TE MANATŪ WAKA
MINISTRY OF TRANSPORT

Domestic Transport Costs and Charges Study

Working Paper C10
Micromobility

Prepared for Te Manatū Waka Ministry of Transport (NZ)
Veitch Lister Consulting Pty Ltd, in association with Ian Wallis Associates Ltd
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Contents

Appendices

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.

Citation

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For more information

For more information about this project and associated report, please contact: info@transport.govt.nz.

Glossary of terms and abbreviations

Term	Definition
CBD	Central business district
DTCC EBI	Domestic Transport Costs and Charges (study) Earnings before interest
IWA	Ian Wallis Associates
MoT NZTA	New Zealand Ministry of Transport New Zealand Transport Agency, or Waka Kotahi
PC-OC	Private car operating cost (model)
QR code	Quick Response code
SAE SM-OM	Society of Automotive Engineers Shared Micro-mobility Operating Cost Model
TOF	Transport Outcomes Framework
VLC	Veitch Lister Consulting Ltd

Executive summary

Overview

The Ministry of Transport Domestic Transport Costs and Charges (DTCC) study aims to identify all the costs imposed by the domestic transport system on the wider New Zealand economy, including costs (financial and non-financial) and charges borne by the transport user.

This working paper presents an analysis of the costs of shared micro-mobility services in New Zealand. Specifically, we develop a cost model (SM-OM) that estimates per kilometre and per trip costs of using shared scooter services. The focus is on scooters defined as a "Powered Standing Scooter" for the purpose of the Society of Automotive Engineers Definition and a "Powered Transport Device" under the NZTA Accessible Streets Definition. These are powered by 300W motors, which typically allow average operational speeds of 7.5-10kmh, with a mean trip distance and time of 1.3 km and ~10 minutes. They are provided via dockless shared schemes in urban zones, and accessed by a smartphone app.

Micro-mobility services are undergoing rapid change. Lime's entry into the New Zealand market in 2018 has led to rapid growth in demand for scooters. Several micro-mobility companies are now active in the New Zealand market, with schemes operating in Auckland, New Plymouth, Hamilton, Wellington, Christchurch, and Dunedin. User charges are typically based on a flag-fall plus a per minute charge, though certain companies also offer discounted subscription options. Rapid changes in industry structure, technological and operational characteristics, and business models complicate our analysis.

Methodology

The Shared Micro-mobility Operation Model ("SM-OM") has four major cost components:

- *Fixed Capital Expenditure* – which considers costs related to purchasing vehicles/parts and preparing them for deployment, with allowances for caps, vehicle churn, and repairability.
- *Variable Operational Expenditure* – which considers variable costs associated with operating shared scooter services, such as distributing and recharging vehicles, checking and repairing vehicles, and new user promotions and marketing activities.
- *Fixed Operating Costs* – which considers fixed costs required to run the business, including employees, general brand marketing, government relations and fees, legal expenses, insurance, technical development, vehicle, office and warehousing expenses.
- *Taxes and profit* – to cover taxes, repayment of debt and a return to investors.

Results

To arrive at our main results, we draw on trip distribution data from Auckland Council. In the initial 12-month trial to November 2019, 1.78 million shared scooter trips were undertaken in the Auckland region, with an average trip distance of 1.3km, resulting in ~2.2 million person-km p.a. This represents a mode share of 0.08% of trips and 0.01% of distance travelled in the Auckland region. From this we derive a weighted average trip distance of 1.32km and a duration of 10.97 minutes, giving an average speed of 7.2km per hour. We also assume a pricing structure of $0.38 per minute plus an $1.00 unlock fee, which yields a weighted

average charge of $5.00 per trip. Based on this data and these assumptions, we estimate an average charge of $3.79/km. These charges are assumed to cover the rental, basic liability insurance, payment processing fees as well as customer support. Table ES.1 shows the main cost components as a proportion of the total and on a per kilometre basis.

Table ES.1 Main results – cost components per kilometre to generate consumer charge

Line Item	% of total cost	$ per km
1) Fixed Capital Expenditure	20.10%	$0.76
2) Variable Operational Expenditure	43.64%	$1.65
3) Fixed Operating Expenses	19.80%	$0.75
4a) Taxes	5.40%	$0.21
4b) Profit / Repayment of shareholders	11.00%	$0.42
5) TOTAL COST	**100%**	**$3.79**

User charges vary from something over $4.00 per km for very short trips down to $3.00 per km for trips of around 5 per km. Actual user charges will vary depending on the average operating speed.

