COVID MODELLING FOR INFRASTRUCTURE VICTORIA

November 2020

Prepared for Infrastructure Victoria

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CONTEXT AND METHODOLOGY

COVID-19 impacts has potential impacts across many different areas

OBJECTIVE: Define two 'Base Case' scenarios encompassing short-term (6-12 months from November 2020) COVID-19 impacts

Attractiveness of each mode:
Falling preference for public transport amid virus fears. Could this persist? Is active mode travel increasing outside of recreation?

Agent income:
Has COVID-19 decreased household incomes to a level that will impact the willingness to pay monetary travel costs?

Working from home and employment:
Initially through mandates, could elements of working and learning from home persist in the medium term?

Airport & visitor travel, international students:
When is it likely that domestic and international travel will return? What is the impact of levels of travel?

Fuel prices:
Will fuel prices recover to pre-crisis levels and stay there?

Goods vehicles:
What are the trends in goods vehicles? Has increased home shopping changed volumes?
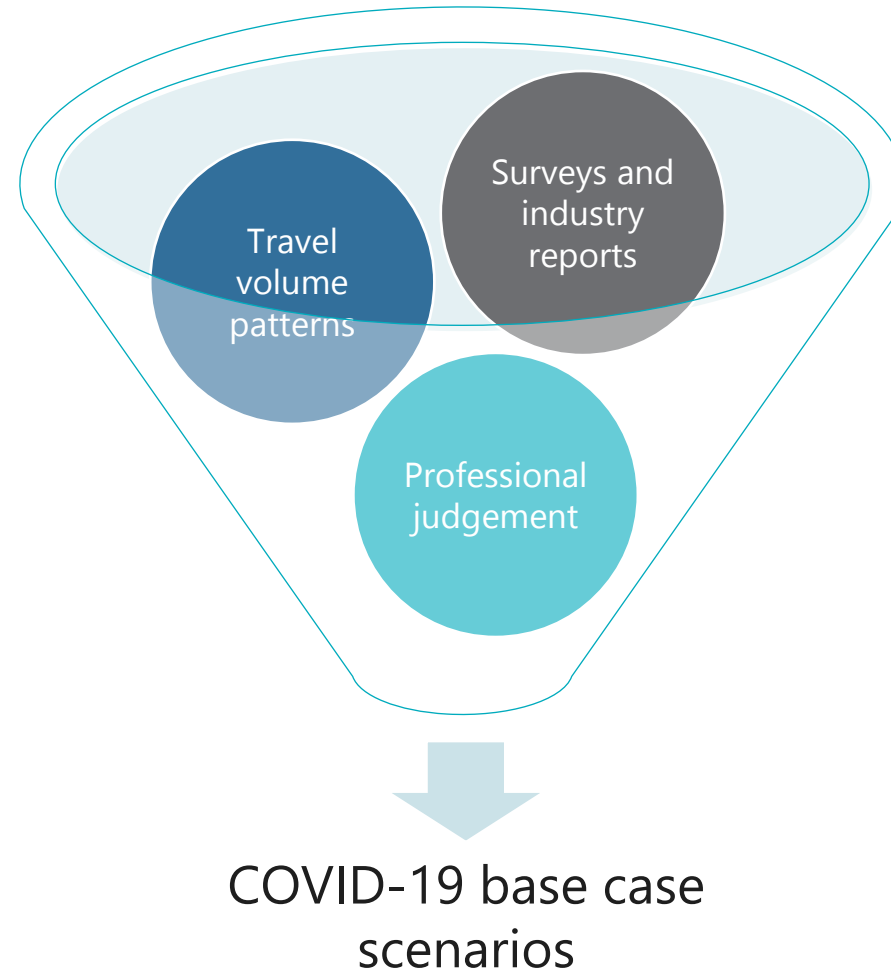
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Analysis scenarios

- To conduct this analysis we have developed several COVID-19 severity scenarios.

- Not all cities analysed have experienced all time periods – for example Melbourne has not recovered sufficiently to have experienced a 'Post-Lockdown' phase.

- Perth, Brisbane and Auckland (until recently) could be considered as being in the Post-Lockdown phase, while Sydney could be considered to be in a Lockdown Easing phase.

Scenario Descriptions	
Pre-Lockdown	Few if any COVID-19 cases with minimal, if any government restrictions. **January 2020 – Early March.**
Full Lockdown	High and growing number of COVID-19 cases with significant Government restrictions in place. **~ March – late May / Early June.**
Lockdown Easing	First wave of COVID-19 has been flattened mostly. Small number of COVID-19 cases with reduced restrictions. **~ June to July.**
Post Lockdown	Few COVID-19 cases, lockdowns have been significantly rolled back. Most activities are allowed excluding large events. i.e. non-essential travel is allowed. Only some jurisdictions have been operating in these conditions. **~ early August.**

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Our research methodology has used data from a number of qualitative and quantitative sources to define future test scenarios

- Around 20 different sources of insight were reviewed

- For each travel impact area, a plausible 'Dialled-Up' and plausible Core assumption was derived.

- Generally, Auckland and Perth are treated as the source of assumptions for a 'Core' (most likely) scenario, whilst Melbourne in June and Sydney are treated as the source for Dialled-Up scenarios.

- The underlying 2018 MABM base year has been assumed to also represent a 2021 scenario where no COVID-19 impacts are present. I.e. beyond accounting for COVID-19 impacts, no further adjustments to the base year scenario are proposed.

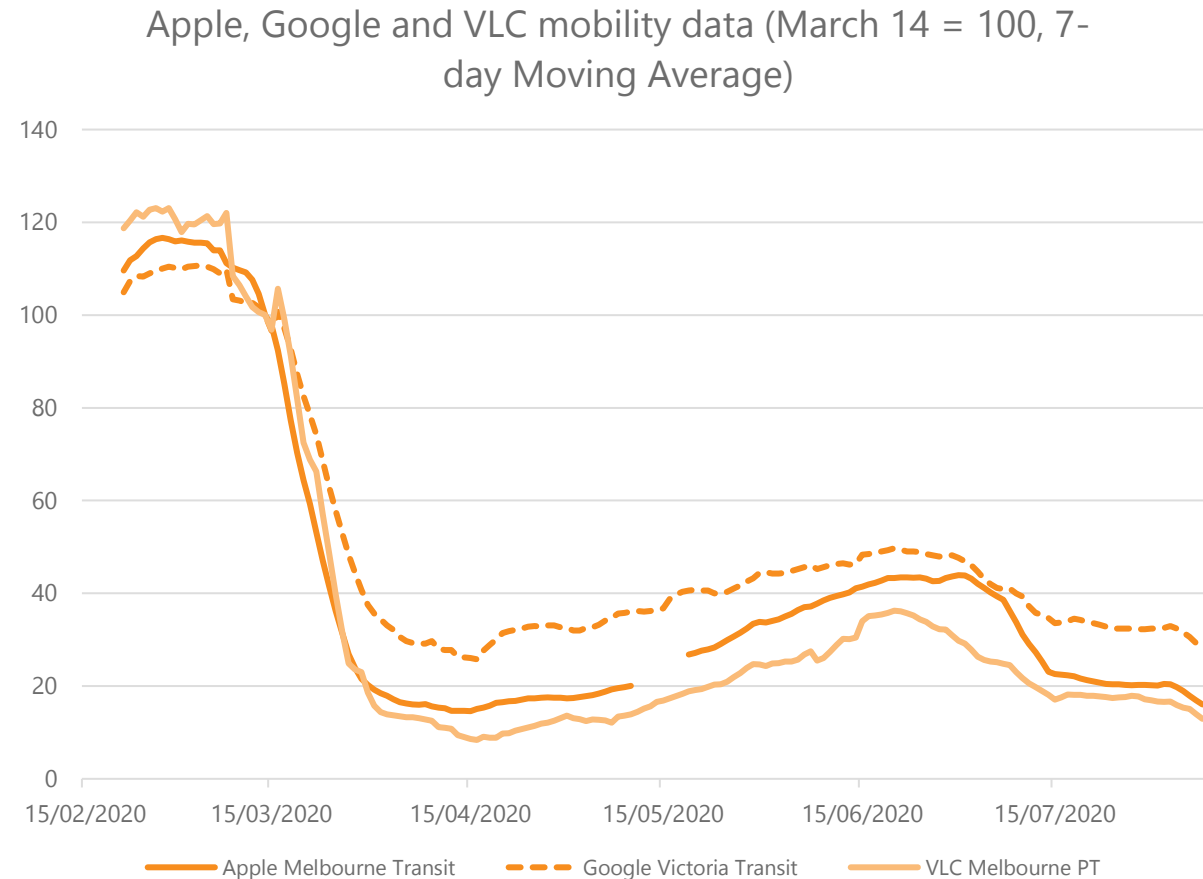- The time horizon considered for the forecast horizon is 6-12 months from November 2020.

Travel volume patterns

Surveys and industry reports

Professional judgement

COVID-19 base case scenarios

ATTRACTIVENESS OF EACH MODE

Impacts of COVID-19 on transport modes

- To determine the impacts of COVID-19 on different modes of transport we analysed a variety of transport data sources including Apple and Google mobility data, Household Travel Survey data and media commentators.

- We reviewed data for a variety of major cities in Australia as well as Auckland, New Zealand which were affected by COVID-19 to different degrees.

- Auckland, Perth and Brisbane were used as a 'Core' or most likely scenario as these cities have very low levels of active COVID-19 cases.

- Sydney can be used as an indication of a secondary scenario where COVID-19 is still circulating in the community to some degree, but successful management of testing and cases enables lighter restrictions than otherwise to be in place.

Apple, Google and VLC mobility data (March 14 = 100, 7-day Moving Average)

Legend: Apple Melbourne Transit — Google Victoria Transit (dashed) — VLC Melbourne PT

Apple Mobility Data: https://covid19.apple.com/mobility
Google Mobility Data: https://www.google.com/covid19/mobility/
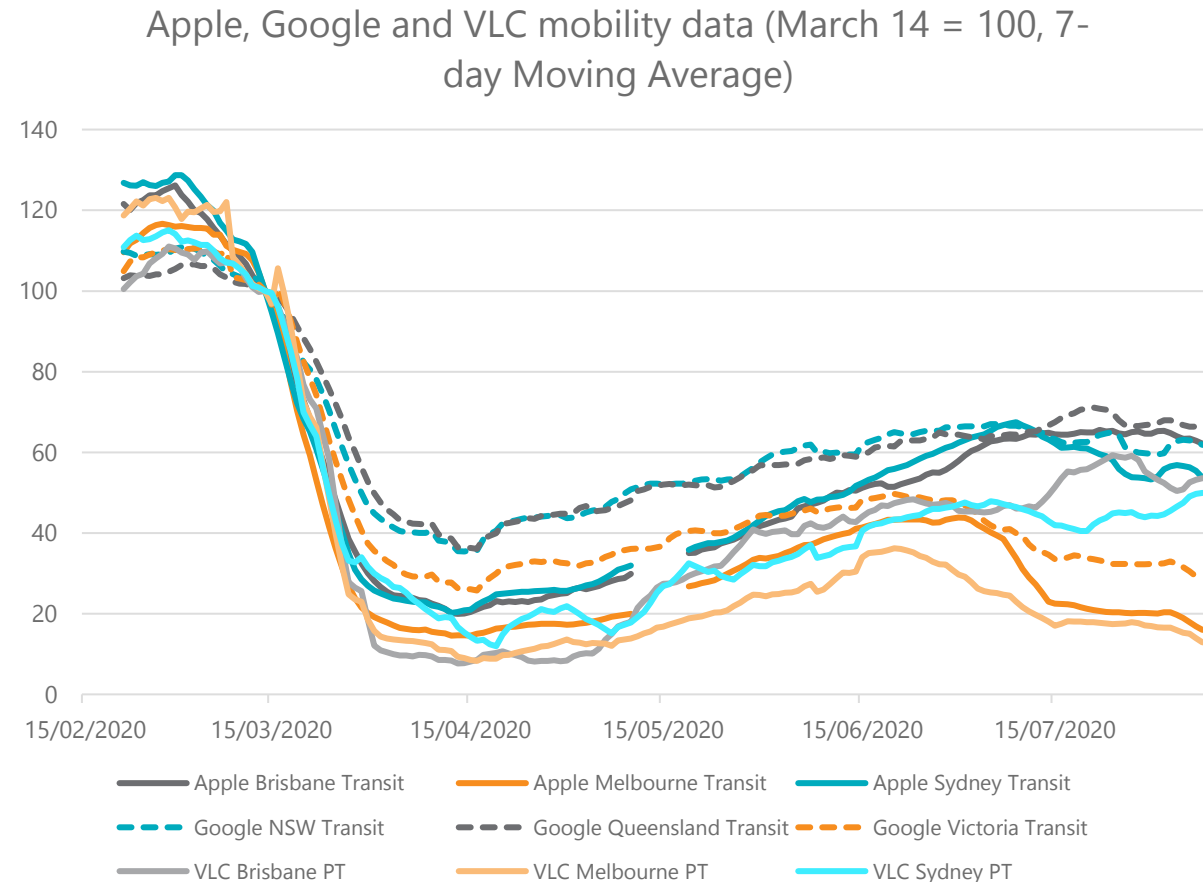
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Impacts of COVID-19 on transport modes

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Apple, Google and VLC mobility data (March 14 = 100, 7-day Moving Average)

Legend:
- Apple Brisbane Transit
- Apple Melbourne Transit
- Apple Sydney Transit
- Google NSW Transit
- Google Queensland Transit
- Google Victoria Transit
- VLC Brisbane PT
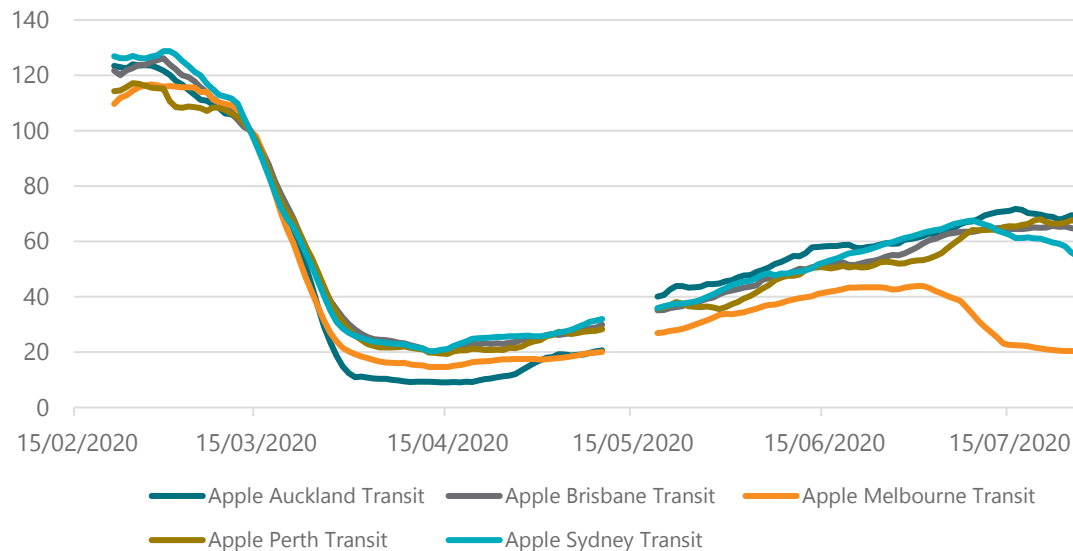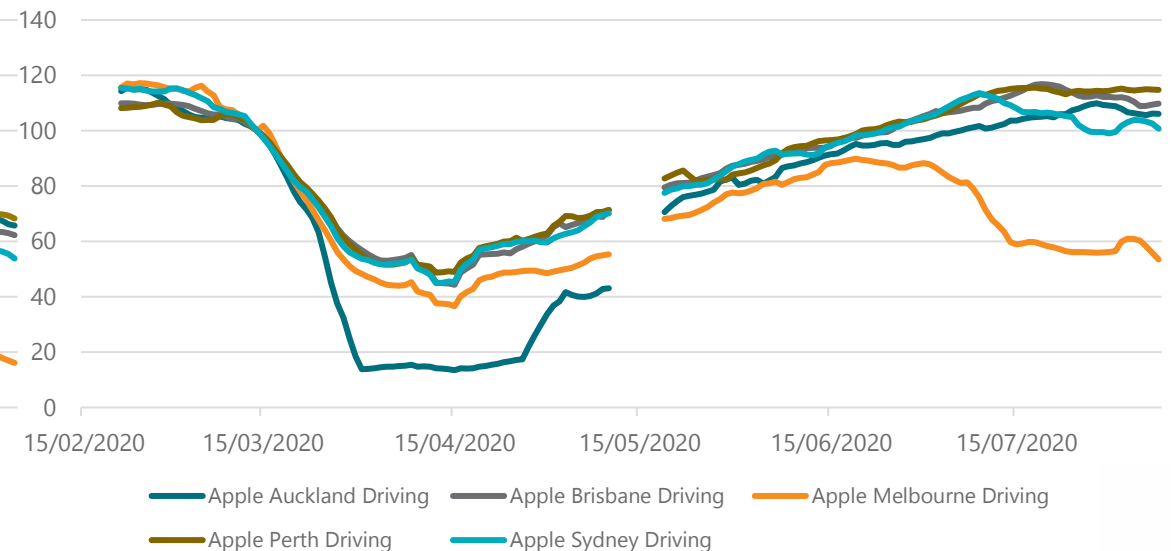- VLC Melbourne PT
- VLC Sydney PT

Impacts of COVID-19 on transport modes

- Apple mobility data was of particular interest as it was split out by mode, enabling the us to assess the relative impact of restrictions on each mode.

- Apple mobility data is drawn from direction requests through the Apple maps app.

Apple transit data (March 14 = 100, 7-day Moving Average)

Legend: Apple Auckland Transit, Apple Brisbane Transit, Apple Melbourne Transit, Apple Perth Transit, Apple Sydney Transit

Apple drive data (March 14 = 100, 7-day Moving Average)

Legend: Apple Auckland Driving, Apple Brisbane Driving, Apple Melbourne Driving, Apple Perth Driving, Apple Sydney Driving
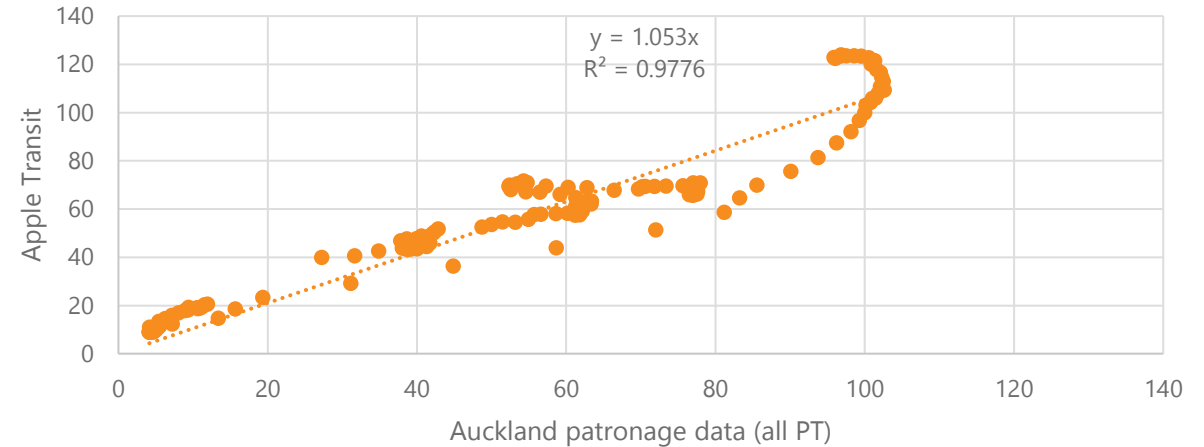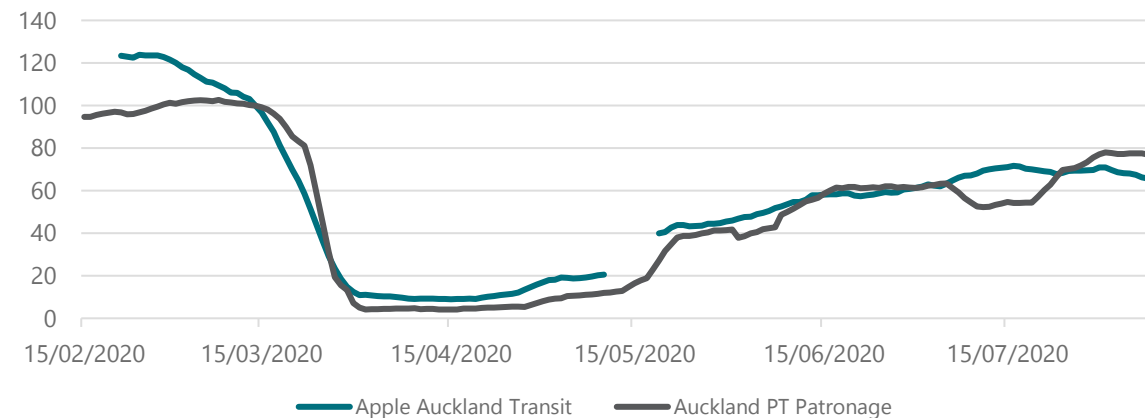
Apple transit validation - Auckland

- PT patronage data for Auckland indicates that Apple Transit data represents the change in observed patronage data since COVID-19 reasonably well.

- During the lockdown, patronage data was slightly lower, however over the recovery period was quite accurate.

- Notably, Apple transit does not pick up all types of trips – for example a decline in bus patronage around mid July due to school holidays is not reflected in Apple data, but is in actual patronage data.

Auckland Apple Transit vs Patronage Data

$y = 1.053x$
$R^2 = 0.9776$

X-axis: Auckland patronage data (all PT)
Y-axis: Apple Transit

Auckland Apple Transit data vs Auckland PT patronage data (March 14 = 100, 7-day Moving Average)

Legend: Apple Auckland Transit — Auckland PT Patronage

Auckland Transport Data Source:
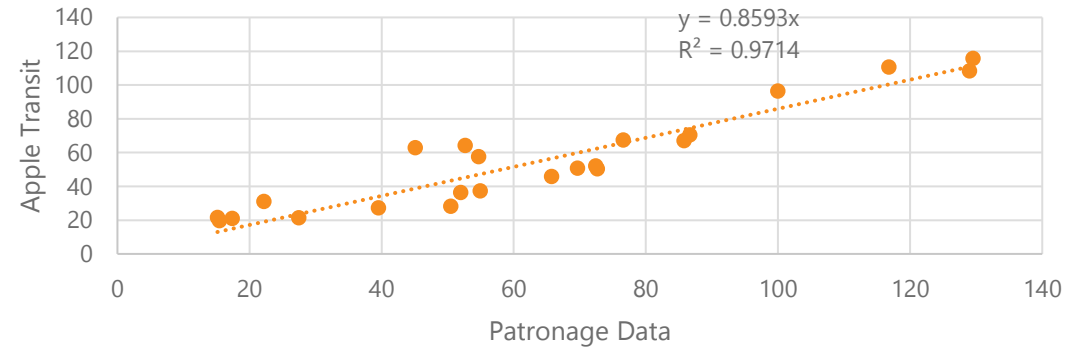https://at.govt.nz/about-us/reports-publications/at-metro-patronage-report/
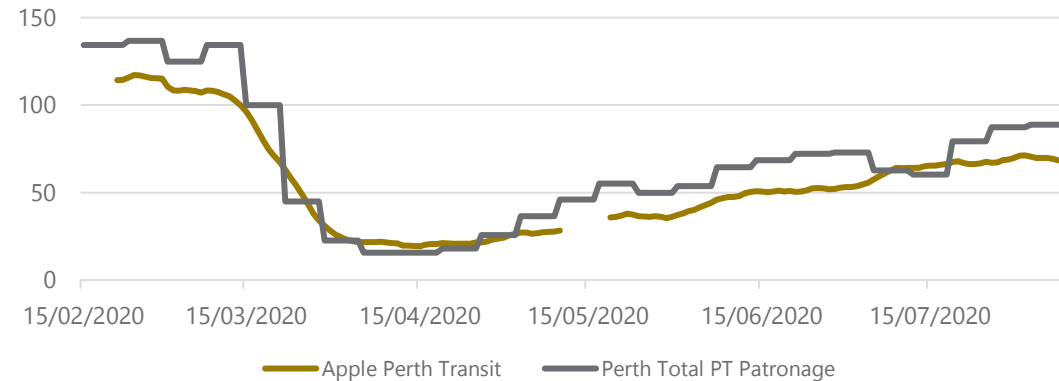
Apple transit validation - Perth

- Percentage changes for Perth Apple transit data also validated well against observed Perth PT data.

