

Domestic Transport Costs and Charges Study

Working Paper C5 Road Vehicle Operating Costs

Prepared for Te Manatū Waka Ministry of Transport (NZ)
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Disclaimer

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Research, Economics and Evaluation

The Research, Economics and Evaluation team operates within the System Performance and Governance Group of Te Manatū Waka Ministry of Transport. The team supports the Ministry's policy teams by providing the evidence base at each stage of the policy development.

The team is responsible for:

- Providing sector direction on the establishment and use of the Transport Evidence Base (see below) – including the collection, use, and sharing of data, research and analytics across the transport sector and fostering the development of sector research capabilities and ideas.
- Leading and undertaking economic analyses, appraisals and assessment including providing economic input on business cases and funding requests.
- Performing the evaluation function for Te Manatū Waka, including designing monitoring and evaluation frameworks and approaches, developing performance metrics and indicators, and designing, conducting and procuring evaluations.

The Transport Evidence Base

The Transport Evidence Base Strategy creates an environment to ensure data, information, research and evaluation play a key role in shaping the policy landscape. Good, evidence-based decisions also enhance the delivery of services provided by both the public and private sectors to support the delivery of transport outcomes and improve wellbeing and liveability in New Zealand.

The Domestic Transport Costs and Charges study aims to fill some of the research gaps identified in the 2016 Transport Domain Plan (Recommendation R6.2), which forms part of the Transport Evidence Base.

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For more information

For more information about this project and associated report, please contact:

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Glossary of terms and abbreviations

Terms	Definitions or description
50MAX	Heavy goods vehicle with a special axle configuration allowed to operate at a maximum GVW of up to 50 tonnes across all parts of the road network except where explicitly prohibited
AA	Automobile Association New Zealand
CoF	Certificate of Fitness (Heavy Vehicles)
EEM	Economic Evaluation Manual. Waka Kotahi Now superseded by the MBCM
HPMV	High productivity motor vehicle. A heavy vehicle permitted to operate at a gross vehicle mass above that for standard vehicles on specified routes.
HTS	Household Travel Survey, Ministry of Transport
LCV	Light commercial vehicle
MBCM	Monetised Benefits and Costs Manual, Waka Kotahi
WIM	Weight in Motion
Te Manatū Waka	Ministry of Transport
WoF	Warrant of Fitness (Light vehicles only)
Waka Kotahi0	NZ Transport Agency

Executive Summary

Introduction

This working paper describes the operating cost models for cars, trucks and motorcycles. These aim to cover the full range of the vehicle operating costs faced by users of motorised vehicles. For trucks the figures also include the costs of the driver (wage and time costs). For cars and motorcycles, which are primarily used for private travel, these costs have not been included in the basic cost models, but unit values are provided in an appendix.

Car operating costs

Car operating costs have been primarily derived from the models developed by the AA for a range of vehicles of different sizes. These models have a primary focus on the use of private vehicles for business purposes and the results have therefore been adjusted as appropriate to provide information which is more applicable to the car fleet as a whole.

The estimated unit costs for petrol cars align closely with the figures derived from the Waka Kotahi Monetised Benefit and Cost Manual (MBCM).

With the growing interest in electric vehicles, separate models of operating costs have been developed for pure electric vehicles and for hybrid vehicles. Because these are relatively new on the NZ scene, there is an element of uncertainty about the costs for these, especially in relation to their batteries, where the position seems to be changing quickly. This has been highlighted in the analysis.

Truck operating costs

Truck costs have primarily been estimated using the operating cost model developed by National Road Carriers for use by its members considering establishing new services. Because this produces estimates for specific vehicle types and operating patterns, the opportunity has been taken to provide estimates for a wide range of vehicles. Particular attention has been paid to the different operations undertaken by the heaviest vehicles including logging vehicles which have particular cost characteristics and also the operation of vehicles as HPMVs or 50 MAX vehicles.

In addition to the total operating costs of the vehicles, estimates have been made of the typical payloads allowing the costs per net tonne-km to be estimated for different vehicle types and operational characteristics.

Again, a comparison with figures derived from the MBCM indicates a fairly close alignment between the two sets of costs.

Motorcycle operating costs

No current costing model exists for estimating motorcycle operating costs in NZ and one was therefore developed from scratch. This followed the structure developed for the car operating cost model but with specific values related to motorcycle use. A feature of motorcycle use is the relatively low usage, with an average annual distance travelled of about 2,400 kms compared to 11,000 kms for cars: this therefore results in a relatively high cost per km.

Links with other DTCC working papers

The results of this WP have been applied in combination with several other working papers to estimate the total annual user and broader social costs associated with motorised travel and the roading system and provide these in the context of the full costs of the provision, management and use of the road network.

Chapter 1 Introduction

1.1 Study Scope and Overview

The Domestic Transport Costs and Charges (DTCC) study aims to identify all the costs associated with the domestic transport system and its impacts on the wider New Zealand economy, including costs (financial and non-financial) and charges borne by transport users.

The Study is an important input to achieving a quality transport system for New Zealand that improves wellbeing and liveability. Its outputs will improve our understanding of the economic, environmental and social costs associated with different transport modes - including road, rail, public transport and coastal shipping - and the extent to which those costs are currently offset by charges paid by transport users.

The DTCC is intended to support the wider policy framework of Te Manatū Waka, in particular the Transport Outcomes Framework (TOF). The TOF seeks to make clear what government wants to achieve through the transport system under five outcome areas:

- Inclusive access,
- Economic prosperity,
- Healthy and safe people,
- Environmental sustainability, and
- Resilience and security.

Underpinning the outcomes in these areas is the guiding principle of mode neutrality. In general, outputs of the DTCC study will contribute to the TOF by providing consistent methods for (a) estimating and reporting economic costs and financial charges; and (b) understanding how these costs and charges vary across dimensions that are relevant to policy, such as location, mode, and trip type.

Robust information on transport costs and charges is critical to establishing a sound transport policy framework. The Study itself does not address future transport policy options; but the study outputs will help inform important policy development in areas such as charging and revenue management, internalising externalities, and travel demand management.

The Study was undertaken for Te Manatū Waka by a consultant consortium headed by Ian Wallis Associates Ltd. The Study has been divided into a number of topic areas, some of which relate to different transport modes (including road, rail, urban public transport and coastal shipping), and others to transport-related impacts or externalities (including accidents, congestion, public health, emissions, noise, biodiversity and biosecurity).

Working papers (25) have been prepared covering each of the topic areas. Their titles, topic areas and specialist authors are listed in Appendix 1.

1.2 Costing Practices

The focus of DTCC is on NZ transport operations, economic costs, financial costs and charges for the year ending 30 June 2019 (FY 2018/19). Consistent with this focus, all

economic and financial cost figures are given in NZ\$2018/19 (average for the 12-month period) unless otherwise specified.

All financial costs include any taxes and charges (but exclude GST); while economic costs exclude all taxes and charges.

The DTCC economic and financial analyses comprise essentially single-year assessments of transport sector costs and charges for FY 2018/19. Capital charges have been included in these assessments, with annualised costs based on typical market depreciation rates plus an annualised charge (derived as 4% p.a., in real terms, of the optimised replacement costs of the assets involved).

1.3 Paper Scope and Structure

This working paper sets out the operating cost models for cars, light and heavy commercial (freight) vehicles and motorcycles for use in the DTCC study. The costs for urban bus services are considered separately¹. The paper provides estimates of the costs which vary with vehicle use and can therefore be considered as the short-run marginal costs of operation, and those which are fixed (typically annual costs) and would not in principle vary with use at least over the short term. The costs have also been split into the financial costs which the owner/driver of the vehicle would face and the economic costs which exclude duties and levies and so which represent the consumption of resources.

In practice for a number of the costs regarded as fixed there is some linkage with vehicle use, but while this has been noted it has not been taken into account in the appraisal. This particularly applies to vehicle depreciation which would in practice have at least some variable elements with vehicle use. However, while this is recognised, it is difficult to identify with any precision and as a result this has not been separated out in the analyses reported here.

Conversely some of the costs regarded as variable such as maintenance may also have a fixed component. Again, the difficulty of identifying this component and its likely small scale mean that this element has not been included in the analysis. It is however possible that these two effects may cancel out.

The operating costs for cars include an assessment of the relative costs for hybrid and fully electric vehicles. The relative cost for these vehicles, especially fully electric vehicles, is evolving rapidly and the position set out in this working paper is likely to change over the short /medium and longer terms.

The values developed in this paper are in terms of real prices and relate to conditions in 2018/19. In addition, while some of the material on which this analysis is based includes GST, the numbers reported all exclude GST.

¹ The costs for urban bus services are considered separately in WP C12: Urban Public Transport.

Chapter 2 Fuel prices

An important component of vehicle operating costs is fuel prices: these comprise resource costs plus a significant proportion of taxes, duties and levies. The costs of fuel are based on the average pump price for 2018/19 as derived from the Energy Prices spreadsheet published by MBIE². This gives the following costs for 2018/19 (in 2018/19 prices) as set out in Table 2.1. The notes are taken from the MBIE spreadsheet from which the Table 2.1 figures are derived.

Table 2.1: Average fuel prices in 2018/19 (c/l)

Cost component	Regular Petrol [*]		Automotive Diesel	
	Inc GST	Exc GST	Inc GST	Exc GST
Average pump price	212.18	184.50	150.13	130.54
Import cost plus freight and insurance ^{**}	76.34	76.34	82.94	82.94
Duties, taxes and levies ^{***}	72.58	72.58	4.10	4.10
Goods and Services Tax (GST)	27.68	Nil	19.58	Nil
Emissions Trading Scheme levy (ETS) ^{****}	5.13	5.13	5.93	5.93
Gross importer's margin	30.45	30.45	37.58	37.58
Retail price excl. taxes and duties	106.79	106.79	120.52	120.52
Total Duty		77.71		10.03

Notes:

* Petrol prices expressed here are retail prices sourced from Statistics NZ. These are a different source to that published on the MBIE weekly oil price monitoring page and include some measure of fuel docket discounting.

** Import cost is assumed to be ex. Singapore.

*** Excludes GST and ETS

**** The New Zealand Emissions Trading Scheme for liquid fuels started on 1 July 2010. The ETS component of the retail price expressed here is estimated based on a mid-range price for New Zealand carbon units and is an estimate of the price impact of the ETS on New Zealand consumers.

The cost of electricity used for electric vehicles has been taken to be 23c per kWh. This is based on the typical cost of recharging at home although this would vary according to the particular tariff faced by the users. In addition, it does not reflect the different costs which might be faced by users recharging their vehicles in other locations, where the costs might be substantially higher as the providers of the facilities cover their capital and operating costs.

These prices have been used in the subsequent analysis described in this paper.