While the SM-OM model estimates the cost structure for shared micro-mobility as it exists today, we expect technological innovations will progressively reduce costs and (given the competitive nature of the market) also user charges. Possible projections for future cost curves, in which we make assumptions on these innovations, are provided in Appendix C. Finally, we understand Waka Kotahi / NZTA is currently assessing scenarios for future micro-mobility mode share (for both owned and shared devices). Similar studies in Paris have suggested the potential mode share for such devices may approach between 10% and 21% of all person km by 2030.

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 on the wider New Zealand economy including costs (financial and non-financial) and charges borne by the transport user.

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 imposed by different transport modes - including road, rail 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, especially 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 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 (1) estimating and reporting economic costs and financial charges and (2) 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 including areas such as charging and revenue management, internalising externalities, and travel demand management.

The Study has been undertaken for Te Manatū Waka by a consultant consortium headed by Ian Wallis Associates. 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 impacts or externalities (including accidents, congestion, public health, emissions, noise, biodiversity and biosecurity).

Working papers are being prepared for each of the topic areas. The 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). Unless otherwise noted, the analyses in this paper are based on the following key assumptions:

- ***Base price period.*** All prices are expressed in NZ$2018/19 (i.e. prices typical of or averaged over the 12 months ending 30 June 2019).

- ***Pricing in real terms.*** All prices are expressed in constant real $ terms, i.e. excluding any inflationary components.
- ***GST.*** The financial costs given in this paper include a GST component (except where noted). All economic costs given exclude any GST component.
- ***Other taxes and duties.*** Economic analyses are concerned with resource costs rather than financial costs, so taxes or duties are excluded from the prices of goods and services. That said, we retain GST in our analysis of (financial) charges to the traveller. Note that transport fees and charges are included in specific working papers to understand the cost burden to users.

Where appropriate, we adopt the same structure and assumptions as used in other parts of the DTCC study.

One notable departure is the cost of capital, where our conversations with industry participants led us to adopt a rate of 5% p.a.(in real terms), which is slightly higher than the 4% p.a. that has been used in other parts of the DTCC (for which capital costs are financed principally through the public sector). We suggest the slightly higher cost of capital is appropriate here given the structure of the ride-hailing and taxi industries, which are both privately-owned and currently face somewhat elevated risk profiles compared to other parts of the transport sector. These risks arise in response to factors affecting both the ride-hailing and taxi industries directly, such as competition from new entrants, as well as indirectly, such as competition from shared e-scooters and e-bikes.

1.3. Paper Overview

This draft working paper presents an analysis of the costs of shared micro-mobility services in New Zealand. Specifically, we develop a cost model (SM-OM) that estimates per kilometre and per trip costs of using shared scooter services.

Like many parts of the transport system, micro-mobility services are undergoing rapid change. Lime's entry into the New Zealand market in 2018 has led to rapid growth in demand for scooters. Several micro-mobility companies are now active in the New Zealand market and vehicle numbers are expected to continue to grow. Changes in the industry structure; technological and operational characteristics; and the evolution of business models complicate our analysis. The pace of change presents challenges to analyses based on backwards looking data, such as this.

We recommend readers keep such dynamics in mind. For clarity, we estimate costs for an average scooter service in New Zealand as they exist with their pricing today. In Appendix C, we estimate near-term future costs based on projected operational improvements.

The outputs from the micro-mobility topic are expected to mainly contribute to the TOF inclusive access and economic prosperity outcomes.

1.4. Key Definitions

Micro-mobility: We draw on two frameworks – the Society of Automotive Engineers (SAE) classification system developed in 2019, and the NZTA Accessible Streets package—as adopted by the NZTA Non-Traditional Modes of Transport (Micro-mobility Study) which is currently under review. We analyse costs and charges of shared scooter business models. These scooters are defined as a "Powered Standing Scooter" for the purpose of the SAE Definition and a "Powered Transport Device" under the Accessible Streets Definition. Scooters are permitted for use on the road and footpaths and will soon be permitted in bike

lanes. While other micro-mobility technologies exist, none have seen similarly widespread deployment in NZ as scooters.

Scooters: In terms of vehicle technology, we analyse scooters powered by 300W motors, which typically allow average operational speeds of 7.5-10kmh, with a mean trip distance and time of 1.3 km and ~10 minutes. Scooters can travel at up to 25kmh, although a combination of safety concerns and a lack of infrastructure means they are often speed-limited in dense areas in Auckland and Wellington. Scooters used for shared schemes in New Zealand are classified as 'recreational' vehicles, which means they do not require a licence or helmet to operate.

Business model: This working paper focusses on scooters provided via dockless shared schemes in urban zones. A list of operators in New Zealand cities as of July 2020 is in Chapter Chapter 2. Shared scooter schemes are administered by the local councils and operate under a street trading permit. Councils typically design the scheme and award tenders to applicant companies. Operationally, the scooters are deployed on the street and activated by users scanning a QR code on their smartphone. Scooters use 3G/4G networks to upload location and telematic data to operators.