- The gradient is 0.86 indicating that percentage changes in the Apple transit data were lower than percentage changes in the observed data.

- As with Auckland – a decline in PT patronage during school holidays was not captured in the Apple transit data.

Perth Apple Transit vs Patronage Data (only for available weeks)

$y = 0.8593x$
$R^2 = 0.9714$

Apple Transit (y-axis)
Patronage Data (x-axis)

Apple drive data (March 14 = 100, 7-day Moving Average)

— Apple Perth Transit   — Perth Total PT Patronage

Perth data received from Transperth
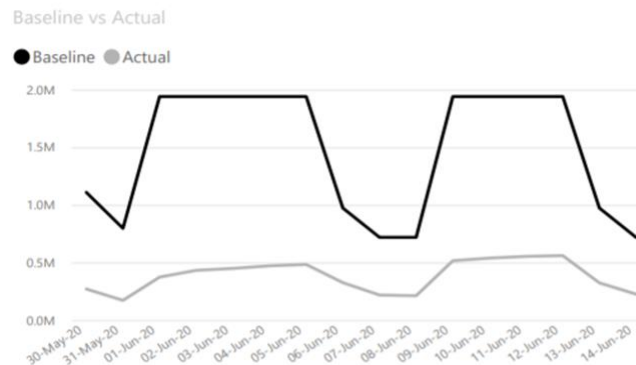
Apple transit validation - Melbourne

- Apple transit data for Melbourne approximates the changes observed in Myki data provided by the Department of Transport.

- 2020 Myki data (grey line) shows an increase in daily network wide patronage between April and June of around 50 per cent (growing from approx. 0.25 million to 0.5 million). Followed by a decline of around 50 per cent from June to July / August (0.5 million to 0.25 million or lower).

- Apple Transit data for Melbourne approximately follows this pattern with June showing approximately a 50 per cent increase on April levels, before a 50 per cent decline in July and August.
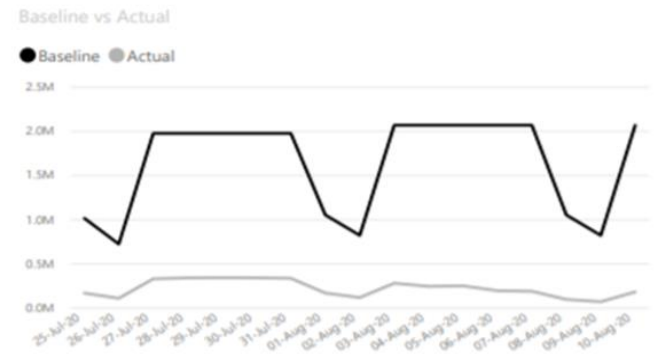
Apple Transit data, Melbourne (March 14 = 100, 7-day Moving Average)

Apple Melbourne Transit
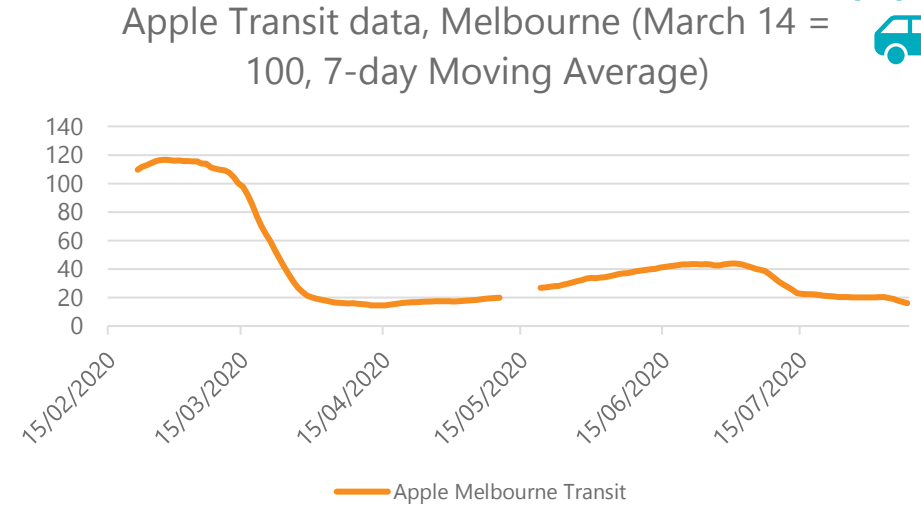
Myki – Late March – Mid April

Myki – Late May – Mid June

Myki – Late July – Early August


Source: DOT, 2020

Apple traffic validation - Melbourne

- Analysis by Chris Loader of Charting Transport shows that Apple driving data is a reasonable approximation of traffic signal volumes in Melbourne.

- Notable from this plot is that the Apple data tends to under-represent traffic volumes – particularly during the first lockdown period.

Melbourne road traffic measures relative to same day of week in February 2020 public holidays excluded — chartingtransport.com — data sources: DoT, Apple

Median traffic signal volumes
Apple driving direction requests
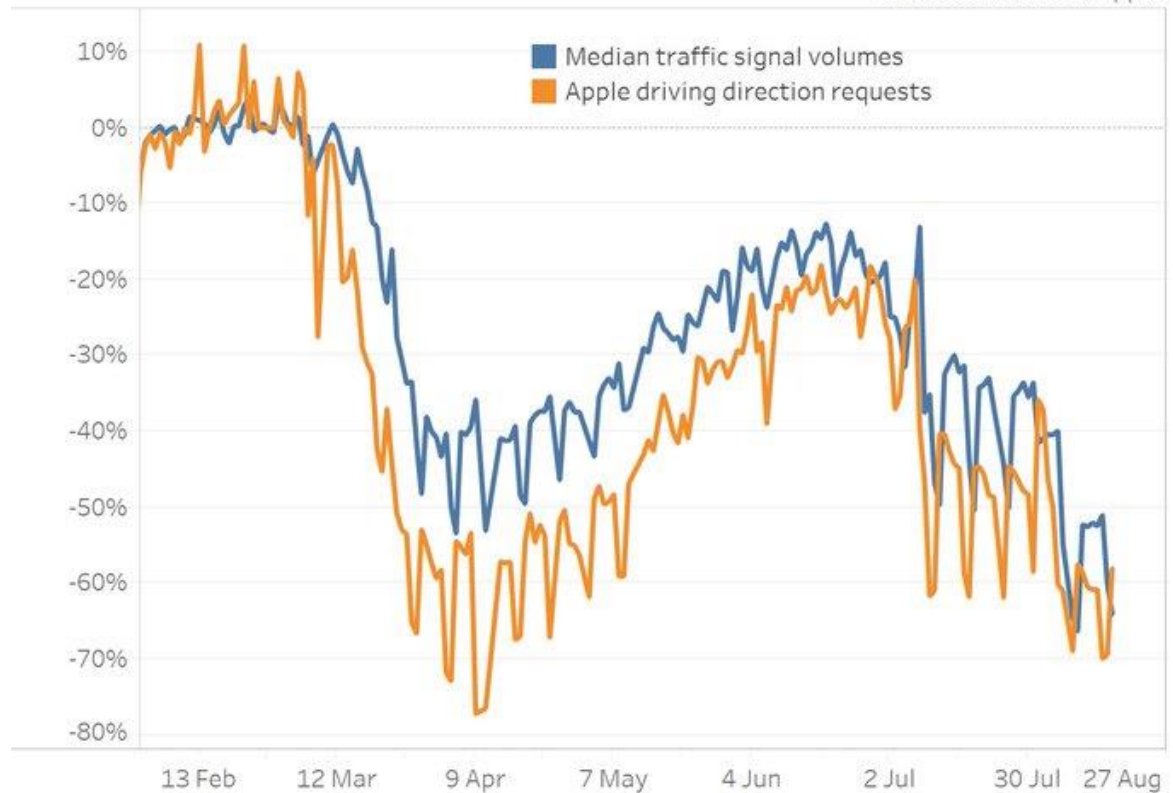
VISTA data – Trip purposes.

- We also analysed VISTA survey data results*.

- Notably in VISTA we see a large increase in the number of trips by active transport since 2018 – particularly for recreation and shopping.

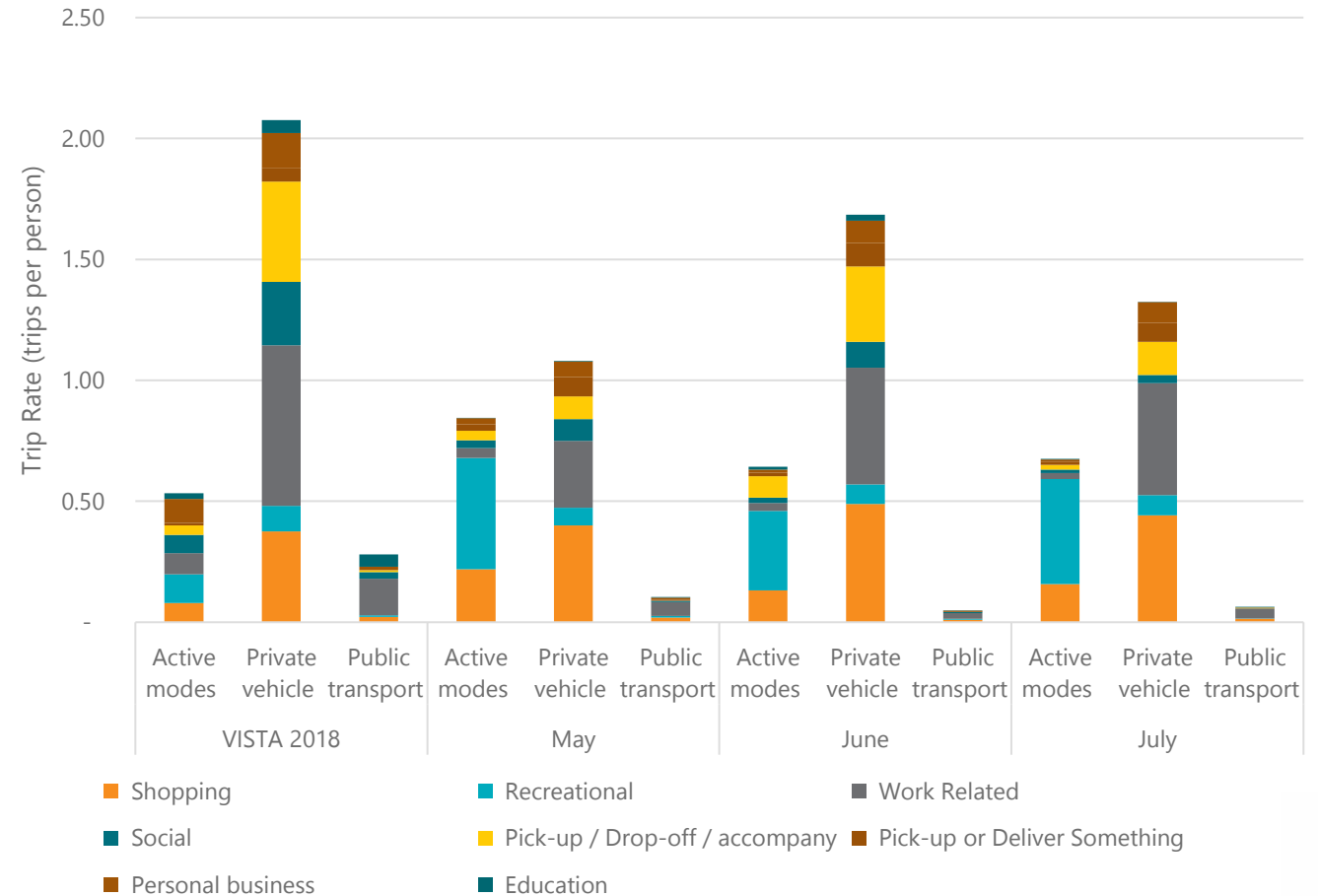- Work related trips also fell significantly, most so for public transport
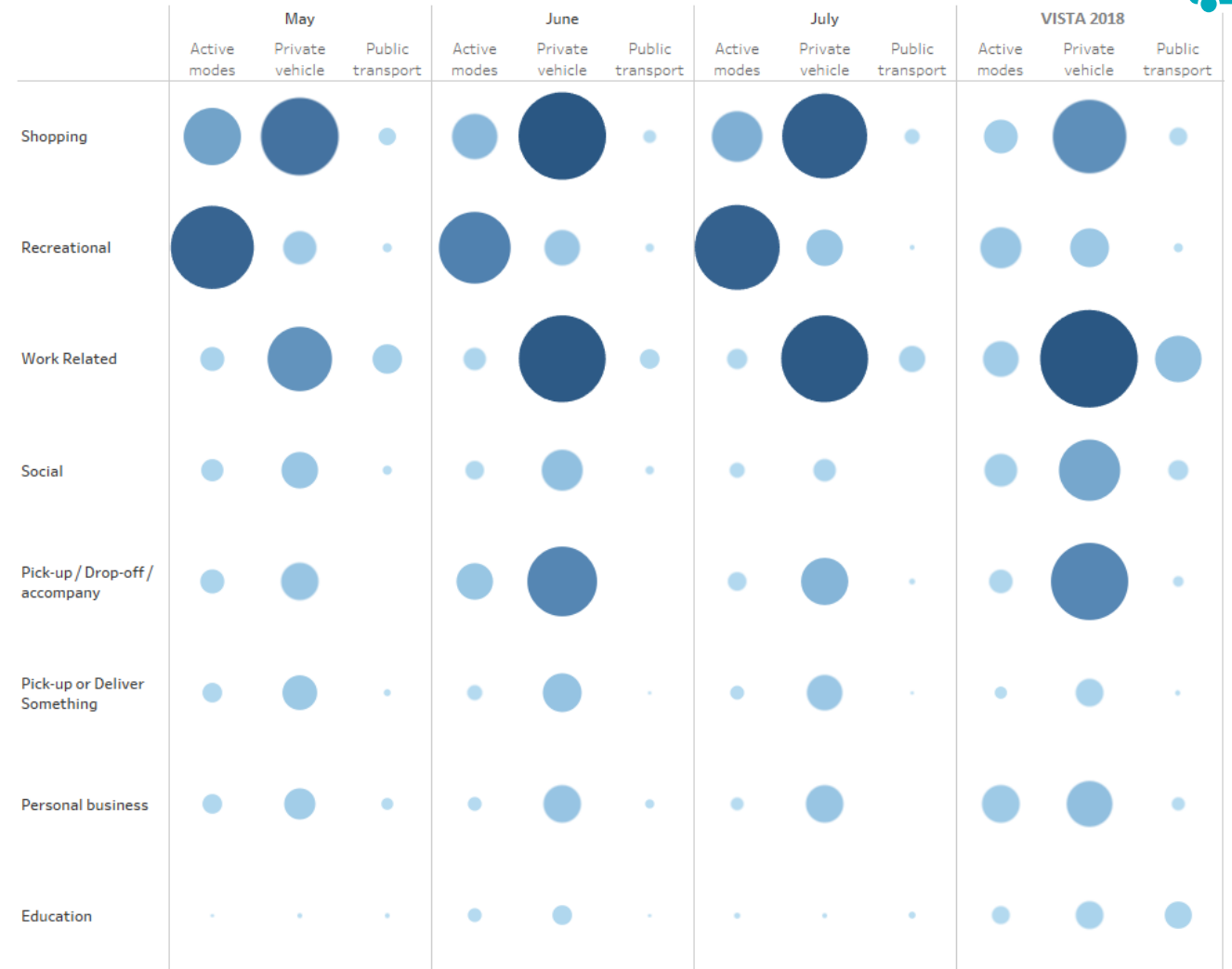
VISTA data – Trip rates

- Compared to 2018, the VISTA survey shows a significant decline in trip rate for public transport and driving, while active modes sharply increase.

- Recreational and shopping trips increase significantly for all modes. It is expected that these are mainly short trips and that the trend of more local trips will continue in some form during the recovery phase.

- However, given that these trips are likely to be short, they are not considered for application of any adjustment in the model (this would also be technically challenging). Short distance trips are unlikely to have significant impacts on the modelling results given the strategic context of the study and MABM model.

- It should be noted that the reduction in public transport trips leads to issues related to low sample size for public transport trips within the survey when looking at any dimension in detail.

VISTA - Trip rates by mode

Trip Rate (trips per person)

Legend:
- Shopping
- Recreational
- Work Related
- Social
- Pick-up / Drop-off / accompany
- Pick-up or Deliver Something
- Personal business
- Education

Categories: Active modes, Private vehicle, Public transport — for VISTA 2018, May, June, July

Mode Share in VISTA

- Analysing mode share in VISTA, we see a significant increase in active travel. As noted above, this is largely due to an increase in recreational active travel during lockdown periods.

- Excluding recreation trips from mode share calculations significantly reduces the active mode share, highlighting that active mode share impacts as a result of COVID-19 are largely due to recreation trips.

- It is of note that June and July mode shares for active modes (once recreation is excluded) are around the same levels as VISTA.

	Observed Mode share in VISTA (unweighted)			Observed Mode share in VISTA (unweighted, drive and transit only)	
	Drive	Transit	Active	Drive	Transit
VISTA 2018	72%	10%	18%	88%	12%
May	53%	5%	42%	91%	9%
June	71%	2%	27%	97%	3%
July	64%	3%	33%	95%	5%

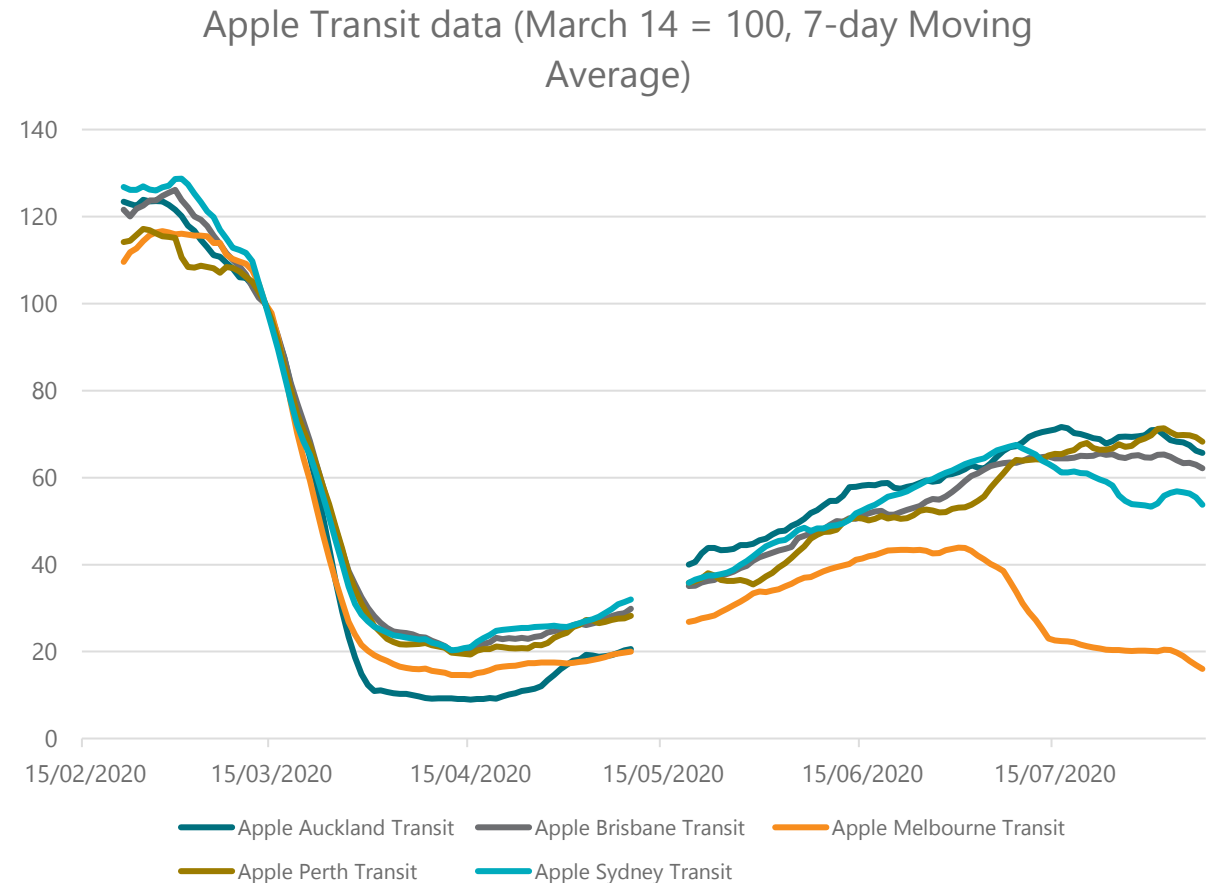|	Observed Mode share in VISTA (unweighted, excluding recreation)			Observed Mode share in VISTA (unweighted, drive and transit only, excluding recreation)	
	Drive	Transit	Active	Drive	Transit
VISTA 2018	74%	10%	16%	88%	12%
May	68%	7%	26%	91%	9%
June	82%	2%	16%	97%	3%
July	80%	4%	16%	95%	5%

Comparing VISTA and Apple Transit Data

- There is some inconsistency between VISTA and Apple data:
  - Apple transit and walk data shows an increase over from May to June followed by a decline from June to July.
  - VISTA data for PT and active modes shows the opposite of this with a decline from May to June and an increase from June to July.

- Given the reasonable validation of Apple transit data for other jurisdictions we have chosen to use Apple data for calculating mode attractiveness.

- Walk data however is treated with caution as it is likely that Apple Maps does not cover many of these trips very well given the low likelihood that a routing request would be submitted for most of these trips.