² <https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-statistics/energy-prices/>

Chapter 3 Car operating costs

3.1 Model development

The costing is based on the car operating cost model developed by the New Zealand Automobile Association (AA) which is publicly available³, but with some amendment to the fixed costs. The AA model is focussed on the operating costs for the first five years of a vehicle's life, whereas the typical vehicle in the New Zealand fleet is much older. While an allowance has been made for the different costs particularly the capital costs that would be incurred by older vehicles and the insurance costs have been adjusted to reflect the lower vehicle value as it ages, no data is available on the running costs for vehicles of different ages.

For vehicles powered by internal combustion engines, attention has been focussed on petrol-engine vehicles which represent about 90 per cent of the New Zealand car market. Analysis of the AA figures indicates that the costs of diesel and petrol operation are similar for the different vehicle sizes. Separate figures have been provided for electric vehicles but following the same general approach.

The costs have been divided into three main categories:

- Variable operating costs
- Fixed operating costs
- Fixed ownership costs (capital charges).

No costs have been included in the car cost model to reflect the values of working or non-working time (savings) for car drivers or passengers. Where appropriate, these may need to be added on to the current model cost estimates.

For the petrol engine vehicles, the costs have been developed for four main categories conforming to those used in developing the AA model. These have then been averaged to give the costs for the average vehicle in the NZ car fleet.

While the data available on the number of cars by cc rating does not match exactly the categories used by the AA, the proportions in each group at the end of 2018 are estimated as shown in Table 3.1.

Table 3.1: Estimated breakdown of the New Zealand petrol passenger car fleet by engine capacity

CC rating	Proportion of vehicle fleet (1)	Average fuel consumption (litres per 100 kms) (2)
1,500 or less	0.195	6.3
1,501-2,000	0.343	7.7
2,001 - 3,500	0.371	9.3
More than 3500	0.092	11.6
Weighted average all sizes		8.4

Source: (1) Ministry of Transport NZ Vehicle Fleet Statistics 2018 Table 3
(2) AA Cost model

³ Source: <https://www.aa.co.nz/cars/owning-a-car/fuel-prices-and-types/vehicle-running-cost/>
While this covers a range of car types its focus is primarily on privately-owned cars used for employers' business.

The average engine size for the whole light passenger vehicle fleet is about 2,200cc based on the proportions of the total vehicle fleet.⁴

The volumes of hybrid and pure electric vehicles are relatively small, although growing rapidly. In 2018/19 the average size of the electric vehicle fleet (pure and plug-in EVs) was about 12,000: this represents about 0.4 per cent of the total light vehicle fleet.

3.2 Variable operating costs

Variable costs for petrol vehicles cover the following items:

- Petrol
- Oil
- Tyres
- Repairs and maintenance.

The values used, which have mainly been taken from the AA model, are summarised on a per km basis in Table 3.2 and Figure 3.1.

The costs for electric vehicles (pure electric and hybrid) are also included in Table 3.2 and Figure 3.1. An issue arises in considering the operating costs for pure electric vehicles since the batteries degrade with use. As a result, they will need to be replaced at regular intervals although there is only limited experience of the actual lifetime achieved and the costs of replacement. For the purposes of this paper, the battery cost is included in the running cost on the basis of a replacement cost of about \$9,000 (or \$8,000 excluding GST)⁵, although this could be much higher.⁶ On the basis of a battery life of 100,000 kms this would give a cost of about \$0.08 per km (excluding GST). It should however be emphasised that this figure is only approximate and costs may fall in the future as the technology develops and also as alternative uses for the used batteries are developed⁷. For hybrid vehicles, where there is a larger market for replacement batteries because of the length of time over which these vehicles have been in operation, the costs appear to be lower with reconditioned batteries available. For these vehicles we have assumed a battery cost of half of that of a fully electric vehicle. Excluding the battery cost would give an average electricity cost per km of about \$0.03.

It should also be noted that, as an incentive to their purchase and operation, pure electric cars are currently not subject to any form of fuel duty or road user charges. As a result, they do not contribute to the costs that they impose on the road network. It is likely that with increasing use of electric vehicles, some form of charging will need to be imposed to reflect these costs, so the total costs of operation would therefore increase.

⁴ NZ Vehicle Fleet Statistics 2018 Table 4.1b

⁵ See <https://www.newshub.co.nz/home/money/2018/10/electric-vehicle-costs-how-easy-is-it-to-be-green.html>

⁶ <https://www.tvnz.co.nz/one-news/new-zealand/nissan-leaf-owner-range-anxiety-told-new-battery-13-000-car-would-cost-121-v1>

⁷ <https://www.stuff.co.nz/motoring/111367821/what-happens-to-all-those-ev-batteries>

Table 3.2: Car distance related costs (\$ per km)

Cost category	Average cost per km by veh size - Petrol vehicles (\$)					Average cost per km - Hybrid and electric vehicles (\$)	
	1,500cc or less	1501cc-2000cc	2001cc-3500cc	More than 3500cc	Average petrol vehicles	Hybrid vehicles	Electric vehicles
Fuel (petrol or electricity) - resource costs excl battery cost for hybrid and electric vehicles	0.07	0.08	0.10	0.12	0.09	0.06	0.03
Battery cost	-	-	-	-	-	0.04	0.08
Fuel -duty	0.05	0.06	0.07	0.09	0.07	0.04	0.00
Oil	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Tyres	0.02	0.03	0.03	0.04	0.03	0.02	0.02
Repairs and maintenance	0.04	0.04	0.04	0.05	0.04	0.03	0.02
Total	0.19	0.22	0.25	0.31	0.24	0.19	0.15
Total resource costs	0.14	0.16	0.18	0.22	0.17	0.15	0.15

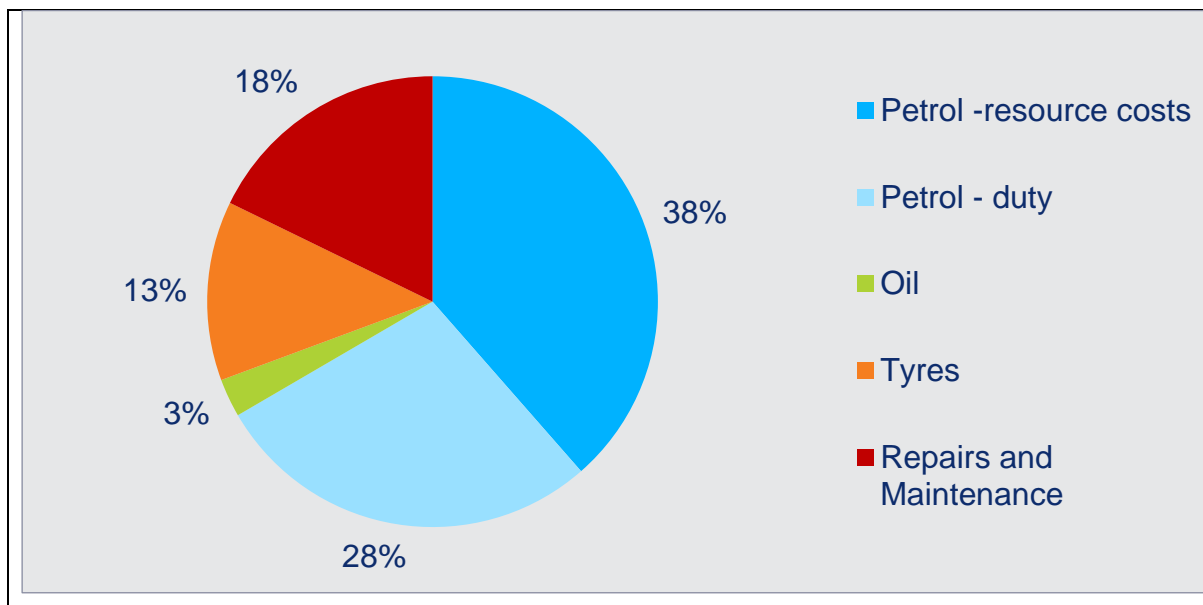


Figure 3.1: Breakdown of total distance related costs per km- Petrol vehicles (average)

For petrol vehicles, these figures clearly show the dominance of fuel costs and the substantial share of fuel duty in the distance-related operating costs. Comparisons between the distance-related costs of operation for different fuel types are set out in Figure 3.2.

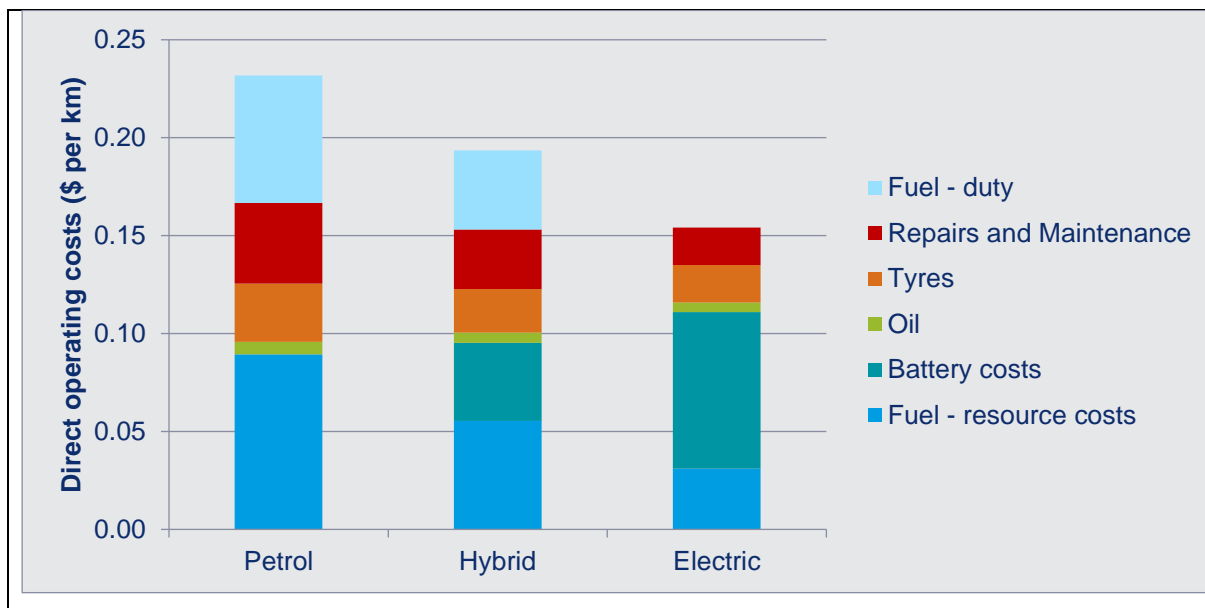


Figure 3.2: Direct operating costs for petrol and electric vehicles 2018-19 (\$ per km)

Note: Costs for electric include allowance for battery replacement at \$0.08 per km.

Fuel prices have been split between resource costs and taxes/charges where appropriate based on prices averaged over 2018/19. While the costs per km remain unchanged the figures in the model are based on an average annual distance travelled per car of 11,000 kms in line with the position for the fleet as a whole⁸. This is below the figure of 14,000 kms per year assumed by the AA (which relates to a newer fleet profile with vehicles used more intensively).