1.5. Specific Terms

The following paragraphs define specific terms that are used in subsequent Chapters of this report.

Small Passenger Service: In 2017, NZ adopted reforms to the regulatory framework governing the provision of taxi and ride-hailing services, with the aim of creating a more level playing field. The main changes included[1]:

- Streamlining the processes for a driver to obtain a Passenger (P) Endorsement by removing course requirements, area knowledge certification, and the English Language Requirement.
- Providing greater flexibility for pricing, where fares are not set via a fixed price schedule, provided the cost of the ride is agreed by the customer in advance.
- Clarifying the requirements for in-car cameras, removing the requirement for ride-hailing (as long as the passenger is registered on the system).
- Removing requirements to operate a service 24/7.
- Removing the requirement for a Passenger Service Licence.
- Removing the need for an 'approved taxi organisation' to operate.
- Extending the maximum work-time without a break to 7 hours for all small passenger services.

The effects of these regulatory reforms are still working through the industry, with many taxi companies going through restructures in response to the changes in requirements.

Ride-hailing refers to a service that links a rider to a driver through a technology platform, predominantly operated via smartphone apps. Riders first register their phone number and a credit card, after which they can order rides. Ride-hailing drivers are typically contractors with Passenger (P) Endorsements that operate vehicles with a Certificate of Fitness (CoF). The technology platforms are required to have a Transport Service Licence (TSL), which specifies requirements for quality aspects, such as driver vetting, customer service, and local representation. All rides are dispatched via the platform and riders accept pricing and

[1] "Small Passenger Services Review | Ministry Of Transport." *Transport.govt.nz*. N.p., 2020. Web. 28 July 2020.

payment terms at the time of booking. Once a rider has been paired with a driver then the ride can commence and, when complete, all payments are facilitated through the platform itself. Cash payments are not accepted. We define ride-hailing services to exclude dial-a-driver or scheduled shuttle services, such as airport transport vans.

Taxi refers to services operating under a taxi company that holds a Transport Service Licence (TSL). Vehicles must be decalled (or have signs). Prices are set using a fixed schedule, although prices for pre-arranged trips can be negotiated. As for ride-hailing, drivers must have P-Endorsements and the vehicles must have a CoF. In addition, taxis must be fitted with a camera system with local storage to record interactions between passengers/drivers. Taxis obtain rides in two ways – via dispatch or rank. With dispatch, the driver is given the dispatch address through a technology platform (traditionally custom hardware, but increasingly app-based) and then travels to the location. For rank, or ‘street hail’ work, the vehicle is positioned in a specific location, such as an airport, downtown location, or hotel, where riders can enter the taxi and direct the driver to their destination, where payment is processed.

Chapter 2 Operational Landscape

2.1 Operators

We focus specifically on micro-mobility vehicles operating via shared schemes within urban zones within New Zealand. At the time of writing, these schemes are currently being operated in Auckland, New Plymouth, Hamilton, Wellington, Christchurch, and Dunedin, as summarised in Table 2.1.

Table 2.1 Shared Scooter Schemes Currently Operating in New Zealand

City	Companies with tenders operating in 2020 (including size of scooter quota)	Programme status
Auckland	Jump (now Lime, 735), Neuron (880), Beam (880), Flamingo (630)	Trial to end Dec 2020
New Plymouth	Blip (100)	Contract to end 2022
Hamilton	Lime (500)	March 2021
Wellington	Flamingo (400), Jump (now Lime, 400)	Trial to end Dec 2020
Christchurch	Lime (1000), Beam (300), Flamingo (300)	On rolling trial
Dunedin	Lime (500)	No trial – ongoing service

2.2 User Charges

User charges are typically charged on a flag-fall and then per minute, as shown in Table 2.2 below. We note that certain companies also offer discounted subscription options.

Table 2.2 User Charges for Existing Scooter Schemes

Operator	Charges
Lime	Dunedin - $1.10 unlock and 44c/min
	Christchurch - $1 unlock and 38c/min
	Hamilton - $1 unlock and 43c/min
	Wellington - $1 unlock and 38c/min
Neuron	Auckland - $1 unlock and 38c/min
Beam	Auckland - $0.45c unlock and $0.45c/min
	Christchurch - No unlock fee and $0.38c/min
Flamingo	Auckland - $1 unlock and 38c/min

For the SM-OM model, we assume an average of $1 unlock fee and $0.38/minute charge to the end user. This covers the rental, basic liability insurance, payment processing fees as well as any customer support that is required.