Apple data for Melbourne (March 14 = 100, 7-day Moving Average)

Legend: ── Apple Melbourne Driving ── Apple Melbourne Transit ── Apple Melbourne Walking
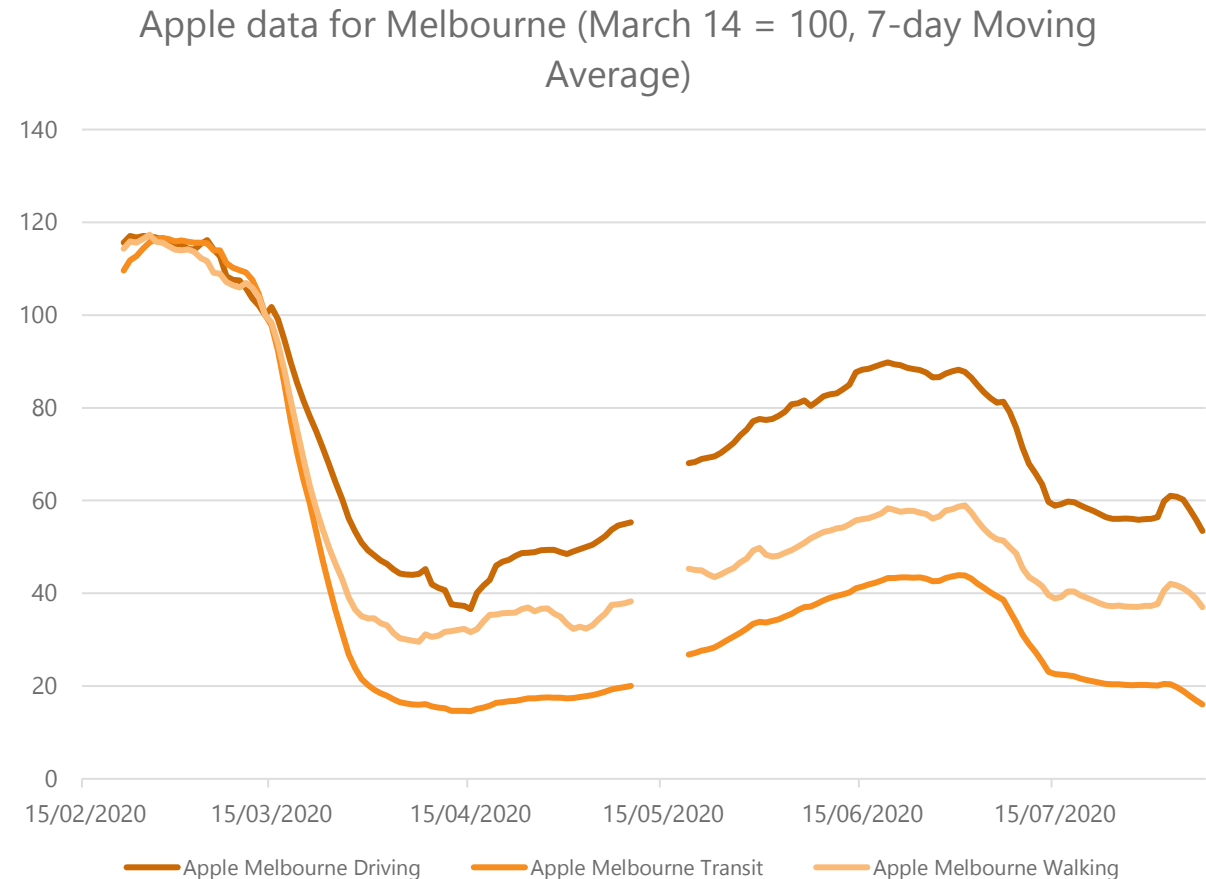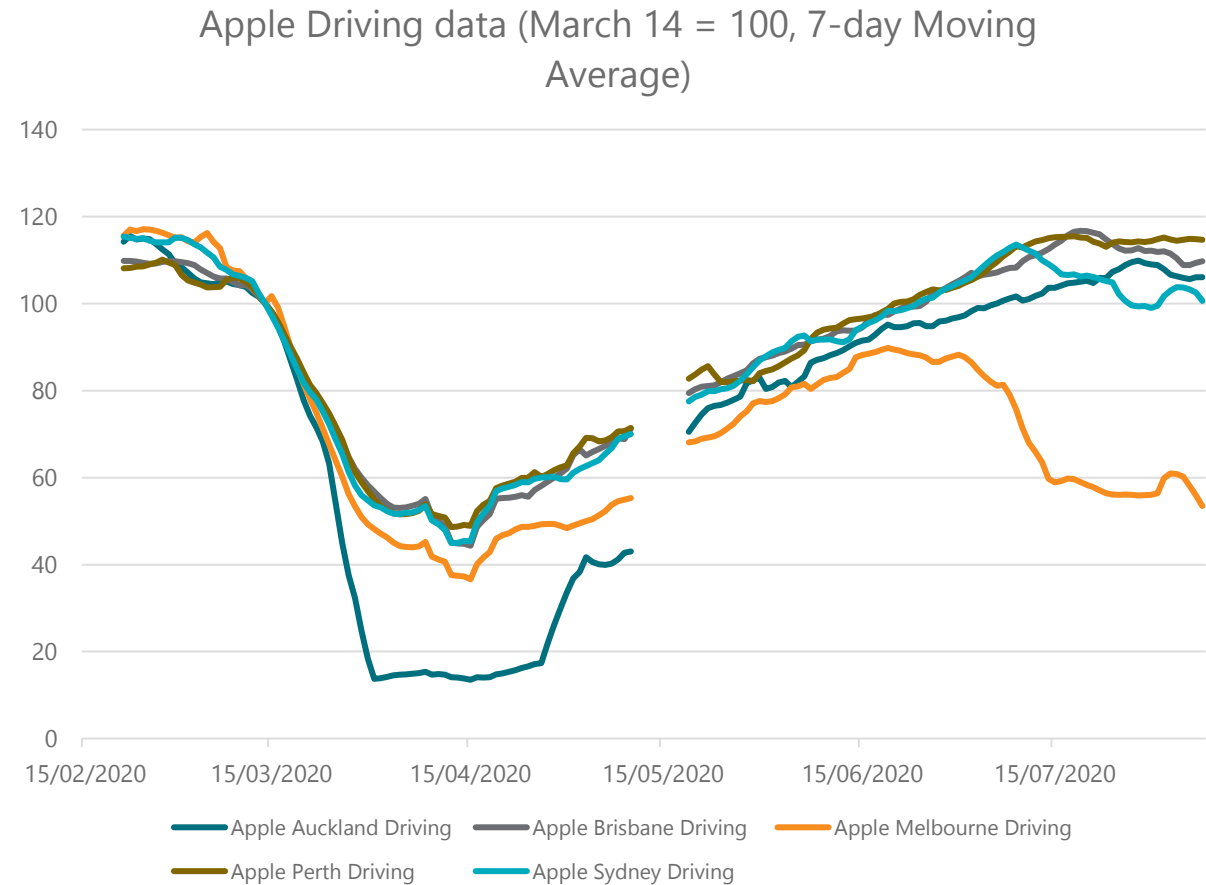
Change in volumes due to COVID-19 - Transit

- Apple data shows a large decline in transit usage during lockdown. Even in cities where cases are almost zero, transit does not appear to have reached 80 per cent of early March levels.

- In Sydney, with only a small number of daily cases, transit usage appears to have declined in July from a peak of around two thirds.

- In Melbourne, with a second lockdown, there has been a significant drop to almost 10 percent of early March levels.

- Auckland, Brisbane and Perth are sitting at just over 60 per cent in July / August, despite recording very few cases and having relatively few formal restrictions.

Apple Transit data (March 14 = 100, 7-day Moving Average)

Apple Auckland Transit · Apple Brisbane Transit · Apple Melbourne Transit · Apple Perth Transit · Apple Sydney Transit

Change in volumes due to COVID-19 - driving

- Apple data shows that driving is more resilient to the impacts of COVID-19 lockdowns compared to transit.

- Apple data suggest that in cities other than Melbourne, driving has almost fully recovered to pre-COVID-19 levels.

- A portion of this driving recovery may be due to shifts from other modes, suggesting that COVID-19 has resulted in a greater preference for driving.

Apple Driving data (March 14 = 100, 7-day Moving Average)

Legend: Apple Auckland Driving, Apple Brisbane Driving, Apple Melbourne Driving, Apple Perth Driving, Apple Sydney Driving

Change in volumes due to COVID-19 – walking / active modes

- Apple data shows a variety of changes in walking outcomes for cities. Generally cities with less cases appear to have a smaller decline in walking direction requests, however only Perth appears to have reached early March levels of walking.

- Some of this may be seasonal, as winter may be considered a less pleasant time to walk than Autumn.

- Apple map direction requests may not be as accurate for walking trips as other trips – particularly local recreation trips made during lockdown.

Apple Driving data (March 14 = 100, 7-day Moving Average)

Legend:
- Apple Auckland Walking
- Apple Brisbane Walking
- Apple Melbourne Walking
- Apple Perth Walking
- Apple Sydney Walking
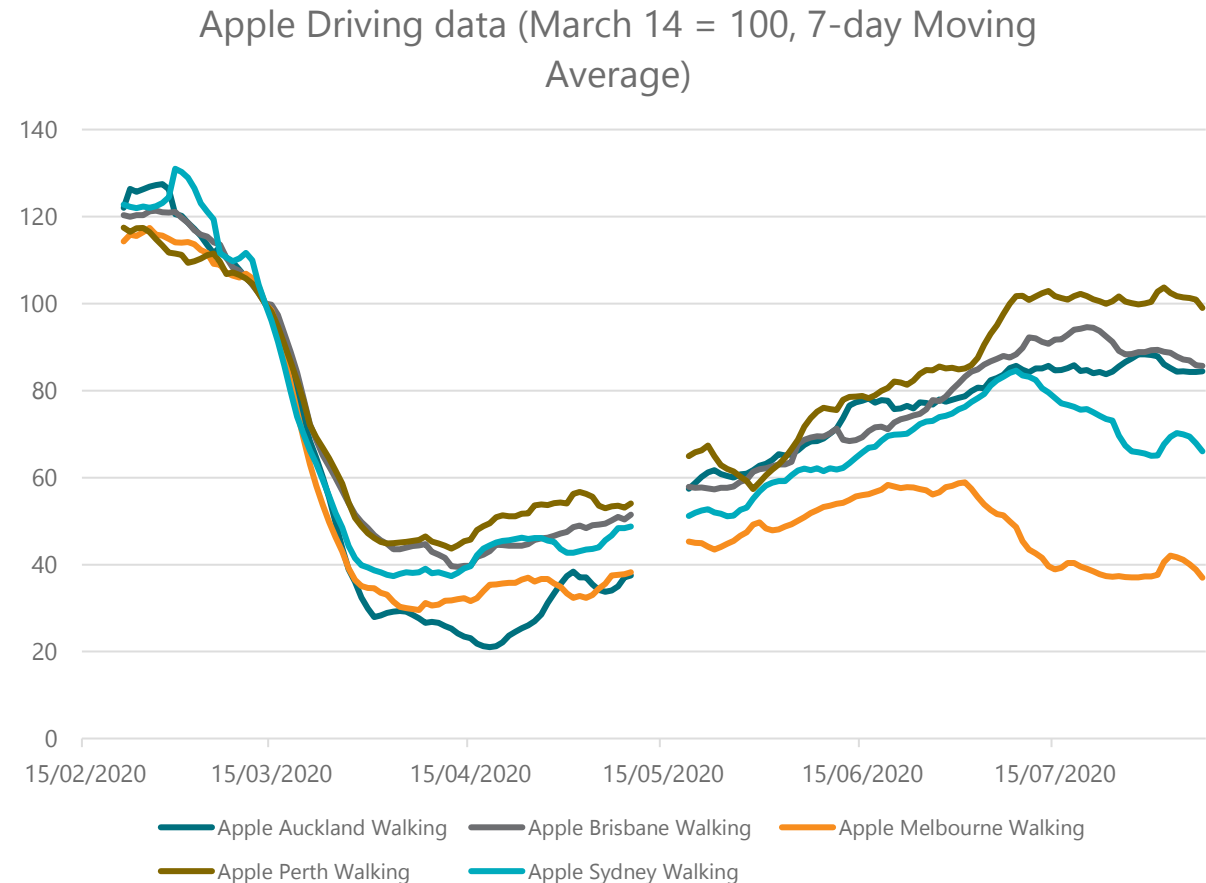
Seasonality - Transport

- Transportation volumes can vary at different times of the year due to extraneous factors such as weather or special events such as school or public holidays.

- We applied seasonality factors for both public transport and road traffic based on Auckland / Sydney Public Transport and Melbourne Scats counts respectively.

- Active transport seasonality was calculated using an average of Public Transport and Traffic seasonality factors in the absence of further information.
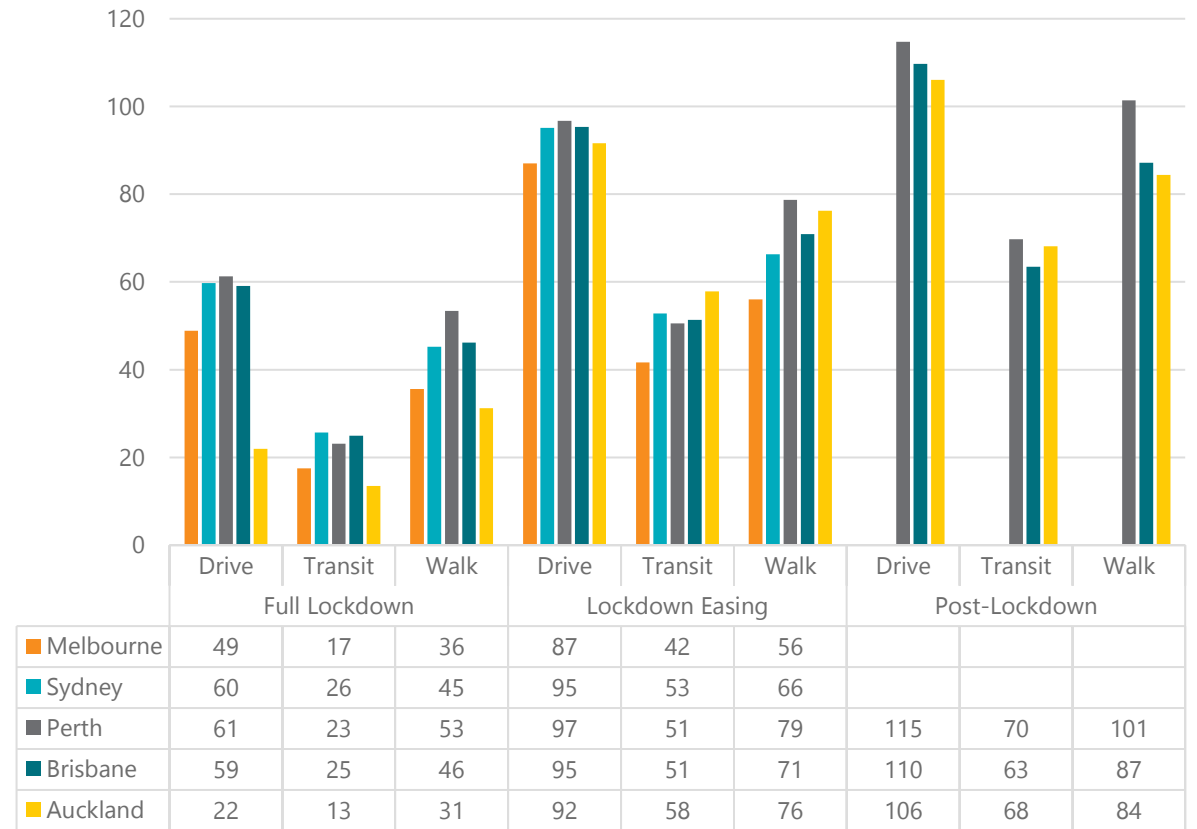
Month	PT Seasonality Factor	Traffic Seasonality Factor	Active Seasonality Factor
January	1.37	1.11	1.24
February	1.16	0.99	1.08
March	1.00	1.00	1.00
April	1.19	1.05	1.12
May	1.01	1.00	1.00
June	1.17	1.05	1.11
July	1.12	1.03	1.08
August	1.05	1.01	1.03
September	1.12	1.04	1.08
October	1.08	0.98	1.03
November	1.08	0.99	1.04
December	1.31	1.04	1.18

Changes in volumes due to COVID-19

- The graph to the right shows that all modes increase as lockdowns are eased.

- Car and walk / active grow across all scenarios, although the change is smaller between easing and post lockdowns (except for Perth).

- Car travel is fully recovered in cities where there are smaller number of COVID-19 cases (i.e. other than Melbourne and Sydney) by Post-Lockdown.

- Transit growth never fully recovers from the decline in full lockdown.

Volumes as a percentage of Pre-Lockdown

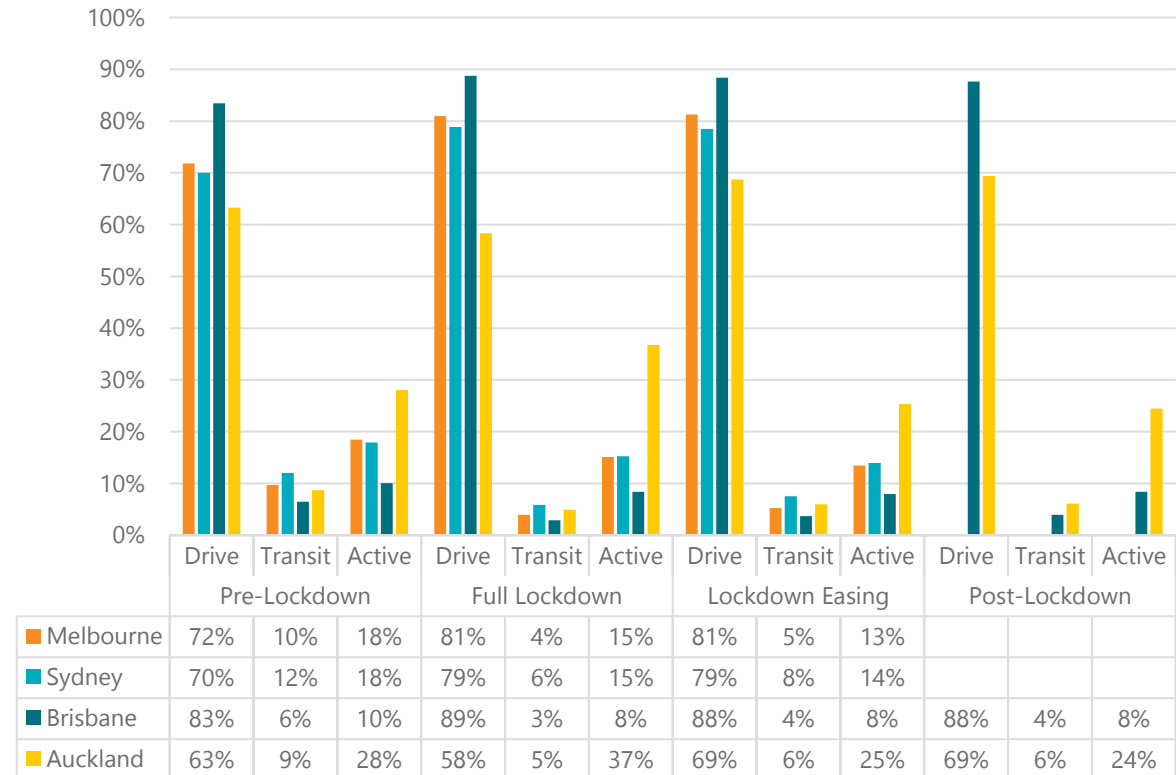|	Drive	Transit	Walk	Drive	Transit	Walk	Drive	Transit	Walk
	Full Lockdown			Lockdown Easing			Post-Lockdown		
Melbourne	49	17	36	87	42	56			
Sydney	60	26	45	95	53	66			
Perth	61	23	53	97	51	79	115	70	101
Brisbane	59	25	46	95	51	71	110	63	87
Auckland	22	13	31	92	58	76	106	68	84

Public transport mode share has dropped in all cities, it does not recover even as trips approach pre-COVID-19 levels

- Here we use the starting mode share from household travel surveys and adjust them in line with growth seen from Apple mobility data.

- Combining Apple and Household travel survey data generally shows that car mode share will increase throughout all lockdown scenarios, while transit will decline.

- Transit mode share declines by around 50 per cent or greater in full lockdown, before recovering a small amount in lockdown easing.

- Car and PT do not show significant changes between Lockdown Easing and Post-Lockdown scenarios. This may in part be due to the length of time where data is available for the 'Post-lockdown' period.

Implied mode share based on Household travel surveys and Apple mobility data

	Pre-Lockdown			Full Lockdown			Lockdown Easing			Post-Lockdown		
	Drive	Transit	Active	Drive	Transit	Active	Drive	Transit	Active	Drive	Transit	Active
Melbourne	72%	10%	18%	81%	4%	15%	81%	5%	13%			
Sydney	70%	12%	18%	79%	6%	15%	79%	8%	14%			
Brisbane	83%	6%	10%	89%	3%	8%	88%	4%	8%	88%	4%	8%
Auckland	63%	9%	28%	58%	5%	37%	69%	6%	25%	69%	6%	24%

MABM Scenario Definition – Mode Attractiveness

- Changes in mode attractiveness are calculated by adjusting the starting mode share for each city according to mobility trend data from Apple Maps at each lockdown stage.

- Public Transport is estimated to be at depressed levels for some time.

- Car is estimated to be more attractive than pre-COVID-19.

- The Core scenario is based on Auckland (Brisbane is also similar), whilst the Dialled-Up case is modelled on Melbourne in the recovery phase.

- The mode shares in the model will be modified to achieve the relativities implied by the table. Where the numbers are internally inconsistent in application, public transport changes will be prioritised.

- Whilst active modes could be adjusted, it is not recommended as the trips have a fixed mode in MABM and adjustment will not have a major impact on the model

|	Mode	Core Scenario	Dialled-Up Scenario
Change in mode share	Car	~ 10 % increase	~ 15 % increase
	Public Transport	~ 30 % decrease	~ 50 % decrease
	Active	No change	No change

WORKING FROM HOME AND EMPLOYMENT

Employment levels overall are likely to recover to within 5-10% of pre-COVID-19 levels in the short to medium term but this is uncertain

- Since March 14, across all industries employment has not declined by greater than 10 per cent.

- During the initial lockdown phase (late March to end of May) there was a steep decline in employment – analysis by industry indicated that this was mainly due to large declines in Accommodation and Food and Arts and Entertainment employment categories. Other industries experienced smaller declines.

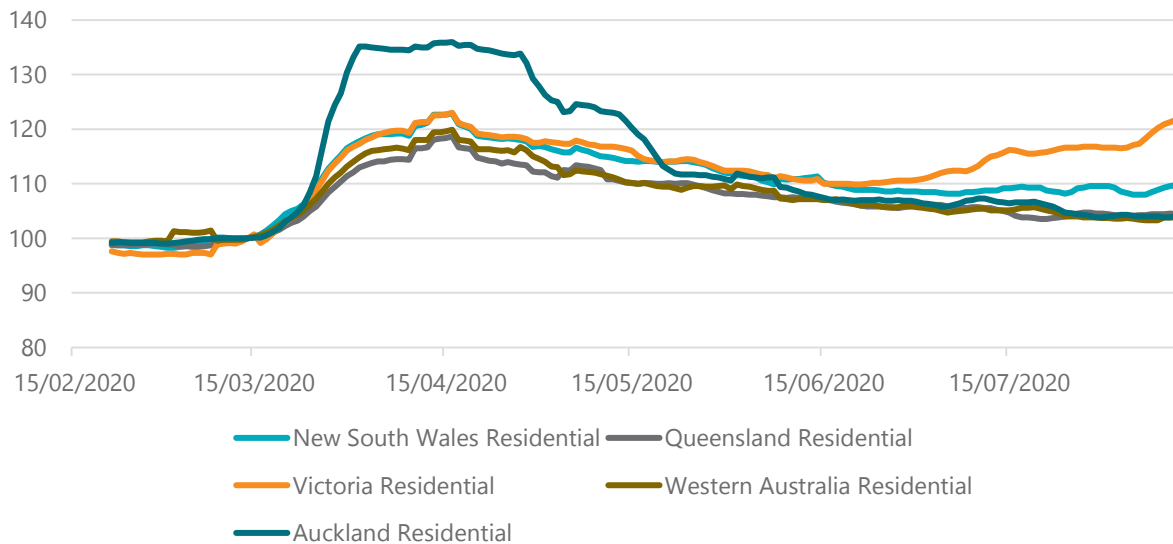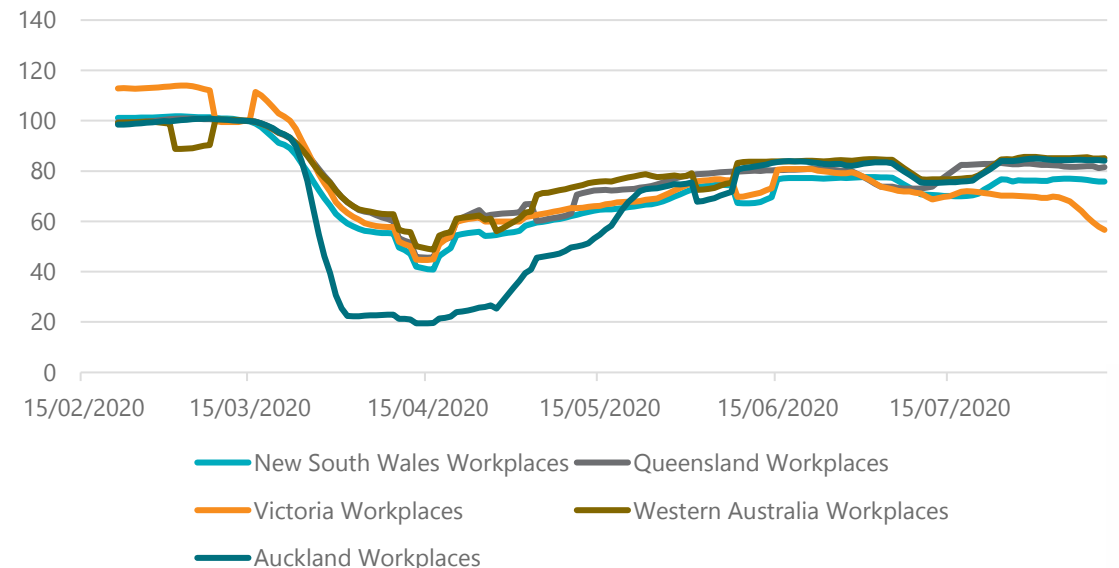Wages and Employment - VIC, NSW, WA, QLD (all industries, March 14 = 100)
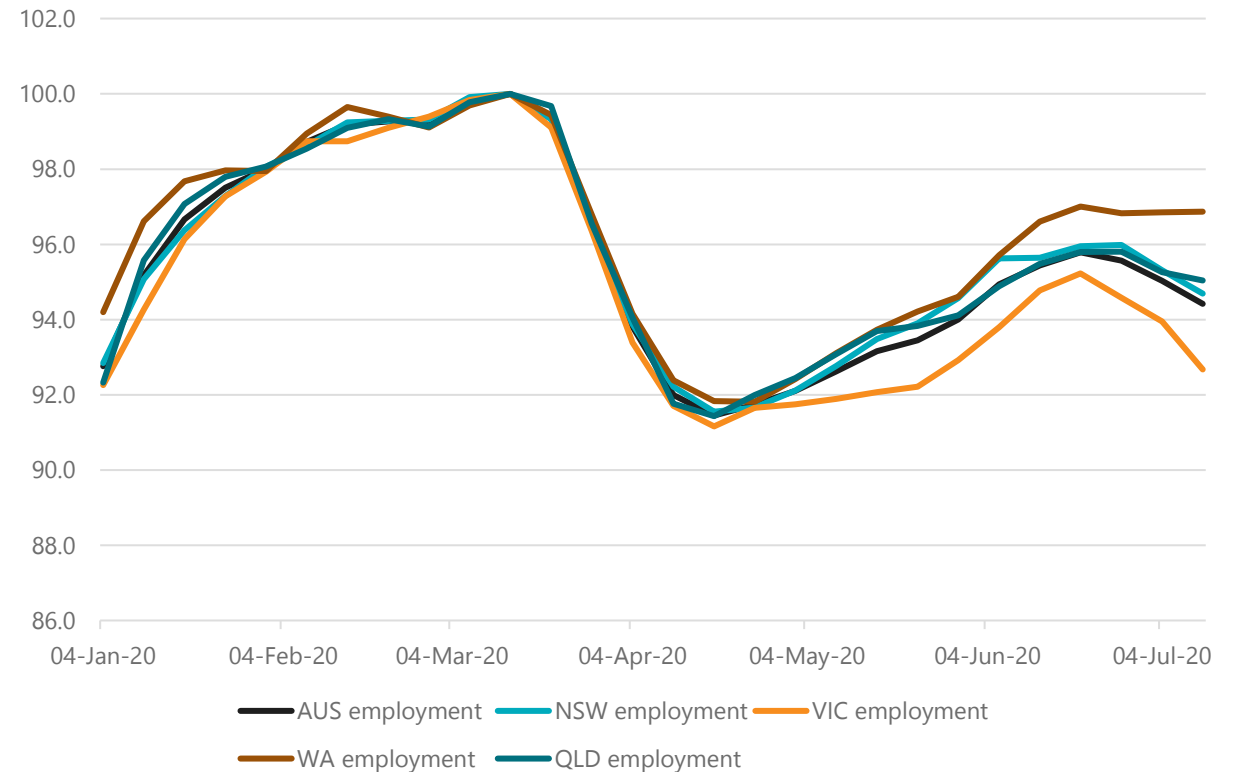
Google[2] data suggests that lockdowns led to large increases in residential activity and declines in workplace activity

Working from home appears to have persisted with levels of residential activity shown to be 5% above baseline levels in Auckland, WA and Queensland. Continued trends of lower workplace activity support the hypothesis that a proportion of the workforce will continue to work from home in the near term. This is further supported by surveys of a sample of respondents across Australia conducted by ITLS (Hensher et. al, 2020[1]) which suggests that around 40% of people would want to work from home at least some of time as restrictions ease.