With the inclusion of the battery replacement costs, the direct operating costs of electric vehicles amount to about 65 per cent of those of petrol vehicles and hybrid vehicles about 85 per cent of petrol vehicles. However, the battery costs comprise a substantial part of the costs for electric vehicles and to a lesser extent for hybrid vehicles. Excluding these would give the costs for electric vehicles and hybrid vehicles at about 30 per cent and 65 per cent of those for petrol vehicles.

A check has been made on the fuel consumption figures for petrol vehicles derived from this model by comparing the average figure based on the consumption for the individual categories of vehicle identified, weighted by volume (8.4l per 100 kms) with alternative top-down estimates. These top-down estimates are based on the total distance travelled by cars (light passenger vehicles) published by the Ministry of Transport⁹ and total petrol consumption produced by NZ Transport Agency as part of their reporting on the effects of the imposition of the regional fuel tax¹⁰. These give an average consumption of 8.9l per 100 kms. Given that the top-down figure includes petrol powered light vans and other commercial vehicles with higher consumption rates, the consumption figures produced by the AA model appear appropriate and have therefore been used for the analysis of car operating costs.

⁸ MoT NZ Vehicle Fleet Statistics 2018 Tables 1.1, 1.2 and 1.3a,c

⁹ Table 2b from MoT Quarterly Fleet Statistics <https://www.transport.govt.nz/mot-resources/vehicle-fleet-statistics/quarterly-fleet-statistics-data-tables-april-to-june-2020-update/>

¹⁰ Petrol and diesel deliveries as set out in <https://www.nzta.govt.nz/resources/regional-fuel-tax-quarterly-reports>

3.3 Fixed operating costs

Fixed costs represent operating costs that are incurred on an elapsed time basis, rather than varying directly with car use. They comprise the following:

- Annual Vehicle Licensing
- Warrant of Fitness Certification
- Insurance.

Vehicle licensing costs have been split between taxes/charges (the major portion) and resource costs (for administration). The average annual vehicle licensing charge reflects the relatively high initial costs and then the lower annual relicensing charges.

The cost of insurance is assumed to be a fixed annual cost but the figures have been adjusted to take account of the lower value of the average car compared to the newer fleet profile assumed in the AA model¹¹. Earlier work assumed that a component of insurance was distance-related but based on the interrogation of their web sites this factor does not appear to be taken into account to any major extent by insurers.

Warrant of Fitness Certification has been taken as a fixed cost.

3.4 Fixed ownership costs

Capital charges associated with the purchase (and depreciation) of cars have been calculated on an annualised (mortgage) basis, over an economic life of 19 years¹². As discussed earlier it has been assumed that these charges are fixed and would not vary with the annual mileage of the vehicle. While it is recognised that this may be an approximation since depreciation may vary with the mileage travelled the effects of this are considered to be limited. The assumption about typical vehicle lives are taken to apply equally to petrol and electric vehicles, although as yet there is little evidence on the life of electric vehicles.

The depreciation rate is based on the rates supplied by the AA, typically amounting to about 15 per cent per year (in money terms) applied on a diminishing value basis. This rate applied varies slightly by car type but is consistent with the average vehicle life (the average age of scrappage) of 19 years. The quoted depreciation rates have been adjusted to reflect rates in real terms assuming average new car price inflation of 2 per cent per year (which increases the real depreciation rate¹³, to about 17%). The typical interest rates quoted by the AA amount to 3.3 per cent (in money terms) of the outstanding value. These have been adjusted to real values giving a real interest rate of 1.3 per cent.

Calculations have been undertaken for each of the four vehicle size categories, and a weighted average then derived.

¹¹ Based on costs for cars of different values obtained from insurers' websites

¹² This is based on the average age of scrappage of light vehicles of 19 years in MoT NZ Vehicle Fleet Statistics Table 7.1.7.2

¹³ The real depreciation rate measures the reduction in the value of the vehicle over time excluding the effects of inflation on the vehicle prices, assumed to be 2 per cent. Thus, if the value of a vehicle at a point of sale falls by 15 per cent, but this includes inflation of 2 per cent, the real depreciation rate will be 17 per cent.

3.5 Model results

Total costs and costs per km travelled based on an average travel distance of 11,000 kms per year and average fuel consumption of 8.4 l per 100km are set out in the associated spreadsheet for each of the vehicle categories specified by the AA.

Based on the average 19 year life for vehicles and 11,000 kms per year, the average car operating costs are summarised in Table 3.3.

Table 3.3: Annual car operating costs (GST exclusive)

Item	Variable costs (\$/km)	Fixed annual operating costs (\$ pa)	Capital (\$ pa)	Total Cost (\$ pa) (1)
Petrol vehicles				
Resource Costs	0.17	799	2,364	4,997
Charges	0.07	84	0	799
Total	0.23	883	2,364	5,796
Average Cost/Km	0.23	0.08	0.21	0.53
Hybrid Vehicles				
Resource Costs	0.15	820	2,752	5,256
Charges	0.04	84	0	527
Total	0.19	904	2,752	5,783
Average Cost/Km	0.19	0.08	0.25	0.53
Electric vehicles				
Resource Costs	0.15	925	3,494	6,114
Charges	0.00	84	0	84
Total	0.15	1,009	3,494	6,198
Average Cost/Km	0.15	0.09	0.32	0.56

Notes (1) Based on 11,000 kms per year

Overall, the total vehicle operation costs per year are slightly higher for electric vehicles with the lower fuel costs being offset by the higher vehicle costs and the estimated costs of battery replacement. As discussed earlier it is possible that over time both the vehicle capital costs and the costs of battery replacement may fall, making the position for electric vehicles more favourable, although this may well be (totally or partially) offset by any moves to charge electric vehicles in some way for the use of the road network.

3.6 Costs for alternative operating scenarios

The costs derived above relate to average travel conditions. For use in traffic modelling and economic evaluation these need to be provided for different traffic conditions and the results of this are set out in Table 3.4 (for distance -related costs only). The average fuel consumption per km is very similar to that estimated in the earlier STCC study¹⁴ possibly reflecting increases in engine sizes offsetting improvements in fuel efficiency and the same

¹⁴ See STCC Working paper 0621

ratios between the different operating conditions have been assumed for this work, both for petrol vehicles and for hybrid and electric vehicles.

Table 3.4: Car fuel consumption and variable operating costs for different road and traffic conditions

Area type	Traffic/ LoS ¹⁵	Fuel consumption (l per 100 kms)	Fuel resource costs (1)	Unit costs \$/km		
				Other resource costs	Duty	Total costs
Petrol vehicles						
Base	All	8.4	0.09	0.08	0.07	0.23
Rural	All	6.1	0.07	0.08	0.05	0.19
Urban	A/B	7.7	0.08	0.08	0.06	0.22
	C/D	9.5	0.10	0.08	0.07	0.25
	E/F	10.4	0.11	0.08	0.08	0.27
Hybrid vehicles						
Base	All	5.2	0.06	0.06	0.04	0.15
Rural	All	3.8	0.06	0.06	0.03	0.13
Urban	A/B	4.8	0.05	0.06	0.04	0.15
	C/D	5.9	0.06	0.06	0.05	0.17
	E/F	6.5	0.07	0.06	0.05	0.18
Electric vehicles						
Base	All	NA	0.03	0.12	0.0	0.15
Rural	All	NA	0.02	0.12	0.0	0.15
Urban	A/B	NA	0.03	0.12	0.0	0.15
	C/D	NA	0.04	0.12	0.0	0.16
	E/F	NA	0.04	0.12	0.0	0.16

Notes (1) Battery costs are included in "Other resource costs"

3.7 Comparison with MBCM figures

The values derived above for petrol vehicles can be compared with those set out in the MBCM. For a passenger car, the variable operating costs for a basic situation are about \$0.24 per km at 2018/19 prices (based on a speed of 70km/hr and a 2 per cent gradient)¹⁶. This is in line with the resource cost of \$0.23 per km for the base scenario estimated for this study as set out in Table 3.4.

¹⁵ Levels of services (LoS) can be broadly defined as follows:

A/B Free flow conditions but with increasing volumes of traffic in LoS B

C/D Steady volumes of traffic but with some constraints on the speeds that can be achieved

E/F Congested conditions with an increasing risk of traffic flow breakdown

¹⁶ See Waka Kotahi Monetised Benefits and Costs Manual (MBCM) Table A7.1

Chapter 4 Truck operating costs

4.1 Introduction

Truck operating costs have been defined for a range of vehicle types and operating conditions. These have been designed to illustrate the range of costs for different vehicle sizes and also to explore the effects of operating vehicles as HPMVs, either as 50 MAX vehicles or as other types of HPMVs with gross vehicle masses which exceed the current standard limits of 45 or 46 tonnes. It should be noted that the operating costs for buses are not considered here but are covered in WP C12.

The vehicle types considered are:

- LCV vans/Courier vehicles operating at low or high mileages
- Other LCVs
- MCV
- HCV 4 axle rigid
- HCV 8 axle T+T
- HCV 8 axle T+T operating as 53 tonne HPMV
- 50MAX operating as a line haul truck
- 50MAX operating as logging truck
- 50MAX operating as 53 tonne HPMV logging truck.

Two examples of logging trucks have been selected reflecting their particular conditions of operation, with fully-loaded truck and trailer movements carrying logs away from the forests being balanced by the truck returning with the trailer loaded onto the vehicle. This reduces the costs of operation and in particular the road user charges which would be levied since these would not apply to the trailer on its return journey. In addition, fully loaded logging trucks often operate on lightly constructed routes where the damage costs may be substantial. The extent to which these damage costs are recouped from the charges on heavy vehicles may therefore be an issue.

All costs exclude GST.

4.2 Approach to estimating costs

The model developed uses outputs from the Truck Operating Cost model developed by National Road Carriers (NRC) which is primarily designed as an aid for their members in assessing the viability of new trucking operations. The results from this have been adjusted to reflect the requirements in the DTCC for real rather than nominal costs and also to reflect a longer term view of capital recovery costs over the lifetime of the vehicle rather than the shorter term horizon for which the NRC model has been developed. The capital costs have been based on depreciation rates in part derived from discussions with NRC and in part derived from analyses of the prices of vehicles of different ages based on entries in vehicle sales websites for truck dealers. The data from the NRC model has been supplemented for light trucks.

The costs include an allowance for profit ('return') by the owner of the asset. Following discussions with NRC this has been taken to be 10 per cent of the costs of the operation, taken to include both annualised capital costs and operating costs. This covers both a return on the investment and for the management of the operation.

Costs have been estimated in six main categories:

- Fuel costs
- Other costs which vary with the distance travelled
- Time-related costs, taken to be the costs of the wages (and direct on-costs) of the driver
- Fixed costs related to the ownership of the vehicle itself
- Fixed costs relating to the overheads of the operation including an allowance for a return to the owner of the vehicle.
- Capital and depreciation costs.

