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Micromobility’s contribution to emissions reduction

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Decarbonising Transport

Transportation Conference

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My Research

- There is a global gap in knowledge on the potential impact of the growth in micromobility use on global transport emissions.

  e.g: *“Are e-bikes the key to achieving decarbonisation targets?”*

- The objective of my research was to:
  - **fill this knowledge gap** in Aotearoa / New Zealand, and
  - provide a framework to extend the research to other national transport sectors and **fill the gap in global knowledge**.

My Research Method

- Literature review (peer reviewed):
  - Waka Kotahi (2021) research report 674: Mode Shift to Micromobility.
  - ITF (2020) Good to Go? Assessing the Environmental Performance of New Mobility.
- Methodology:
  - Mode shift forecast (range)
  - Trip market analyses (veh-km)
  - Transport carbon by mode analyses
- Results:
  - Carbon reduction due to mode shift to micromobility as a percentage of transport carbon emissions (range)
- Conclusions and Recommendations

What do we mean by Micromobility?

E-Scooter

Powered Transport Devices
(Waka Kotahi Determination)

E-Bike

Powered Wheelchairs

E-Mopeds

Powered Transport Devices
(Waka Kotahi Determination)

WAKA KOTAHI
NZ TRANSPORT AGENCY

Research Report 674

Mode shift to micromobility

February 2021

M Ensor, Beca
O Maxwell, Beca
O Bruce, Micromobility Industries

Forecast Mode Share for Micromobility

Overall, **e-scooter mode share could increase to up to 5.7%** mode share**, e-bikes mode share up to 8.1%,** depending on a range of context factors.

Up to **5.7%** mode share

Up to **8.1%** mode share

Mode Shift to Public Transport

Up to a **9% increase** in PT trips

Overall, 'first mile last mile' use of micromobility in conjunction with public transport is expected to **increase public transport trips by up to 9%,** depending on a range of context factors, and **decrease car trips by up to 2%**.