Google location data - Residences (14 March = 100, 7 day Moving Average)**

Google location data - Workplaces (14 March = 100, 7 day Moving Average)**

[1] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7434414/
[2] https://www.google.com/covid19/mobility/

**note difference in graph y-axes

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Seasonality - Workplace

- Workplace / residential activity can vary across different times of the year based on external factors such as public or school holidays.

- We applied seasonality factors workplace / residential readings based on a weighted average of Public Transport and Traffic seasonality factors in the absence of further information.

Month	Work / residential Seasonality Factor
January	1.33
February	1.14
March	1.00
April	1.17
May	1.00
June	1.15
July	1.11
August	1.04
September	1.11
October	1.06
November	1.07
December	1.27

Google data suggests that workplace activity is likely to recover to between 80% and 90% of pre-COVID-19 levels in the near term

- Auckland suffered the largest contraction of workplace activity during the 'Full lockdown' phase due to its stringent conditions

- Victoria fell to 60% of usual levels and recovered to nearly 80% of usual levels during June.

- Residential activity has followed the inverse of the workplace trends as expected.

- Post-lockdown, data suggests that workplace activity should recover to between 80% and 90% of usual levels in Melbourne accounting for uncertainty in the relationship between workplace activity and jobs.
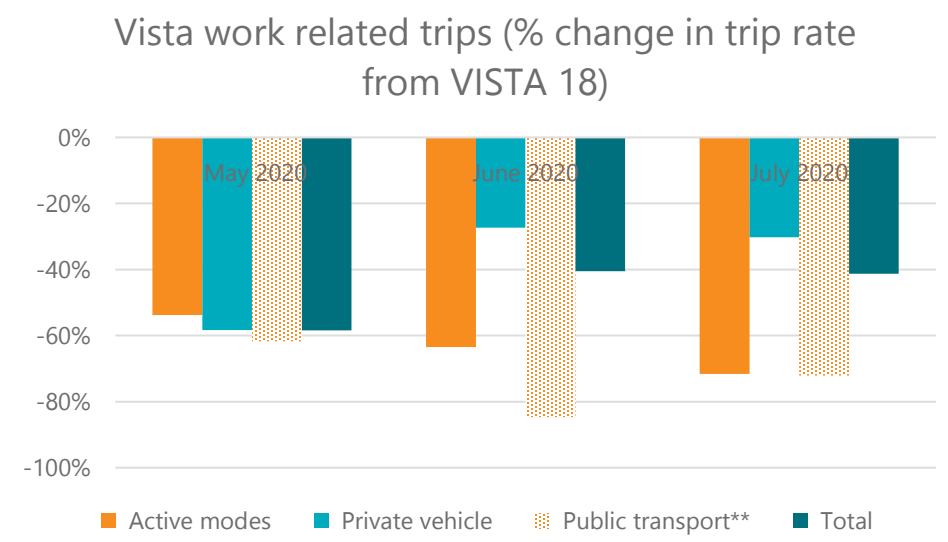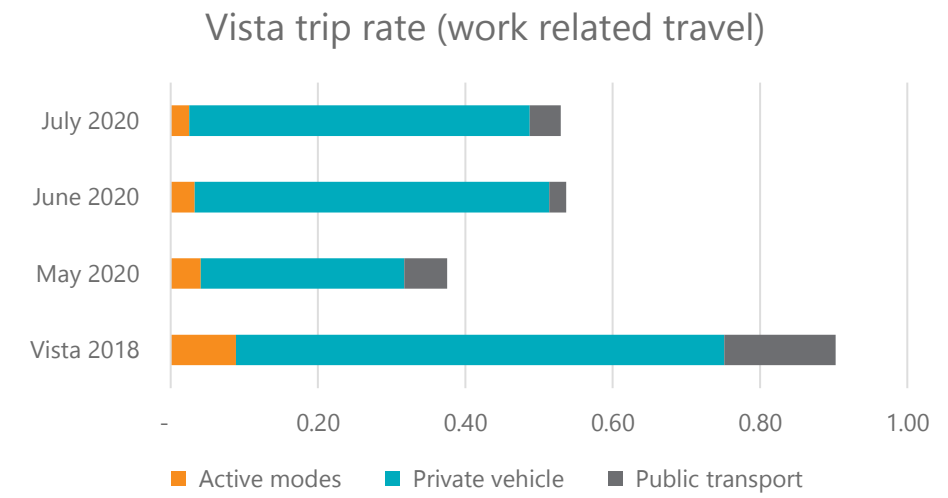
Google data - Workplace and Residential readings as a percentage of Pre-Lockdown

| | Full Lockdown | | Lockdown Easing | | Post-Lockdown | |
	Workplace	Residential	Workplace	Residential	Workplace	Residential
Victoria	62	118	78	111		
New South Wales	58	117	77	110	77	108
Western Australia	65	114	84	107	84	104
Queensland	63	113	80	107	80	104
Auckland	36	126	83	107	83	104

VISTA data for Melbourne between May and July shows that work related travel reduced to between 40% and 60% of pre-COVID-19 levels*
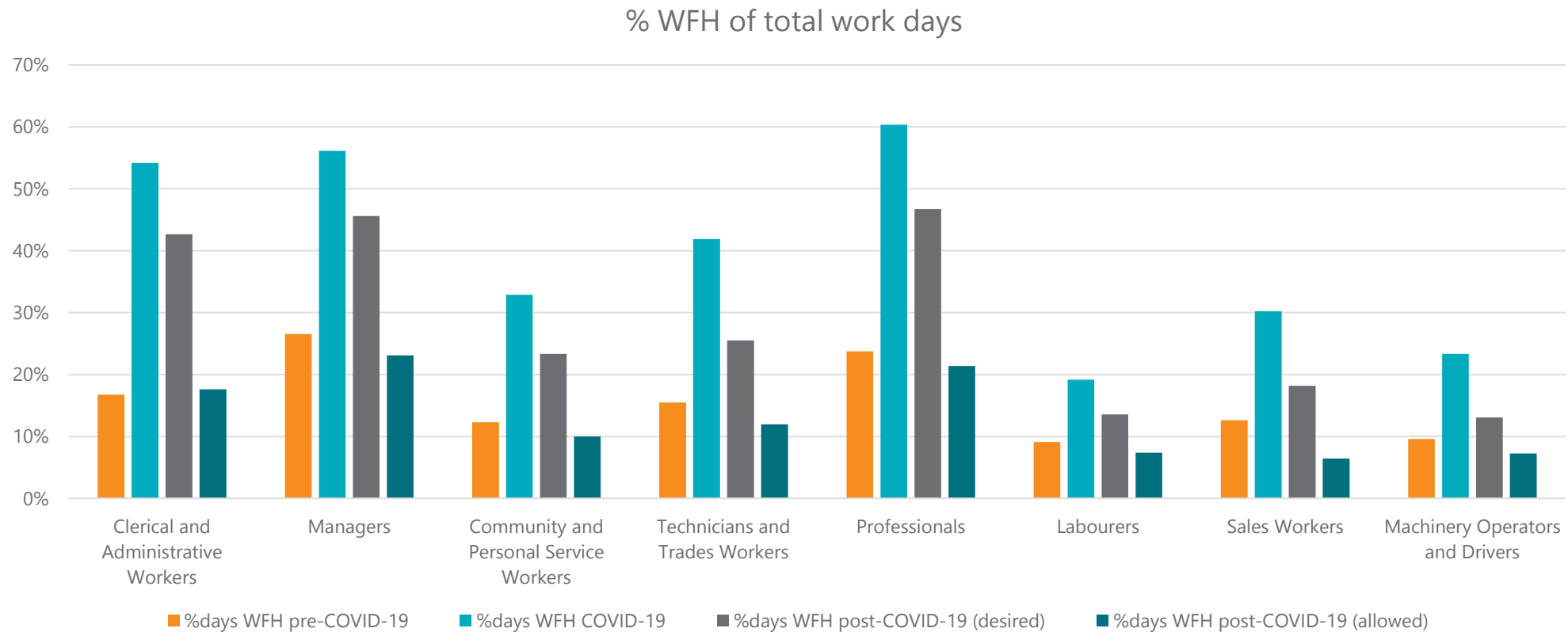
- The overall decline during this period is corroborated by Google workplace activity data.

- Work trips by public transport have seen the largest reduction. However, low sample sizes and use of an unweighted sample suggest caution in interpreting trends by month.

- Car work related trips have recovered through June and July to a degree but still remain around 30% below VISTA 18 by the end of July.

- Active mode trips whilst accounting for a relatively small share in VISTA 18 (10%), see a significant reduction due to COVID-19.

Vista trip rate (work related travel)

Vista work related trips (% change in trip rate from VISTA 18)

*COVID-19 VISTA Survey (DOT, 2020), unweighted sample - refer to disclaimer on slide 16 for further details.

DJPR Survey data shows that many workers plan to work from home more but employers may not be supportive

- Charts below show the proportion of days worked from home on average pre-COVID-19, during COVID-19 and expected post-COVID-19 for each occupation. Post expectations are split into respondent preference (desired) and respondent expectations of what would be allowed by employers (allowed).

- Interestingly, there is a significant increase for all groups post-COVID-19

% WFH of total work days

Legend:
- %days WFH pre-COVID-19
- %days WFH COVID-19
- %days WFH post-COVID-19 (desired)
- %days WFH post-COVID-19 (allowed)

vlc

33

Most occupations report that they would like to increase working from home post-COVID-19

- The added yellow line, shows the percentage change in proportion of days worked from home pre and post-COVID-19. It is the percentage difference between the orange and grey bars (%days WFH post-COVID-19 (desired)).

- This suggests Clerical and Administrative workers are likely to shift to WFH the most. This is about a 155% increase in pre-COVID-19 levels suggesting that workers anticipate going from around 1 day per week from home on average to more than 2 days a week.

% WFH of total work days and % change in WFH post-covid (line)
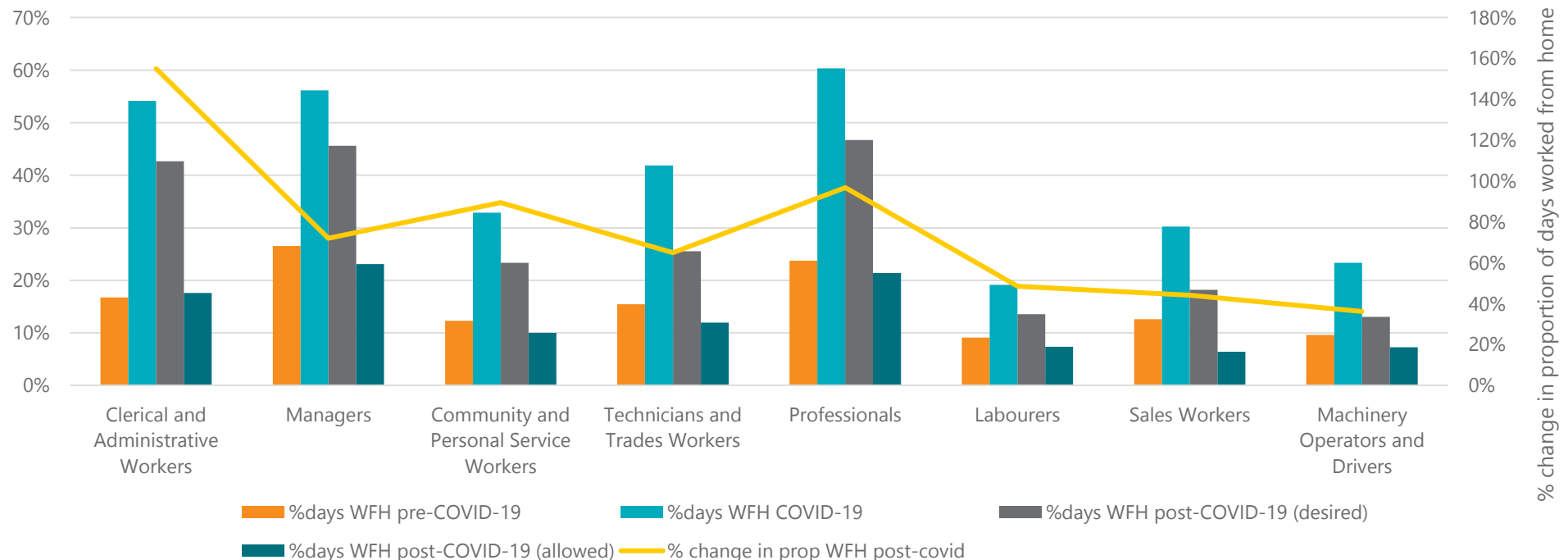
DJPR survey data by industry show a large change in some industries including public administration and safety

- Impacts vary by industry but given that jobs by industry are unlikely to be well represented in MABM. Therefore, application of industry based factors is not recommended.

## % WFH of total work days and % change in WFH post-covid (line)

Legend:
- %days WFH pre-COVID-19
- %days WFH COVID-19
- %days WFH post-COVID-19 (desired)
- %days WFH post-COVID-19 (allowed)
- % change in prop WFH post-covid

DJPR Survey Data: August 2020 Work From Home Survey data provided by DJPR
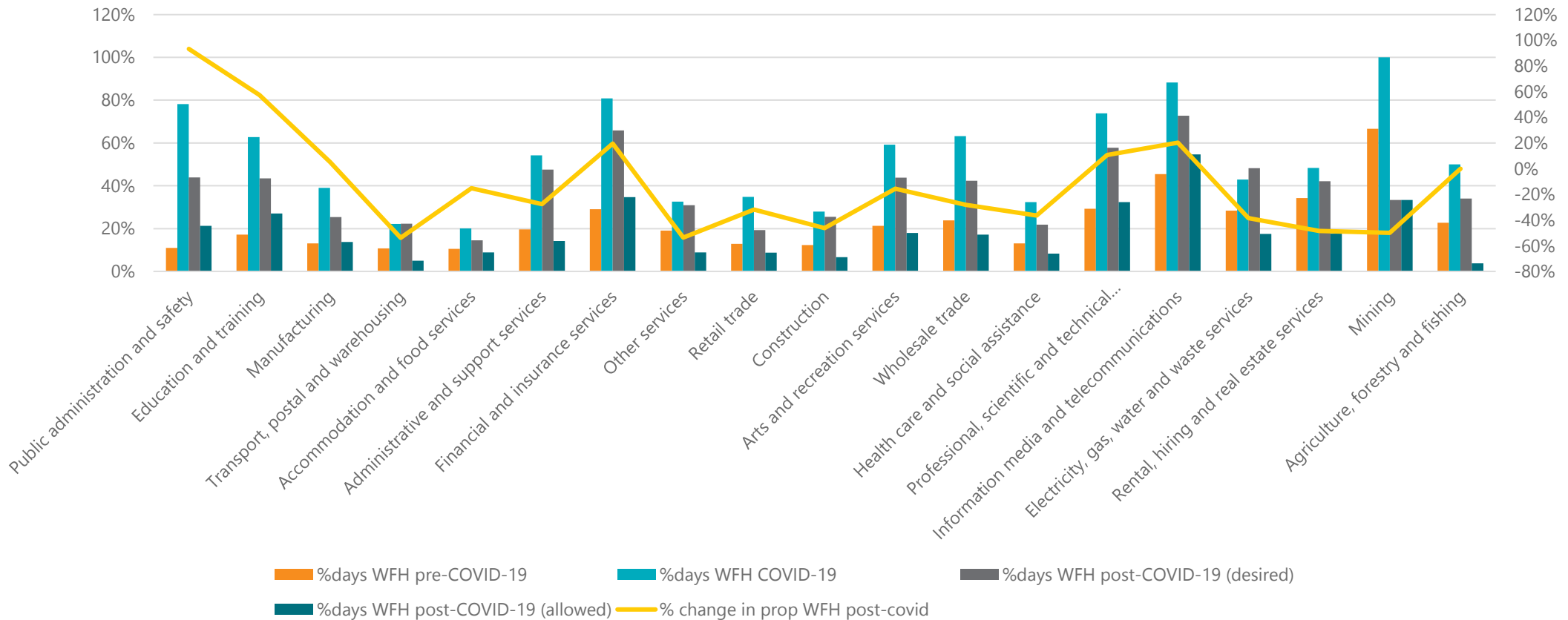
MABM Scenario Definition – Working from home and Employment

1. Google data is used to ascertain overall reduction in work related travel (see right). No structural change assumed so all changes are assumed to be due to WFH rather than employment level changes.

2. DELWP[1] occupations that are not identified as WFH are removed from analysis.

3. Industry splits are derived from DJPR data by occupation based on the level of change in WFH suggested from pre to post-COVID19 and also adjusted to account for relative segment size in MABM. The combined weight as a % is used to determine the proportion of trips removed from each segment.

4. These proportions are then applied to the total trips in scope for removal and shown as percentages of each occupation segment as a sense check.

1	**Core Scenario**	**Dialled-Up Scenario**
Working from home trip adjustment	Commuter travel reduced to 90% (10% reduction) of usual levels, industry assumptions as below	Commuter travel reduced to 80% (20% reduction) of usual levels, industry assumptions as below

2 **3** **4**

Occupation	DELWP WFH occupation	Survey based weight	MABM segment size weight	Combined weight	Combined weight as %
Clerical and Administrative Workers	1	1.00	1.0	1.00	24%
Managers	1	0.46	1.2	0.55	13%
Community and Personal Service Workers	0	0.58		-	0%
Technicians and Trades Workers	1	0.42	0.9	0.38	9%
Professionals	1	0.63	3.1	1.95	48%
Labourers	0	0.31		-	0%
Sales Workers	1	0.29	0.7	0.20	5%
Machinery Operators and Drivers	0	0.23		-	0%

% of trips removed for each occupation
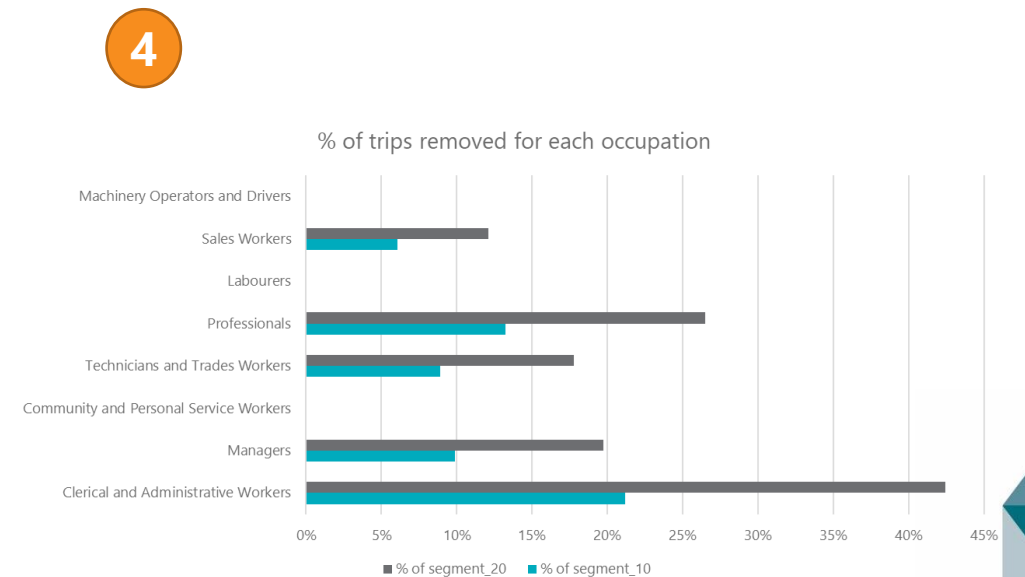
[1] DELWP applied Dingel and Neiman (2020) WFH occupation research to understand which occupations could work from home, the outcomes are adopted here
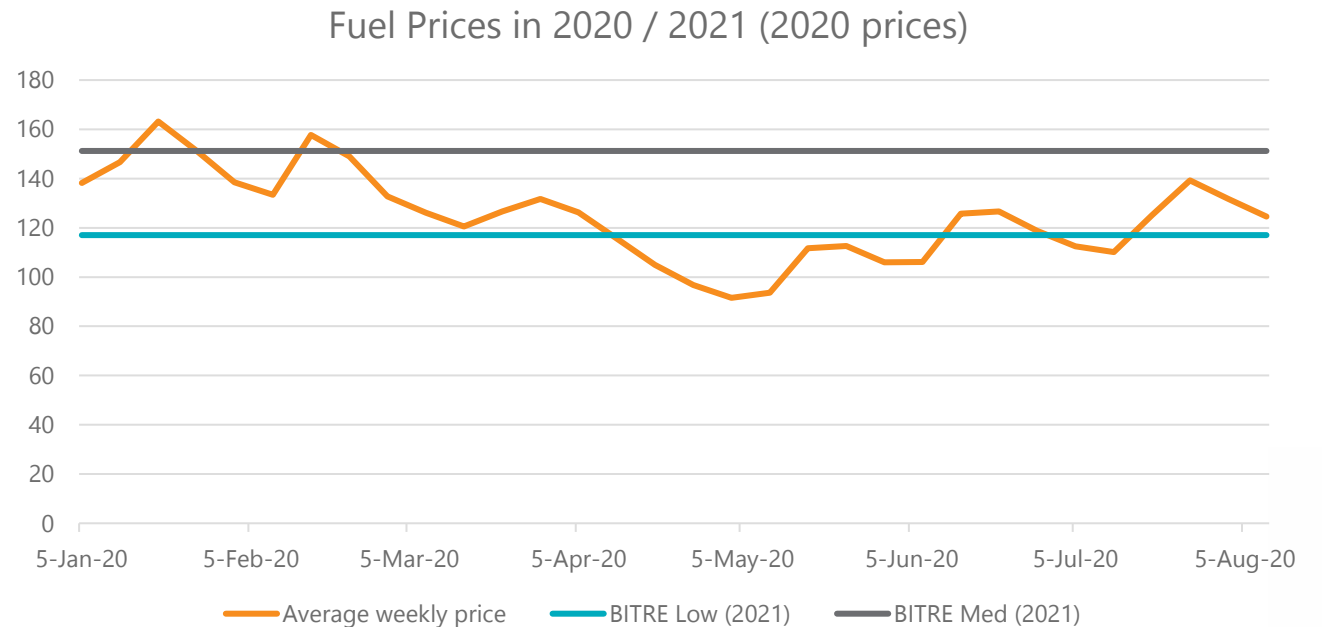
FUEL PRICE

MABM Scenario Definition – Fuel Price

- Our current assumption is that fuel prices may recover to pre-COVID levels within 6 months or be around 5 – 10 per cent lower.

