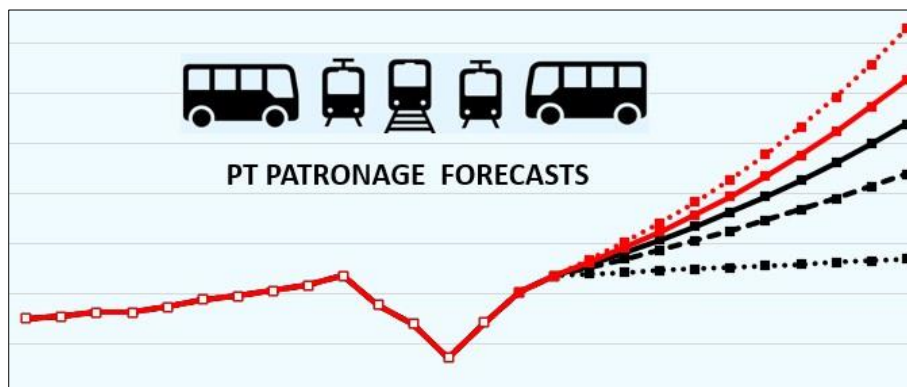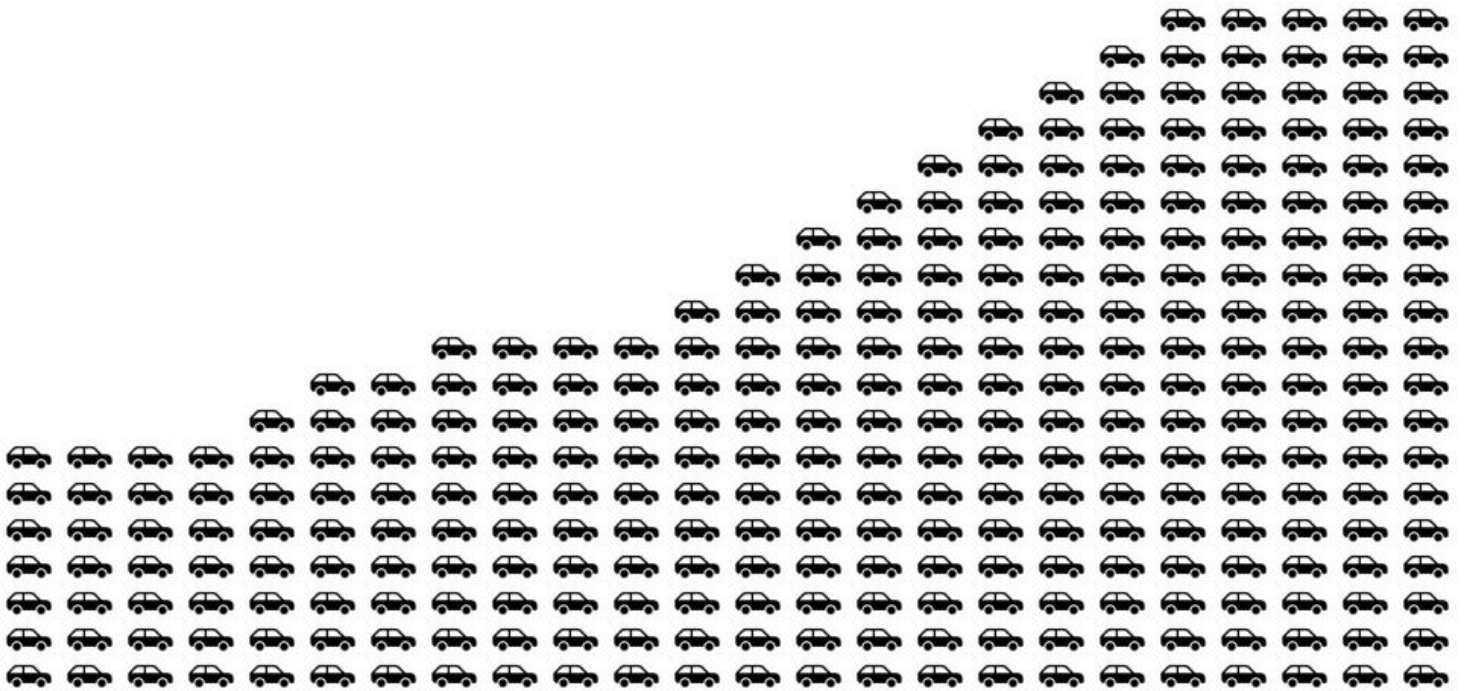# Vehicle Kilometres Travelled Reduction

Public Transport Base and Target Forecast Study

Vehicle Kilometres Travelled (VKT) Reduction
Public Transport (PT) Base and Target Forecast Study

Contents

Vehicle Kilometres Travelled (VKT) Reduction

Public Transport (PT) Base and Target Forecast Study

1.0 Summary

Purpose

0.1   Estimate the size of the public transport (PT) share of the task required to meet the 2035 national light-vehicle kilometres travelled (LVKT) 20% reduction target, using available data and forecasts.

National Assessment

LVKT Forecasts

0.2   The initial assessment of PT task requirements was undertaken at the national level, prior to more detailed sub-national assessment. To meet the 20% reduction target, total LVKT needs to be slightly below (≈1%) the 2019 LVKT level, by 2035.

PT Estimates

0.3   Estimation of overall PT (all sub-mode) demand was undertaken for five scenarios, namely: Base (minimal population growth and crowding relief), Business as Usual (BAU), Rodier (a conservative assessment of policy combinations), Emissions Modelling (research findings based on analysing major conurbations) and MoT Target (an upper assessment of policy combinations). In overall national terms, the BAU Scenario represents a 57% increase in current levels of PT passenger-km and the LVKT MoT Target Scenario requires an increase in PT passenger-km of 156%, to support the target of a 20% reduction in LVKT by 2035.