4.3 Costs by category

4.3.1 Fuel costs

Fuel costs have been based on the consumption rates implied from the NRC model valued at the costs set out above in Table 3.4. Fuel consumption figures are derived from data from users rather than the figures published by vehicle manufacturers. The estimated diesel fuel consumption costs have been compared with alternative estimates¹⁷ and some adjustments have been made for light vehicles. The consumption figures which result are set out in Table 4.1.

Table 4.1: Fuel consumption and costs for individual truck types

	Vehicle type									
	LCV van/ Courier vehicle - low mileage	LCV van/ Courier vehicle - high mileage	Other 2 axle rigid	3 axle rigid	4 axle rigid	44t 8 axle truck & trailer (T+T)	44t T+T as 53t HPMV	50 MAX line haul	50 MAX logs	50MAX as 53T HPMV logs
Fuel consumption (l per 100 kms)	18	18	19	29	52	56	63	63	56	62
Total fuel costs per km (\$)	0.24	0.24	0.24	0.38	0.68	0.73	0.82	0.82	0.73	0.81

4.3.2 Other distance-related costs

Other distance related costs include:

- Repairs and maintenance
- Road user charges
- Tyres and tubes

Other costs could include items such as truck stops/overnighting and truck washes. These however are considered to be small and have not been included. For trucks crossing the Cook Strait, there would be costs associated with the voyage, but these are best considered when looking at specific truck movements.

¹⁷ Real-world fuel economy of heavy trucks Prepared by Haobo Wang, Iain McGlinchy and Ralph Samuelson, Transport Knowledge Conference 2019 (5 December)

4.3.3 Time-related costs

Time related costs are based on the drivers' costs as identified by NRC, which are typically in the range of \$24-36 per hour. With the exception of courier vans (for which a rate of \$26.5 per hour has been assumed), the wage rates increase with the size of the vehicle. The number of hours worked per year is also assumed to vary with the type of operation with the high mileage operations having relatively high drivers' hours and with shorter work times for the vehicles with lower mileages.

4.3.4 Fixed costs related to vehicle ownership

Fixed costs related to the ownership of the vehicle include licensing, the ACC levy, certificates or warrants of fitness and the costs of insurance.

4.3.5 Capital and depreciation costs

Nominal and real depreciation rates (these exclude the effects of price inflation over time on the prices of used vehicles) have been determined for heavy commercial vehicles and light goods vehicles separately. For all vehicles except LCV vans, this has been taken to be 13 per cent real (11 per cent nominal) on a diminishing value basis, based on an average life when scrapped of 22 years¹⁸. For the LCV vans, which tend to have a shorter life (on average scrapped at 18 years), a real depreciation rate of 15 per cent (13 per cent nominal has been assumed).

4.3.6 Other overhead costs and owners return

Other overhead costs take into account the costs of business associated with the vehicles and also the owners return; these are taken to be 10 per cent of the costs of the operation.

4.3.7 Resource and financial costs

The costs have also been split into resource and financial costs. The latter primarily include the charges associated with road user charges and vehicle licensing but also take into account additional small levies included in the diesel fuel price including the:

- Auckland regional fuel tax
- local authority petroleum tax
- ETS levy
- petroleum or engine fuels monitoring levy.

For 2018/19 these were estimated at an average across the country of about 10 cents per litre.

The costs for the different vehicle types are considered in the following section. These are typically based on the average utilisation by vehicle type but we have also considered the results for vehicles operating over high annual mileages and also for vehicles operating in more specialised roles.

¹⁸ MoT NZ Vehicle Fleet Statistics Table 7.1,7.2

4.4 Cost results

The estimated operating costs for the individual truck types and representative sample mileages are set out in. In presenting these costs, they have been separated into the resource costs and the duty, reflecting road user charges and the taxes on fuel. The costs are based on a vehicle life of 22 years for all but LCV vans and 18 years for LCV vans.

Table 4.2: Vehicle operating costs for individual truck types (2018/19)

Vehicle type Item	LCV van/ Courier veh - low mileage	LCV van/ Courier veh - high mileage	Other 2 axle rigid	3 axle rigid	4 axle rigid	44t 8 axle T+T av mileage	44t 8 axle T+T high mileage	50 MAX line haul av mileage	50 MAX line haul high mileage	50MAX as 53T HPMV logs	44t T+T as 53t HPMV	50 MAX logs
Value New	51,000	51,000	106,000	153,000	270,000	643,000	643,000	673,000	673,000	559,000	649,000	559,000
Assumed operating hours pa	1410	2760	2000	971	1113	2760	3312	2760	3312	2898	3312	2898
Assumed distance pa (kms)	14100	55000	14963	14082	16691	57506	180000	57506	180000	145000	180000	145000
Distance related costs (\$/km)												
Fuel and oil resource cost per km	0.24	0.24	0.24	0.38	0.68	0.73	0.73	0.82	0.82	0.81	0.82	0.73
Fuel and oil duty cost per km	0.02	0.02	0.02	0.03	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Tyre cost per km	0.01	0.01	0.03	0.03	0.05	0.11	0.11	0.13	0.13	0.09	0.11	0.09
Repairs and maint cost per km	0.11	0.11	0.14	0.11	0.17	0.20	0.20	0.23	0.23	0.19	0.22	0.20
Road user charges per km	0.07	0.07	0.06	0.10	0.36	0.53	0.53	0.58	0.58	0.51	0.74	0.43
Total cost per km	0.43	0.43	0.48	0.62	1.25	1.57	1.57	1.76	1.76	1.59	1.89	1.45
Resource cost per km	0.35	0.35	0.39	0.49	0.84	0.99	0.99	1.17	1.17	1.02	1.09	0.96
Duty cost per km	0.08	0.08	0.08	0.13	0.41	0.58	0.58	0.59	0.59	0.57	0.80	0.49
Total distance related costs per year	6,076	23,700	7,125	8,736	20,870	90,448	283,109	100,995	316,122	230,968	340,412	210,723
Total duty per year	1,188	4,634	1,220	1,806	6,869	33,612	105,209	33,910	106,140	82,737	144,480	71,008

Time related costs (\$)												
Time related costs per hour	26.5	26.5	24.0	30.3	35.9	35.9	35.9	35.9	35.9	35.9	35.9	35.9
Time related costs per year	37,334	73,080	66,240	97,440	107,804	99,180	119,016	99,180	119,016	104,139	119,016	104,139
Fixed and overhead costs (\$pa)												
Overhead resource costs including owners return	12,652	17,989	16,558	15,387	19,026	57,217	78,467	58,407	81,903	63,963	84,237	61,939
Vehicle capital charges	3,922	3,922	7,199	10,379	18,315	43,638	43,638	45,625	45,625	37,918	44,038	37,918
Total fixed resource costs per year	16,574	21,911	23,757	25,766	37,341	100,855	122,105	104,031	127,528	101,881	128,275	99,856
Total costs (\$)												
Total resource costs per year	58,796	114,056	54,428	62,083	91,329	256,870	419,021	270,296	456,525	354,251	443,223	343,710
Total duty per year	1,726	5,172	1,758	2,344	7,407	37,568	109,165	37,226	109,457	86,333	148,436	74,604
Total full costs per year	60,522	119,228	56,186	64,427	98,736	294,439	528,185	307,522	565,982	440,584	591,660	418,314
Total resource costs/ km	4.2	2.1	3.6	4.4	5.5	4.5	2.3	4.7	2.5	2.4	2.5	2.4
Total resource costs/ hr	41.7	41.3	27.2	63.9	82.1	93.1	126.5	97.9	137.8	122.2	133.8	118.6

The distance-related costs per km are summarised in Figure 4.1.

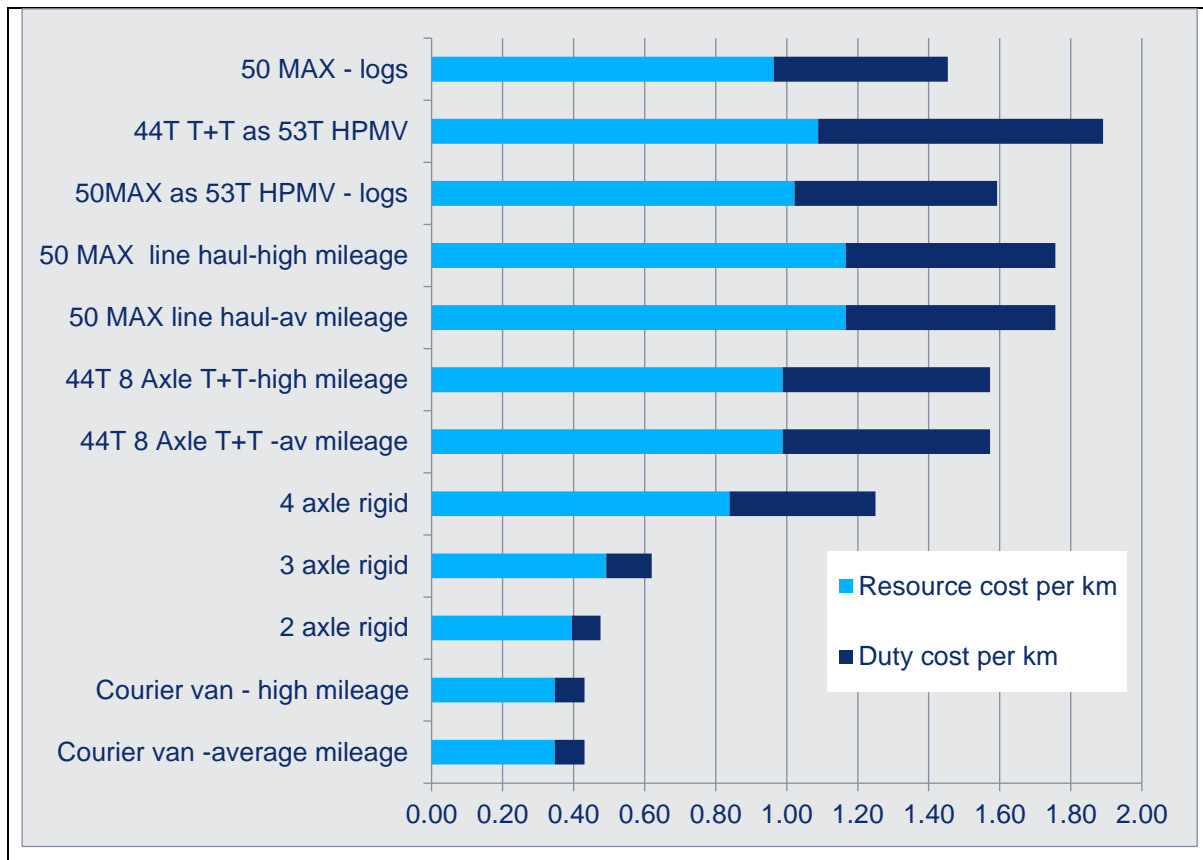


Figure 4.1: Distance related costs per km 2018/19 (\$ per km)

The distance related costs per km increase as vehicle sizes increase and also with the growing impact of road user charges which represent a higher proportion of the distance related costs at larger vehicle sizes. These road user charges are higher for vehicles operating as HPMVs.