- While COVID-19 has coincided with a significant drop in travel demand, this has not pushed fuel prices far outside previous forecasts.

- There are a number of concurrent events – including a fuel price war between Russia and Saudi Arabia in early March - which have had a major impact on fuel prices.

- Whilst a reduction could be applied, it is not clear that one is required.

	Core Scenario	Dialled-Up Scenario
Fuel Price	No Change	No Change

Fuel Prices in 2020 / 2021 (2020 prices)

Legend: Average weekly price — BITRE Low (2021) — BITRE Med (2021)
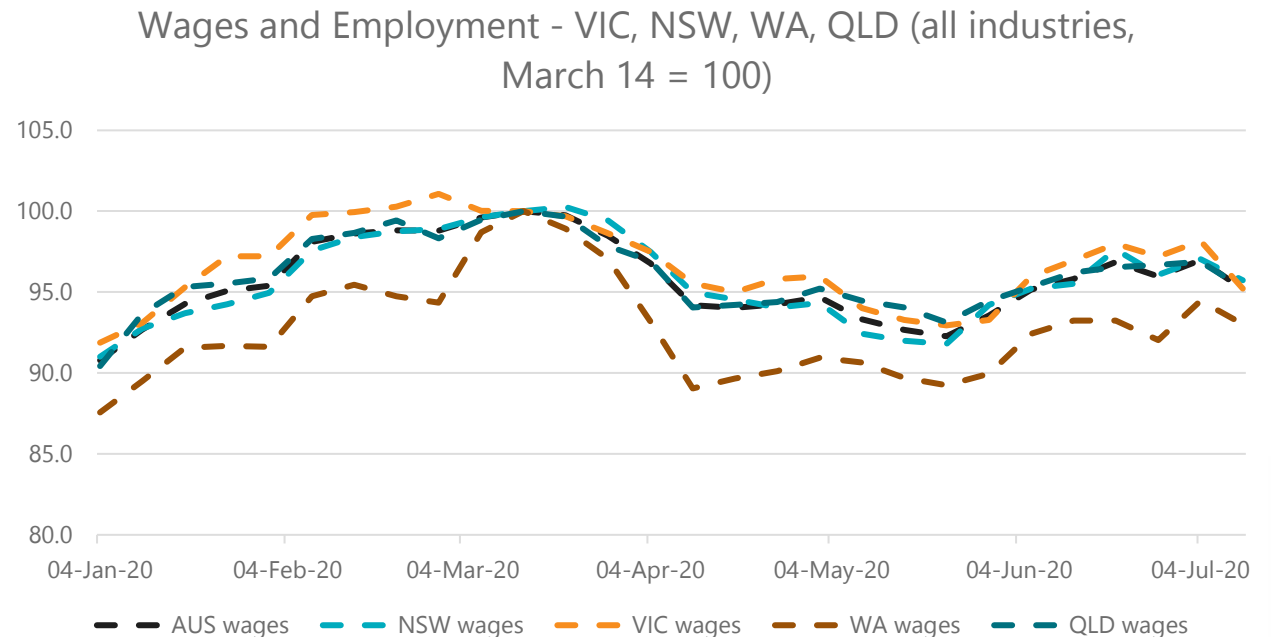
AGENT INCOME

MABM Scenario Definition – Agent Income

- Changes to income due to COVID-19 appear to be less than 10 per cent with the exception of WA.

- Mining income in WA has experienced large declines which were occurring prior to COVID-19. The reason for this is unclear.

- Data by industry shows large fluctuations. It is therefore not considered that strong enough evidence can be found to support a change in the income within the MABM.

	Core Scenario	Dialled-Up Scenario
Agent Income	No Change	No Change

Wages and Employment - VIC, NSW, WA, QLD (all industries, March 14 = 100)

ABS employment and wage data: ABS 6160.0.55.001, - Weekly Payroll Jobs and Wages in Australia, Week ending 11 July 2020 from www.abs.gov.au
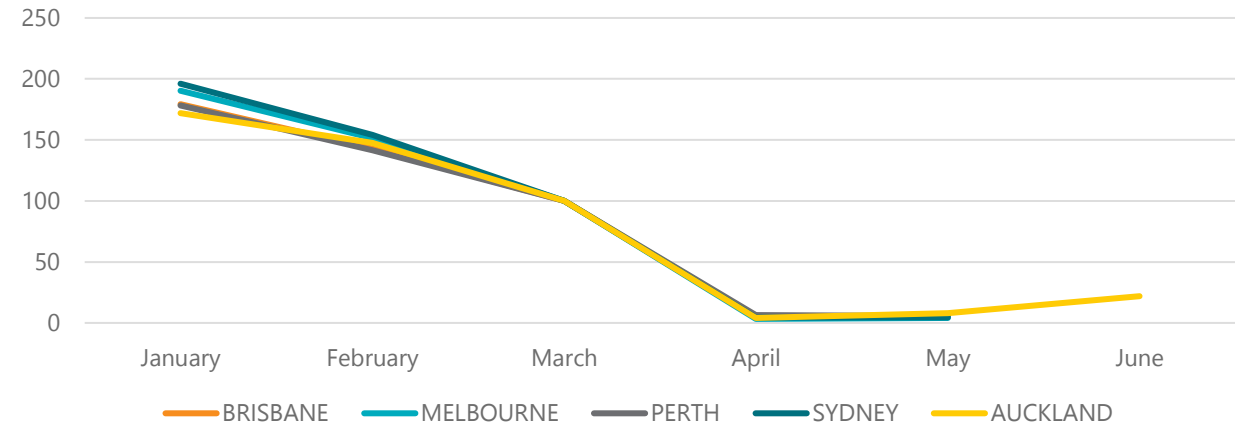
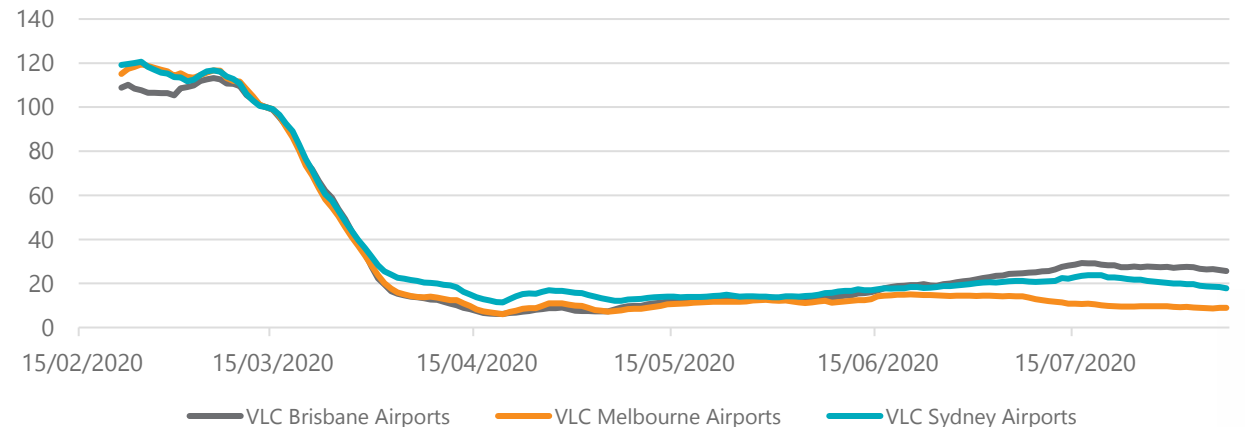# AIRPORT TRAVEL AND INTERNATIONAL STUDENTS

Airport and visitor travel has been severely impacted by COVID-19

- As at May 2020, monthly total airport passengers was at less than 10 per cent for all major Australian cities (BITRE, 2020).

- Auckland experienced some recovery in June – driven almost entirely by domestic passengers.

- VLC LBS data shows since the week of March 14, travel to the airport declined by more than 80 per cent.

- In Brisbane, even with a significant drop in COVID-19 cases and relaxation of restrictions, the number of people travelling to the airport only sits at around 30 per cent of pre-COVID-19 levels.

Total Airport Passengers (BITRE) 2020 (March = 100)

BRISBANE — MELBOURNE — PERTH — SYDNEY — AUCKLAND

VLC Airport data (March 14 = 100, 7-day Moving Average)

VLC Brisbane Airports — VLC Melbourne Airports — VLC Sydney Airports

International Students

- International student visa approvals have declined by around 20% nationally (from financial year 18/19 to 19/20) while new enrolments (commencements) have declined by 16% (NSW) and 19% (VIC) relative to 2019 levels.

- International student numbers are likely to be more significantly impacted by in the second half of the year due to the ongoing pandemic.

- The Mitchell Institute reports that in April 2020 only 30 international students arrived or returned to Australia – compared to 46,480 in April 2019.

- In 2018, there were (Department of Education) 480k international students (30% of the total)

- A reasonable assumption would be that international student numbers would drop by at least 20%, although highly uncertain.

SA4s most affected by reduced international students

Area (SA4)	May 2020 reduction in international student population[8]
Melbourne - Inner	- 13,650
Melbourne - South East	- 9,841
Sydney - City and Inner South	- 7,110
Sydney - Eastern Suburbs	- 5,695
Adelaide - Central and Hills	- 4,823
Sydney - Inner West	- 4,780
Sydney - Ryde	- 4,495
Sydney - Inner South West	- 4,335
Melbourne - Inner East	- 3,610
Brisbane - West	- 3,488
Perth - South East	- 3,425
Brisbane Inner City	- 3,401
Sydney - North Sydney and Hornsby	- 3,400
Melbourne - Inner South	- 3,190
Perth - Inner	- 3,138

YTD commencements (new enrolments) - NSW and VIC
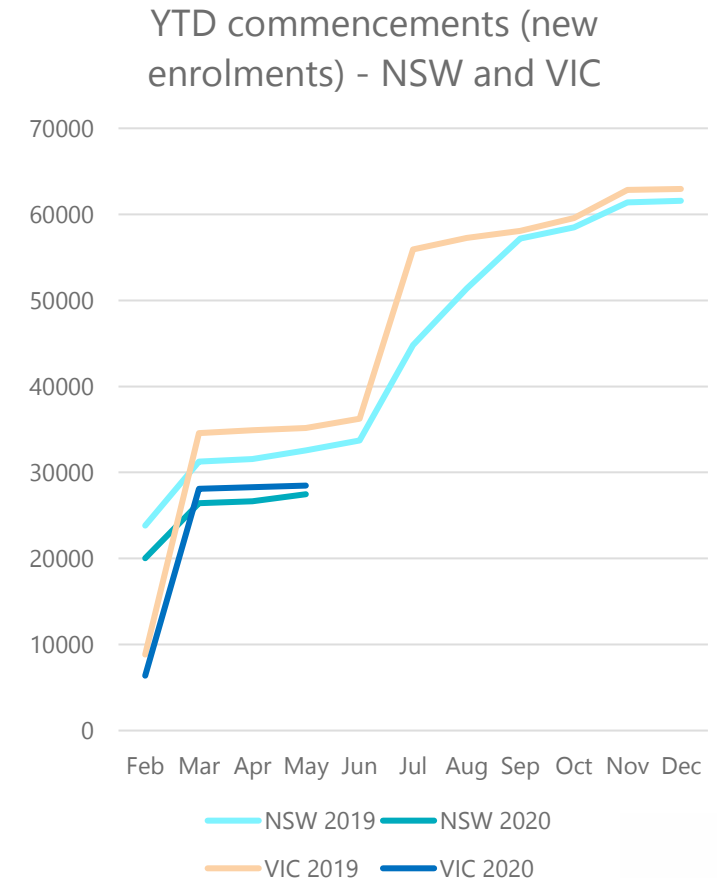
MABM Scenario Definition – Airport travel and international students

- According to airport passenger data, Melbourne airport usually has an approximate domestic to international travel split 70:30 (BITRE, 2020).
  - Core Scenario: 20% higher than Brisbane/ Auckland levels, equating to 50% of usual levels.
  - Dialled-Up Scenario: Based on July/ August Brisbane and Auckland levels.

- For international students, a reduction of 20% is assumed as a best case. In the absence of further information, a 60% reduction is assumed in the Dialled-Up case.

- All other trips associated with those agents identified as international students will also be removed.

	Core Scenario	Dialled-Up Scenario
Airport travel	50% of usual levels	30% of usual levels
International students	20% reduction	60% reduction

COMMERCIAL VEHICLES

MABM Scenario Definition – Goods Vehicles

|	Core Scenario	Dialled-Up Scenario
Goods vehicle traffic	No change	No change

- There is little publicly available information on the impact of COVID-19 on commercial vehicle traffic.

- The general sentiment appears to be that an increased reliance on delivery of is likely to have resulted in an increase in commercial vehicle traffic.

- Transurban's recent Industry Report, *Urban Mobility Trends from COVID-19*, states that purchases made online in Australia increased by 41 per cent in April and continued to by elevated after the first lockdown ended with a 73 per cent increase in Sydney and 65 per cent increase in Brisbane relative to the same time in 2019.

- Transurban's traffic data (shown left) indicates that large vehicle traffic spiked heavily during April 2020 and has remained steady out till June.

- Further data to support any adjustment to this has not been found.

- No change is therefore recommended

FIGURE 18. WEEKLY TRAFFIC PERFORMANCE BY VEHICLE CLASS
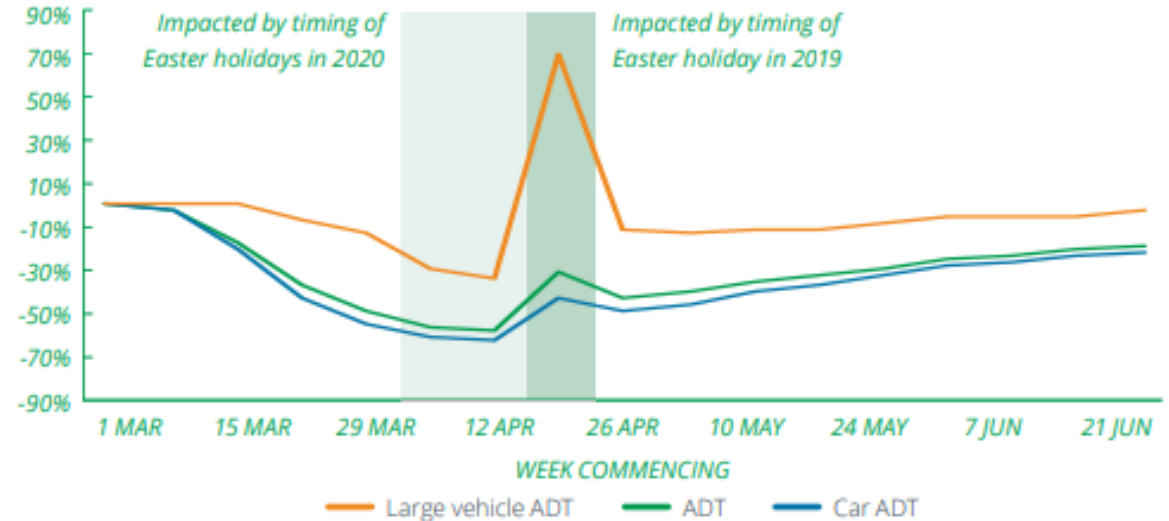
Source: Transurban: Urban Mobility Trends from COVID-19

SUMMARY OF MABM SCENARIO DEFINITIONS

COVID Scenario Assumptions Summary

|		Core Scenario	Dialled-Up Scenario
Change in mode share	Car	~ 10 % increase	~ 15 % increase
	Public Transport	~ 30 % decrease	~ 50 % decrease
	Active	No change	No change
Working from home trip adjustment		Commuter travel reduced to 90% of usual levels	Commuter travel reduced to 80% of usual levels
Fuel Price		No Change	No Change
Agent Income		No Change	No Change
Airport travel		50% of usual levels	30% of usual levels
International students		20% reduction	60% reduction
Commercial vehicle traffic		No change	No change

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COVID Scenario Uncertainties

- **Consistency and quality of datasets**
  - VISTA – Sample size and sample weighting
  - Apple Maps – Limited validation, may be unreliable for active modes and regular short trips
  - Google Mobility data – validation of place based metrics difficult and unknown

- **Uncertainty of the future situation**
  - Vaccine development
  - New technology
  - Rapid easing of borders
  - Step backwards with new virus outbreaks

- **Assumptions**
  - Seasonality factors calculated from limited data
  - Very little good data on
  - WFH industry split

WFH adjustment application

- 10% and 20% scenario of agents set as WFH based on Slide 48

- All agents who are set to WFH will have
  - Business trips that are part of the commute tour removed

  - Work trips replaced by WFH and the mode set to walk_wfh effectively removing their trips from the network. Activity set to work_home, with activity scoring parameters copied from work. This ensures that the work activity is still present in MABM except with travel removed.

  - 'Other' trips that were part of the commute tour:
    - Initial mode changed to whatever mode of previous first leg was, i.e. previous mode outward from home
    - Activity locations re-distributed according to MABM process for assigning those destinations except with trip length drawn from observed 'other' trip length distribution of VISTA work-from-home agents.

Student Adjustment (distribution)

- 19,831 tertiary students in total
- 5,949 overseas students (30%)
- 1,180 (20%) students removed in 'Core' scenario
- 3,565 (60%) removed in 'Dialled-Up' scenario

Students removed
- 0% - 0.1%
- 0.1% - 0.2%
- 0.2% - 0.3%
- 0.3% - 0.5%
- 0.5% - 0.7%
- 0.7% - 1.2%
- 1.2% - 3.6%
- 3.6% - 14%
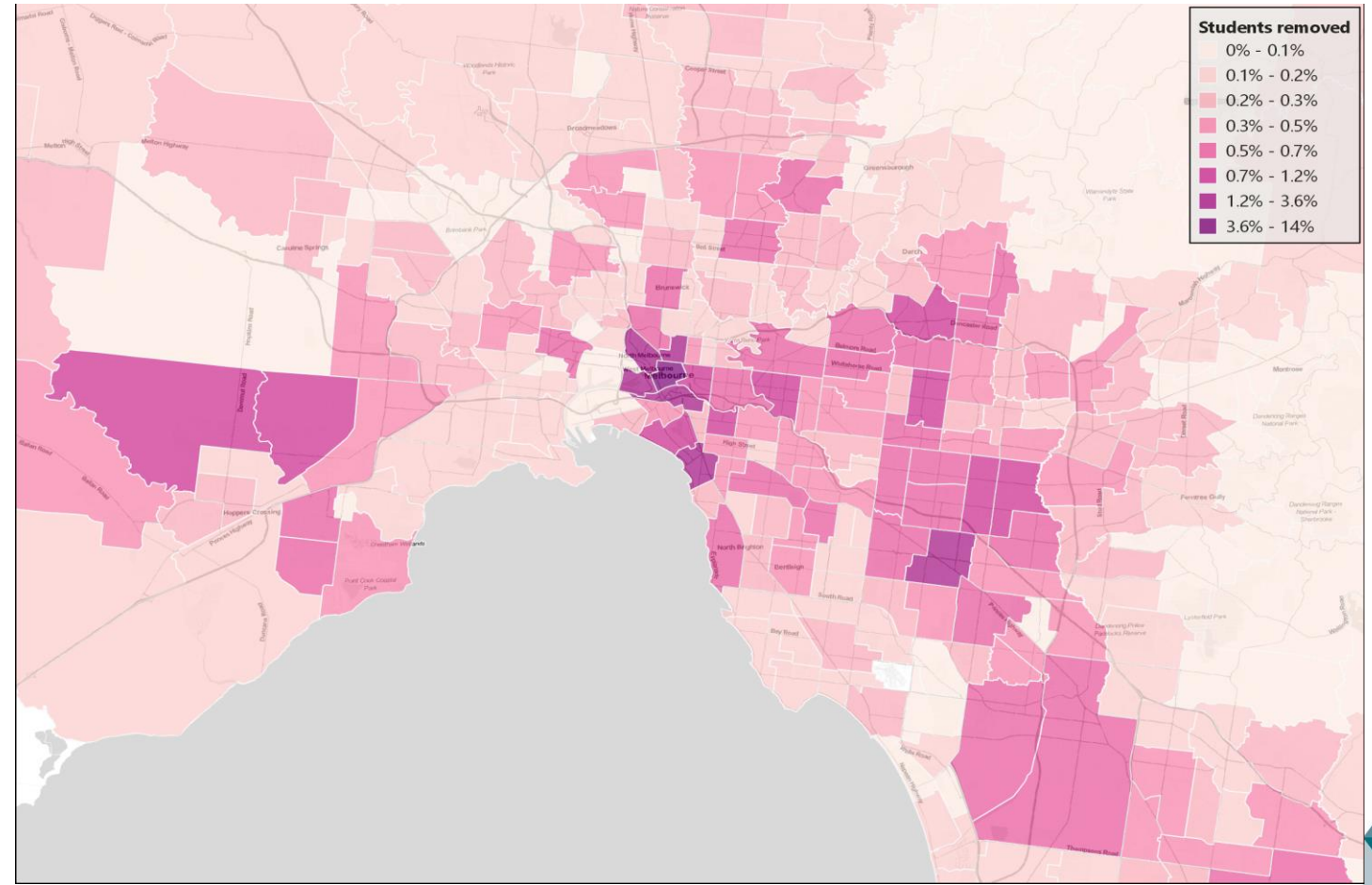
Student and airport trip adjustment application

Student trip adjustment

- 10% and 20% scenario assumptions applied as per slide 48

- 30% of tertiary students across Melbourne assumed to be international (and removed) with the distribution of international students to be removed assumed based on census data by SA2.

- All trips (including non-education trips) removed for international students which have been removed.

Airport trip adjustment

- 10% and 20% scenario assumptions applied as per slide 48

- Airport trips removed uniformly across Melbourne

Car and public transport attractiveness

- The target changes in attractiveness cannot be achieved perfectly due to a number of reasons
  - The changes in attractiveness (mode share) are based on Auckland mode shares where car mode share is lower. This means that whilst a 30% decrease in PT mode share is equal to a 10% increase in car mode share, this is not the case for Melbourne
  - MABM over estimates car mode share, this means that a 30% decrease in public transport mode share makes up less car mode share again.
  - The mode share impacts include the effect of reduced active mode share, since active trip mode share is not adjusted in our runs, the actual decrease in both modes should be slightly less.
- Targets (approximate) accounting for this are shown below*:

CORE	Pre-COVID			Post-COVID***			%change			Post-COVID Adjusted (total =100%)			Post-COVID % change (Target)		
	Car	Transit	Active	Drive (+10%)	Transit (-30%)	Active (0%**)	Car	Transit	Active	Car	Transit	Active	Car	Transit	Active
Melbourne (VISTA)	72%	10%	18%	79%	7%	19%	10%	-30%	5%	75%	6%	18%	5%	-33%	0%
Auckland	63%	9%	28%	69%	6%	25%				69%	6%	25%			
MABM	76%	8%	16%	83%	6%	17%	10%	-30%	6%	79%	6%	16%	4%	-34%	0%

Dialled-Up	Pre-COVID			Post-COVID			%change			Post-COVID Adjusted (ensuring total =100%)			Post-COVID % change (Target)		
	Car	Transit	Active	Drive (+15%)	Transit (-50%)	Active (0%)	Car	Transit	Active	Drive	Transit	Active	Car	Transit	Active
Melbourne (VISTA)	72%	10%	18%	83%	5%	20%	15%	-50%	7%	77%	5%	18%	7%	-53%	0%
MABM	76%	8%	16%	87%	4%	17%	15%	-50%	9%	80%	4%	16%	6%	-54%	0%

*note that this analysis ignores approx. 1% of trips in MABM composed of other modes.
** this is the change required to keep the final target (last column) mode share change at 0% for Melbourne and MABM)
***the total is not controlled to 100% in this column

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CORE SCENARIO INPUT CHECKS

Scenario input changes – Core

Area of adjustment	MABM 2018 trips	COVID Scenario trips	Difference	%difference	% of Total MABM 2018 trips
All trips	14,493,836	14,110,052	-383,784	-2.65%	-2.65%
Airport	76,432	38,216	-38,216	-50%	-0.25%
International students	72,420	58,092	-14,328	-20%	-0.10%
Work trips	2,233,308	2,010,204	-223,104	-9.99%	-1.54%
Business trips	398,212	380,024	-18,188	-4.57%	-0.13%
Other trips	4,419,140	4,416652	-2,488	-0.06%	-0.02%

Note – 'Other' trips removed for international students

Trip length distribution of altered other activities

- Very similar distribution for pre-covid (blue) and scenario (red), mean nearly identical

- Compare this with trip length distribution of hypothetical scenario where destinations of other activities were not changed (yellow): Longer mean trip length and distribution quite different.

- Shows that the trip length has been shortened through this adjustment.

