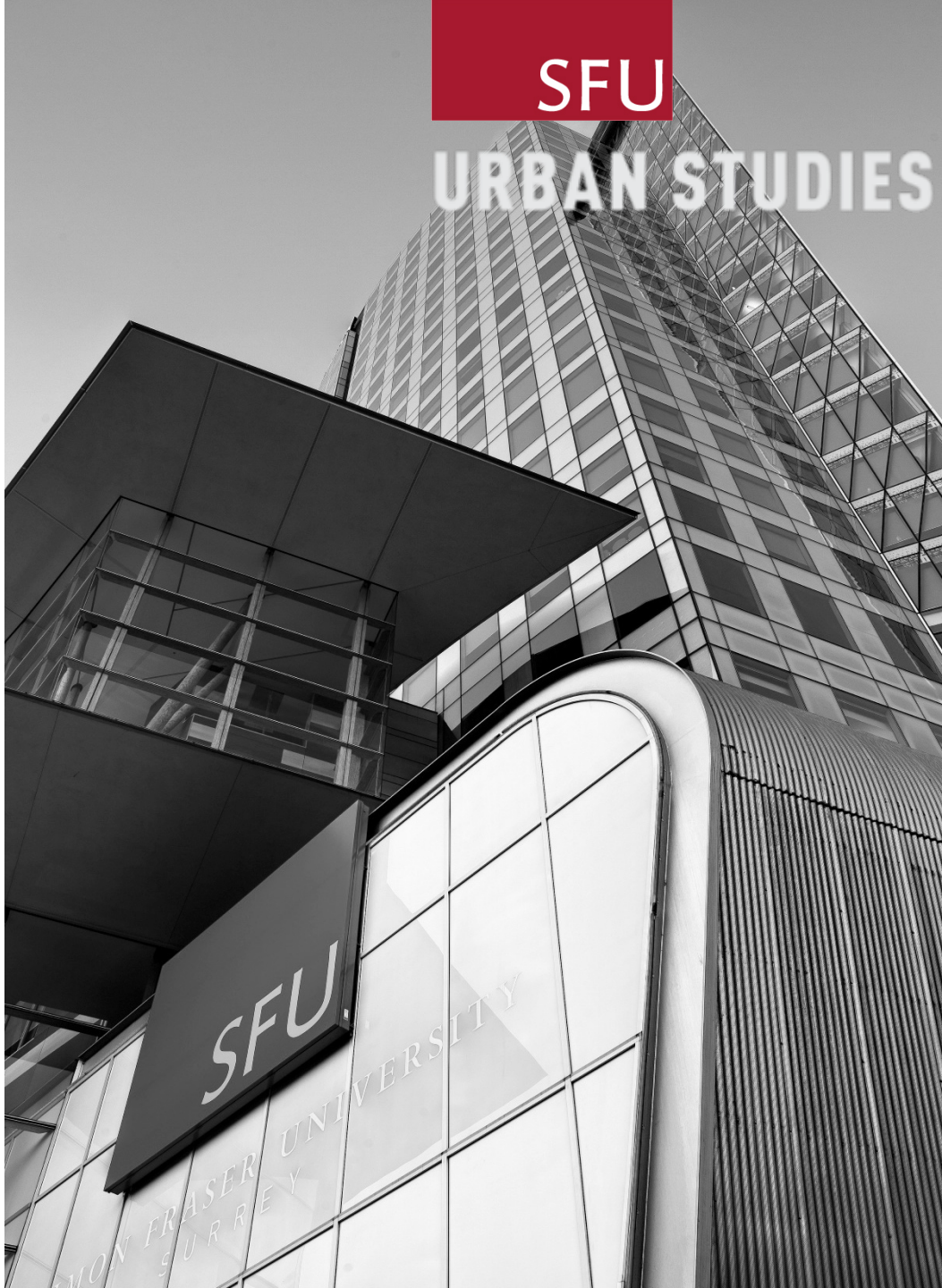
SEEKING SUSTAINABILITY IN THE PANDEMIC ADAPTATIONS OF PUBLIC TRANSIT

23 JUNE 2021

ANTHONY PERL AND LEANDRO CORRÊA



Acknowledgements

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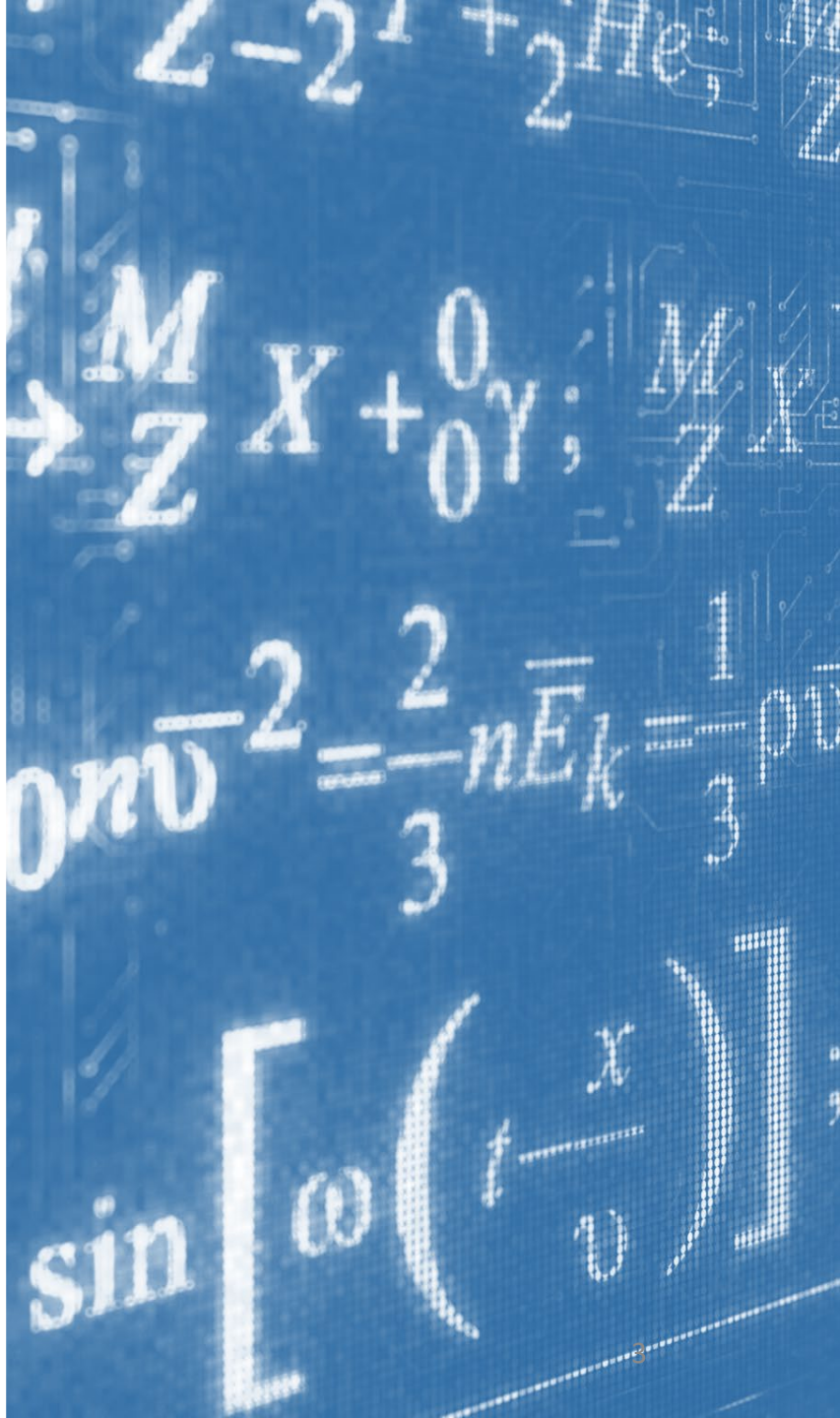
Community Energy
Association