The estimated total annual costs are set out in Figure 4.2.

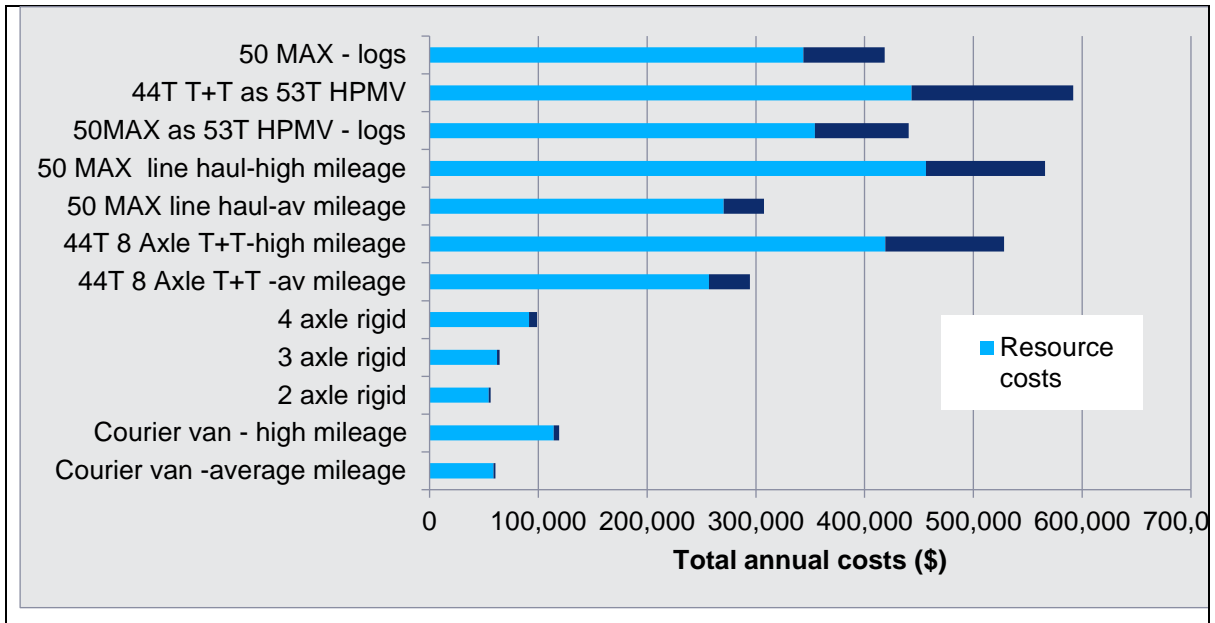


Figure 4.2: Total annual costs for different vehicle types, 2018/19 (\$)

In part the total costs reflect the different annual mileages assumed to be travelled by the different vehicle types, with the larger vehicles travelling higher mileages (details in Figure 4.2).

If allowance is made for the differences in the distances travelled, the average cost per km for each of these vehicle types and mileage combinations is set out in Figure 4.3.

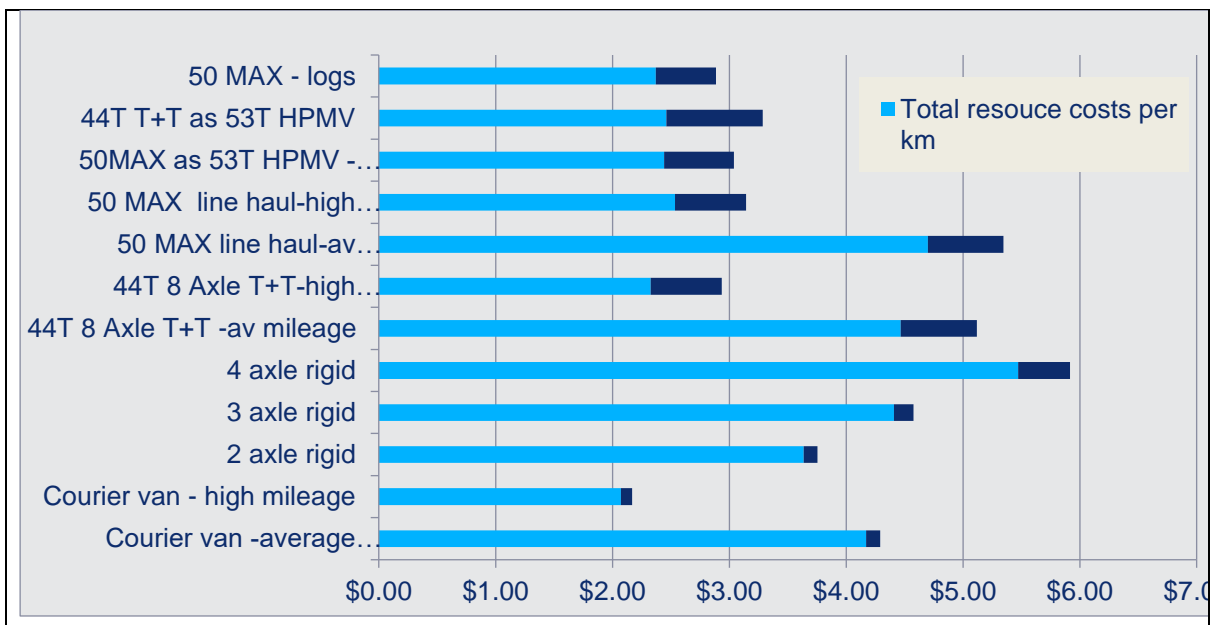


Figure 4.3: Total costs per km 2018/19 (\$ per km)

The high distances assumed for the heavier vehicles have largely reduce the differences in average costs per km between these and the lighter vehicles as the fixed costs of vehicle operation are spread over a larger annual mileage. It is notable that, with the exception of the high mileage courier van, the total costs/km tend to reduce as the vehicle capacities increase, largely reflecting the assumptions on higher mileage. The main exception arises in respect of the low mileage courier van which has average costs per km considerably above those of the larger vehicles (primarily reflecting the low distance and average speed assumed).

4.5 Average costs per tonne km

The estimated costs have also been related to typical payloads for the vehicle types involved to give a figure for the cost per tonne-km, as set out in Table 4.3. These payloads are largely based on an analysis of Weigh in Motion (WIM) data from the 7 sites across the country for 2019. From this data it is possible to determine the average loaded weight for a range of vehicle types. This would cover both laden and unladen vehicles and this has been compared with the estimated tare weight to give the average payloads. These tare weights have been determined from a combination of manufacturers' specifications and observed vehicle weights at the WIM stations. Some adjustments have been made for the specialised logging traffic, where vehicles typically operate at their maximum permitted weight for the loaded part of their journeys. It must be emphasised that these figures are representative only and in practice there would be a wide variation in payloads and so in the average costs actually experienced.

For the smallest vehicle size, the courier vans for which no data is available, a typical payload of 0.5 tonnes has been assumed.

Table 4.3: Vehicle operating costs per net tonne-km for individual truck types

	Vehicle type											
	LCV van/ Courier veh - low mileage	LCV van/ Courier veh - high mileage	Other 2 axle rigid	3 axle rigid	4 axle rigid	44t 8 axle T+T av mileage	44t 8 axle T+T high mileage	50 MAX line haul av mileage	50 MAX line haul high mileage	50MAX as 53T HPMV logs	44t T+T as 53t HPMV	50 MAX logs
Assumed distance pa (kms)	14,100	55,000	14,963	14,082	16,691	57,506	180,000	57,506	180,000	145,000	180,000	145,000
Average payload (tonnes)	0.5	0.5	2.8	5.7	6.5	13.4	13.4	17.3	17.3	18.5	18.8	17.0
Distance related costs per tonne -km (\$)												
Total	0.86	0.86	0.17	0.11	0.19	0.12	0.12	0.10	0.10	0.09	0.10	0.09
Duty	0.17	0.17	0.03	0.02	0.06	0.04	0.04	0.03	0.03	0.03	0.04	0.03
Total operator costs per tonne-km (\$)												
Total	8.58	4.34	1.33	0.81	0.91	0.38	0.22	0.31	0.18	0.16	0.17	0.17
Duty	0.24	0.19	0.04	0.03	0.07	0.05	0.05	0.04	0.04	0.03	0.04	0.03
Distance costs as per cent of total costs per tonne-km	10%	20%	13%	14%	21%	31%	54%	33%	56%	52%	58%	50%

The total cost per net tonne-km figures as set out in Figure 4.4 are illustrated in Figure 4.4, which includes all the vehicle types considered, and Figure 4.5 which excludes the results for the courier vehicles to allow a better representation of the costs for the larger vehicles.

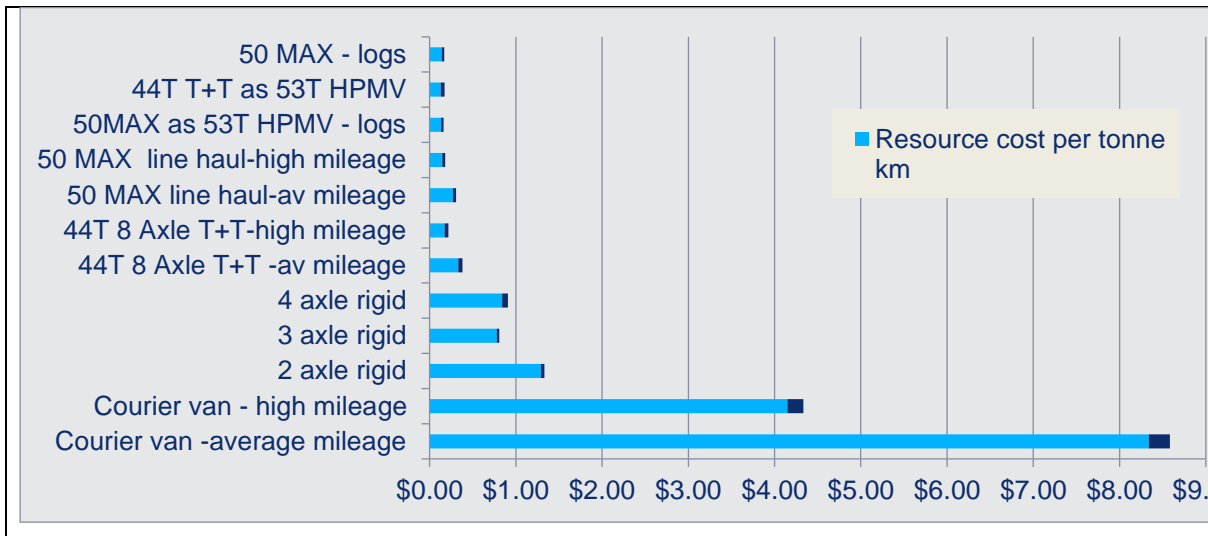


Figure 4.4: Total costs per net tonne-km - specified vehicle distances - all vehicles