Legend:
- Pre-covid, mean 9.95km
- 10pct scenario, mean 9.90km
- scenario no dest, mean 14.84km
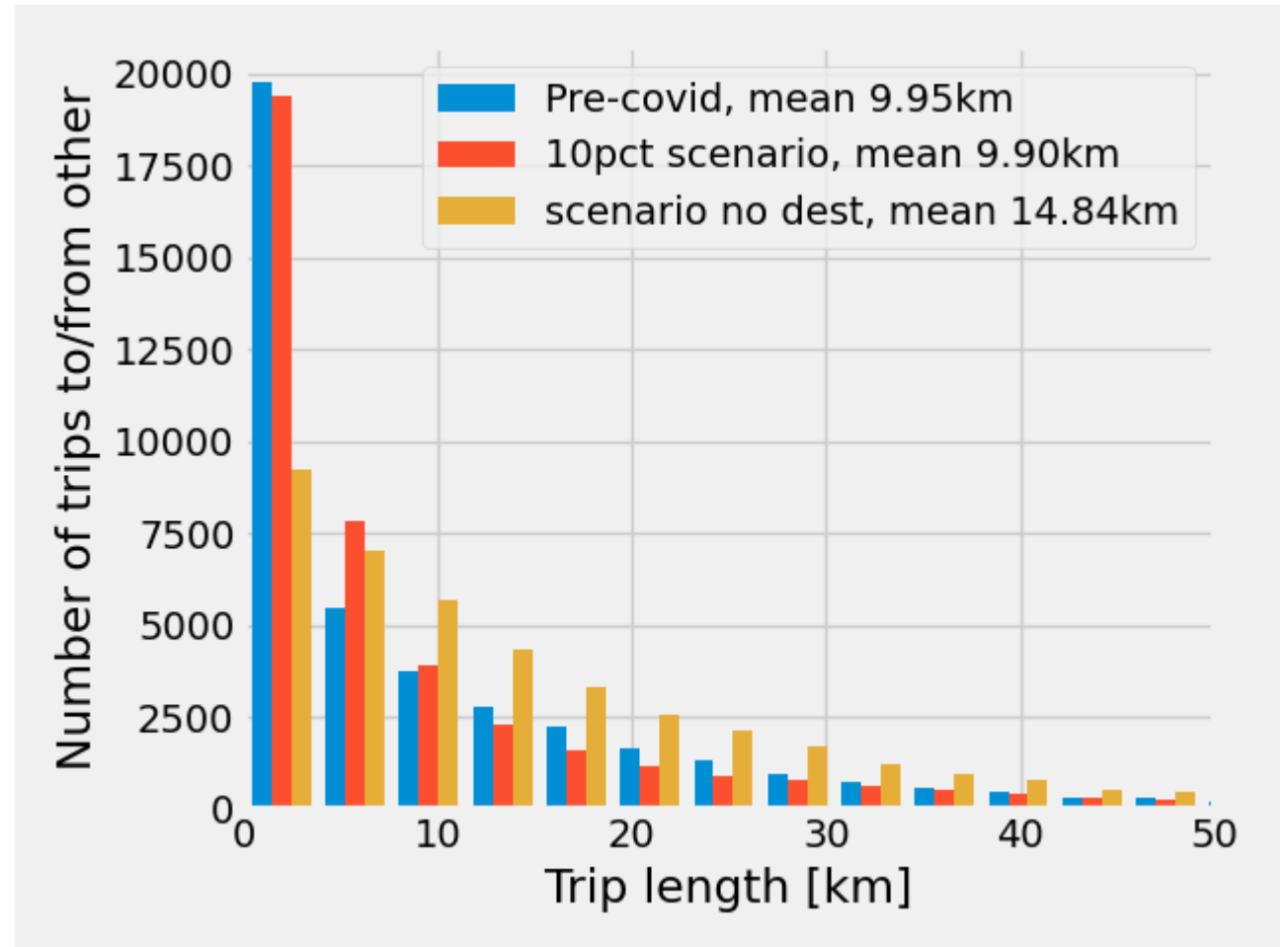
100 iterations run – mode share adjustment

- Initial run for 100 iterations, 80 with innovations, we checked PT mode share following adjustment to ASC change.

- % Difference in mode share compared to 2018 MABM base scenario:

% change in mode share	PT ASC = -1.03 utils (reduced by 1.53)	PT ASC = -4.11 utils (reduced by 4.61)
Car	2.97%	5.06%
PT	-26.24%	-42.20%

- Dollar equivalent of alternative-specific constant (ASC) change for person with mean income:
  - 1.53 utils correspond to about 10$ for 185$ of (working) day household income
  - 4.61 utils correspond to about 30$ for 185$ of (working) day household income

- Based on these results, we estimate that an adjustment by -1.89 utils (to -1.39 from 0.5) to in order to achieve a mode share decrease of 30%. This adjustment is equivalent to about $12 at average income levels. This value will be used for the 'Core' run.
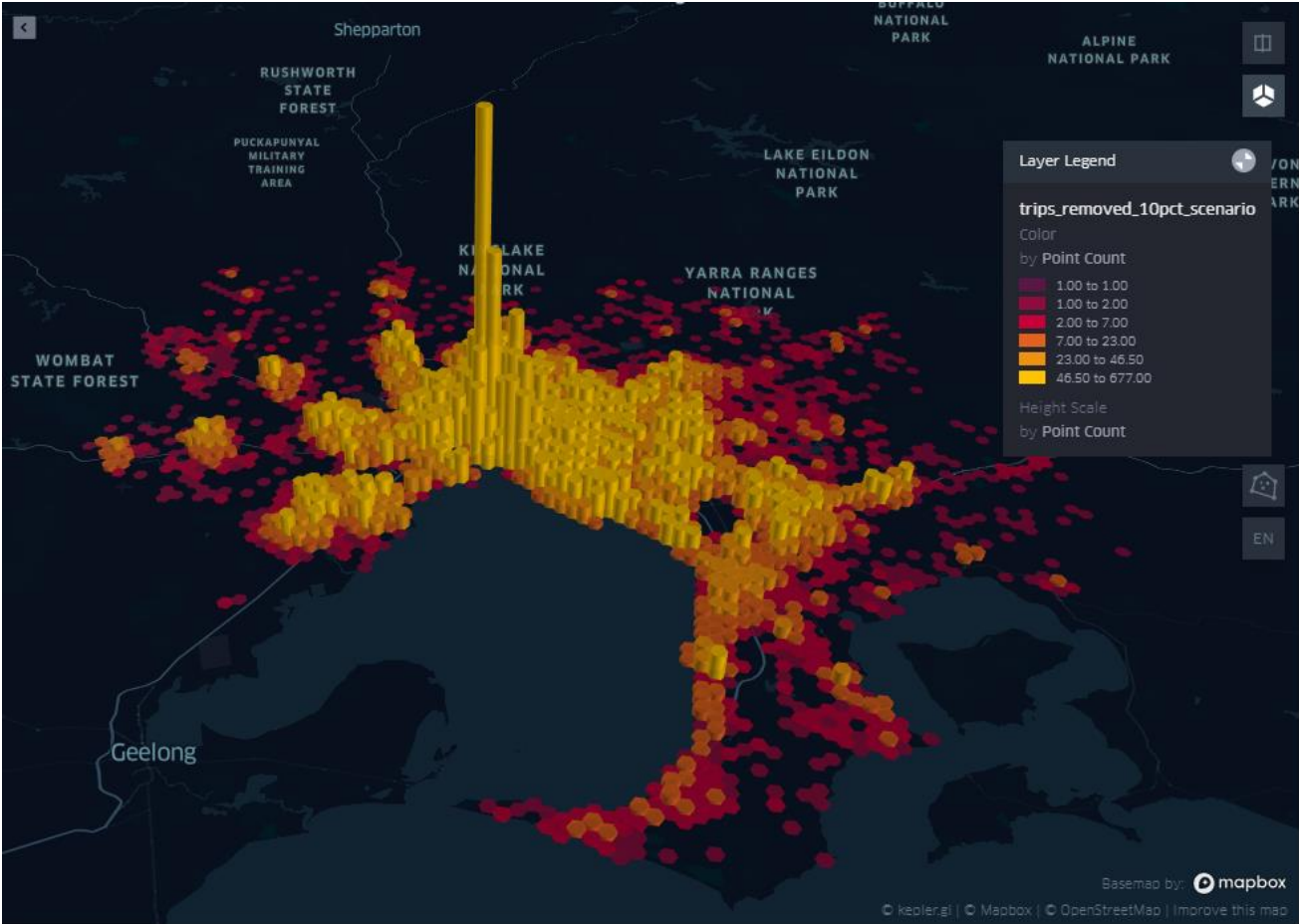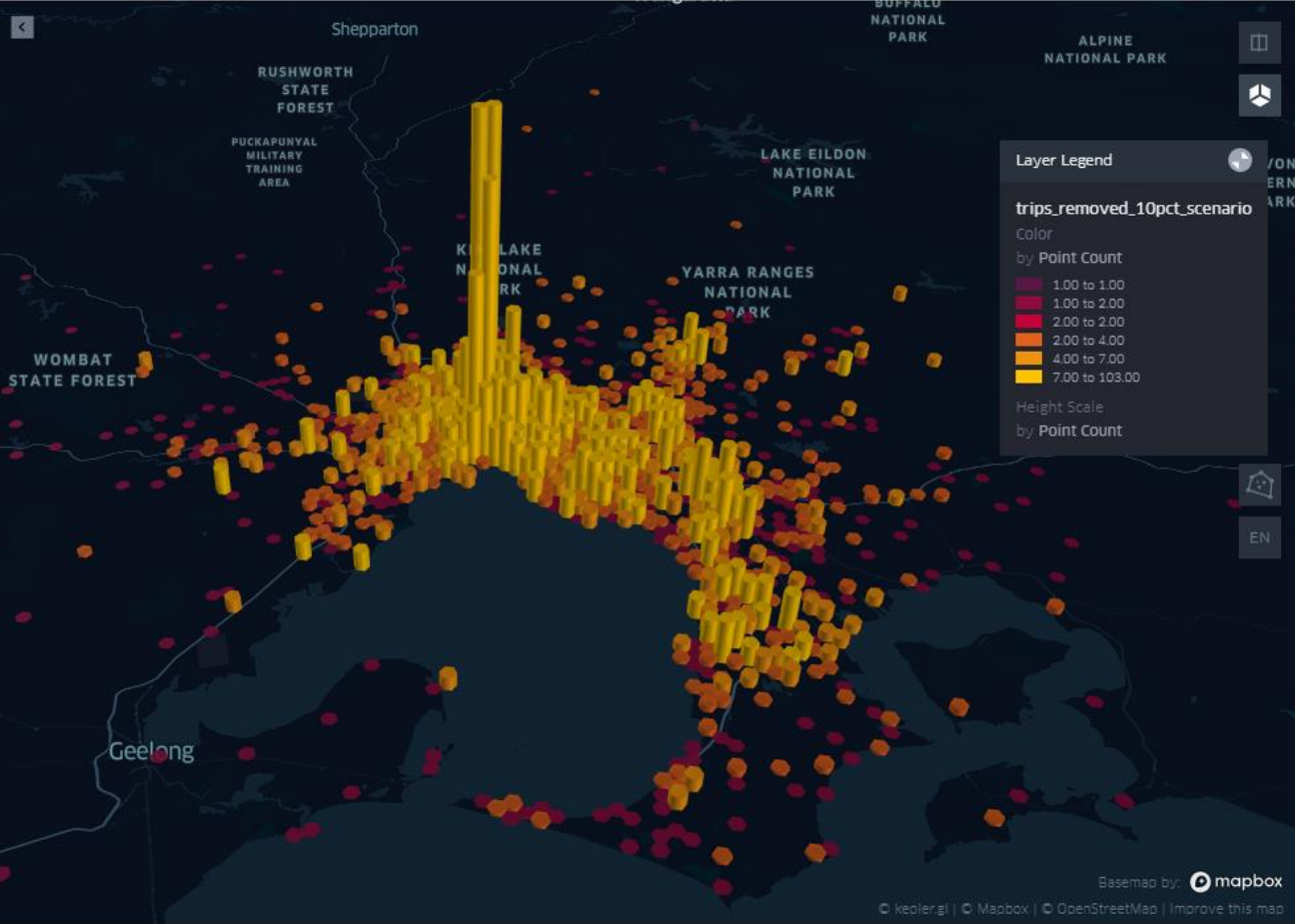
Removed trips by destination
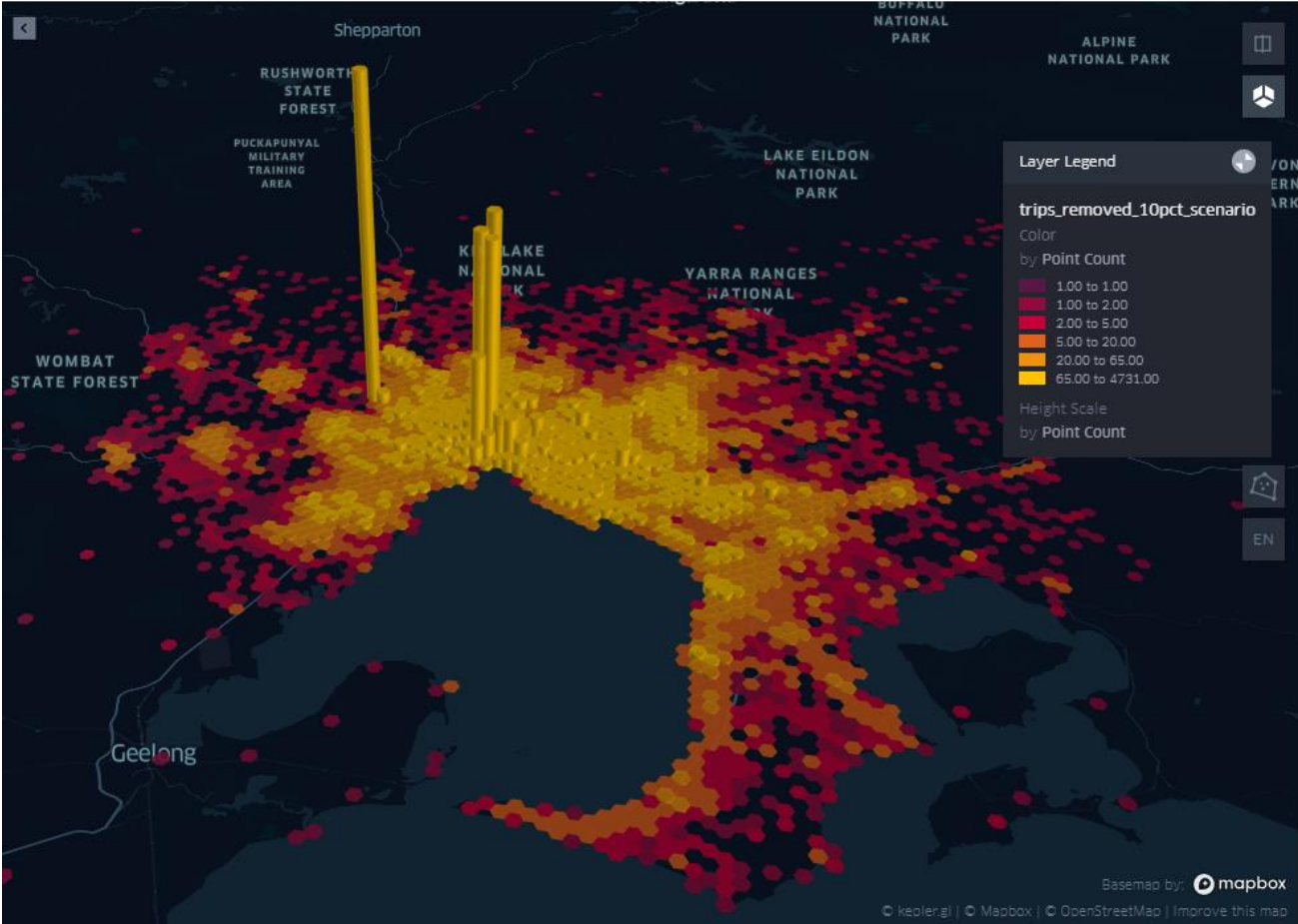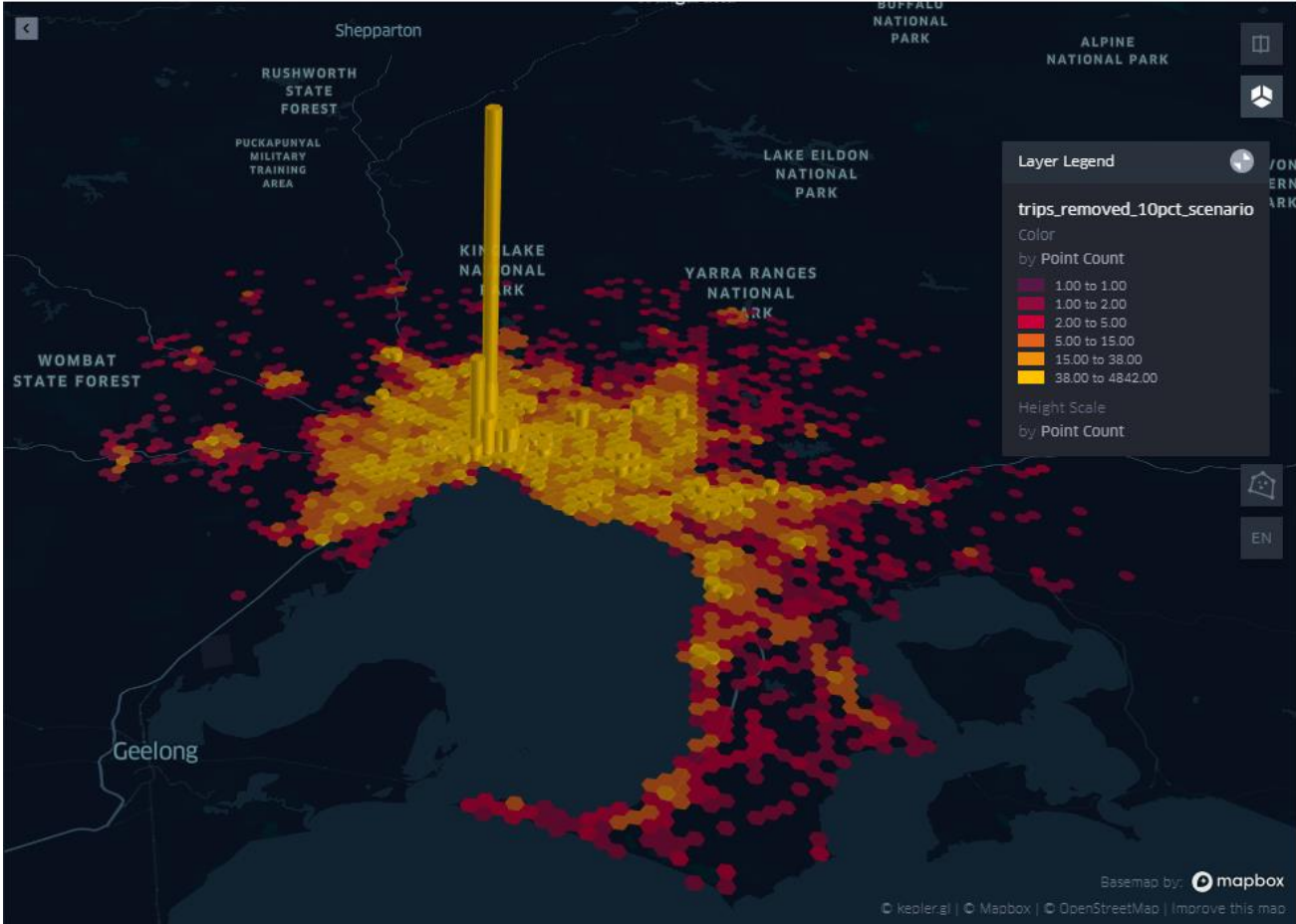
Removed trips with destination activity work
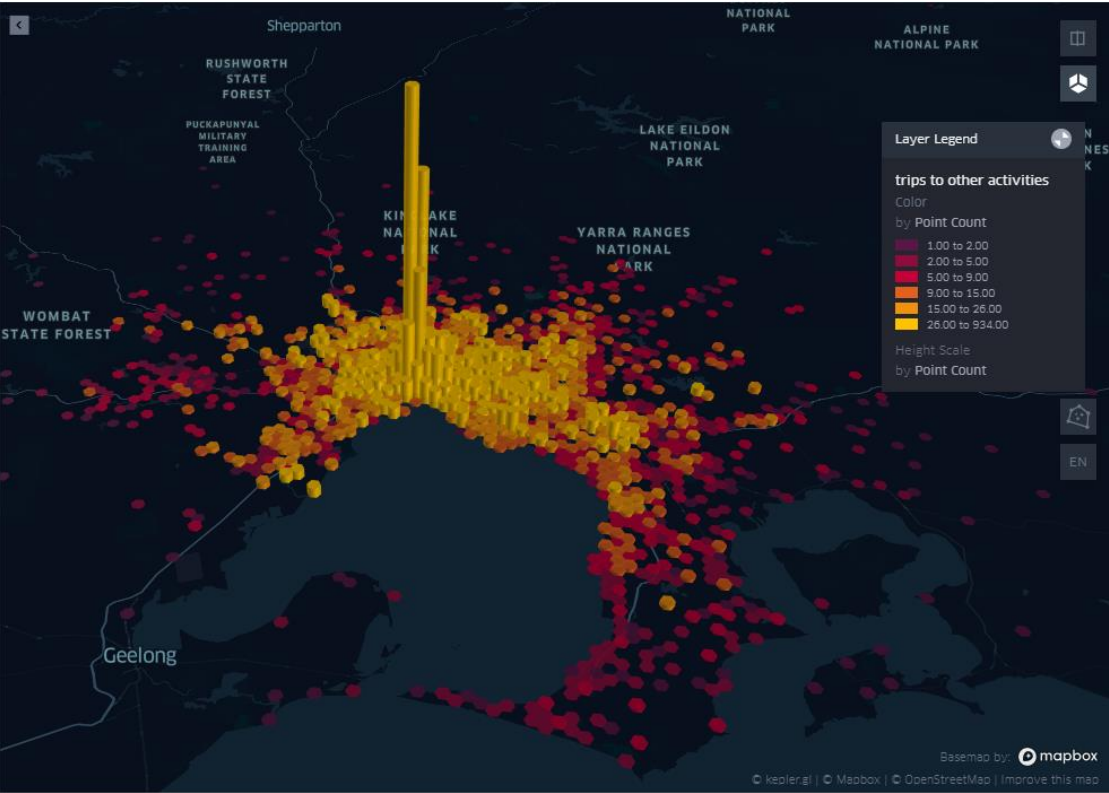
Removed trips with origin activity home
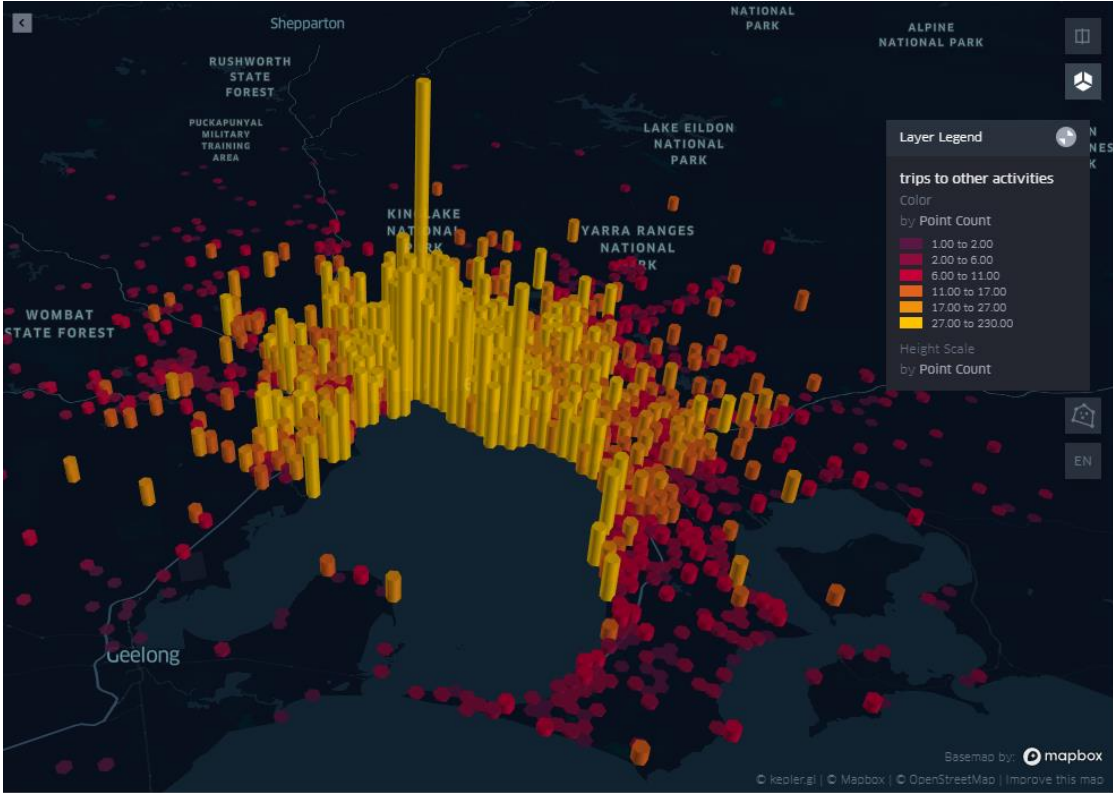
Removed trips with destination activity business

Previous trips to other activities

Pre-COVID

'Core' scenario

DIALLED-UP SCENARIO INPUT CHECKS

Scenario input changes – Dialled-Up

Area of adjustment	MABM 2018 trips	COVID Scenario trips	Difference	%difference	% of Total MABM 2018 trips
All Trips	14,493,836	13,731,544	-762,292	-5.26%	-5.26%
Airport	76,432	22,928	-53,504	-70%	-0.37%
International Students	72,420	28,612	-43,808	-60%	-0.30%
Work trips	2,233,308	1,785,356	-447,952	-20.06%	-3.09%
Business trips	398,212	360,668	-37,544	-9.43%	-0.26%
Other trips	4,419,140	4,411,392	-7,748	-0.18%	-0.05%

Note – 'Other' trips removed for international students

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Trip length distribution of trips to/from altered other activities

- Very similar distribution for pre-covid (blue) and scenario (red), mean nearly identical

- Compare this with trip length distribution of hypothetical scenario where destinations of other activities were not changed (yellow): Longer mean trip length and distribution quite different.