PICS project # FT20LC

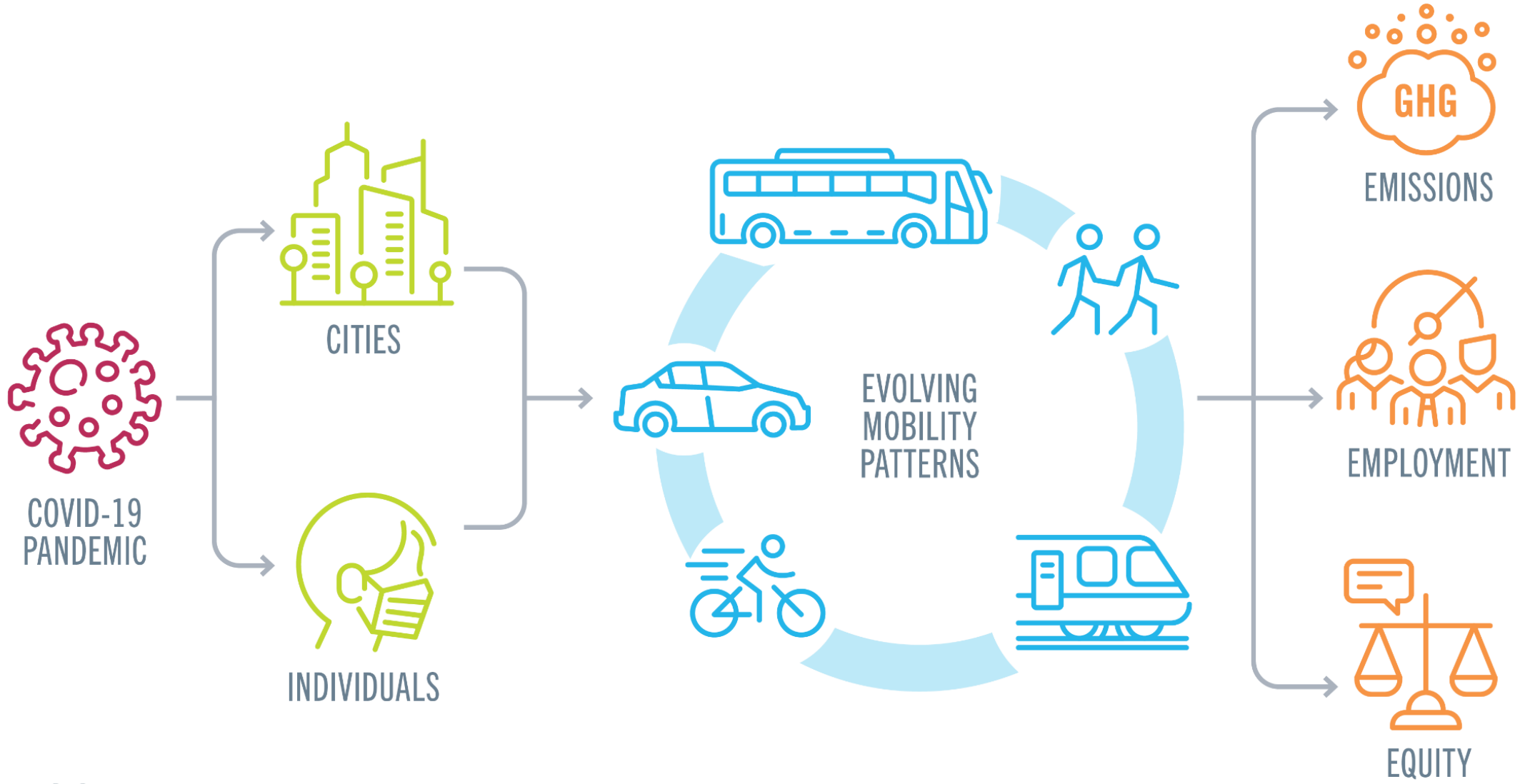
Research focus

We sought to explain how ***external disruptive forces***, such as lockdowns and employer policies on working from home, and ***internal transit agency adaptations***, such as suspending fare collection, requiring mask-wearing, customer communications, and schedule changes, have ***influenced transit ridership*** in cities outside Canada during the first wave of the pandemic.

What ***lessons*** can be drawn from this experience in terms of risks and opportunities ***to advance climate protection, equity, and employment opportunities?*** What ***initiatives and strategies*** could be considered as promising policy adaptations within the Canadian context based on this international experience?