Figure 5.12 Mode share for e-bikes under various scenarios, by trip length

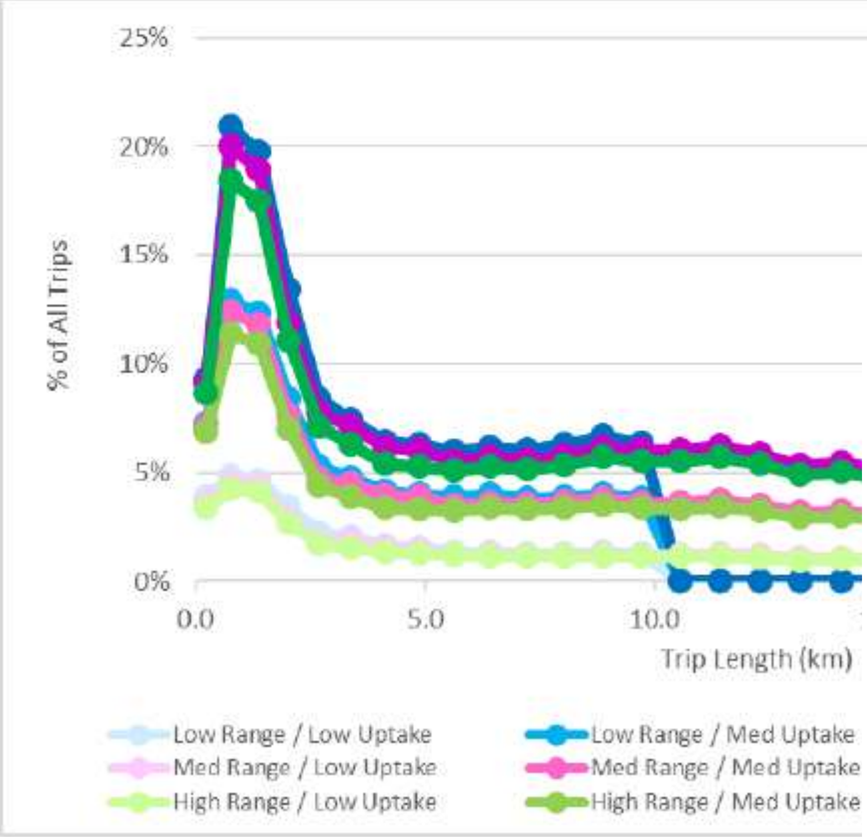

Figure 5.13 Mode share for e-scooters under various scenarios, by trip length

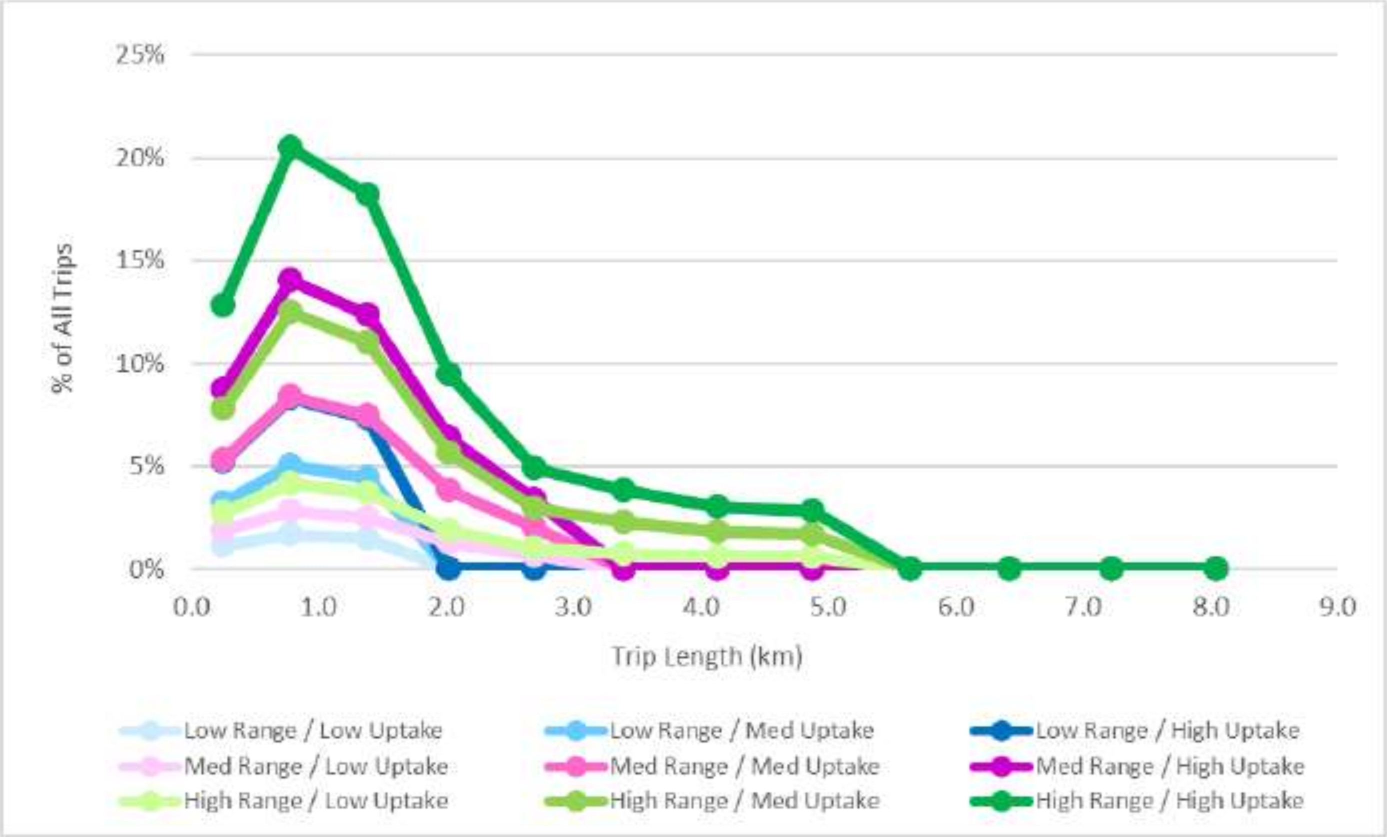

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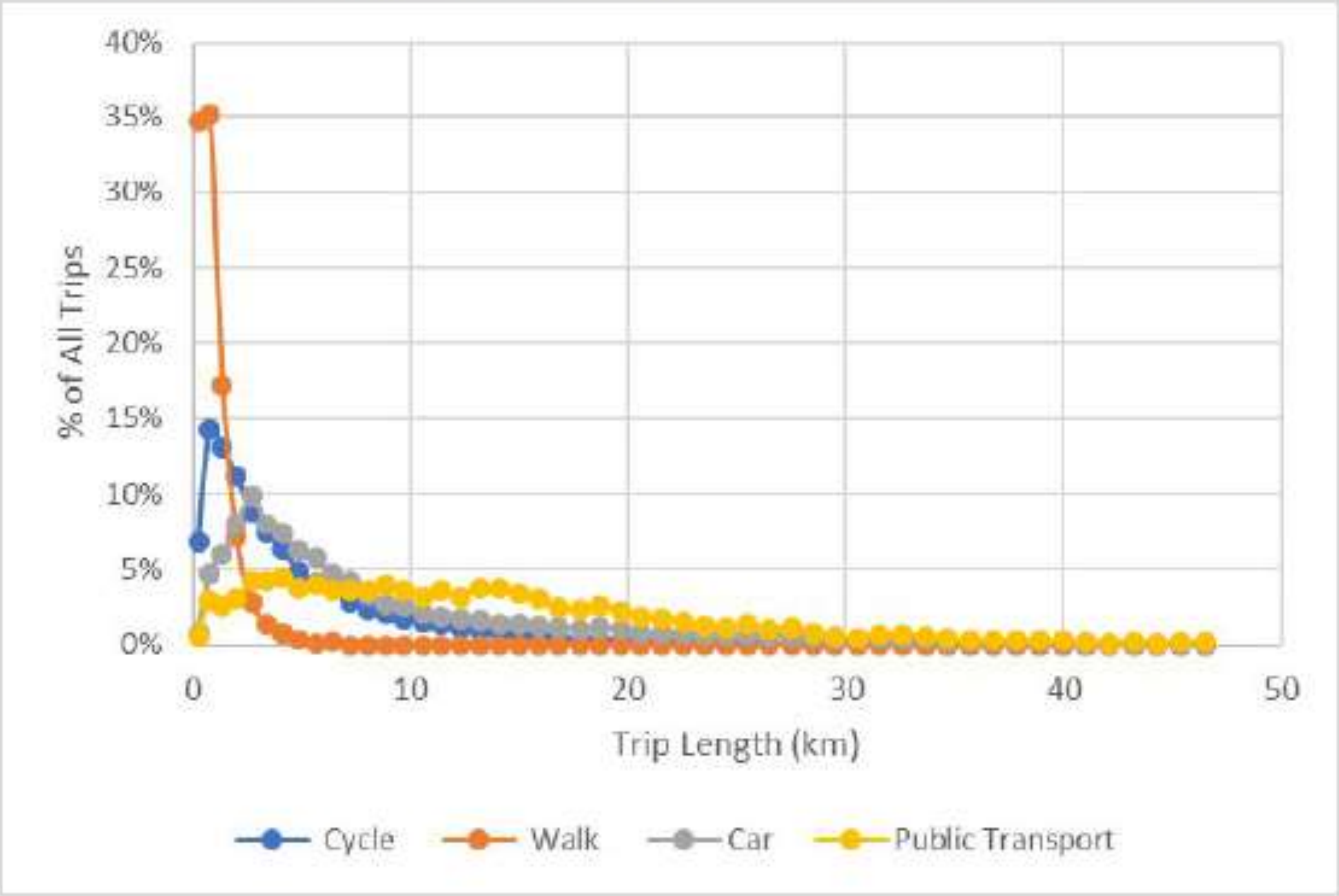
Figure 5.4 Distribution of the existing 'market' of trips for each major mode, by trip length



Trip Market Analyses

Equation 1:

*Average trip distance (micromobility) = $\sum_{i \text{ to } n}$ (mode shift to micromobility % $_i$ * number of veh trips $_i$ * median trip distance $_i$) / number of mode shift micromobility trips*

The percentage change in veh-car distance is calculated by dividing the total mode shift to micromobility veh-km calculated in Equation 1 by the total car veh-km of travel. This is shown in Equation 2.