- Shows that the trip length has been shortened through this adjustment.
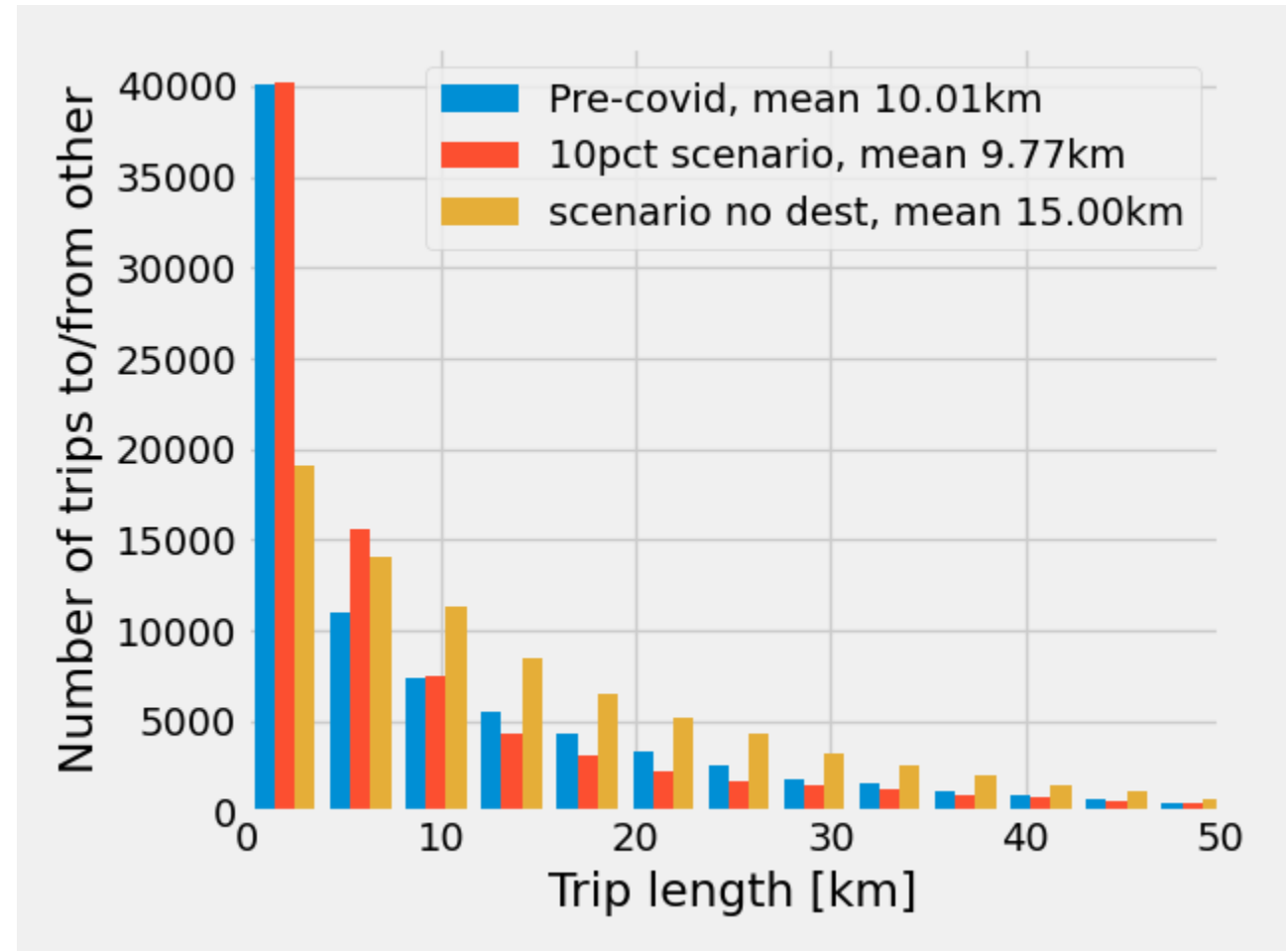
100 iterations run – mode share adjustment

- Initial run for 100 iterations, 80 with innovations, check PT mode share adjustment to ASC change.

- % Difference in mode share compared to 2018 MABM base scenario:

% change in mode share	PT ASC = -4.11 utils (reduced by 4.61)	PT ASC = -8.67 (reduced by 9.17 utils)
Car	5.83	7.12
PT	-51.87	-61.43

- Dollar equivalent of alternative-specific constant (ASC) change for person with mean income:
  - 4.61 utils correspond to about 30$ at 185$ of (working) day household income
  - 9.17 utils correspond to 60$ at 185$ of (working) day household income

- Based on these results, we estimate that an adjustment by -4.199 utils (to -3.699 from 0.5) will achieve a mode share decrease of 50%. This adjustment is equivalent to about $27.5 at average income levels. This value will be used for the Dialled-Up run.
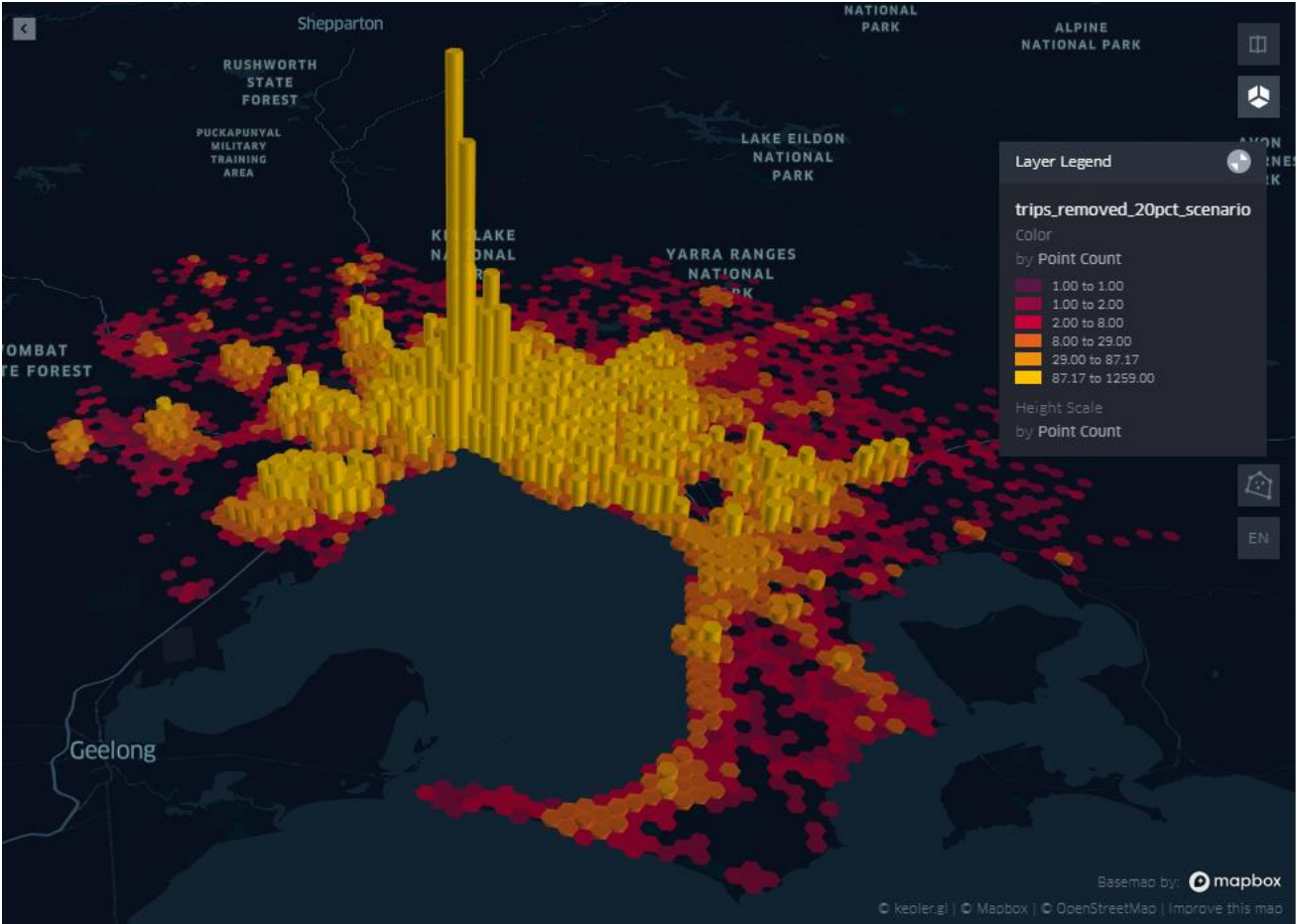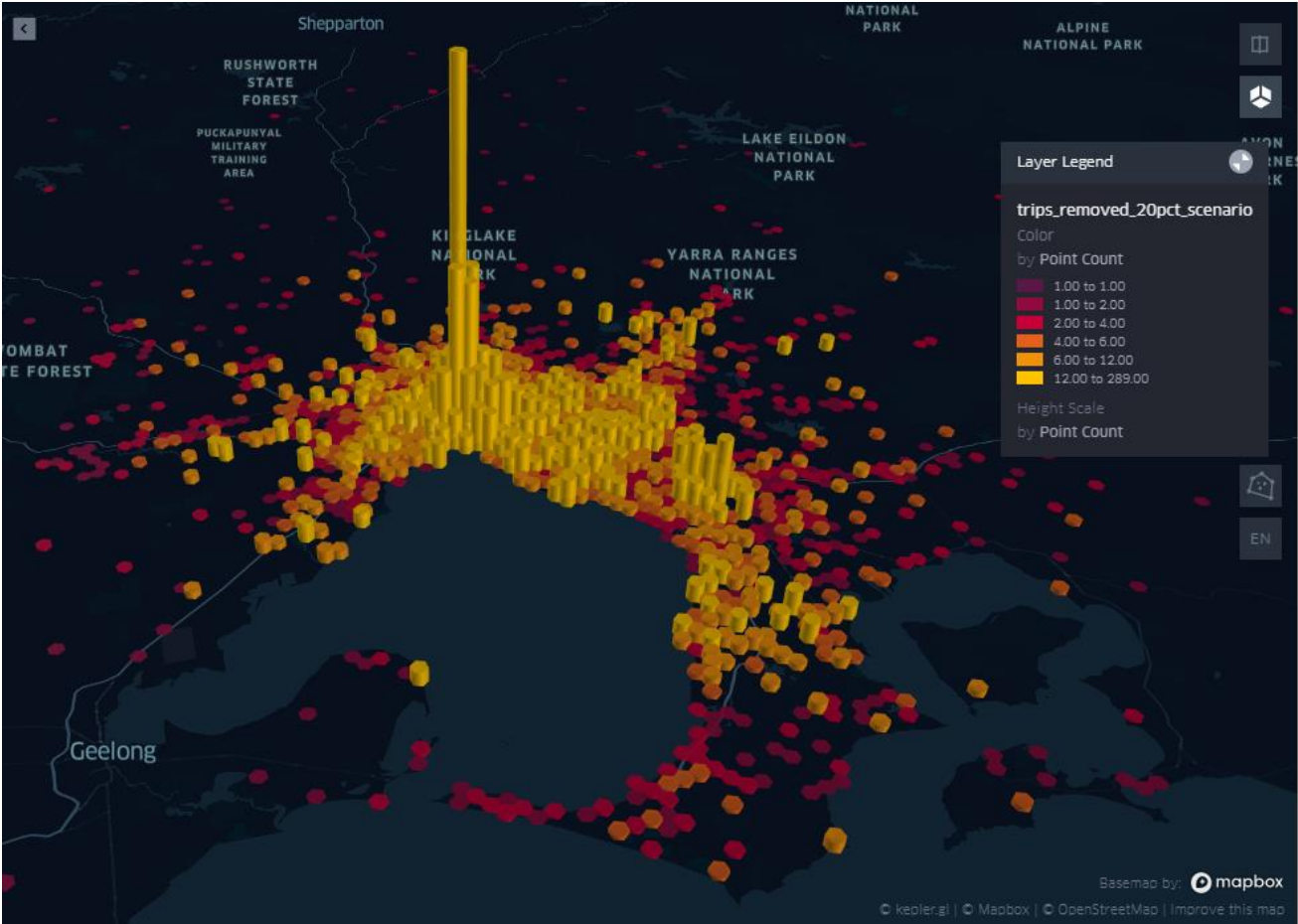
Removed trips by destination
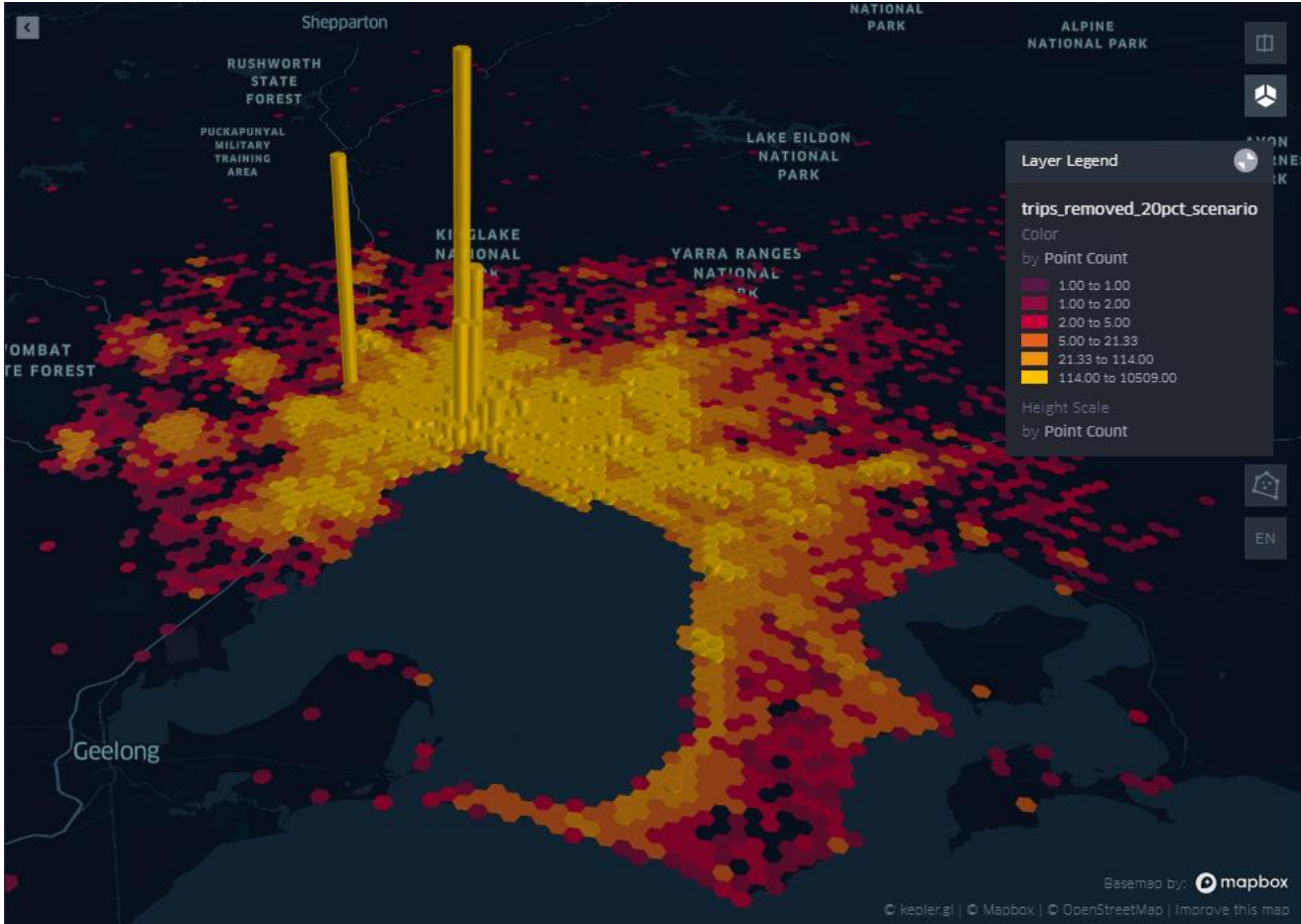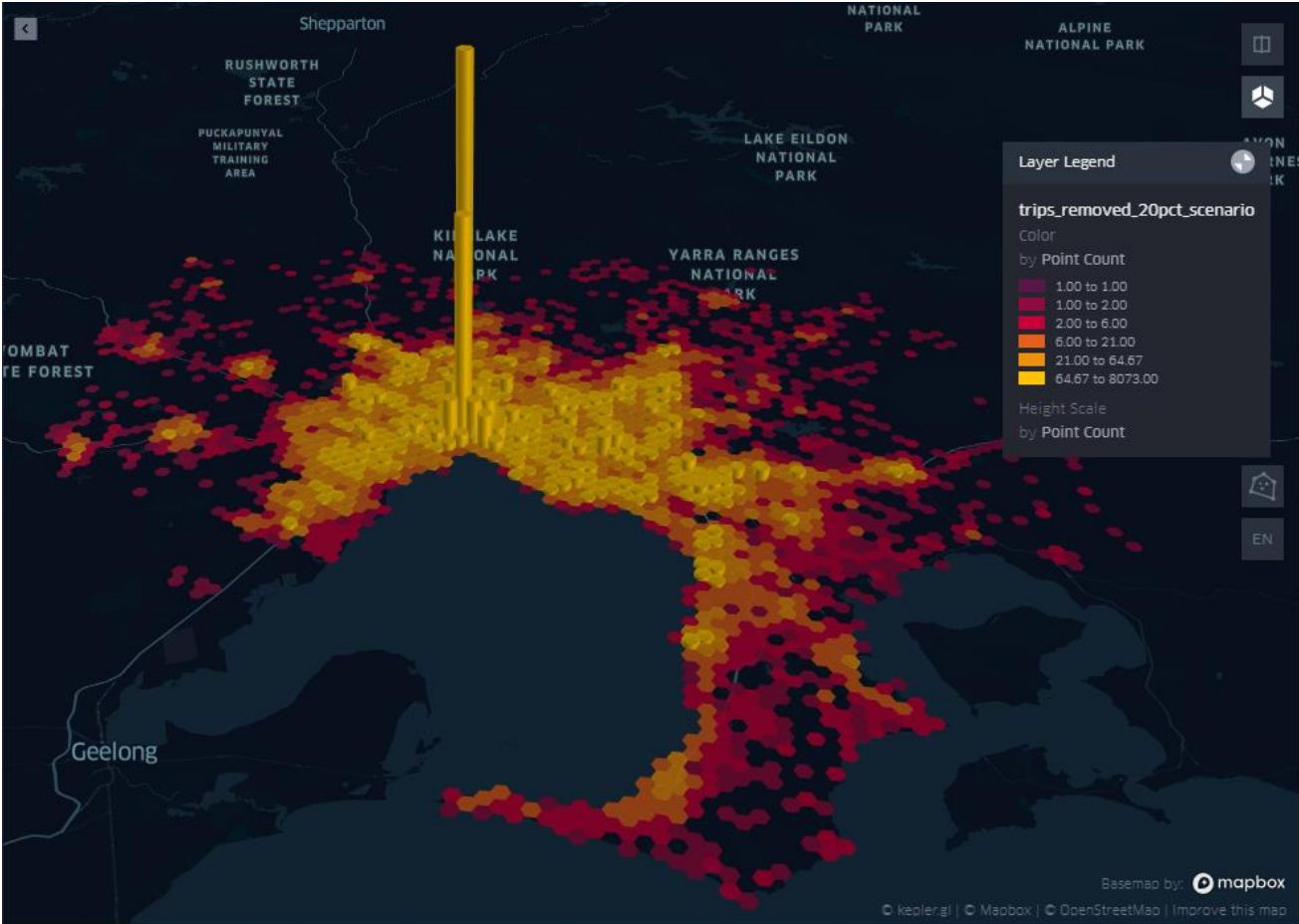
Removed trips with destination activity work

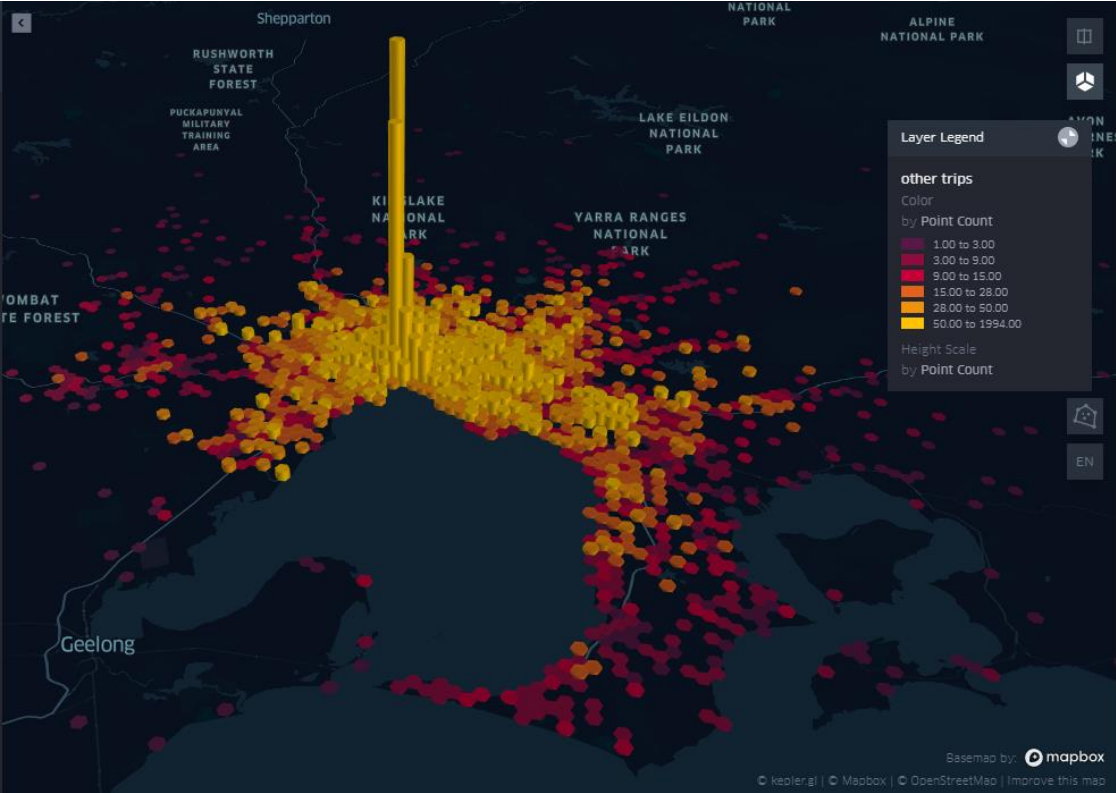# Removed trips with origin activity home

Removed trips with destination activity business

Previous trips to other activities

Pre-COVID

Dialled-Up scenario

POLICY SCENARIO TEST - SENSE CHECK

16 OCTOBER 2020

RUN 1_Active Uptake Scenario Impact Summary (1)