Research Framework



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Data Sources

Public Transit & Travel behavior

- Transit agencies
- E-urban mobility data (Apple and Google)

Covid-19

- Local Health authorities

Restriction Measures

- Stringency Index - Oxford. Our World in Data.

Demographics

- Local Census
- Local sources for mobility and social behaviors

Selected Cities:

Auckland and **Wellington** in New Zealand and **Bellingham - WA** and **Portland - OR** in the US.

Case Selection

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15 candidate cities

- Auckland Region – NZ
- Wellington City – NZ
- Christchurch City – NZ
- Hamilton City – NZ
- Miami – FL – US
- Phoenix – AZ – US
- Washington – DC – US
- San Francisco – CA – US
- Austin – TX – US
- Seattle – WA – US
- Houston – TX – US
- Portland – OR – US
- Richmond – VA – US
- Kitsap County – WA – US
- Bellingham – WA – US

First filter: Ridership Data

General information about ridership data availability

Second filter: Detailed data

Qualitative analysis of five key data:

Ridership, Google Mobility, Apple Mobility, the OxCGRT scale, Covid-19

Plus availability of public opinion and travel behavior surveys.

Third filter: Balance

Comparative analysis:

- Population
- Mode Share
- Population Density

What lessons could our sample offer for BC cities / communities?

4 selected cities

- Portland
- Auckland
- Wellington
- Bellingham

Case Selection

Canadian Urban Transit Association (CUTA)'s framework

Community group	Population range
Group A: Major metropolitan areas	2 million or more
Group B: Large cities	400,000 to 2 million
Group C: Medium-sized cities	150,000 to 400,000
Group D: Small cities	50,000 to 150,000
Group E: Small and rural communities (with transit)	Less than 50,000
Group F: Small and rural communities (without transit)	Less than 50,000

CUTA divides Canadian Transit systems into six different groups based on both populational size and the presence of public transit. Our sample was selected to match part of these groups.

Source: CUTA – Transit Vision 2040 – five years of progress, 2015.

Case Selection

A wide range of comparative possibilities – CUTA Transit Groups

Group A: Major Metropolitan Areas (2 Million or more)	
Group B: Large cities (400,000 to 2 Million)	PORTLAND, AUCKLAND
Group C: Medium-sized cities (150,000 to 400,000)	WellingtonNZ
Group D: Small cities (50,000 to 150,000)	
Group E: Small cities& Small/Rural (< 50,000 with existing transit)	BE IN Bellingham WHATCOM COUNTY

Selected Cities at a glance

Quick Figures

	Portland	Auckland	Wellington	Bellingham
City Population	**654,741**	**1,571,718**	**202,737**	**92,314**
Urban Scale (USc) for Transit	Multnomah, Washington and Clackamas Counties - OR	Region	Region	Whatcom County
Population for USc	**1,832,634**	**1,571,718**	**506,814**	**229,247**
Population Density for USc	**230.1**	**318.1**	**63.0**	**42.0**
Median income per urban household - USD	$78,800.20	$82,436.91	$75,633.42	$69,372.00
Transit Agency	TriMet - Tri-County Metropolitan Transp. Dist. OR	Waka Kotahi NZTA + Auckland Transport	Waka Kotahi NZTA + Metlink	WTA - Whatcom Transp. Authority
Geographic Scale	Metro Area	Region	Region	County
Rail system?	Yes	Yes	Yes	No
Bus system?	Yes	Yes	Yes	Yes
Bus Fare	Time-Based	Zone-Based	Zone-Based	Fixed Price
Other Transportation Modes?	Paratransit	Ferry	Ferry	Paratransit, Vanpool, Zone Service
Transit mode share	6.1%	10.7%	18.0%	3.0%
Walking mode share	3.5%	4.3%	10.4%	4.7%
Cycling mode share	2.2%	1.0%	2.5%	2.0%
Cars + Private mode share	81.3%	73.9%	58.3%	83.4%

Additional Information

Qualitative analysis

We collected further information about transit operations during the pandemic, including the following measures:

1) Was there a Free Fare policy?
2) Was Rear boarding implemented?
3) Is there Online Occupancy data available?
4) Were there service cuts or reductions?
5) Are facial masks mandatory?
6) Did they make available information about internal disinfection measures?
7) Did they make available information on additional external cleaning?
8) Did the transit agency adapt routes?