0.4   Under the MoT Target Scenario, bus passenger-km would need to increase by 115%, rail by 306% and ferry by 86% over the period 2024/5 to 2034/5.

Sub-national Assessment

VKT Forecasts

0.5   Target reductions in LVKT have been provided by MoT, primarily in Tier 1 and 2 areas, which by 2035, are forecast to account for 75% of LVKT, nationally.

PT Estimates

0.6   The concentration of PT in Auckland, Wellington and Christchurch is expected to increase by 2035 (under the MoT Target Scenario) to account for 95% of national PT passenger-km.

0.7   In order to meet the PT share of MoT VKT targets, PT patronage would need to return to pre-COVID levels and then increase by more than double the rate of pre-COVID growth rates.

0.8   More detailed sub-national estimation (for the LVKT MoT Target Scenario) indicates a requirement to increase overall PT passenger-km (between 2024/25 and 2034/35) by 186%.

Vehicle Kilometres Travelled (VKT) Reduction

Public Transport (PT) Base and Target Forecast Study

1.0 Introduction

Purpose

1.1   The purpose of the study[1] is to estimate the size of the public transport (PT) task[2] required to meet the public transport share of the 2035 light-vehicle kilometres travelled (LVKT) reduction target under the Emissions Reduction Plan[3] (ERP), compared to a business-as-usual (BAU) forward planning base case.

Background

1.2   The ERP requires LVKT to be reduced by 20% nationally, compared to the forecast baseline, by 2035 and PT is expected to play an important role in meeting this target.

1.3   LVKT reduction is intended to be achieved through coordinated packages of interventions, for example: through increased PT services, urban land use intensification and road pricing type measures.

1.4   Using available information sources, Section 2.0 and 3.0 of this report focus on the national scale of PT services (all sub-modes, namely: bus, rail, ferry combined) required to support the LVKT reduction target.

1.5   Section 4.0 considers implications for PT sub-modes nationally and Section 5.0 describes sub-national VKT and Section 6.0 estimates the potential implications of establishing PT sub-national and sub-mode targets.

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[1] Waka Kotahi *'PT VKT Base and Target Forecast Study'*, Contract 8340
[2] Primarily in terms of PT passenger-kilometres.
[3] https://environment.govt.nz/what-government-is-doing/areas-of-work/climate-change/emissions-reduction-plan/

2.0   National LVKT forecasts and targets

National LVKT Forecasts

2.1   The 20% LVKT reduction target for 2035 is the primary input for this study. Current and forecast LVKT are taken from Ministry of Transport (MoT) supplied information[4]. This shows the effects of COVID reduced LVKT levels in 2019, 2020 and 2021, however by 2022, the 2018 LVKT level was exceeded, with further LVKT growth then forecast to continue thereafter, as shown below:

Figure 1: MoT National LVKT Trend and Forecast
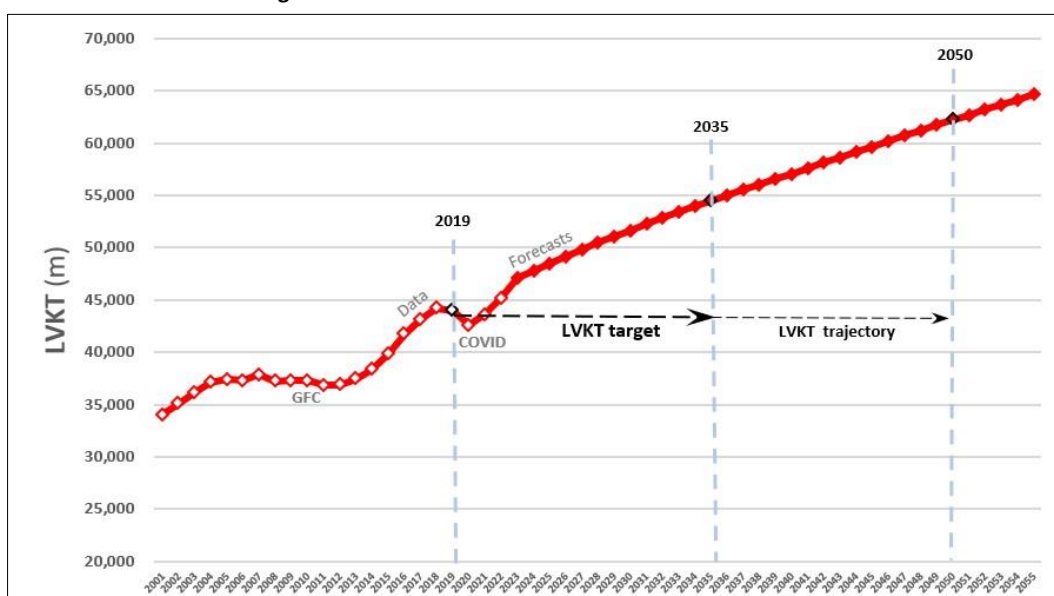
2.2   Between 2010 and 2019 (nationally) LVKT increased by 18%. On the basis of BAU forecasts (i.e., without specific further interventions) LVKT is anticipated to grow by 24% from 2019 to 2035 and by 42% from 2019 to 2050. To meet the 20% reduction target, LVKT needs to be slightly (≈1%) below the 2019 level by 2035. In the absence of further target guidance, it has been assumed the constraint on LVKT growth will continue to apply through to 2050.

Regional LVKT Forecasts

2.3   Regional variations in LVKT growth are also forecast[5] under the BAU Scenario, between 2019 and 2035. These sub-national data and forecasts are consistent with the national MoT LVKT forecasts as shown in Figure 1, above (see also further discussion in Section 5.0).

2.4   Measures to achieve LVKT reduction in Auckland, Christchurch and Wellington have been modelled, with results contained in the Waka Kotahi draft '*emissions research report[6]*'. This modelling tested a range of assumptions and policy combinations, designed to contribute to the national 2035 LVKT reduction target. The research work confirmed that most travel demand, and therefore VKT, is non-commuting, occurring outside the weekday (morning and evening) peak periods, which provides opportunities for PT to utilise available non-peak capacity.