Equation 2:

Percentage change in veh-km (car) = veh-km (micromobility) from mode shift / veh-km (car)

Micromobility Mode	Scenario	Average Trip Distance (km)	% of car veh-km
E-Scooters	Low Range Low Uptake	1.04	0.02%
	Med Range Med Uptake	1.48	0.24%
	High Range High Uptake	1.93	0.94%
E-Bikes	Low Range Low Uptake	3.20	0.65%
	Med Range Med Uptake	4.02	2.16%
	High Range High Uptake	4.55	3.69%

Table 1 – Average Trip Distance for Micromobility Modes and Scenarios

Access to micromobility scenarios	Major city suburbs/ regional city fringe (high levels of PT)
Limited access to micromobility (low to moderate availability of shared devices, low rate of device ownership)	Car usage down 0.4%
Moderate access to micromobility (high availability of shared devices, low to moderate rate of device ownership)	Car usage down 1.0%
Easy access to micromobility (high availability of shared devices, high rates of device ownership)	Car usage down 1.3%

Table 2 – Scenarios for Mode Shift to Public Transport from first/last mile micromobility

Carbon Emissions

Vehicle | Fuel | Infrastructure | Operational

The ITF assumption of **563 g CO2e /kWh** has been replaced by **110 g CO2e /kWh**, reflecting New Zealand's relatively 'green' electricity

Device / Vehicle	Vehicle (g CO2e / p km)	Fuel (g CO_2e / p km)	Infrastructure (g CO_2e / p km)	Operational (g CO_2e / p km)	Total (g CO_2e / p km)
Private e-scooter	26	1	9	0	37
Shared e-scooter	66	1	9	25	101
Private e-bike	13	2	9	0	24
Shared e-bike	37	2	10	25	74
Private car - ICE	24	126	12	0	162
Bus - ICE	8	72	4	8	91
Metro/urban train	2	10	11	0	23