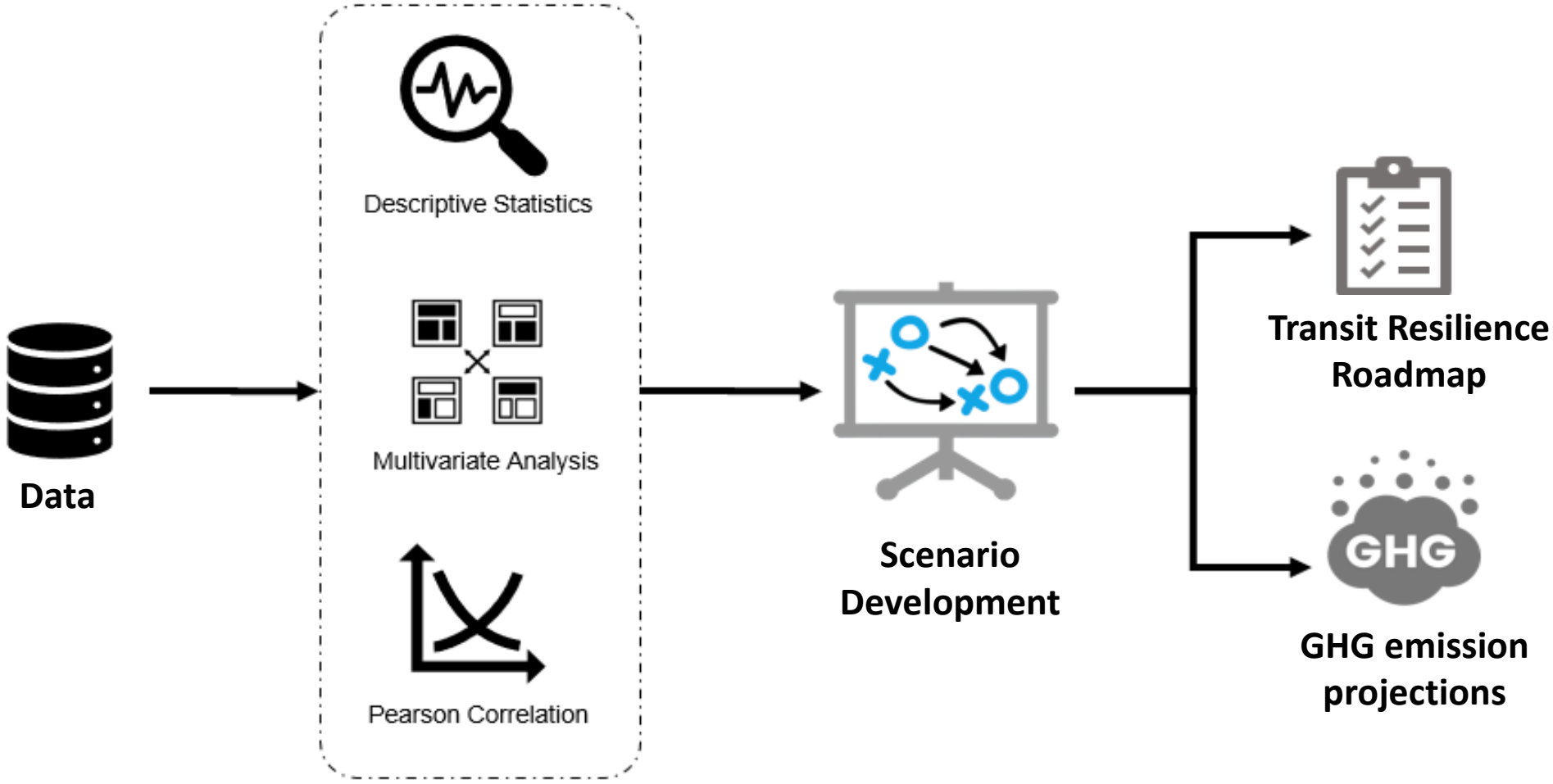
Additional information

Public Transit Measures

Best Combination

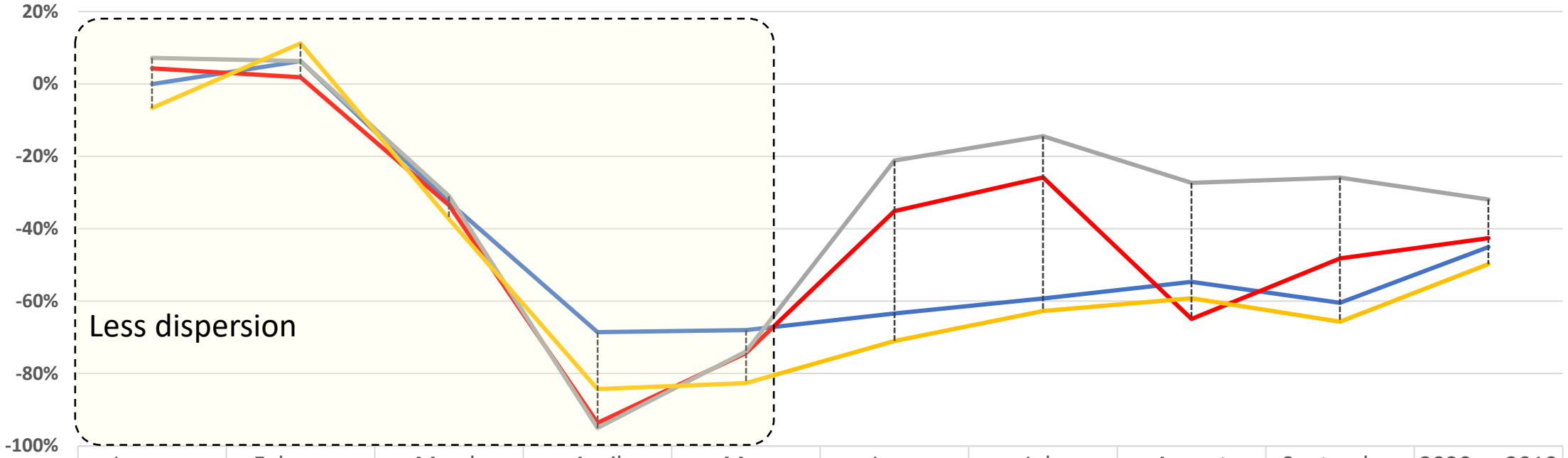
Item	Portland	Auckland	Wellington	Bellingham
Free Fare	No	Yes - during the lockdown phases 3 and 4 (from 27 April to 13 May)	Yes - up to June 30 (from 27 April to 30 June)	Yes, until now.
Rear boarding	No	Yes - during free fare	Yes - during free fare	Yes
Online Occupancy	No	Yes - Official + Transit App	No	No
Return of service cuts	Not up to September. Trimet returned to regular level on Oct 1st.	Yes. Service cuts only during the Lockdown on phases 4 & 3 – Full service from May 14 on	Yes. Before the end of the Lockdown phase 3. Full operation was resumed on 26 Apr (Bus) and 4 May (trains)	No, WTA has not returned to regular service levels yet
Boarding Capacity (physical distancing)	Yes	Yes	Yes	Yes
Mandatory Facial masks	Yes	Yes	Yes	Yes
Internal Cleaning	Yes	Yes	Yes	Yes
External Cleaning	Yes	Yes	Yes	Yes
Route adaptation	Unclear	Unclear	Unclear	Unclear

Methods


Descriptive Statistics
Multivariate Analysis
Pearson Correlation
Data
Analysis
Scenario Development
Transit Resilience Roadmap
GHG
GHG emission projections