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[4] MoT '*I_VFEM worksheet - Series 4*' *''the series we will be using going forwards, it is the latest version of VFEM (VFEM3 run202204_Adj_ghg&fuel_CY_(base-case only)web.xlsx) and includes all fuel types. It assumes a high ETS price in line with the Climate Change Commission's recommendations''*.

[5] Waka Kotahi, '*VKT and GHG emissions baseline report',* Research Note 008, September 2022.

[6] Waka Kotahi*, 'Interventions to reduce land transport greenhouse gas emissions In Auckland, Christchurch and Wellington, March 2023'*.

3.0 National PT estimates and targets

Context

3.1 The national estimation of overall (bus, rail, ferry combined) PT requirements was undertaken in order to compare the implications of alternative estimation approaches and to identify a scenario for further PT sub-mode (Section 4.0) and sub-national PT (Section 6.0) analysis.

3.2 COVID effects reduced PT travel demand, especially for peak period commuting into central urban areas, and increased levels of working from home. In the future, in the context of the 2035 LVKT reduction target, new policy settings are anticipated, including: increased PT service provision, intensified land use activity (especially around PT nodes) and road pricing for light vehicles. Whilst details of these policies have not yet been designed in detail, formally considered or confirmed, for the purposes of this study, a future policy mix, similar to those recommended in the emissions modelling and MoT Target guidance, have been assumed to estimate the broad effects of LVKT reduction measures on PT requirements.

3.3 The metrics considered in the PT estimation work include: PT passenger-km, service-km, passenger boardings, PT trip length and 'passenger-km per service-km' (representing average service utilisation).

Trends

3.4 To estimate growth trends, the study has concentrated on pre-COVID data, between 2009/10 and 2018/19, for which continuous PT data is available for all relevant metrics. Over this period, PT passenger-km average growth was recorded of 4.3% p.a., 4.5% p.a. growth in PT boardings, 2.5% p.a. growth in PT service-km, 0.6% p.a. growth in PT trip length and 1.4% p.a. growth in PT passenger-km per service-km. These trends may indicate that increases in service-km has a multiplier effect on other PT metrics, potentially due to service frequency elasticities and the introduction of PT services into additional areas and/or time periods.

Table 1: Pre-COVID PT Growth Trends and Demand Levels.

Years	PT Metric				
	Passenger-km	Boardings	Service-km	Trip-length	Passenger-km per Service-km
2009/10 – 2018/19	4.3%	4.5%	2.5%	0.6%	1.4%
2018/19 also *equivalent to* 2024/25	1,676.2 (m)	168.4 (m)	125.3 (m)	9.96 km	13.4

3.5 Compared with LVKT, PT experienced more substantial COVID impacts, with greater COVID-related reductions in PT metrics and a longer post-COVID recovery period. PT is in many ways 'supply-driven' and service-km can therefore be viewed as a 'planned' metric, albeit usually in response to changes in underlying demand. Service-km has not responded in the same way as either boardings or passenger-km to COVID effects, partly because during the COVID period, additional government subsidy was made available to supplement revenue and to permit continued service operation.

Estimation Approach

3.6 After reviewing available information and alternative approaches to the estimation of future PT metrics (see Annex A.1), the following approach was adopted:

i)   A focus on 2035, the LVKT reduction target year.

ii) Patronage recovery rate monitoring indicates overall PT demand is expected to return pre-COVID levels by 2024/25, with patronage growth anticipated to resume thereafter.

iii) The PT estimation methodology adopted incorporates Waka Kotahi derived regional service-km forecasts[7], known relationships with other PT metrics, literature findings and key results from emissions research modelling.

iv) The study results have a PT passenger-km focus, whilst also reporting on patronage (boardings) and PT service-km.

Passenger-km estimates

3.7 Data trends and estimates of passenger-km under identified scenarios are shown below:

Figure 2: National Overall PT Passenger-km
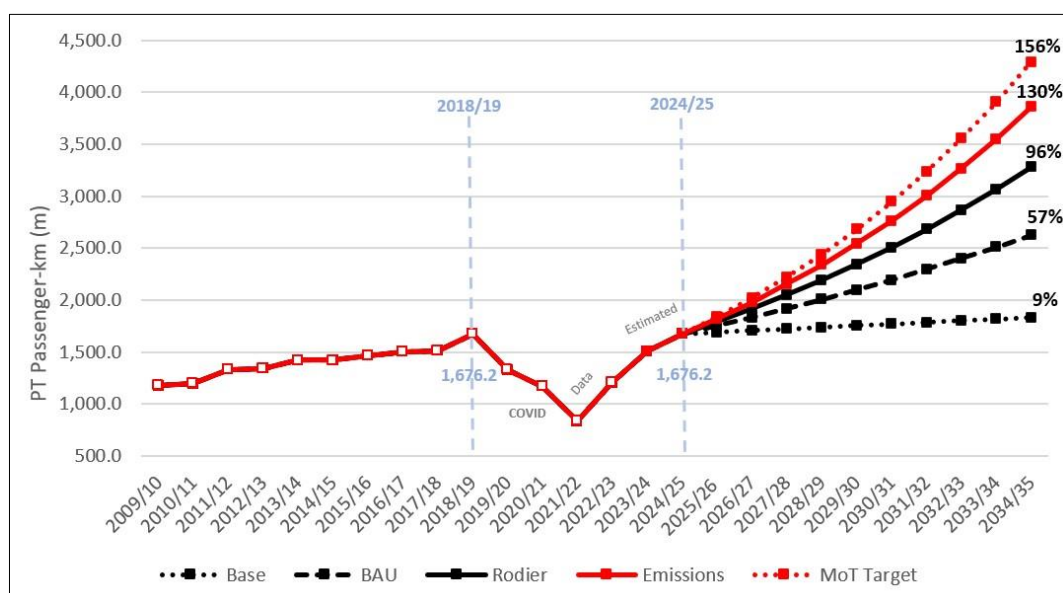
Base Scenario 2035 PT estimate

3.8 A minimum PT boardings base growth of 0.95% p.a. was adopted, based on median population forecasts[8] plus an element[9] to reflect peak travel crowding responses, and applied proportionately to other PT metrics. The Base Scenario is not expected to meaningfully contribute to either the LVKT reduction or mode shift targets.