Table 3 – g CO2e / passenger kilometer travelled

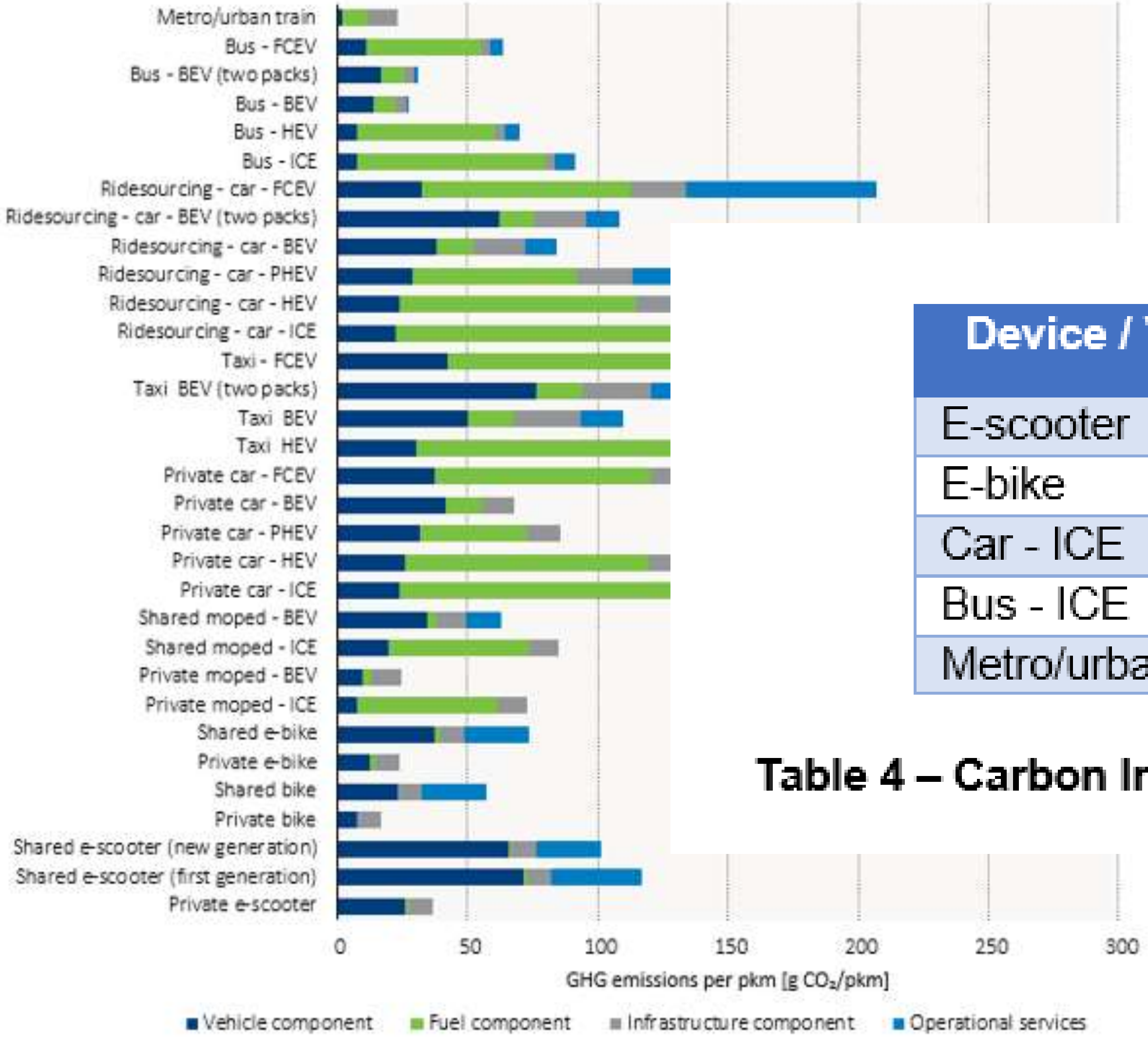


Figure 3 – Carbon Emissions per passenger km by transport mode (using NZ electricity generation)

Device / Vehicle	Total for Mode (g CO_2e / p km)
E-scooter	34
E-bike	20
Car - ICE	150
Bus - ICE	88
Metro/urban train	12

Table 4 – Carbon Intensity of transport modes per passenger km.

Decarbonisation Calculation

Equation 4:

Change in total urban veh-km (car) (%) = mode shift to public transport (veh-km) / total veh-km (car)

The public transport calculation assumes that the distance travelled is unchanged but will occur at the carbon intensity of public transport as compared to that of a car. This is shown in Equation 5.

Equation 5:

*Reduction in g CO_2e (%) = mode shift from car (%) * (g CO_2e / p km (car) - g CO_2e / p km (public transport))*

Device	g CO_2e per km	% of total urban veh-km (Car)	% mode shift from car	Reduction in CO_2e
E-Scooter (low)	34 (77% saving)	0.02%	40%	0.01%
E-Scooter (med)		0.24%		0.07%
E-Scooter (high)		0.94%		0.29%
E-Bike (low)	20 (87% saving)	0.65%	50%	0.29%
E-Bike (med)		2.16%		0.94%
E-Bike (high)		3.69%		1.61%
Public Transport (low)	69 (54% saving)	0.4%	100%*	0.22%
Public Transport (med)		1.0%		0.54%
Public Transport (high)		1.3%		0.70%
Total (low)				0.52%
Total (med)				1.55%
Total (high)				2.60%

Table 5: Reductions in CO_2e emissions for a range of scenarios.

* This is already the reduction in car veh-km as the distance travelled by new public transport trips is assumed to be the same as the car trip it replaces.

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Factors Affecting First Mile / Last Mile Use Of Micromobility

- Presence / maturity of mobility as a service (MaaS) .
- Quality of public transport provided.
- Availability of shared micromobility.
- Provision for micromobility parking at connection points.
- Ability to take devices onboard public transport services.
- Maturity of micromobility culture in the location of interest.

Results

"The combined impact of micromobility on transport could be a **saving of between 0.5% and 2.6% in carbon emissions** from urban light vehicle transport."

Conclusions & Recommendations

1. Even at high levels of uptake of micromobility, the available “market of trips” (trip length) **restricts the impact to 2.6% or less.**
2. **Changes in land use** which reduce the proportion of longer trips will both reduce emissions from less veh-km of travel and **increase the attractiveness of mode shift to micromobility.**
3. On the basis of the contribution of micromobility to decarbonisation, a **suitable mandate is required to increase spending on active mode infrastructure**, especially first mile / last mile with PT!
4. **The investment and land use changes are aligned** with the recommendations of the **NZ Climate Commission’s** 2021 draft report.
5. This research provides a methodology for the **calculation of global reductions in emissions due to mode shift to micromobility**, filling a significant gap in the global evidence base.

Thank you.

Discussion is welcome.