2.3 Regulatory Landscape

Shared scooter schemes are regulated by local councils, with the services operating under a street trade permit. Councils typically designate service areas, including operating characteristics such as parking and any speed restrictions. Currently, highly pedestrianised areas of Auckland and Wellington have a 15kmh speed restriction, for example. Scooter companies are then typically invited to submit tenders that meet Council requirements, with the best-performing proposals accepted by Council.

In Auckland, Council has imposed 'tiers' to the service areas to expand the provision of vehicles to lower socio-economic areas. Tier 1 is primarily CBD and inner suburbs (Zone 1), while Tier 2 is the nearer suburbs and nearby North Shore and Tier 3 expands down to South/West Auckland. The deployable number of scooters is limited in each zone at the start of the day, with a company-specific ratio stating that Tier 1 cannot be 'full' without a corresponding number of scooters in Tiers 2/3.

Table 2.3 Service area tiers in Auckland

Tier	Beam	Flamingo	Jump	Neuron	Total
1	330	330	210	330	1,200
2	200	200	400	200	1,000
3	350	100	125	350	925
Total	880	630	735	880	3,125

Tiers are intended to improve 'equity' of access and are modelled on similar schemes from the United States. However, the utilisation (rides/day) in Tier 3 are consistently less than 2/day, or approximately 30-50% less than Tier 1, so they seem likely to act as loss leaders for more highly utilised CBD areas.[2]

2.4 Operating Considerations

Parking. To avoid instances where scooters block footpaths, most councils impose requirements on operators regarding where and how scooters can be parked, with fines being issued for non-compliance. To facilitate scooter parking, Councils are trialling—at their own cost—dedicated infrastructure ("corrals") for scooters in Christchurch and Auckland, as shown in Figure 2.1 below.

[2] Derived from conversations with industry participants.

Figure 2.1 Scooter Parking Corral (Source: Author's photo)

The technology does not yet exist to confirm corrals are being used properly.

In the US, some jurisdictions are partnering with operators to deploy custom branded parking infrastructure. Most local councils in New Zealand are unlikely to view this as a desirable outcome in the near-term, preferring instead to wait until the technology and business model matures.

Similarly, and in response to Council requests, operators have started restricting the areas where users can 'end' trips. Currently, it is not permitted to end a trip in the pedestrianised area of Cuba Street in Wellington or next to Takutai Square in Britomart station in Auckland, for example.

Curfews. Wellington, Christchurch and Auckland councils all impose curfews, with general operating hours and specific nightlife areas where scooters are locked to reduce risk of operating under the influence. Further research into the effectiveness of curfews and similar restrictions would seem to be warranted.

Data sharing requirements. All scooter trip data is provided to the councils utilising the Mobility Data Specification, a global standard developed by the Los Angeles Department of Transportation and administered by The Open Mobility Foundation in the United States.

Gig working chargers/'Juicers'. Most scooter operators in New Zealand currently offer contracts to "juicers" at a rate of $4-6 per scooter charged and redeployed. This is being phased out in other countries as operations become more efficient, a process which New Zealand is likely to follow.

2.5 Operating Charges

Initially, street trading permits issued to operators only carried a basic administrative cost. However, as the schemes became more popular and it became clear that they would require additional council resources, councils started to attempt to recover costs. In Auckland, for example, operators currently pay $73 per vehicle on an annualised basis in Tier 1, $44 in Tier 2 and $11 in Tier 3. This works out to approximately $17,000-18,000 per operator per 6-monthly period (i.e. the length of the permits), which translates into a charge-back rate for council staff of around $160/hour for scheme management. Other cities are seeking to adopt similar fee regimes.[3]