Combined Ridership

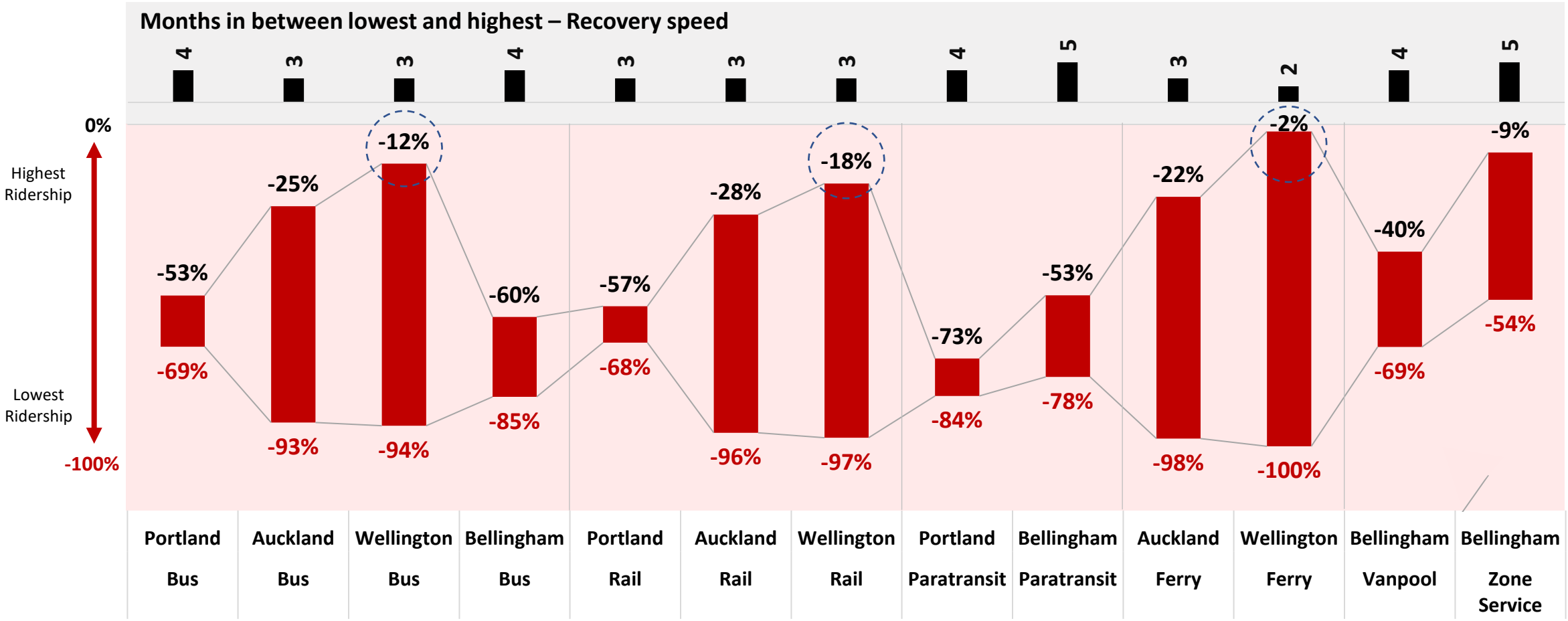
% variation in relation to same month in 2019



	January	February	March	April	May	June	July	August	September	2020 vs 2019
Portland	0%	6%	-33%	-69%	-68%	-63%	-59%	-55%	-60%	-45%
Auckland	4%	2%	-34%	-94%	-74%	-35%	-26%	-65%	-48%	-43%
Wellington	7%	6%	-31%	-95%	-74%	-21%	-14%	-27%	-26%	-32%
Bellingham	-7%	11%	-37%	-84%	-83%	-71%	-63%	-59%	-66%	-50%