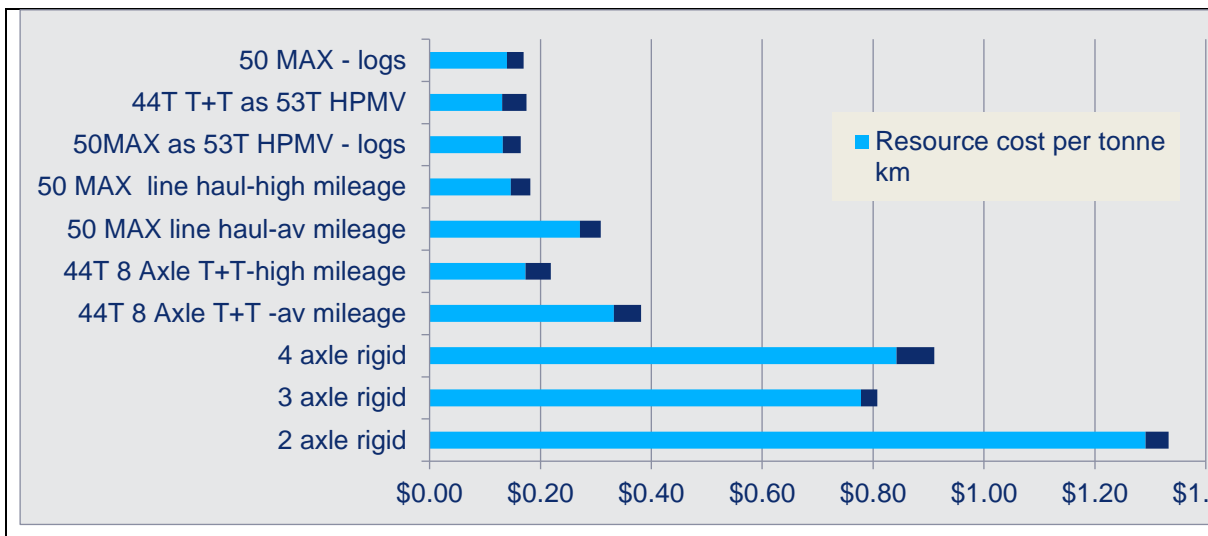


Figure 4.5: Total costs per net tonne-km - specified vehicle distances - all vehicles excluding courier vans

As noted earlier, the total costs of operation can vary very significantly according to the way in which the vehicle is utilised and the costs per tonne-km are further affected by the loading patterns of the vehicles. The costs provided should therefore be regarded as broadly indicative rather than as exact estimates. As a consequence, in any comparisons between moving freight by rail or road, the particular truck type used and its effective average payload will be important considerations.

In general (unsurprisingly) the larger vehicles offer the lowest costs per net tonne-km. There are also significant reductions in costs as the average mileages of vehicles increases, as can be seen for the results for both a standard 44 tonne truck and trailer and the larger 50 MAX units.

To give an indication of the breakdown of the longer-distance movements of these vehicles (excluding the courier vans) the details of the traffic recorded at the 7 WIM sites across the country are set out in Appendix 2. The major flows in this which largely correspond with the vehicle types identified above are highlighted.

As a final step, the share of the distance-related costs in the total costs is set out in Figure 4.6.

The share of distance-related costs in total costs generally increases with increased vehicle size reflecting the higher utilisation for the larger vehicles: for the larger vehicles, the distance-related costs are typically around 50% - 60% of total costs. As a share of the total, distance related resource costs are lower than for total costs largely reflecting the effects of road user charges and duties on fuel in the total costs.

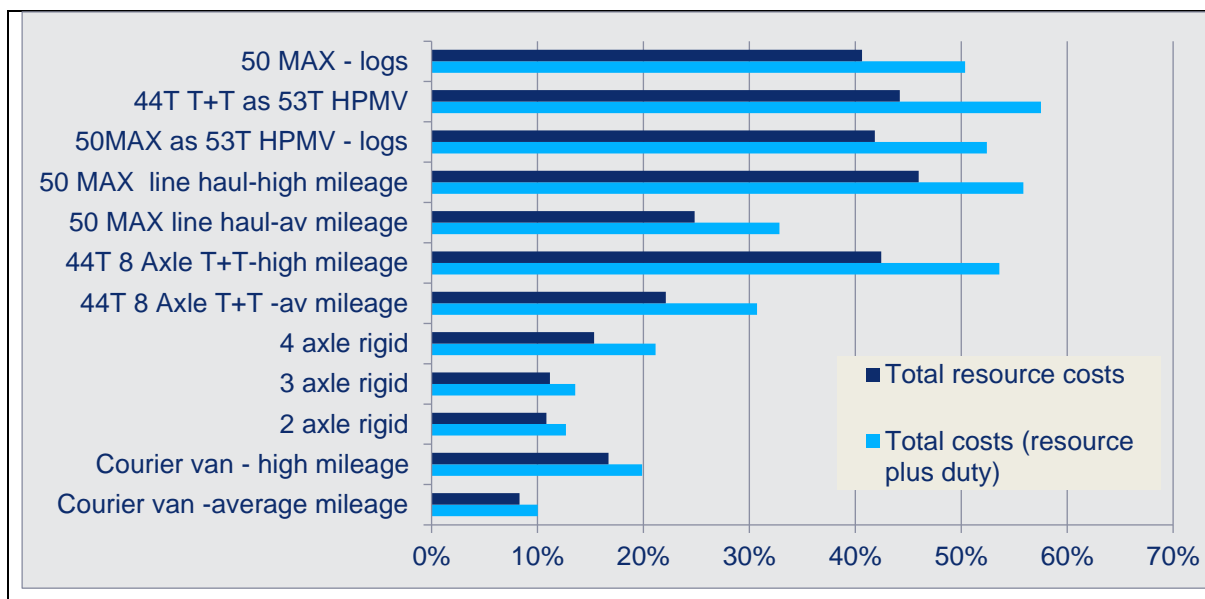


Figure 4.6: Share of distance related costs in total costs (per cent of total)

4.6 Comparison with MBCM figures

The results obtained using the approach described above have been compared with those derived from the MBCM as set out in Table 4.4. In general, the DTCC cost estimates are broadly in line with those derived from the MBCM, especially for the larger vehicles.

Table 4.4: Heavy commercial vehicles - comparison of MBCM and DTCC costs

Vehicle type	Estimated annual cost DTCC (\$000s)	Estimated annual cost MBCM (\$000s) ¹⁹
HCV2- high mileage	530-570	580
HCV2 average mileage	290-310	310
HCV1	100	80
LCV	55-65	70

¹⁹ Based on MBCM Tables 15-16 for time related costs and Tables A72-A75 for distance related costs.

Chapter 5 Motorcycle operating costs

5.1 Introduction

Motorcycles represent a fairly small proportion of the vehicle fleet in New Zealand with registrations of about 175,000 vehicles compared to about 3.3 million light passenger vehicles²⁰

There are few if any examples of motorcycle cost models either in New Zealand or internationally. For this study therefore a framework for estimating motorcycle operating costs has been developed from that used for the car operating cost modelling described in Section 3. This has then been applied to a range of different types of machines.

Motorcycles come in a number of different forms ranging from relatively small 150cc machines to much larger and more sophisticated machines. Costs have been estimated for 5 types of vehicles judged to be representative of the range of vehicle types:

- Suzuki GSX150 (150cc)
- Suzuki DR650E (650cc)
- Harley Davidson Superlow (883cc)
- Harley Davidson 48 (1200cc)
- Harley Davidson Road Glide (1848cc).

Examination of the composition of the vehicle fleet by size²¹ vehicle registration figures indicates that about 36 per cent of the fleet is composed of machines with a cc rating of 600cc or less, 35 per cent with a rating of 600-1000cc and 28 per cent with a rating above 1000cc. These weights have therefore been used to estimate average costs for the motorcycle fleet as a whole.

The costs have been split into those which are variable with distance and those which are essentially fixed. The variable costs are:

- Fuel
- Tyres
- Maintenance.

The fuel consumption figures estimated are set out in Table 5.1.

Table 5.1 Motorcycle petrol consumption rates (l per 100 kms)

Vehicle type	Suzuki GSX150	Suzuki DR650E	Harley Davidson Superlow 883	Harley Davidson 48	Harley Davidson Road Glide	Weighted Average
Estimated fuel consumption (l per 100 kms)	4.5	7.5	6.5	7.0	7.8	6.2

²⁰ MoT NZ Fleet Statistics Table 1.1, 1.2

²¹ MoT NZ Fleet Statistics Table 4.4

The main fixed costs identified comprise:

- Licensing and registration
- Insurance
- WoF
- Capital charges.

Depreciation rates (on a diminishing value basis) were initially calculated using data from dealers based on the new price and the estimated price after 10 years. These are typically in the range of 5-10 per cent per year (DV basis) with the higher rates being associated with the smaller machines.

However, to determine the appropriate depreciation rate over the full life of the machine, it is necessary to establish the typical age when these are scrapped. There is some inconsistency between the average life of the motorcycle fleet, about 15 years²², and the reported average age at scrappage of 12 years²³. The capital charges associated with each vehicle have therefore been estimated based on an average life of 15 years.

However, assuming a low scrappage value would imply rather higher depreciation rates for the period after 10 years, than those estimated for the earlier period. An average rate over the life of the machine has been assumed for the analysis, assuming that the value of the machine at the end of its life (taken to be 15 years) is 10 per cent of the initial value (in real terms), potentially reflecting its value for spares: this results in a real depreciation rate of 14.2% pa on a diminishing value basis.

The annualised capital charges have been estimated assuming a typical interest rate of 6 per cent equivalent to 3.9 per cent in real terms.

All the costs quoted below exclude GST.

5.2 Costs of operation

The details of the costs for each of the machines identified and the average cost for all vehicles are summarised in Table 5.2. These are based on an average mileage of about 2,400 kms per year²⁴. This figure is much lower than that for cars and reflects the limited use made of these vehicles.

²² MoT NZ Fleet Statistics Table 2.5b-2.8.

²³ MoT NZ Vehicle Fleet Statistics Table 7.1,7.2

²⁴ MoT NZ-Vehicle Fleet Statistics 2018 Tables 2.1 - 2.4

Table 5.2 Motorcycle operating costs

Vehicle type		Suzuki GSX150	Suzuki DR650E	Harley Davidson Superlow 883	Harley Davidson 48	Harley Davidson Road Glide	Weighted Average
Proportion of travel		36%	18%	18%	14%	14%	100%
Average veh-kms pa		2,350					
Total distance related operating costs per year (\$)							
Fuel	Total	195	325	284	302	337	269
	Duty	(82)	(137)	(120)	(127)	(142)	(113)
Tyres		41	74	51	51	51	53
Maintenance		179	179	102	102	102	145
Total		415	578	437	455	490	469
Duty		(82)	(137)	(120)	(127)	(142)	(115)
Fixed costs excluding capital charges (\$)							
WoF		48	48	39	39	39	44
Licensing		406	520	520	520	520	478
Registration		3	3	3	3	3	3
Insurance		261	609	609	739	870	556
Total		718	1,180	1,171	1,301	1,432	1,081
Capital charges (\$)							
Price new		2,951	7,560	13,913	17,387	37,174	12,599
Assumed value after 15 years	10%	295	756	1,391	1,739	3,717	1,260
Annualised charge		249	454	835	1,043	2,230	782
Distance related cost per km (\$)							
Total cost		0.18	0.25	0.19	0.19	0.21	0.20
Duty		(0.03)	(0.06)	(0.05)	(0.05)	(0.06)	(0.05)
Total cost per km (\$)							
Total cost		0.59	0.94	1.04	1.19	1.77	0.98
Duty		(0.21)	(0.28)	(0.27)	(0.28)	(0.28)	(0.25)

While the cost of motorcycle operation varies by type of machine, the average total costs at about \$1 per km are relatively high compared to those for cars, which average about \$0.57 per km. Even the costs/km for the smallest machine considered are higher than the average for cars.