3.9 The Base Scenario is estimated to result in an overall increase in PT passenger-km of 9% between 2025 and 2035.

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[7] Spreadsheet *'Modelv6.9 Drivers Wages Costs Updated'*.
[8] *'NZ National population projections: 2020 (base) – 2073',* Stats NZ.
[9] *'National Travel Profiles Part A: Description of Daily Travel'* LTNZ RR 353, Fig 9.1, 2008

Business-as-usual Scenario PT estimate

3.10 Regional estimates derived by Waka Kotahi, under current policy settings, anticipate national service-km growth averaging 2.6% p.a., over the 14 years 2021/22 to 2034/35, slightly higher than the 2.5% p.a. rate of service-km growth recorded over the period 2009/10 to 2018/19.

3.11 The forecast (2.6 % p.a.) growth in service-km was applied together with (pre-COVID) relationships with passenger-km and boardings, to establish future BAU Scenario estimates. The BAU Scenario does not include substantial packages of complementary measures and therefore will make little contribution to either modal share or LVKT reduction targets. The BAU Scenario is estimated to result in an overall increase in PT passenger-km of 57% between 2025 and 2035.

Rodier[10] Scenario PT estimate

3.12 An estimate in the context of policy settings to achieve the VKT reduction targets was derived from MoT supplied worksheets[11] and associated literature. This approach is based on the LVKT reduction target requiring a degree of mode shift by those who would otherwise travel by car. Applying the future combined effects of anticipated VKT reduction policy settings (involving transit[12], land use and VKT pricing measures) is estimated to result in a transit mode share for 'displaced' car users (namely 1,089.7m drivers and 444.6m passengers[13]) of 9.9%. Under this scenario, the expected 2025 level of 168.4m boardings p.a. would increase by 151.1m to 2035. This is the higher impact range of one standard deviation in the research data sample. Boardings were then used to estimate other PT metrics, via the relationship with service-km and by applying expected changes in PT trip length to estimate passenger-km.

3.13 The Rodier Scenario is estimated to result in an overall increase in PT passenger-km of 96% between 2025 and 2035.

Emissions Modelling Scenario PT estimate

3.14 This estimate in the context of policy settings to achieve the VKT reduction targets used outputs from the Emissions Research[14] Modelling outputs. This is based on the PT patronage effects of the Auckland and Wellington 'customised packages of measures' containing a mix of transit, land use and VKT pricing measures. The relationship with boardings was then used to estimate service-km and boardings were also factored by trip length to derive passenger-km.

3.15 The Emissions Modelling Scenario is estimated to result in an overall increase in PT passenger-km of 130% between 2025 and 2035.

MOT Target Scenario PT estimate

3.16 An estimate in the context of consultation for the VKT reduction targets is provided in the MoT supplied worksheet[15] estimating the effects of a package of measures (consisting of transit, land use, VKT pricing and parking pricing) would achieve the required 20% reduction in national LVKT. Estimates were derived for this study from MoT Target consultation material (in turn, also

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[10] *'A Review of the International Modelling Literature: Transit, Land Use, and Auto Pricing Strategies to Reduce Vehicle Miles Travelled and Greenhouse Gas Emissions'* Rodier C, 2008
[11] MoT worksheet *'I_VKT_raw rodier'*
[12] Taken to be interchangeable with the term 'PT'.
[13] Proportion derived from: MoT Analytics, 'NZHTS Travel Patterns', Tableau Public, Mode Share 2019-2022.
[14] Waka Kotahi, draft research report *'Interventions to reduce land transport greenhouse gas emissions In Auckland, Christchurch and Wellington, March 2023'.*
[15] MoT *'O_Consultation worksheet: Reduction by Tier area by intervention type against baseline (mil km and %)'.*

derived from Rodier, see 3.12 above) although, a higher 16.1%[16] mode share was applied to estimate transit's mode share of 'displaced' car users for the MoT Target Scenario.

3.17 The MoT Target Scenario is estimated to result in an overall increase in national PT passenger-km of 156% between 2025 and 2035.

National PT boardings

3.18 Trends and scenario estimates for PT Boardings are shown in graphical format below:

Figure 3: National Overall PT Boardings
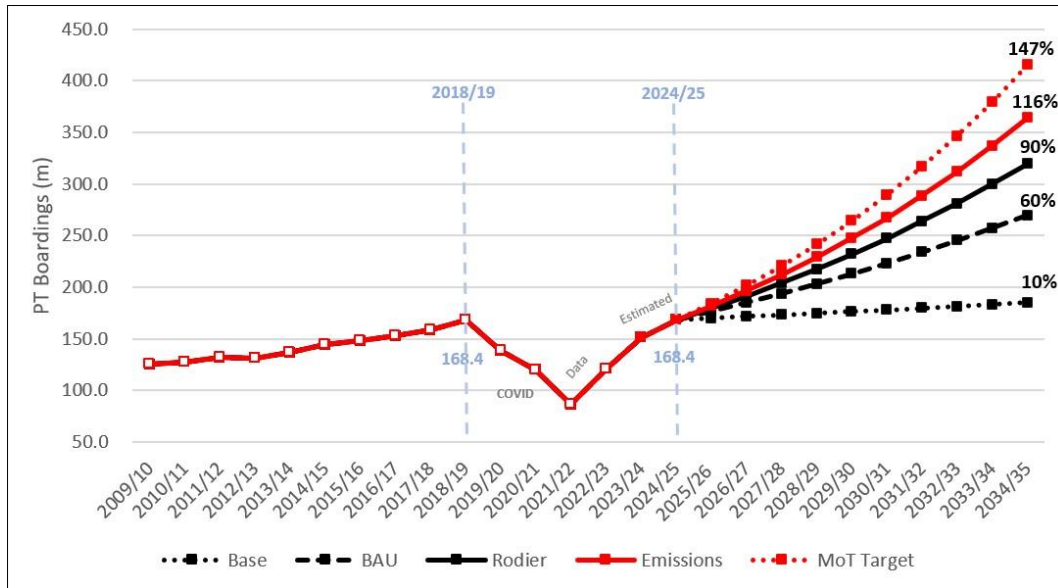
National PT service-km