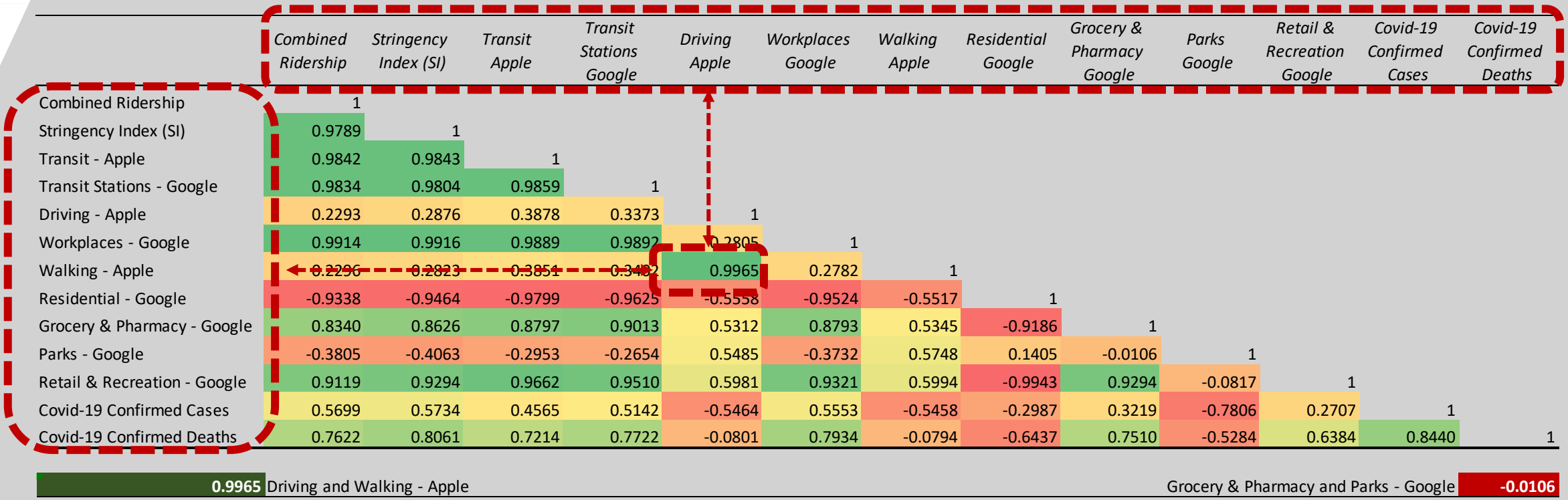
Public Transit Resilience

Variation between the lowest and highest ridership from March to September 2020



Pearson Correlation

Portland



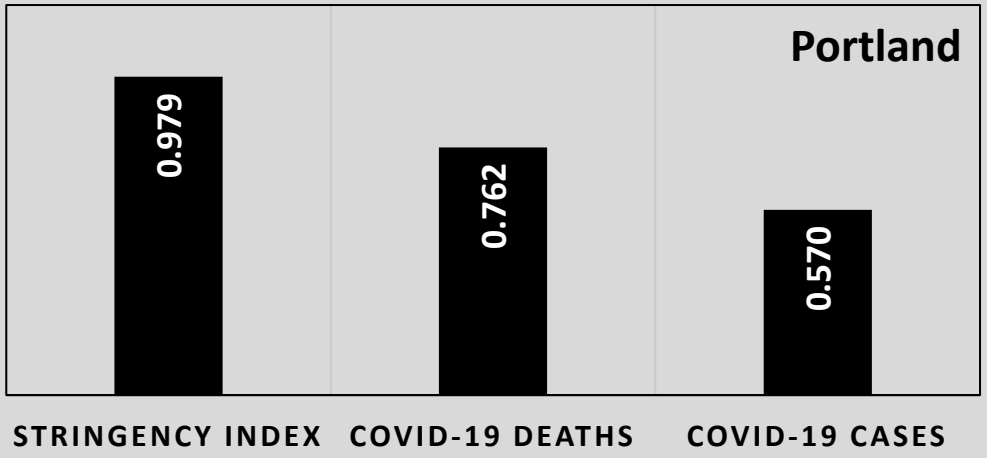
	Combined Ridership	*Stringency Index (SI)*	*Transit Apple*	*Transit Stations Google*	*Driving Apple*	*Workplaces Google*	*Walking Apple*	*Residential Google*	*Grocery & Pharmacy Google*	*Parks Google*	*Retail & Recreation Google*	*Covid-19 Confirmed Cases*	*Covid-19 Confirmed Deaths*
Combined Ridership	1												
Stringency Index (SI)	0.9789	1											
Transit - Apple	0.9842	0.9843	1										
Transit Stations - Google	0.9834	0.9804	0.9859	1									
Driving - Apple	0.2293	0.2876	0.3878	0.3373	1								
Workplaces - Google	0.9914	0.9916	0.9889	0.9892	0.2805	1							
Walking - Apple	0.2296	0.2823	0.3851	0.3482	0.9965	0.2782	1						
Residential - Google	-0.9338	-0.9464	-0.9799	-0.9625	-0.5558	-0.9524	-0.5517	1					
Grocery & Pharmacy - Google	0.8340	0.8626	0.8797	0.9013	0.5312	0.8793	0.5345	-0.9186	1				
Parks - Google	-0.3805	-0.4063	-0.2953	-0.2654	0.5485	-0.3732	0.5748	0.1405	-0.0106	1			
Retail & Recreation - Google	0.9119	0.9294	0.9662	0.9510	0.5981	0.9321	0.5994	-0.9943	0.9294	-0.0817	1		
Covid-19 Confirmed Cases	0.5699	0.5734	0.4565	0.5142	-0.5464	0.5553	-0.5458	-0.2987	0.3219	-0.7806	0.2707	1	
Covid-19 Confirmed Deaths	0.7622	0.8061	0.7214	0.7722	-0.0801	0.7934	-0.0794	-0.6437	0.7510	-0.5284	0.6384	0.8440	1

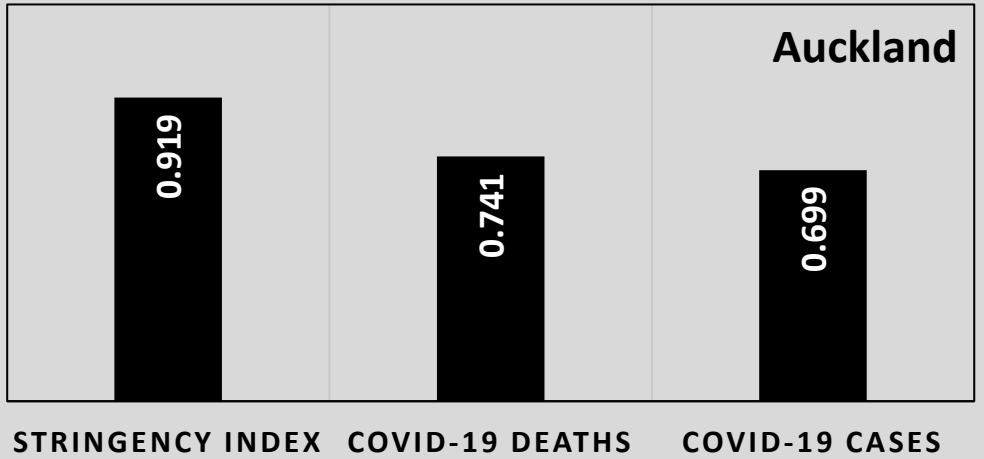
0.9965 Driving and Walking - Apple

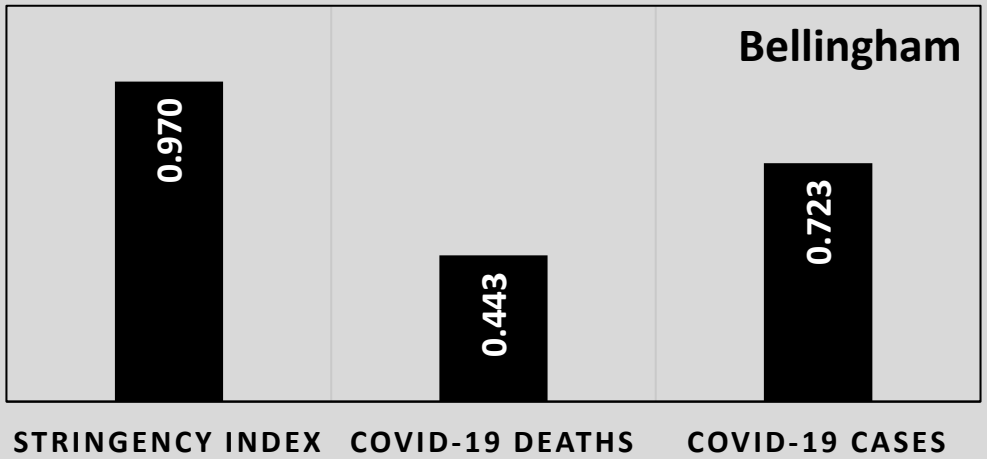
Grocery & Pharmacy and Parks - Google **-0.0106**

