent non-payment of MVR licence fees (greater than 12 months) leads to de-registration of the vehicle under current legislation.

CONCLUSIONS

This report suggests that:

- All options considered deliver savings against the status quo, with almost immediate payback on the upfront costs of implementation;
- Option C is the most cost efficient, delivering significant cost savings against the status quo;
- Option B is the next most cost efficient, followed by Option A then Option A1;
- Overall the annual cost savings (ranging between \$8m for Option A1 and \$37m for Option C) are not highly material compared against the total value of the revenues collected (less than 5%);

- The ratings for “efficiency” in the Economic Report should arguably be adjusted to place Option A and B on a more equal footing; i.e. both rated a 3-4 for efficiency where Option A was rated a 4 (better than the status quo) and Option B was rated a 1-2 (worse than the status quo);
- This change in the efficiency ratings does not, however, change the overall assessment that Option A is, on balance, economically advantageous compared against the alternative options, particularly over time; and
- The Economic Advice report did not consider Option A1, but it is clear that this option delivers the lowest level of cost efficiencies.

APPENDIX 7: BIBLIOGRAPHY

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