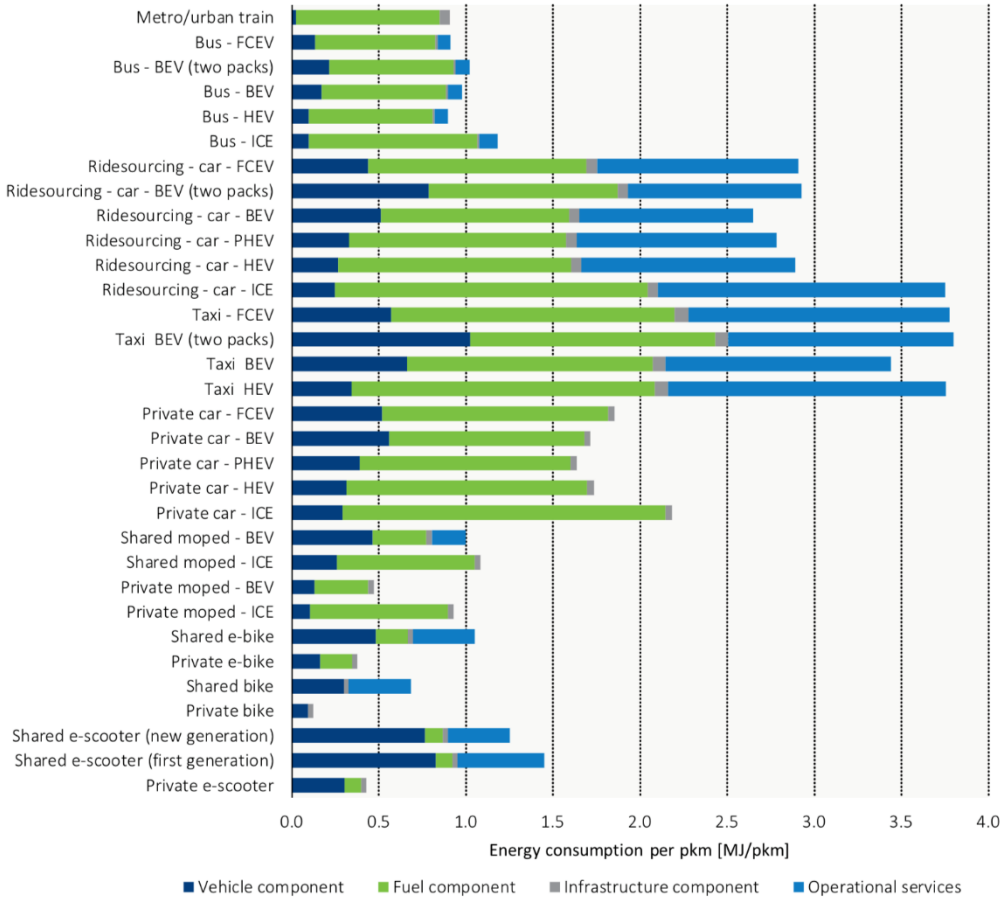
[3] "Updated Conditions Of E-Scooter Licences." *OurAuckland*. N.p., 2020. Web. 18 Aug. 2020.

In the SM-OM model, we have adopted a government fee assumption of $60,000 p.a. As tiered service zones are still relatively new (only implemented in Auckland) and this is sensitive commercial information, it is difficult to analyse the impact on operational unit economics per ride at this time.

2.6 Environmental Impact

Recent research from the International Transport Forum (ITF) places the overall energy consumption, including lifecycle analysis, of existing shared scooters at around 1.4 MJ/km. This is around the same per passenger km as a bus. The same ITF paper also outlines the planned operational and vehicle improvements under way which will bring this figure to under 0.5 MJ/km, similar to a private scooter, as shown in Figure 2. 2 below.[4]

Figure 2. 2 Energy Consumption per km



2.7 Safety Costs

While the costs of e-scooter injuries can be ascertained from ACC data, there is no robust data around the proportion of trips that are taken on shared electric scooters vs. privately owned scooters and therefore a per-km injury figure cannot be reliably calculated.

[4] Cazzola, Pierpaolo, and Philippe Crist. *Good To Go? Assessing The Environmental Performance Of New Mobility*. International Transport Forum, 2020. Web. 24 Sept. 2020.

Chapter 3 Costing Methodology

3.1 Overview

The Shared Micro-mobility Operation Model ("SM-OM") has four major cost components:

- *Fixed capital expenditure* – costs related to purchasing the vehicles/parts and preparing them for deployment
- *Variable operational expenditure* – the ongoing personnel costs for operating the shared services and the user acquisition and retention costs directly tied to vehicle use
- *Fixed operating costs* – all overhead expenses required to run the business
- *Taxes and profit* – to cover taxes and upfront investments.

We first estimate costs on a per in-service kilometre basis, which are then used to estimate the consumer charge per trip from information on the average length and duration of trips.

3.2 Fixed Capital Expenditure

Capital expenditure is dominated by the purchase of vehicles and parts. In New Zealand, the average landed cost of a current generation scooter is approximately NZD $1,000 per unit. Each scooter requires around three swappable batteries, which cost NZD $200 each. Given the early stage of the industry, debt financing of vehicles is not yet possible. For this reason, we assume scooters are financed via balance sheet equity, leading to relatively high financing costs.[5]

As of mid-2020, operators report scooters 'churn' at a rate of around 30% per year, meaning a vehicle in the fleet typically lasts around 3.3 years. In SM-OM, we have assumed a cap of 900 scooters in the council permit, in line with the average Auckland permit allocations for operators in the 2020 trial. New generation vehicles being added to the fleets are expected to have longer lifespans.[6] Due to recycling, we classify parts required for the ongoing maintenance of vehicles under capital expenditure, which is captured in the 'churn' cost covering the overall scooter fleet.[7]

3.3 Variable Operational Expenditure

The operational expenses for the business include staffing for:

- Managing distribution of vehicles, including returning to centralised locations for charging,
- Charging vehicles in the warehouse ready for redeployment,
- Checking the vehicles for damage,
- Staff costs of repairing vehicles back to operational capability, and

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[5] Derived from conversations with industry participants.