These high costs mainly reflect the limited use made of motorcycles, with an average distance travelled of just 2,400 kms compared to about 11,000 kms for cars. As a result, the fixed costs are a much larger proportion of the overall totals, giving a high average cost per km. The duty charge is also a relatively large proportion of the total costs, particularly for the

smaller machines, because of the high annual licensing costs (which include a substantial ACC levy).

The distance related costs alone are \$0.18 - \$0.25 per km with an average of \$0.20. These are only slightly below the car operating costs of \$0.23 per km.

Chapter 6 Total annual user costs for motorised traffic (including the economic value of time)

6.1 Introduction

In order to estimate total user costs, the values of time for private vehicles have been estimated using the parameters set out in the MBCM for time spent on employers' business and other trip times. These have then been combined with the estimates of the values of time derived directly for freight vehicles as set out in Section 4.

6.2 Cars and motorcycles

6.2.1 Unit equity values of time

The unit equity values of time for light vehicle use (as recommended for use in economic evaluations) are set out in Table 15 of the MBCM. These are in July 2002 values and have therefore been increased by a factor of 1.52²⁵ to bring these to values for 2018/19. The basic 2002 values as reported in the MBCM and the values updated to 2018/19 are set out in Table 6.1.

Table 6.1 Values of time (\$ per person hour)

Trip purpose	2002 value	Update factor	2018/19 value
Work (Employers business-EB)	23.85	1.52	36.25
Commuting	7.80	1.52	10.64
Other	6.90	1.52	

6.2.2 Breakdown by trip purpose

The breakdown of journeys by trip purpose separating EB trips from journeys for other purposes has been based on the split between rural and urban travel set out in WP C4 Appendix 3 Table 10. This gives a rural-urban split of light vehicle distance travelled of 55:45. The average car occupancy has been estimated in DTCC Working Paper D4 Air quality and greenhouse gas emissions at 1.56 (Section 3.1.3) The average EB share has been estimated based on 30 per cent share of total trips for rural journeys and 15 per cent for urban journeys (also MBCM Table A50), giving an average share of 23 per cent.

6.2.3 Values of time per vehicle by trip purpose

Applying the unit values of time set out in Table C1 would give a value per vehicle for employer's business journeys of \$56.55 (\$36.25*1.56) or \$13.11 per hour if averaged over all journeys taking into account the 23 per cent share of EB trips in these. On the basis of an

²⁵ Average of the factors to update to 2018 (1.50) and 2019 (1.54)

average travel speed of 41.5km/h, derived from the 2015-2018 HTS, this gives an average EB time cost per vehicle km travelled of \$0.32.

For Other trips the cost per vehicle km travelled has been calculated similarly. On the basis of an average value of time in 2002 values of \$7 per hour (balancing out commuting and other journeys) and applying an update factor of 1.52 and an occupancy of 1.56, this gives a cost per hour per vehicle for “Other purposes” of \$16.60 ($7 \times 1.52 \times 1.56$). Taking into account the 77 per cent share of these trips in total movements, this gives a cost per hour for “Other trips” when averaged over all car movements of \$12.75 ($\16.60×0.77). There is a lack of information on travel speed by time period, but assuming the same average speed of 41.5 km/h gives an average cost for “Other trips” per light veh-km travelled of \$0.31, very similar to the average cost for EB trips per total veh-km travelled. The total time cost per car km is therefore the sum of these two elements, the EB component and the “Other component”, \$0.62 per km.²⁶

6.2.4 Average operating costs

The average car operating costs per km taking into account different assumptions about the inclusion of different time components are set out in Table 6.2.

Table 6.2: Average car operating costs 2018/19 (cents per veh-km)

Cost component	Excluding time costs	Including EB time costs	Including all time costs
Resource costs	45.4	77.0	107.7
Duty (1)	8.2	8.2	8.2
Total	52.7	85.2	115.9

Notes (1) The average duty per km has been estimated using a top down approach on the basis of the total duty paid by light vehicles and the total distance travelled.

A similar process has been assumed for estimating motorcycle costs assuming an assumed average occupancy of 1.1, an average speed of 42.9 km-h (again from the HTS) and no EB trips. This gives the position set out in Table 6.3.

Table 6.3: Average motorcycle operating costs 2018/19 (cents per veh-km)

Cost component	Excluding time costs	Including all time costs
Resource costs	72.9	101.1
Duty(1)	20.5	20.5
Total	121.7	121.7

Notes (1) The average duty has been estimated using a top down approach on the basis of the total duty paid by motorcycles and the total distance travelled. This ensures consistency with the figures in WP C4 Table 9.3

These figures have then been applied to the estimates of the total veh-kms to get the total user costs for each of these modes.

²⁶ The average costs for EB and Other trips have been determined separately to allow the costs without “Other trips” to be calculated if necessary.

6.2.5 Total annual costs

The total annual user costs including all time costs for motorcycles and cars which result are set out in Table 6.4. These are based on the distance travelled in 2018/19 of 35.70 bn veh-kms for cars and 0.40 bn veh-kms for motorcycles.

Table 6.4 Total annual user costs for cars and motorcycles 2018/19 (\$m)

Cost component	Cars	Motorcycles	Total
Resource costs	38.4	0.4	38.8
Duty	2.9	0.1	3.0
Total	41.4	0.5	41.9

6.3 Freight transport costs

6.3.1 Unit operating costs

Total freight transport costs have been estimated using the values described above in Table 6.4 for the total resource costs per km for the average mileage with a small adjustment in the duty element to ensure that the total estimated for these match the top down estimates per vehicle class set out in WP C4 Table 9.3 (excluding fines). The unit costs in terms of cents per km that results are set out below in Table 6.5 .²⁷

Table 6.5: Truck operating costs (cents per km)

Vehicle category	LCV1	LCV2	MCV	HCV1	HCV2A	HCV2B
Typical vehicles	Courier van - petrol)	Courier van - diesel	Other 2 axle rigid	4 axle rigid	44T 8 axle T+T	50 MAX T+T
Resource costs per km	417	417	364	547	447	470
Duty costs per km	10	9	11	40	55	61
Total costs per km	427	426	375	588	502	531

6.4 Total user costs

Taking into account the distances travelled and the total numbers of vehicles in each class the total annual costs of operation for 2018/19 have been determined and these are set out in **Error! Reference source not found.** These take into account the value of time both for commercial vehicle users using the values described above and for private vehicle and motorcycle users, based on the values of time and journey purpose splits set out in the MBCM.

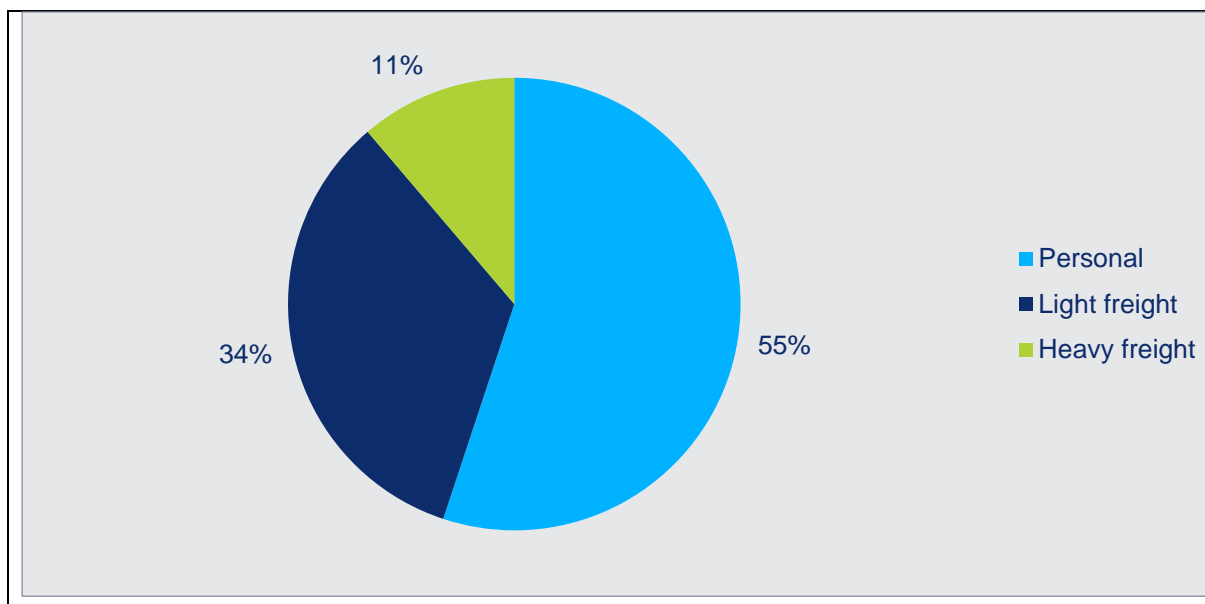
²⁷ For consistency these costs are based on the time values estimated for the different vehicle types set out in section 4.2. With the exception of the lighter vehicles, the time values are consistent with the values for EB trips as derived from the MBCM as discussed above.

Table 6.6: Estimated aggregate total annual costs by vehicle type including time costs 2018/19 (\$bn)

Cost type	Freight travel		Total	
	Person travel	Light freight		Heavy freight
Resource vehicle operating costs	19.8	16.5	5.6	41.9
Time costs in working time	16.9	13.9	3.7	34.6
Other time costs	11.1	-		11.1
Total resource costs	47.7	30.4	9.4	87.5
User charges (Duty)	3.3	0.8	1.0	5.0
Total	51.0	31.2	10.4	92.5

Notes : Person travel includes car, motorcycles and LCV1s, light freight includes LCV2 and MCV and heavy freight comprises HCVs

This gives an estimated total cost incurred directly by users of the road system of about \$93 bn in 2018/19. The breakdown of the total by vehicle type is set out in Figure 6.1.