3.19 Trends and scenario estimates for PT service-km are shown in graphical format below:

Figure 4 National Overall PT Service-km

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[16] Calculated as the ratio of individual contribution of 1.5% (transit) to 2.8% factored by the MoT assessed overall contribution of 6% out of the 20% LVKT reduction required.

National PT summary tables

3.20 Overall growth estimates between 2025 and 2035 for identified scenarios, are shown below:

Table 2: Estimated Overall PT Growth 2024/25-2034/35.

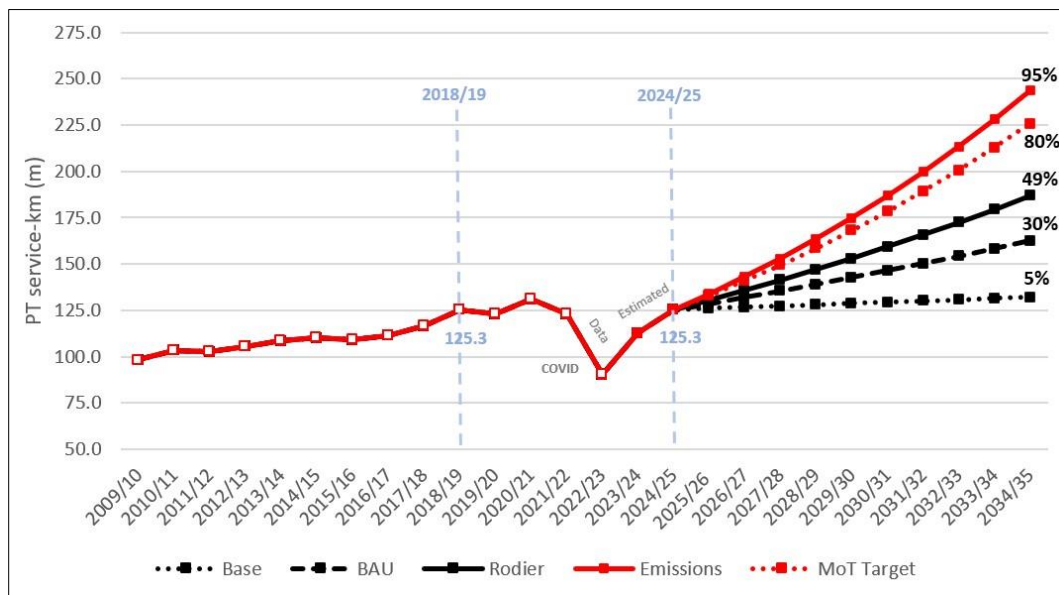|	Scenario				
Metric	Base	BAU	Rodier	Emissions Modelling	MoT Target
Passenger-km % (2034/35 level)	9.4% (1,833.9m)	56.7% (2,626.2m)	95.6% (3,278.7m)	130.1% (3,856.2m)	155.9% (4,289.9m)
Boardings % (2034/35 level)	9.9% (185.0m)	60.1% (269.5m)	89.8% (319.5m)	116.1% (363.8m)	146.5% (415.0m)
Service-km % (2034/35 level)	5.4% (132.1m)	29.6% (162.5m)	49.0% (186.8m)	94.5% (243.8m)	80.1% (225.8m)
Pass-km per Service-km % (2034/35 level)	3.8% (13.9)	20.9% (16.2)	31.2% (17.5)	18.3% (15.8)	42.1% (19.0)

3.21 A substantial increase in utilisation is estimated under the Rodier Scenario with utilisation doubling under the MoT Target Scenario. Emissions modelling was undertaken on a different basis to the Rodier and MoT Target Scenarios, involving an assumed 50% increase in PT frequency (on top of BAU) for modelling purposes.

3.22 A table of estimated national annual growth rates for identified scenarios is shown below:

Table 3: Estimated Annual Overall PT Growth Rates

	Scenario Growth Rates 2024/25-2034/35 (p.a.)				
Metric	Base	BAU	Rodier	Emissions Modelling	MoT Target
Passenger-km	0.90%	4.6%	6.9%	8.7%	9.9%
Patronage	0.95%	4.8%	6.6%	8.0%	9.4%
Service-km	0.53%	2.6%	4.1%	6.9%	6.1%

National Overall PT estimates

3.23 On the basis of the work undertaken to establish the overall national PT task associated with the 2035 20% LVKT reduction target, there is an identified requirement for an increase in PT passenger-km, between 2025 and 2035, by 156% compared to 2019 levels (see Table 2 above).