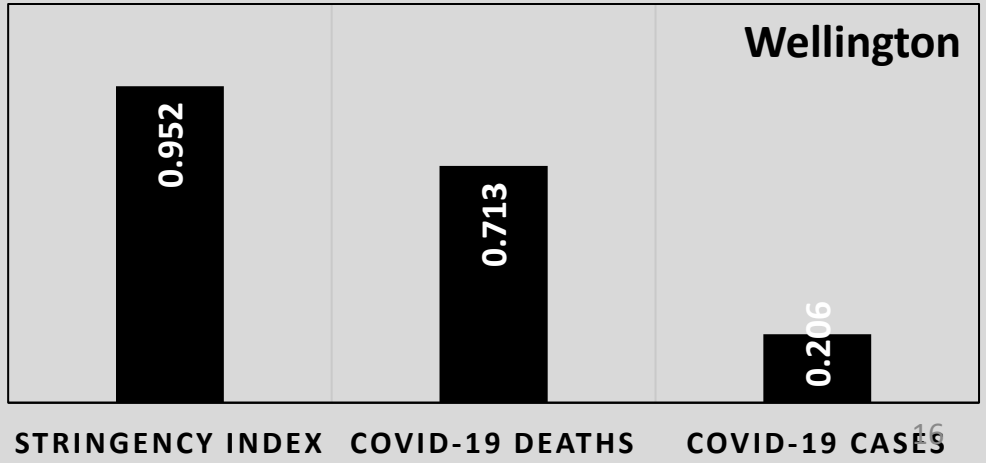
Pearson Correlation Coefficient

Relationship with Combined Ridership – part 1: Causes



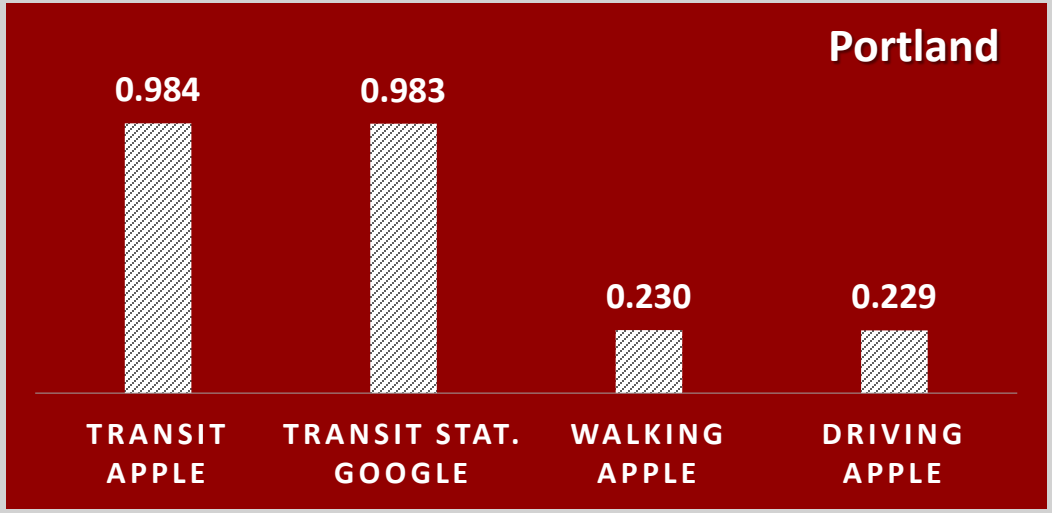


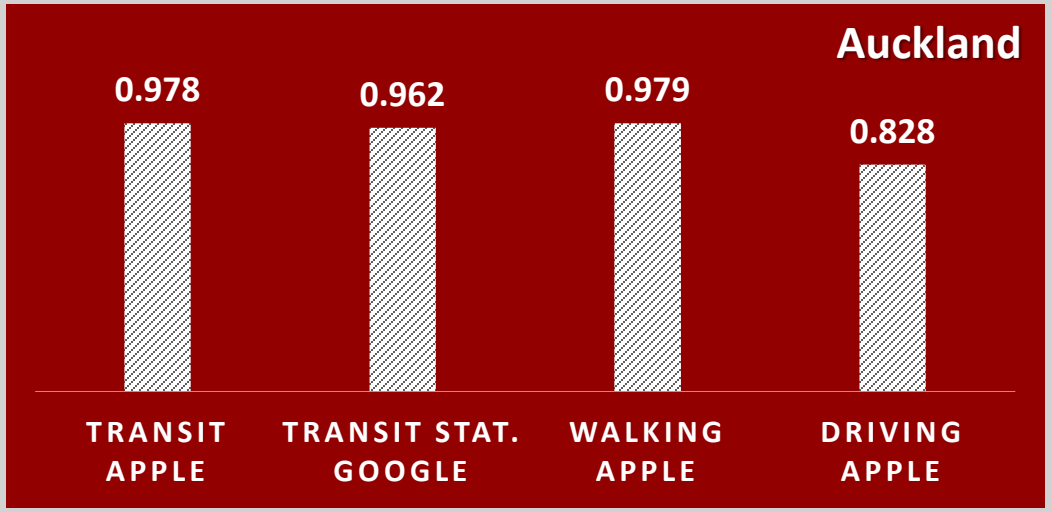


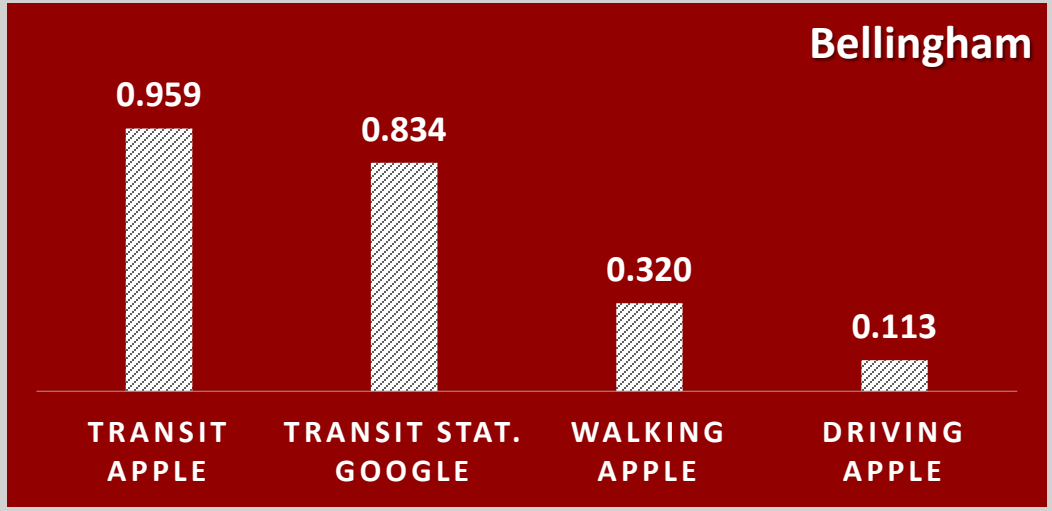