[6] Derived from conversations with micro-mobility industry operators.

[7] Commonly repaired parts include motors and accessories, with scooter batteries and bodies being more robust. At the end of their life, scooters are disposed with only limited opportunities for battery recycling. The design of newer scooters is placing a greater emphasis on their sustainability over the entire product life-cycle.

- Per ride costs for new user promotions for new riders, as well as ongoing rider retention marketing activities.

Typically, staff fall into two categories: chargers and warehouse staff. Chargers are contracted 'gig' workers paid on a per scooter basis for collecting and charging scooters in their own houses. They are provided with a set number of charging units, and are rewarded proportionate to charge level, pick-up and drop-off locations of the scooters they charge. In OM-SM, initial charger rewards were set at $5 per charge, with an average of 6 rides expected per charge per scooter. This cost per km is expected to decrease over time, as charging operations become more efficient and operators deploy swappable batteries requiring less labour. According to operators, the cost basis for battery swap/charging activity with 'gig workers' is 14-15% of revenue.

Warehouse staff are contracted either directly or through a temping agency, though the market is looking to shift towards employee-based servicing and charging through the use of swappable batteries and more mature vehicle types.[8] According to operators, the cost basis for the warehouse staff amounts to about 8% of revenue.

Typically, new riders are given a free first ride to trial the service, with an expectation that the user experience will be sufficient to retain a rider for additional rides. The costs of new user recruitment are a substantial line item cost for the early development of a shared scooter service. Acknowledging the relatively early state of the industry, it is expected these costs will decrease as market penetration increases. According to operators, the cost basis for battery swap/charging activity with 'gig workers' is 22% of revenue in the first year of operations, trending downwards as operations mature.

Overall variable operating expenses account for ~43.5% of overall revenues.

3.4 Fixed Operating Costs

Sales and General Administrative expenses include the overhead costs of running the shared scooter scheme, which include:

- Full time employees, including city managers, policy leads, marketing and operations managers
- Brand marketing not directly related to user acquisition (latter is discussed in Chapter 0)
- Fees for government (to fund council management, bonds, lobbying, operations and regulatory functions)
- Legal expenses
- Vehicle, office, warehousing expenses
- Technology development
- Liability insurance.

Overall sales and general administration costs vary slightly according to the lifespan of the permit issued by Councils, with companies often having significantly higher cost structures for short term arrangements, such as 'trials', due to not having sufficient certainty to be able to commit to capital expenditure or long-term leases. Fees vary by council, with some (such as Auckland) adopting a per vehicle fee according to the 'zone', while others such as

[8] Derived from conversations with industry participants.

Christchurch calculating fees on a per-sqm basis for land allocated to scooter parking.[9] Fee structures typically are anywhere between 1-3% of revenue according to the council.

According to industry sources, warehousing and office rentals account for around 1% of revenue each, though these often can be higher on shorter term rents.

Technology development relates to the consumer app, local operational software and processes and connectivity solutions. For smaller local operators such as Flamingo, this development is done in house or via subscriptions to modular 'white-label' services, which we have assumed at a rate of $120,000 a year. Larger global operators such as Beam, Lime and Jump all have centralised app development in their headquarters: the New Zealand operations would be charged a % of these development costs related to their specific development requirements and local revenues.

Brand marketing includes efforts such as rider education programmes, traditional out-of-home and digital brand marketing and events. Given the novel nature of the technology and the highly visible nature of the vehicles on the street, there has been a perception that scooter operators did not allocate spend to 'traditional' marketing; but conversations with operators indicate that, while that may have been true initially, conventional marketing is now standard practice.

3.5 Tax and Profit/Repayment of Shareholders

Company tax is calculated at 28% of earnings before interest (EBI) profits (Revenue-Capital Expenditure-Operational Expenditure-Selling, General and Administrative Expenses-New User Promotions). The profit margin target for the business is 11% of total expenditure before servicing the repayment of investment in the service.[10] Given the risk profile of the initial services, funding has predominantly been equity financed, leading to a high cost of capital. It is still not clear that these services will be viable entities in the longer term as the market is not yet mature. These are shown under items 4a and 4b in Table 4.1 (following).

[9] Derived from conversations with industry participants.