3.24 The resulting effect of public transport on LVKT and PT passenger-km is shown below:

Table 4: Estimated National LVKT and Overall PT Pass-km Effects by 2034/35

National LV and PT Pass-km		Current	
2018/19	LVKT	43,964	
	PT pass-km	1,676	
	Total	45,640	
	PT share	3.7%	
National PT Pass-km Estimates		Base Scenario	MoT Target
2034/35	PT Pass-km - Shift from LVKT	158	2,614
	PT Pass km - Total	1,834	4,290
	PT Pass-km increase	9.4%	156.0%
National LVKT Estimates		Base Scenario	MoT Target
2034/35	LVKT - Forecast	54,487	54,487
	LVKT - Shift to PT	112	1,857
	LVKT - Non-PT reductions required	10,785	9,041
	LVKT - MoT target	43,589	43,589
	LVKT - Target % shift to PT	0.2%	3.4%
	LVKT - Target % required non-PT shift	-19.8%	-16.6%
	LVKT - Overall target % change	-20.0%	-20.0%
	PT Share of LVKT reduction	1.0%	17.0%

3.24 The precise scale of PT demand for any particular scenario is dependent on a range of factors, including the quality, extent and price of service provision and the relative cost, speed and convenience of alternatives.

3.25 The estimated figures from this study should be regarded as indicative and subject to further verification when policy frameworks and investments are confirmed. In overall terms however, future policy settings are likely to reinforce growth trends in PT at the expense of car travel, even if working at home also continues at elevated levels.

4.0 PT Sub-mode estimates and targets

4.1 In overall terms, PT boardings between 2010 and 2019 increased (nationally) by 34%, bus increased by 25%, rail by 82% and ferry by 38%, as tabulated below:

Table 5: Pre-COVID PT Boarding Trends

PT Sub-mode	2009/10 Boardings	2018/19 Boardings	Growth to 2018/19
Bus	100,958,031	125,970,012	124.8%
Rail	19,612,717	35,713,725	182.1%
Ferry	4,688,045	6,489,377	138.4%
Total	125,258,793	168,173,114	134.3%

4.2 As described earlier (in 3.6 ii) above) by 2024/25 PT patronage is expected to recover to pre-COVID 2018/19 levels and for this reason 2018/19 conditions have been taken to be equivalent to 2024/25 conditions for PT sub-mode and sub-national estimation purposes. Changes in overall national boardings and PT sub-mode split to meet the 2035 LVKT reduction target (for the MoT Target Scenario) are detailed below:

Table 6: Estimated Growth (Boardings) Required: LVKT Reduction Target

Mode	2024/25 Boardings	2024/5 Mode split	2034/35 Boardings	2024/5 Mode split	Growth to 2034/35
Bus	125,970,012	74.8%	258,548,242	62.6%	105%
Rail/MT	35,713,725	21.2%	141,977,044	34.4%	298%
Ferry	6,691,578	4.0%	12,434,008	3.0%	86%
Total	168,375,315	100.0%	412,968,556	100.0%	145%

4.3   Of PT boardings, from Table 6 above, the mode share of bus is expected (under the MoT Target Scenario) to reduce from 75% in 2019 to 63% in 2035, rail/mass transit (MT[17]) is expected to increase from 21% to 34% with ferry mode share expected to remain small.

4.4   In passenger-km terms, the mode share of bus is expected (under the MoT Target Scenario) to reduce from 59% in 2019 to 44% in 2035, rail/MT is expected to increase from 36% to 53% with ferry mode share expected to slightly reduce, as shown below:

Table 7: Estimated Growth (Passenger-km 000's) Required For LVKT Reduction Target

Mode	2024/25 Passenger-km	2034/35 Passenger-km	Growth to 2034/35
Bus	891,698	1,914,561	115%
Rail/MT	600,109	2,438,522	306%
Ferry	90,222	167,370	86%
Total	1,582,030	4,520,454	186%

4.5   A comparison of pre-COVID annual growth rates and future estimated growth rates to meet the LVKT reduction target (under the MoT Target Scenario) is provided below:

Table 8: Annual PT Boardings Target Growth Rates

Mode	2009/10 to 2018/19 Actual Annual Boardings Growth Rate	20024/25 to 2034/35 Target Annual Boardings Growth Rate
Bus	2.5%	7.5%
Rail	6.9%	14.8%
Ferry	3.7%	6.4%
Total	3.3%	9.4%

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[17] Mass Transit Success Factors, NZTA, September 2019.

5.0   Sub-national LVKT estimates and targets

5.1   Nationally, over the period 2010 to 2019 LVKT increased) by 18%. By 2035, without specific intervention under the BAU Scenario, LVKT is forecast to increase over 2019 levels, by a further 24%.

5.2   In sub-national terms, by 2035 under the BAU Scenario, 75% of future LVKT is forecast to be in Tier 1 and 2 areas, as shown below:

Table 9: 2035 LVKT by Location

Location	LVKT	LVKT
Auckland and Wellington	22,810	42 %
Christchurch	5,560	10 %
Hamilton and Tauranga	5,551	10 %
Tier 2	7,130	13 %
Tier 3	13,436	25 %
TOTAL	54,487	100 %

5.3   In order to reflect the ability of different locations to adopt successful LVKT reduction measures, LVKT targets for each location type have been proposed[18], for example:

Table 10: 2035 LVKT Reduction Targets (MoT)

Location	LVKT forecast	LVKT target	LVKT Target
Auckland and Wellington	22,810	16,195	-29 %
Christchurch	5,560	4,281	-23 %
Hamilton and Tauranga	5,551	4,274	-23 %
(12% to 16%) Tier 2	7,130	6,132	-14 %
Tier 3	13,436	12,764	-5 %
TOTAL	54,487	43,647	-10%

6.0   Sub-national PT estimates and targets

6.1   The way in which PT contributes to LVKT reduction targets also needs to vary by location, for example: in Auckland, Wellington and Christchurch PT is likely to be a very substantial component of the LVKT reduction measures package, less so in Hamilton and Tauranga, less again for Tier 2, and very minor in other (Tier 3) areas, apart from in urban centres.

6.2   Regional PT performance over the pre COVID period (2009/10-2018/19) has been mixed for a variety of reasons and is not necessarily the best guide moving forward. For example, some regions have achieved high growth rates under the current policy framework, which serves to demonstrate what can be achieved.