- 265,584 (+49%) trips added to 542,232** active trips.
- Long trips removed successfully
  - Active trips increased from 257,660 to 399,864 (+55%)
  - 142,204 trips removed out of 720,016 total car and public transport trips (between 1 and 8.7km)
- Shortfall in short trips (i.e. walk) added of 113,627 or 52% (of target)
  - Active trips increased from 284,572 to 407,952 (+43%)*
  - Shortfall in all time periods
- Most trips are removed from car in line with starting mode share

*The 'Active trips' number includes only trips <1km, excludes trips between 1km and 2km, whereas the total added includes some trips from 1km to 2km.
**These are only those active trips that are <8.7km in trip length*

Total trips to be switched

	Active	Car and PT
Starting	568,816	1,829,480
Target to remove/ add (2/3)	379,211	379,211
%	67%	21%
Actually added	265,584	265,584
%	47%	15%

Short trip breakdown

|	Trips added	% of total	Constraint (VISTA)
1km	98,704	80%	
1-1.5km	18,504	15%	18,504
1.5-2km	6,172	5%	6,172
Total	**123,380**	**100%**	**24,676**
Target	**237,007**		
Shortfall	**113,627 (-52%)**		

RUN 1_Active Uptake Scenario Impact Summary (2)

- Most trips are removed from car in line with starting mode share
- The average length of long trips added is 4.41km, for short trips it is 0.74km and the maximum trip length is 2.0km
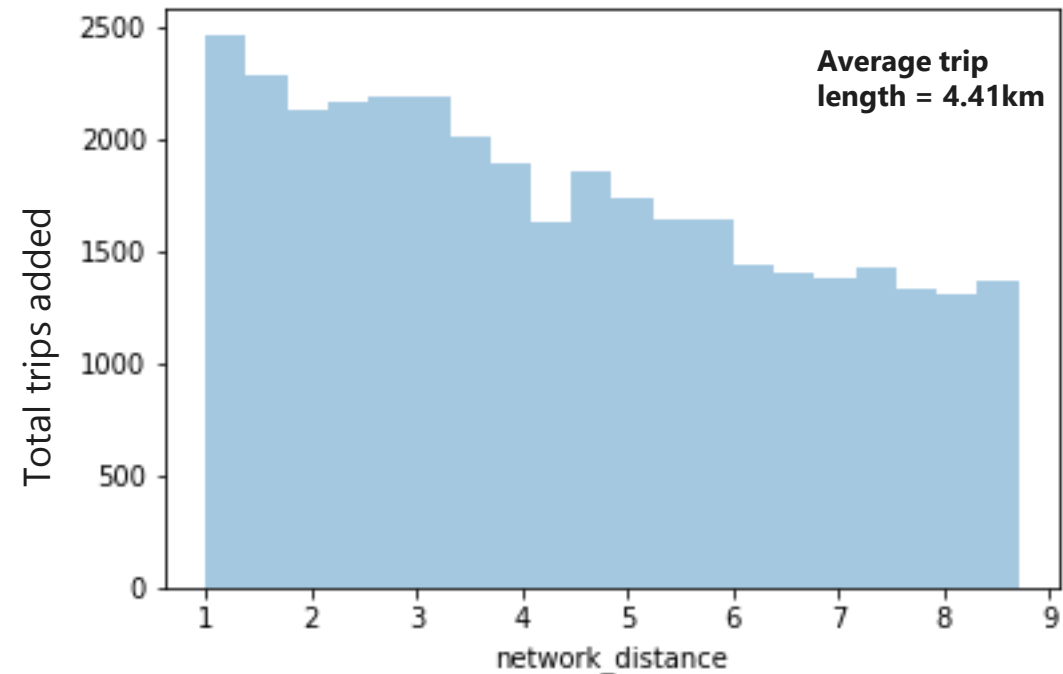
Mode share of trips changed (0 to 8.7km)

	Core Scenario		Run 1 trips removed			
Mode Split	**Short**	**Long**	**AM**	**IP**	**PM**	**OP**
Car	97.9%	75.3%	80.6%	85.9%	80.5%	87.9%
PT	2.1%	24.7%	19.4%	14.1%	19.5%	12.1%

Trip length distribution associated with short trips added (<1km)

Average trip length = 0.74km
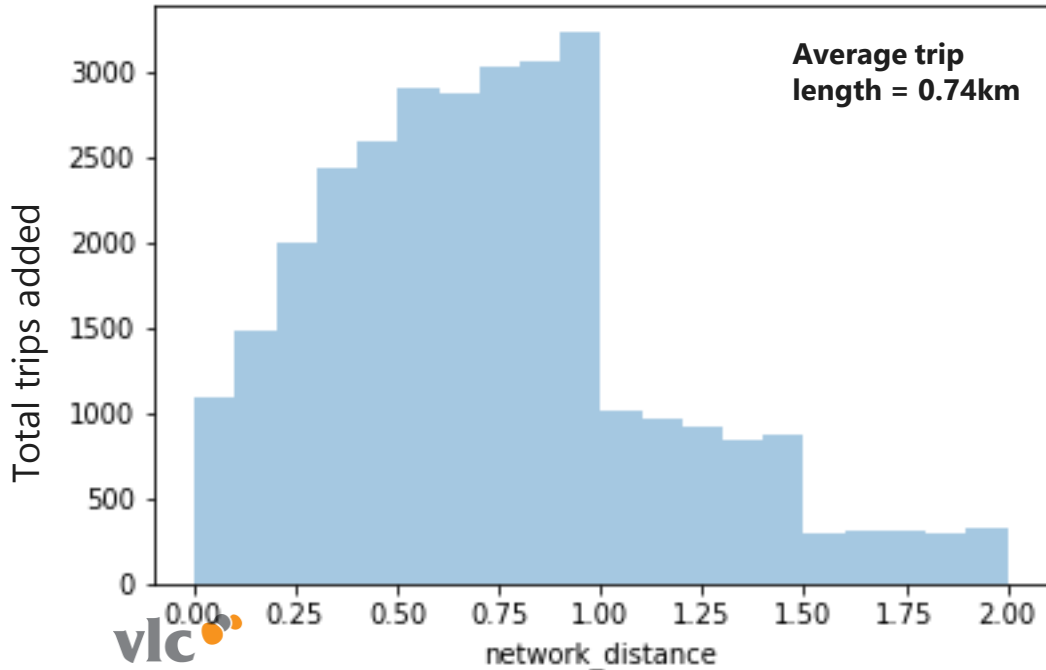
Trip length distribution associated with long trips added (1km to 8.7km)

Average trip length = 4.41km

RUN 1_Active Uptake Scenario Impact Summary - (Spatial distribution of trips removed from PT and Car (<8.7 km)

Trips removed as % of total in zone	AM	IP	PM	OP
To Region Split				
East				
Inner Metro	13.9%	25.0%	20.9%	12.9%
Inner South East	13.9%	11.4%	6.1%	10.7%
Middle East		0.0%	0.0%	0.0%
Middle North	11.9%	9.6%	6.3%	9.8%
Middle West	9.7%	8.5%	5.8%	7.2%
North				
Outer North West				
South				
West				
From Region Split				
East				
Inner Metro	24.4%	20.5%	10.8%	17.9%
Inner South East	7.7%	13.4%	12.6%	7.7%
Middle East		0.1%		
Middle North	8.3%	12.2%	12.4%	7.3%
Middle West	8.0%	9.9%	8.5%	6.1%
North				
Outer North West				
South				
West				

- No single zone with an excessive % of trips removed
- Highest % from Inner Metro
- Therefore looks sensible

RUN 1_Active Uptake Scenario Impact Summary - (Spatial distribution of trips removed from PT and Car (<8.7 km)

| Proportion of trips shifted To/From each region	AM	IP	PM	OP
To Region Split				
East				
Inner Metro	39,964 (90%)	103,960 (85%)	28,116 (79%)	53,060 (84%)
Inner South East	2,936 (7%)	10,116 (8%)	3,888 (11%)	5,700 (9%)
Middle East	(0%)	(0%)	(0%)	(0%)
Middle North	896 (2%)	4,564 (4%)	2,164 (6%)	2,748 (4%)
Middle West	708 (2%)	3,548 (3%)	1,576 (4%)	1,560 (2%)
North				
Outer North West				
South				
West				
TOTAL	**44,504 (100%)**	**122,188 (100%)**	**35,744 (100%)**	**63,068 (100%)**
From Region Split				
East				
Inner Metro	34,348 (77%)	107,608 (88%)	31,568 (88%)	52,012 (82%)
Inner South East	5,148 (12%)	8,412 (7%)	2,552 (7%)	5,868 (9%)
Middle East	(0%)	(0%)	(0%)	(0%)
Middle North	2,928 (7%)	3,576 (3%)	1,032 (3%)	3,136 (5%)
Middle West	2,084 (5%)	2,596 (2%)	612 (2%)	2,060 (3%)
North				
Outer North West				
South				
West				
TOTAL	**44,508 (100%)**	**122,192 (100%)**	**35,764 (100%)**	**63,076 (100%)**

- Inner Metro has the highest change in trips
- Highest % from Inner Metro
- Therefore looks sensible

# RUN 2_Flexible Work Scenario Input Trips Summary

Area of adjustment	'Core' Scenario	Policy test 2	Difference	%difference	% of Total 'Core' scenario trips
All Trips	14,110,052	13,607,476	-502,576	-4%	-3.6%
Airport	38,216	38,216	0	0%	0%
International Students	58,092	58,092	0	0%	0%
Work trips	2,010,204	1,675,352	-334,852	-17%	-2.4%
Business trips	380,024	352,736	-27,288	-7%	-0.2%
Other trips	4,416,652	4,416,652	0	0%	0.0%

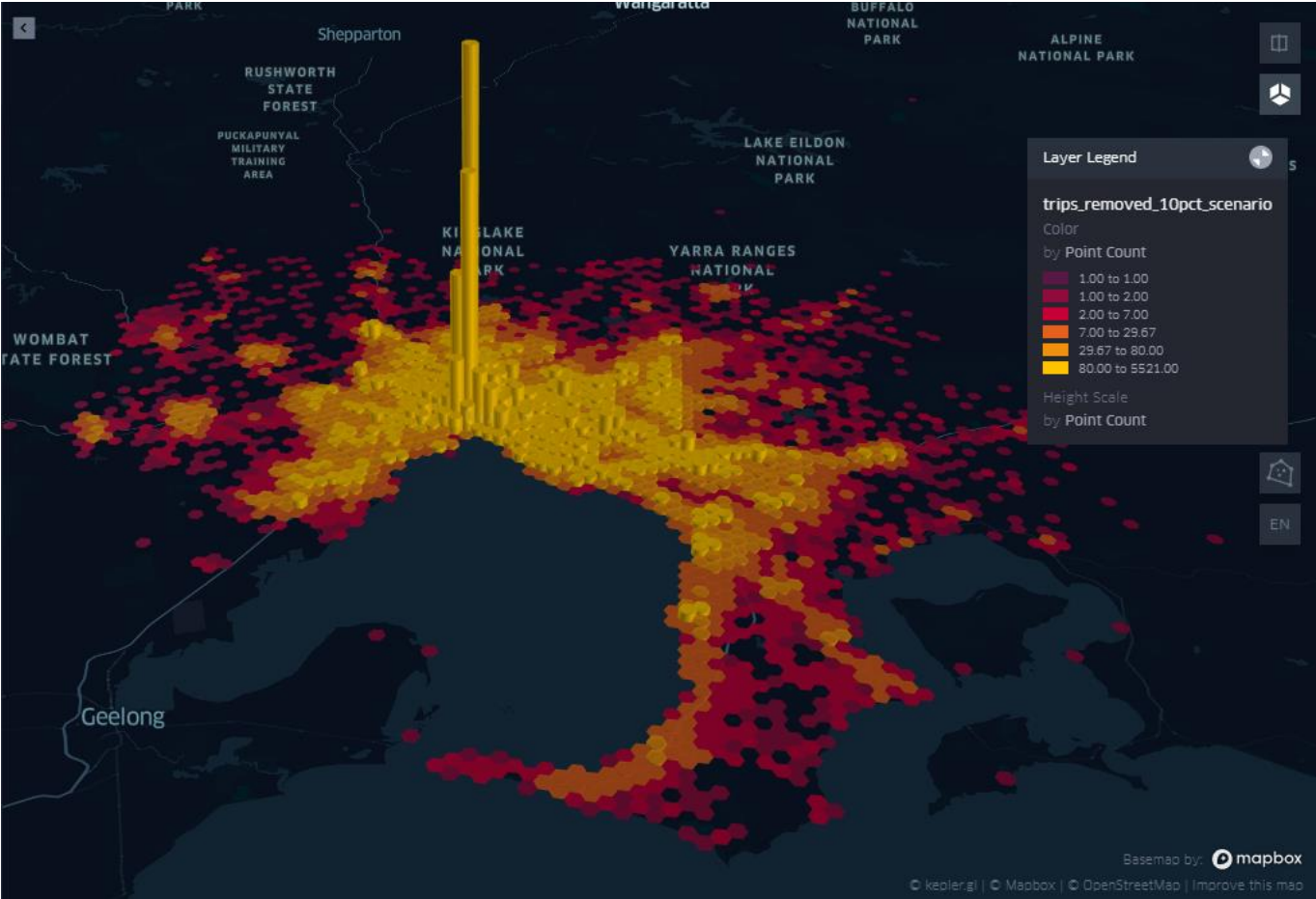**Note – 'Other' trips removed for international students**

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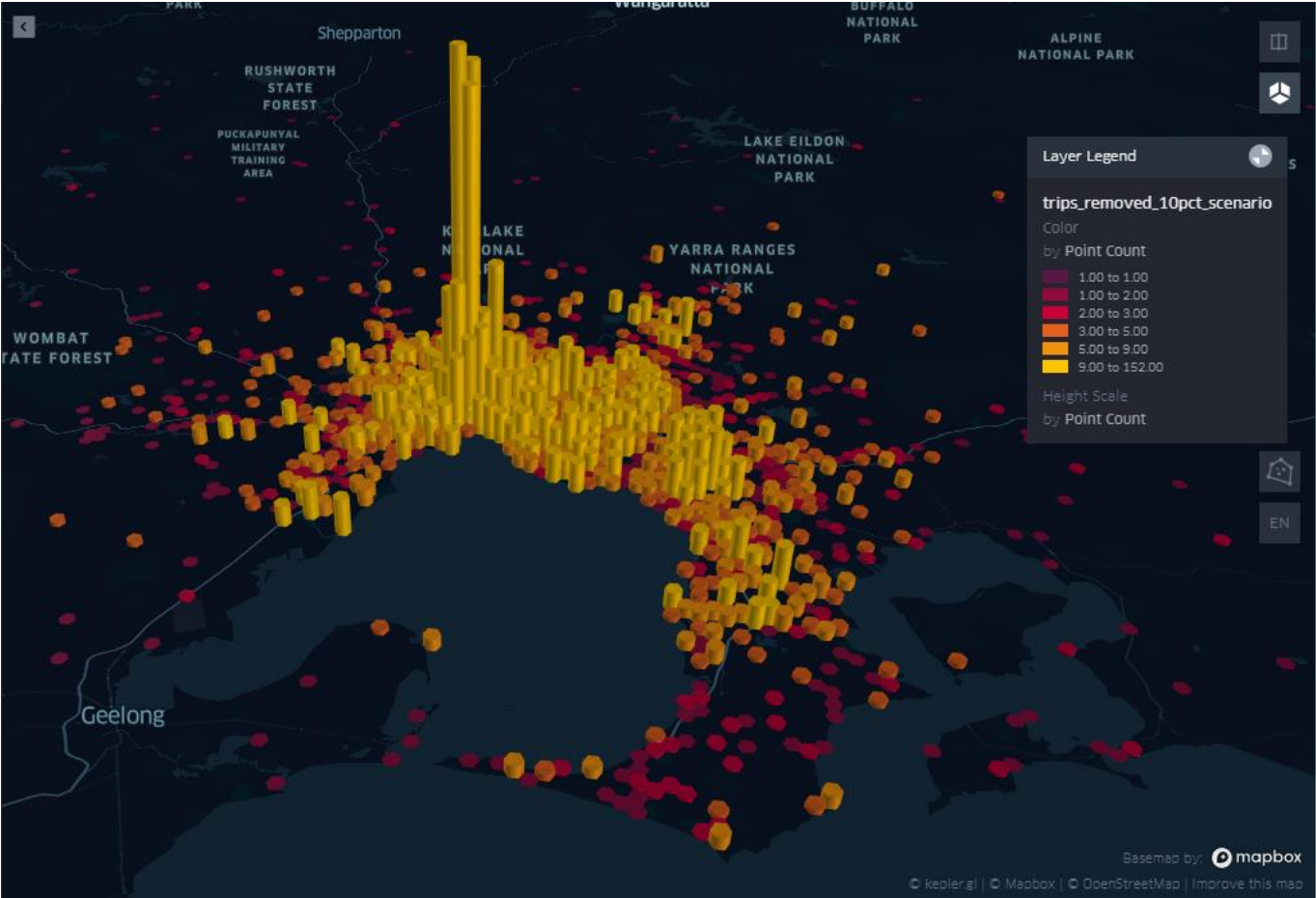# Removed trips by destination (vs 'Core' scenario)
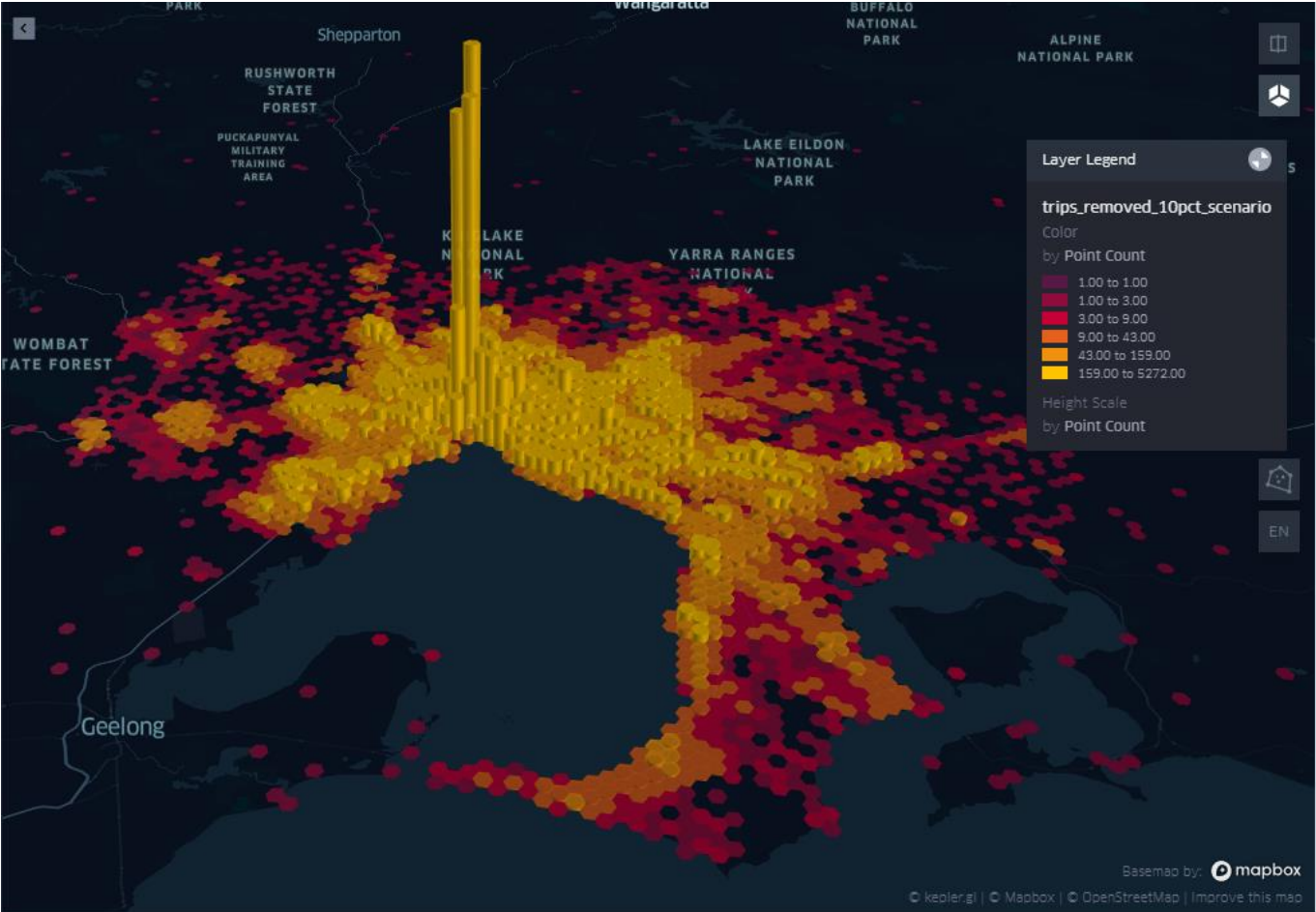
Removed trips with destination activity work (vs 'Core' scenario)
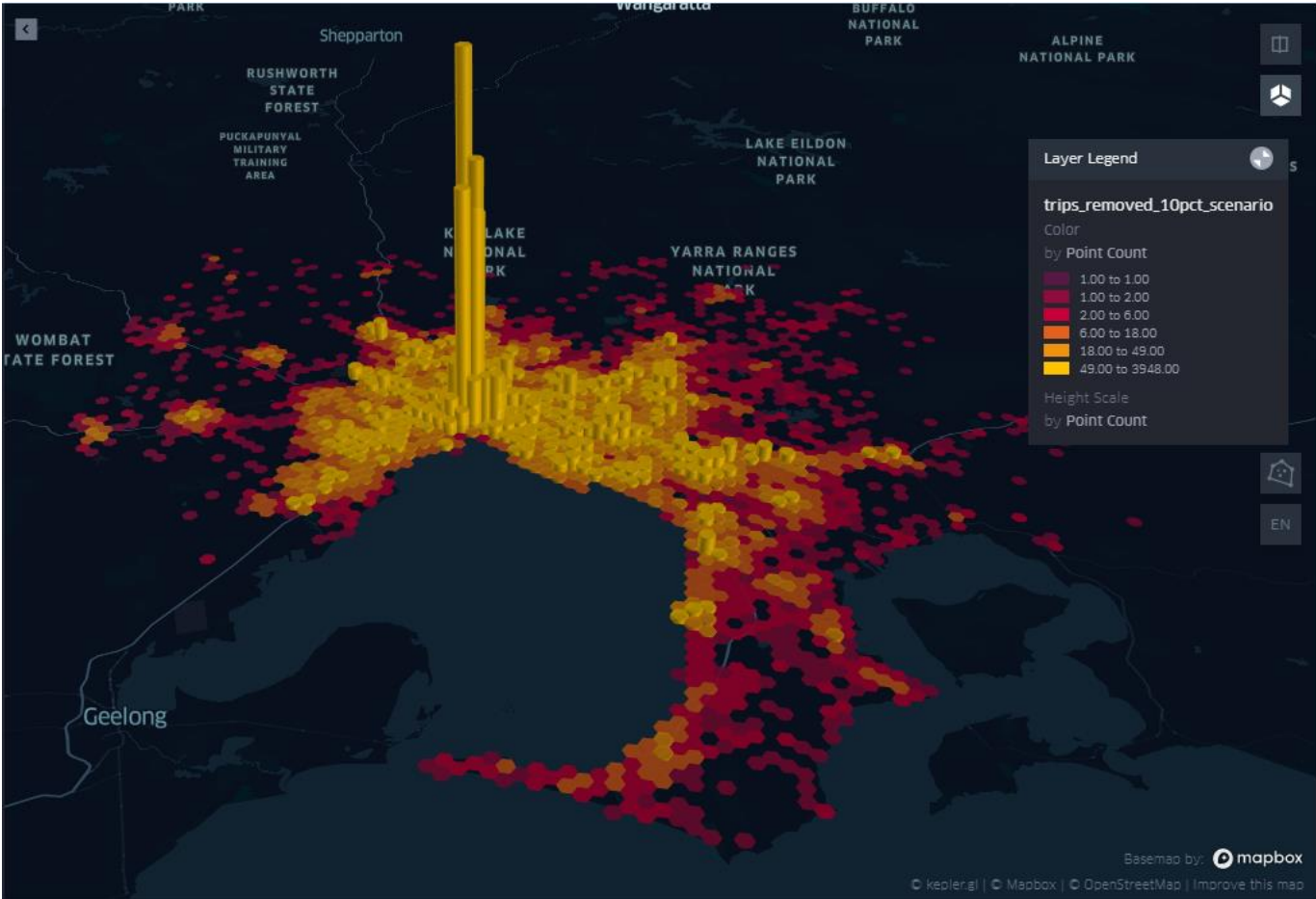
Removed trips with origin activity home (vs 'Core' scenario)

Removed trips with destination activity business (vs 'Core' scenario)

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