[10] Derived from conversations with industry participants.

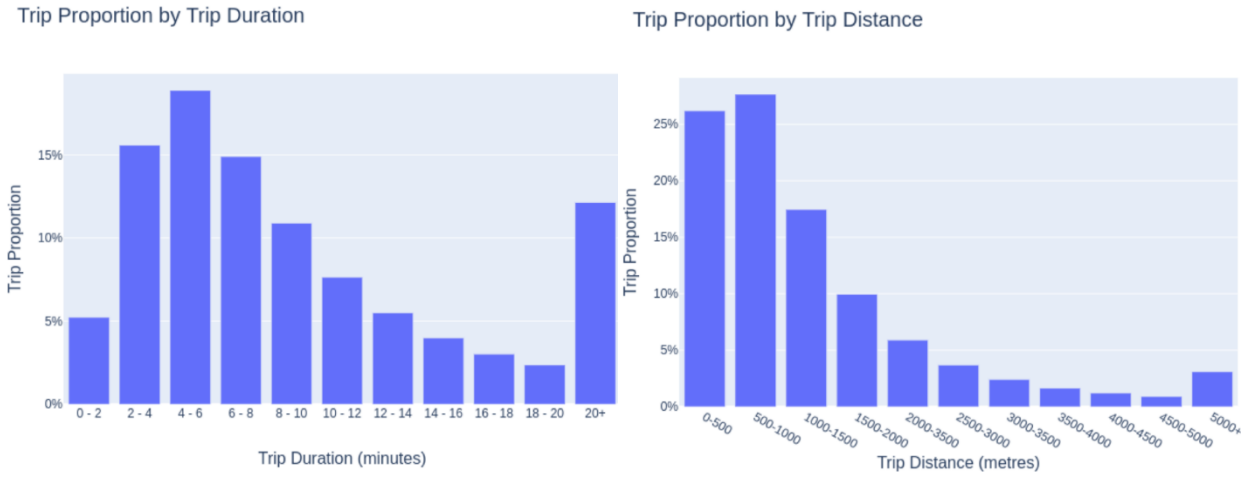
Chapter 4 Results

4.1 Demand and Mode Share Characteristics

All shared scooter operators in New Zealand are required to provide trip numbers and characteristics to the council which regulates the scheme. Our analysis in this Chapter is based on data from Auckland Council as demand data is currently unavailable for other NZ centres.[11]

In the initial trial period November 2018 - November 2019, there were 1.78 million scooter hirings in the Auckland region, with an average trip distance of 1.3km, resulting in around 2.2 million person-km p.a. This represents a mode share of 0.08% of trips and 0.01% of distance travelled in the Auckland region.[12] Figure 4.1 shows the distribution of trips by duration and distance.[13]

Figure 4.1 Scooter trip duration and distance (Auckland Council)



We expect operations to expand as council quotas grow, vehicles become more capable, operators become more efficient, and infrastructure/perceived safety improves.

4.2 Summary of Average Costs Per Km

To arrive at our main results, we draw on the trip distribution data from Auckland Council. From this we derive a weighted average trip distance of 1.32km and a duration of 10.97 minutes, giving an average speed of 7.21km per hour. We also assume a pricing structure of $0.38 per minute plus an $1.00 unlock fee, which yields a weighted average charge of $5.00 per trip. Based on this data and these assumptions, we estimate an average charge of $3.79/km. Assuming that this is a close

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[11] Bruce, O., 2020. *Aggregated Scooter Trip Data - A Official Information Act Request to Auckland Council*. [online] FYI.org.nz. Available at: <https://fyi.org.nz/request/11798-aggregated-scooter-trip-data#outgoing-21434> [Accessed 21 July 2020].

[12] We note the accuracy of these figures is disputed by operators who consider them to be too low, although efforts to resolve the discrepancy between the data and operators' views were unsuccessful.

[13] Auckland Council, 2020. *Rental E-Scooter Trial 2.0*. [online] Auckland: Auckland Council. Available at: www.aucklandcouncil.govt.nz/licences-regulations/report/rental-e-scooter-trial-2.0-evaluation-report.pdf [Accessed 27 July 2020].

approximation to the total costs, the breakdown of the costs used to generate these components is shown in Table 4.1.

Table 4.1 Main results – cost components per kilometre to generate consumer charge

Line Item	% of total cost	$ per km
1) Fixed Capital Expenditure	20.10%	$0.76
2) Variable Operational Expenditure	43.64%	$1.65
3) Fixed Operating Expenses	19.80%	$0.75
4a) Taxes	5.40%	$0.21
4b) Profit / Repayment of shareholders	11.00%	$0.42
5) TOTAL COST	**100%**	**$3.79**

Based on the average operating speed of 7.2km/hr, the pricing structure translates to an average charge/km basis as shown in Table 4.1. Depending on the average operating speed, user charges/km may be expected to vary from something over $4.00 for very short trips down to $3.00 for trips of around 5 km.