6.3   It is assumed that there will be a substantially different policy framework moving forward, involving forms of road pricing, land use intensification and MT investment, and this forms the context for estimating the sub-national PT targets.

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[18] MoT excel file worksheet C_Targets

6.4 Regionally, the following approach has been adopted:

(i) In keeping with national expectations[19] quantified mode shift targets for Wellington and Christchurch were adopted[20]. These targets have been adopted for the purposes of estimating regional PT patronage targets.

(ii) Similar mode shift intentions were also included in regional reports for Auckland, Hamilton and Tauranga, although these were not specifically quantified. In keeping with this, high regional targets have also been estimated for these regions.

(iii) Other areas have lower PT usage, but all regions have potential for substantial increases PT use, typically from a relatively low base.

Results

6.5 Auckland, Wellington and Christchurch represent, collectively, the overwhelming majority of PT boardings and passenger-km, and the concentration of PT in these areas is expected to increase (under the MoT Target Scenario), as shown below:

Table 11: PT by Location[21]

Location	2018/19 Passenger-km	2034/35 Passenger-km	Change in Passenger km (%)	Corresponding reduction in LVKT associated with PT targets
Auckland and Wellington	1,345,812	3,696,384	175%	13.1%
Christchurch	117,032	560,529	379%	2.0%
Hamilton and Tauranga	58,463	146,015	150%	0.5%
Tier 2	52,881	105,762	100%	0.4%
Tier 3	7,842	11,763	50%	0.04%
TOTAL	1,582,030	4,520,453	186%	16.1%

6.6 In order to meet the PT share of MoT VKT targets, PT patronage would need to return to pre-COVID levels and then annual growth rates would need to more than double, in comparison with pre-COVID rates.

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[19] NZ Transport Agency, Keeping Cities Moving, September 2019
[20] Regional Mode Shift Plans for Christchurch and Wellington, September 2020 (see also Annex A.6).
[21] Translation between PT regions and Tier 1, 2 and 3 areas is approximate.

6.7   Regionally based estimates of the increased PT passenger-km required to meet the LVKT reduction target in 2035 are provided below:

Table 12: Potential Regional PT Passenger-km By Mode (000's p.a.)

	2024/5	Bus Passenger-km			Rail/MT Passenger-km			Ferry Passenger-km			2034/5 Passenger-km		
Regions	ALL PT 2024/5 Base	2024/5 Base (Bus)	Increase to 2034/5	% increase	2024/5 Base (Rail/MT)	Increase to 2034/5	% increase	2024/5 Base (Ferry)	Increase to 2034/5	% increase	ALL PT 2034/5	Increase to 2034/5	% increase
Auckland	841,755	493,767	599,706	121.5%	260,583	473,846	181.8%	87,405	74,388	85.1%	1,989,695	1,147,940	136.4%
Wellington	504,057	162,335	162,335	100.0%	339,526	1,038,101	305.8%	2,196	2,196	100.0%	1,706,689	1,202,632	238.6%
Canterbury	117,032	116,579	116,579	100.0%	0	326,465	-	453	453	100.0%	560,529	443,497	379.0%
Otago	22,405	22,405	22,405	100.0%							44,810	22,405	100.0%
Waikato	35,774	35,774	53,661	150.0%							89,435	53,661	150.0%
Bay Of Plenty	22,689	22,520	33,780	150.0%				169	111	65.7%	56,580	33,891	149.4%
Horizons	13,369	13,369	13,369	100.0%							26,738	13,369	100.0%
Taranaki	7,218	7,218	7,218	100.0%							14,436	7,218	100.0%
Hawkes Bay	6,949	6,949	6,949	100.0%							13,898	6,949	100.0%
Nelson-Tasman	2,940	2,940	2,940	100.0%							5,880	2,940	100.0%
Northland	4,748	4,748	2,374	50.0%							7,122	2,374	50.0%
Invercargill	2,059	2,059	1,030	50.0%							3,089	1,030	50.0%
Gisborne	876	876	438	50.0%							1,314	438	50.0%
Marlborough	159	159	80	50.0%							239	80	50.0%
TOTAL	1,582,030	891,698	1,022,863	114.7%	600,109	1,838,413	306.3%	90,222	77,148	85.5%	4,520,454	2,938,424	185.7%

6.8   The results of the regional estimation in Table 12, in terms of the national increase of 186.0% in passenger-km (above) is higher than the earlier (national) estimation of overall national passenger-km of 155.9% (MoT Target Scenario) reported in Table 2. This difference is mainly due to the more detailed analysis of regional trip length variation between PT sub-modes, although a slightly different forecasting base was also used for sub-regional work.

6.9   Regionally based estimates of the increased PT boardings required to meet the LVKT reduction target in 2035 are provided below:

Table 13: Potential Regional PT Boardings By Mode (p.a.)