**Figure 6.1: Breakdown of total road user costs by vehicle type 2018/19 (per cent of total)**

Person travel makes up the largest share of the total expenditure by road users, accounting for about 55 per cent followed light freight activities where the relatively high costs reflect the use of these in working time. Heavy goods vehicles contribute about 11 per cent of the total. The total user costs incurred by heavy freight vehicles of about \$10bn provide an estimate of the total value of heavy freight services since these costs are met by the shippers of the product and reflect a minimum estimate of the increase in the value of the goods as they are moved from location to location. There would also be some contribution to the total value of freight from lighter vehicles, although the position here is more complex since to some extent these vehicles are also used for the movement of workers as well as freight.

Figure 6.2 sets out the split of the total user costs by the type of cost.

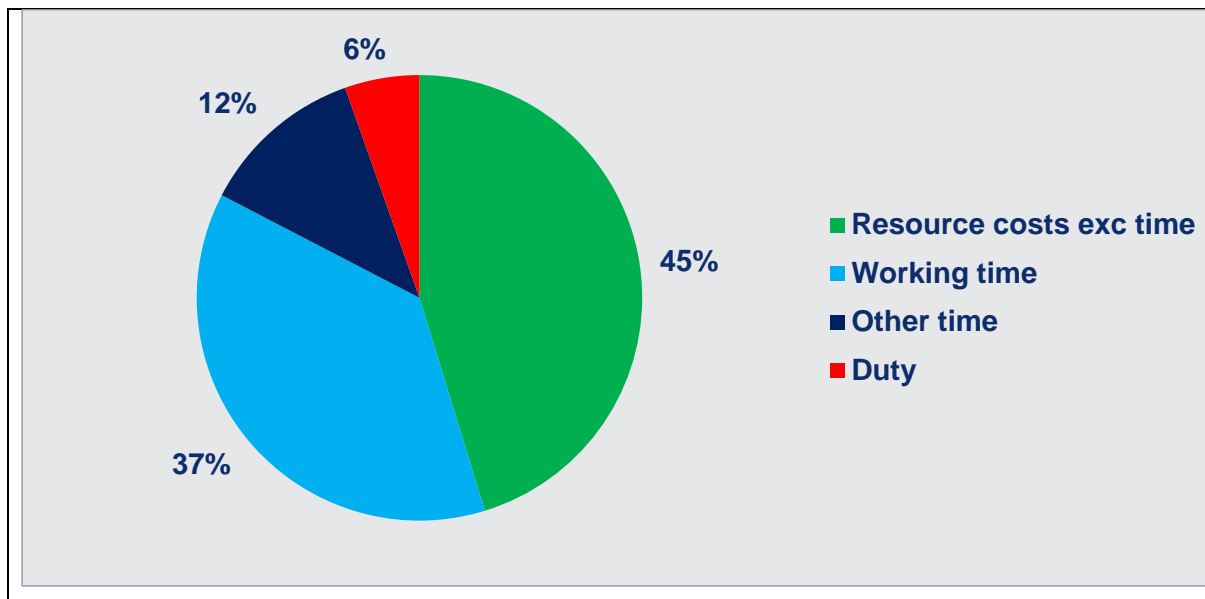


Figure 6.2: Split of total road user costs by type 2018/19 (per cent of total)

Of the costs incurred directly by road users, the value of the time spent travelling either in the course of work for the drivers of CVs and a proportion of cars (in total \$36bn), or for other purposes including commuting and for personal and social reasons (\$11bn) accounts for almost half of the full costs. Other resource costs, typically relating to the use of the vehicle and where appropriate the overheads from vehicle operation, amount to a slightly smaller share of about 45 per cent (\$42bn).

The duties and levies paid by road users represent a much smaller share of the total costs amounting to about 6 per cent of the total (\$5bn), although this share is higher for heavy goods vehicles, (just below 10 per cent), than for lighter CVs, (about 2.5 per cent), and for cars and motorcycles, about 7 per cent . Changing the level of the duties paid would therefore typically only have a relatively small impact on the total costs faced by road users - doubling these costs would increase total user costs by about 6 per cent overall or between 2.5 per cent and 10 per cent for the different vehicle categories.

Appendix 1 Listing of DTCC Working Papers

The table below lists the Working Papers prepared as part of the DTCC Study, together with the consultants responsible for their preparation.

Ref	Topic/Working Paper title	Principal Consultants	Affiliation
MODAL TOPICS			
C1.1	Road Infrastructure – Marginal Costs	David Lupton	David Lupton & Associates
C1.2	Road Infrastructure – Total & Average Costs		
C2	Valuation of the Road Network	Richard Paling	Richard Paling Consulting
C3	Road Expenditure & Funding Overview		
C4	Road Vehicle Ownership & Use Charges		
C5	Motor Vehicle Operating Costs		
C6	Long-distance Coaches	David Lupton	David Lupton & Associates
C7	Car Parking	Stuart Donovan	Veitch Lister Consulting
C8	Walking & Cycling		
C9	Taxis & Ride-hailing		
C10	Micro-mobility		
C11.2	Rail Regulation	Murray King	Murray King & Francis Small Consultancy
C11.3	Rail Investment		
C11.4	Rail Funding		
C11.5	Rail Operating Costs		
C11.6	Rail Safety		
C12	Urban Public Transport	Ian Wallis & Adam Lawrence	Ian Wallis Associates
C14	Coastal Shipping	Chris Stone	Rockpoint Corporate Finance
C15	Cook Strait Ferries		
SOCIAL AND ENVIRONMENTAL IMPACT TOPICS			
D1	Costs of Road Transport Accidents	Glen Koorey	ViaStrada
D2	Road Congestion Costs	David Lupton	David Lupton & Associates
D3	Health Impacts of Active Transport	Anja Misdrak & Ed Randal	University of Otago (Wellington)
D4	Air Quality & Greenhouse Gas Emissions	Gerda Kuschel	Emission Impossible
D5	Noise	Michael Smith	Altissimo Consulting
D6	Biodiversity & Biosecurity	Stephen Fuller	Boffa Miskell

Note:

The above listing incorporates a number of variations from the initial listing and scope of the DTCC Working Papers as set out in the DTCC Scoping Report (May 2020).

Appendix 2 Flows at WIM sites 2019

Table A2.1: Traffic flows by category at WIM sites 2019

Class	Description	Drury	Eskdale	Tokoroa	Waipara	Rakaia	Kairua	Hamana-tua Bridge	Total	Per cent
15	o-o--o (car towing loaded trailer)	47453	8409	9299	25921	23452	22949	5919	143402	2.9%
16	o-o--oo(car towing loaded tandem trailer)	68770	12570	22315	51802	52326	52107	12867	272757	5.5%
20	o-o (wb 2.0-3.2m)	56087	5151	5870	11304	13336	50761	10312	152821	3.1%
21	o--o (wb >3.2m)	352466	40090	79672	75371	119231	230115	32187	929132	18.8%
30	o-o--o	2832	484	899	1099	1913	611	23	7861	0.2%
31	o--oo	168510	10021	31275	20843	39410	83920	7221	361200	7.3%
34	oo--o	423	121	79	220	89	116	95	1143	0.0%
41	o-o--oo	22204	1806	4913	1784	3532	3442	223	37904	0.8%
42	o-oo--o	168	2	15	36	64	12	19	316	0.0%
44	oo-o--o	74	1	3	5	11	4	14	112	0.0%
45	oo--oo	91462	29808	40717	31218	29524	103936	53649	380314	7.7%
47	o--ooo	125	13	11	26	34	62	13	284	0.0%
52	o--oo-o--o T&T	3267	202	582	397	448	576	170	5642	0.1%
53	o-oo--oo T&T	30221	2067	4214	2458	3691	5136	792	48579	1.0%
57	o--o----ooo (artic)	3945	931	1195	1081	1180	1784	110	10226	0.2%
61	o--o--o--oo T & T	8		1	1	26	3	1	40	0.0%
62	o--oo--o-o-o (T+T)	2448	1090	1461	930	1088	846	525	8388	0.2%
63	o--oo-o--oo T & T	6830	265	1313	1110	4452	1937	272	16179	0.3%
66	oo--oo-o--o T & T	1279	166	267	239	863	738	375	3927	0.1%
68	oo--oo--oo T & T	17108	1267	9271	6029	5289	1568	237	40769	0.8%
69	o-oo--ooo	95510	4114	13754	10022	21478	31930	1014	177822	3.6%
74	o-oo--oo-o--o A Train	37	5	12	3	2	62	3	124	0.0%
77	oo--oo-o--oo	7044	1540	2248	3956	3413	2973	2903	24077	0.5%
300	o--o--o (truck towing light trailer)	30156	2605	4474	5230	13205	8234	1298	65202	1.3%
301	o--oo (tractor without semi-trailer)	1576	36	282	647	464	1269	98	4372	0.1%
401	o--o--oo (truck tow light 2 ax trailer)	26702	4059	8978	9349	15309	16960	2790	84147	1.7%
402	o--oo---o (truck tow light 1 ax trailer)	2468	525	1170	794	1679	966	180	7782	0.2%
503	o--oo--oo (truck tow light trailer)	293	109	193	188	265	40	3	1091	0.0%
511	oo--ooo (heavy truck)	1179	85	115	97	69	506	238	2289	0.0%
622	o--o--oo--o-o (A train)	29	12	28	5	42	6		122	0.0%
713	oo-oo--ooo Tri Artic	13189	632	2334	836	5307	7564	215	30077	0.6%
747	o--ooo---ooo Tri Artic	30		5	45	6	3		89	0.2%

751	o-oo--oo--oo B-train or T&T	126155	6536	17745	9931	12770	49409	3385	225931	4.4%
771	oo--o--oo--oo (T+T)	10		1	1			2	14	0.3%
791	o-oo-oooo Quad Artic	50920	3118	16093	13990	20788	8294	219	113422	2.0%
811	o--oo--oo--ooo (B train)	11036	220	1139	209	489	6410	113	19616	0.7%
826	oo-oo--oooo Quad Artic	77735	6949	23783	13457	38175	38029	118	198246	3.7%
847	o--ooo---oooo Quad Artic	143	1	15	119	27	2		307	0.1%
851	o-oo--ooo--oo B Train	17960	2594	7633	7149	11930	8077	177	55520	2.0%
891	oo--oo-oo--oo T&T	130445	26148	72489	48159	67386	70709	16904	432240	7.8%
914	oo-oo--oo-oo T&T	466	82	293	345	224	958	1	2369	2.0%
915	oo-oo--oo-ooo T&T	227084	52112	139989	95467	141409	131240	37646	824947	15.6%
951	o-oo-ooo-ooo B Train	75950	11105	43989	42180	30609	24257	30	228120	3.8%
1020	oo-oo-ooo-ooo B Train	1997	773	1807	2472	1379	5093	2	13523	0.2%
1032	o-oo-ooo-oooo B Train	1	0	0		0	0	0	1	0.0%
		1773795	237824	571941	496428	686384	973614	192363	4932349	100%

Appendix 3 Unit values of time for car and motorcycle users (\$ per hour)

Time spent on employers' business	\$36.25
Other time	\$10.64

Domestic Transport Costs
and Charges Study

Working paper C5
Road Vehicle Operating Cost

transport.govt.nz

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Te Kāwanatanga o Aotearoa
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