In terms of how user charges may change in the future, Appendix C provides broad estimates of how cost structure, and most likely the corresponding user charges, may vary over the next few years in response to further developments in technology and provision of improved infrastructure. Figure C.1 in Appendix C illustrates user charges reducing to around $2.50 per km for typical trip distances for an average speed of 12.5 km/hr, which is approximately 30-35% lower than the user charges estimated above.

In terms of future market potential, we understand Waka Kotahi/NZTA has commissioned separate research into this question that will be published shortly. This research considers the potential for micro-mobility in NZ, by both shared and privately-owned vehicles: It is expected to produce similar findings to the Carbone report conducted by Bird, which assessed scenarios for future micro-mobility mode share in Paris of between 10% and 21% of all person km by 2030.[14]

[14] 2019. *The Role Of E-Scooters and Light Electric Vehicles in Decarbonizing Cities*. [ebook] Carbone 4. Available at: Vehicleswww.carbone4.com/wp-content/uploads/2019/09/Carbone-4-for-Bird-E-Scooter-and-Cities-decarbonization.pdf [Accessed 21 July 2020].

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 : Future State Costs

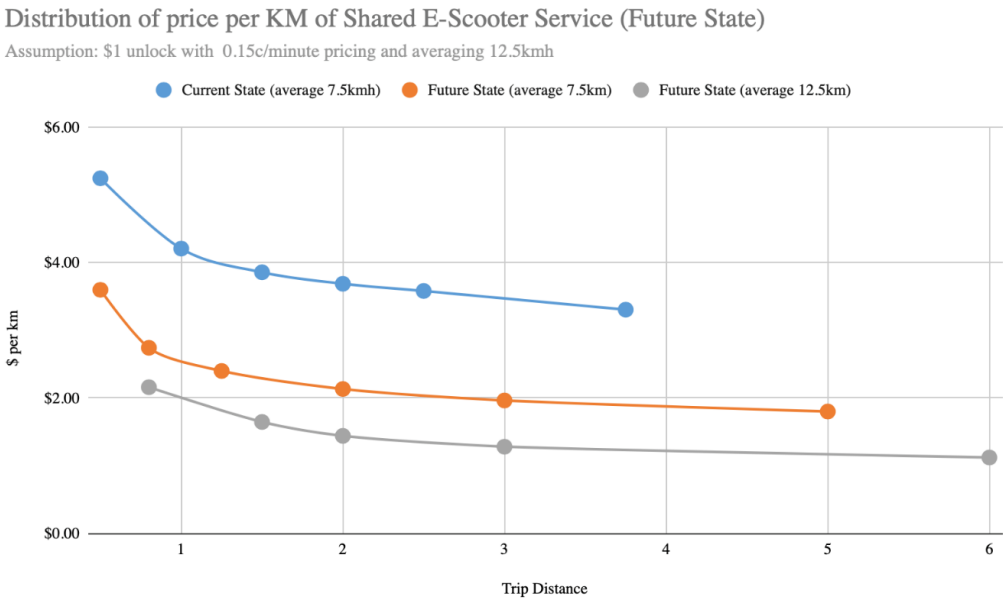
The micro-mobility industry is still in its early stages, with only 3-4 years of operational experience in New Zealand. We understand several cost efficiency initiatives are currently underway that seem like to be deployed in New Zealand, including:

- More durable scooters, lasting 4-5 years (versus around 3-years for current models)
- Swappable batteries, bringing down operational costs for charging from $5 to $1.50
- Longer contracts with councils supporting investments in vehicles and infrastructure
- Faster service speeds due to improved infrastructure
- Longer battery range (at least on the doubling of existing range)
- Higher levels of utilisation through lower costs and better infrastructure for scooter users
- Cheaper access to funding capital as debt financing becomes available for scooter vehicles.

We used our model to assess the potential effects of these initiatives on estimated costs, as illustrated in Figure C.1. We find costs could drop by about one-third, from the current average of $3.79 per kilometre to around $2.50 per km for trips around 2km in length as a result of technology and efficiency developments; and potentially drop further to around $1.50 per km with improved infrastructure facilitating increases in average operating speeds.

We expect many of these improvements will be adopted in New Zealand within the next couple of years. The significance of these cost reductions, and the rate at which they seem likely to eventuate, suggest there may be value in updating the estimated costs in this paper within the next few years.

Figure C.1 Distribution of price per km for shared e-scooter services in future state



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