	2024/5	Bus Boardings			Rail/MT Boardings			Ferry Boardings			2034/5		
Regions	ALL PT 2024/5 Base	2024/5 Base (Bus)	Increase to 2034/5	% increase	2024/5 Base (Rail/MT)	Increase to 2034/5	% increase	2024/5 Base (Ferry)	Increase to 2034/5	% increase	ALL PT 2034/5	Increase to 2034/5	% increase
Auckland	100,748,898	73,047,950	76,631,974	104.9%	21,389,847	38,895,488	181.8%	6,311,101	5,371,215	85.1%	221,647,575	120,898,677	120.0%
Wellington	39,273,072	24,746,993	24,746,993	100.0%	14,323,878	43,795,257	305.8%	202,201	202,201	100.0%	108,017,523	68,744,451	175.0%
Canterbury	13,866,220	13,715,126	13,715,126	100.0%	-	23,572,574	-	151,094	151,094	100.0%	51,305,014	37,438,794	270.0%
Otago	4,013,254	4,013,254	4,013,254	100.0%							8,026,508	4,013,254	100.0%
Waikato	4,008,457	4,008,457	6,012,686	150.0%							10,021,143	6,012,686	150.0%
Bay Of Plenty	2,742,094	2,714,912	4,072,368	150.0%				27,182	27,182	65.9%	6,841,644	4,099,550	149.5%
Horizons	1,335,248	1,335,248	1,335,248	100.0%							2,670,496	1,335,248	100.0%
Taranaki	649,874	649,874	649,874	100.0%							1,299,748	649,874	100.0%
Hawkes Bay	645,297	645,297	645,297	100.0%							1,290,594	645,297	100.0%
Nelson-Tasman	417,918	417,918	417,918	100.0%							835,836	417,918	100.0%
Northland	336,265	336,265	168,133	50.0%							504,398	168,133	50.0%
Invercargill	182,640	182,640	91,320	50.0%							273,960	91,320	50.0%
Gisborne	133,426	133,426	66,713	50.0%							200,139	66,713	50.0%
Marlborough	22,652	22,652	11,326	50.0%							33,978	11,326	50.0%
TOTAL	**168,375,315**	125,970,012	132,578,230	105.2%	35,713,725	106,263,319	297.5%	6,691,578	5,742,430	85.8%	412,968,556	244,593,241	145.3%

6.8   The results of the regional estimation in Table 11, for example, the national increase of 145.3% in boardings (above) is very close to the national estimation of overall national increase of 146.5% (MoT Target Scenario) as reported in Table 2. The difference is due to minor correction of regional data, although a slightly different forecasting base was also used for sub-regional work.

A.1 Methodology

Approaches Considered

A.1 Alternative approaches to estimating future PT demands were considered during the study, including:

- The MoT report *'Transport Outlook Future Overview, 2019'* forecasts growth in PT trips (nationally) over the period between 2025 and 2035 in the *'Baseline Scenario'* of 14.2% and for the highest, '*Staying Close To The Action Scenario',* forecast growth is 86.7% over the same period.

- Using published elasticities, a reduction in car driver travel of 20% would generate an increase in PT patronage of approximately 13.7%. From NHTS data the current transit mode share for personal travel, after taking out car drivers, is 6.7%.

- Regionally, land use transportation models are best suited to forecasting the effects of major road network changes on BAU demands and are relatively unresponsive in testing the effects of substantial policy changes.

Study Approach

A.2 The results presented in this study estimate patronage (boardings) growth over the period 2025 to 2035 of 9.9% for the Base Scenario, 60.1% for BAU and for identified VKT reduction scenarios, 89.8% Rodier, 116.1% Emissions Modelling and 146.5% for the MoT Target Scenario when calculated on a combined sub-mode national basis.

A.3 From the MoT worksheet[22] data the combined effects of future policy measures are greater than the sum of individual elements. The estimated PT mode share of car users that would be 'displaced' as a result of LVKT reduction policies has been derived (for the Rodier Scenario) from the 'intensified land use, transit and pricing' policy package, from the 2035 'high' variable column, this indicates the largest potential contribution to LVKT reduction within one standard deviation of the research sample. This was applied as follows: the individual stand-alone transit element plus one third of the residual combined package effect to assess contribution to VKT reduction. This indicates that PT represents (-2.2/-22.3) or 9.9% of the target contribution to VKT reduction. Hence applied in reverse, 9.9% of VKT reduction can be ascribed to PT patronage. This is a conservative approach, and other estimates derived from this data are higher, for example, the MoT Target Scenario at 16.1%.

A.4 The customised packages from the Emissions Modelling, referred to in the study, assumes an increased PT frequency (on top of BAU) of 50%. If this BAU assumption is varied, it will affect the potential of PT to contribute to LVKT reduction objectives under the Emissions Modelling Scenario. However, even with a fixed PT supply assumption, PT metrics and LVKT effects may vary substantially, depending on the range and combination of alternative measures and policies considered. For the three major conurbations, many of the Emissions Modelling tests were forecast to have effects, including PT effects, much greater than those from the recommended 'customised packages'.

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[22] '*I_VKT_raw rodier'*

PT sub-mode and sub-national estimates

A.5 Regional mode share reviews and associated targets[23] indicate required growth in PT patronage of 175% in Wellington and 270% for Christchurch, over the period 2020 to 2035. These 2035 targets have taken to remain valid, irrespective of COVID impacts. A lesser proportionate increase in PT boardings of 120% was adopted for Auckland, given the relatively large existing PT base.

A.6 Ambitious targets have also been adopted for Hamilton and Tauranga (150% increase in PT boardings) in view of the potential for economic and population growth in these areas. Tier 2 Areas are assumed to have a target of a 100% increase in PT boardings, and in Tier 3 Areas an equivalent increase of 50% has been adopted.

Caveats:

A.7 Qualifications on the work undertaken to date are provided below:

(i) The actual nature and scale of any given combination of new PT services and improvement measures will influence the scale of PT demand in any given circumstances. Packages of PT measures are often highly variable, and this makes assumptions and comparisons with other PT forecasts difficult. The estimates reported in this study are therefore subject to change as specific packages of measures and policies are developed.

(ii) The regional bus boardings growth rate 2009/10 to 2018/19) estimate of 2.6 % p.a. was applied to all PT boardings to estimate the 2034/5 future BAU. However, because overall PT boardings actually grew at a rate of 3.3% p.a., the BAU Scenario should be interpreted as being a conservative estimate.

(iii) Estimates to date have derived average annual growth rates although, in reality, growth will be irregular, and will increase more rapidly as large investments are implemented. These timing effects do not impact the overall assessment of the scale of PT required, but will affect the timing of increased PT demand and provision. For major investments, ramp-up effects should also be allowed for in further, more detailed, work.

(iv) The results in this study represent order of magnitude estimates (only) and require further refinement prior to application.

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[23] For example: the *'Regional Mode Shift Plan(s)'* for Greater Christchurch and Wellington, September 2020.