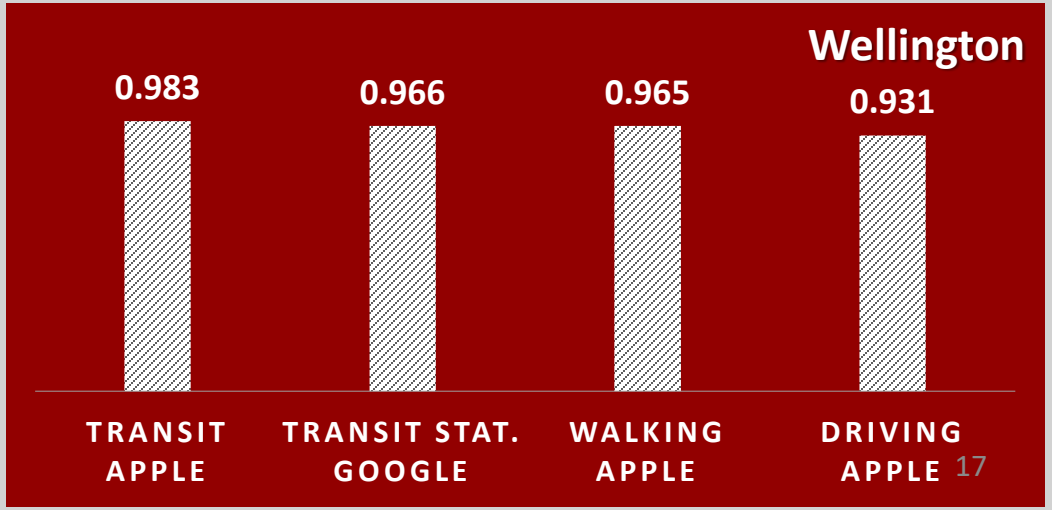
Pearson Correlation Coefficient

Relationship with Combined Ridership – part 2: Mobility



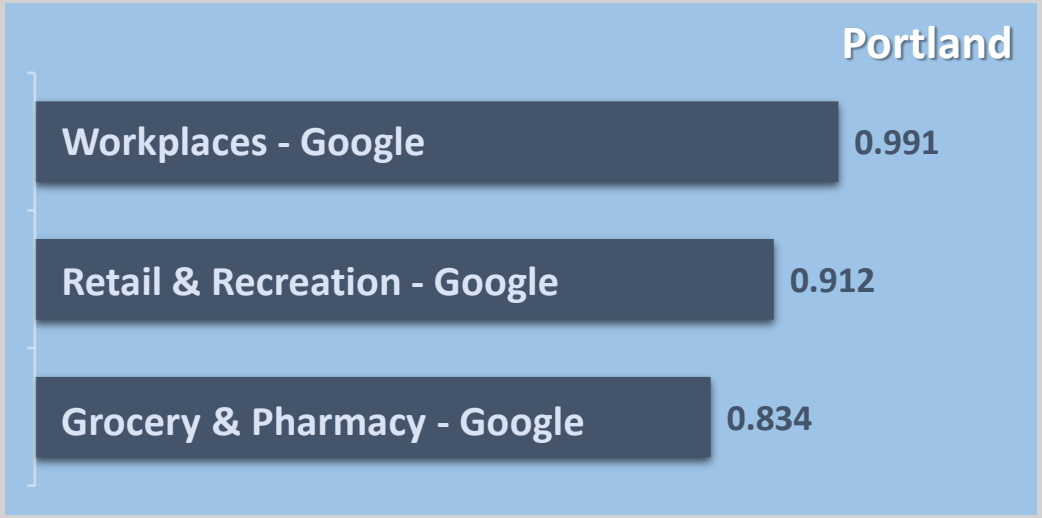






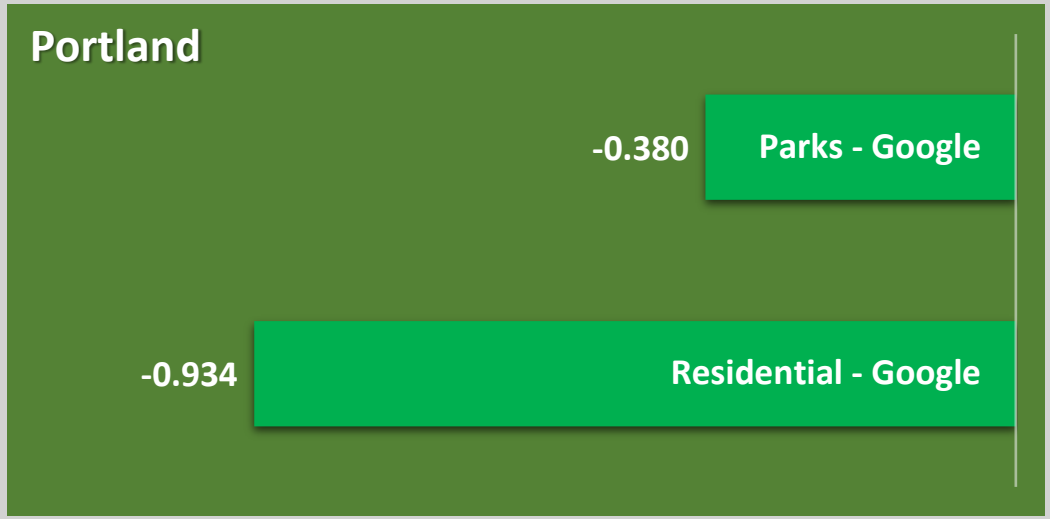
Pearson Correlation Coefficient

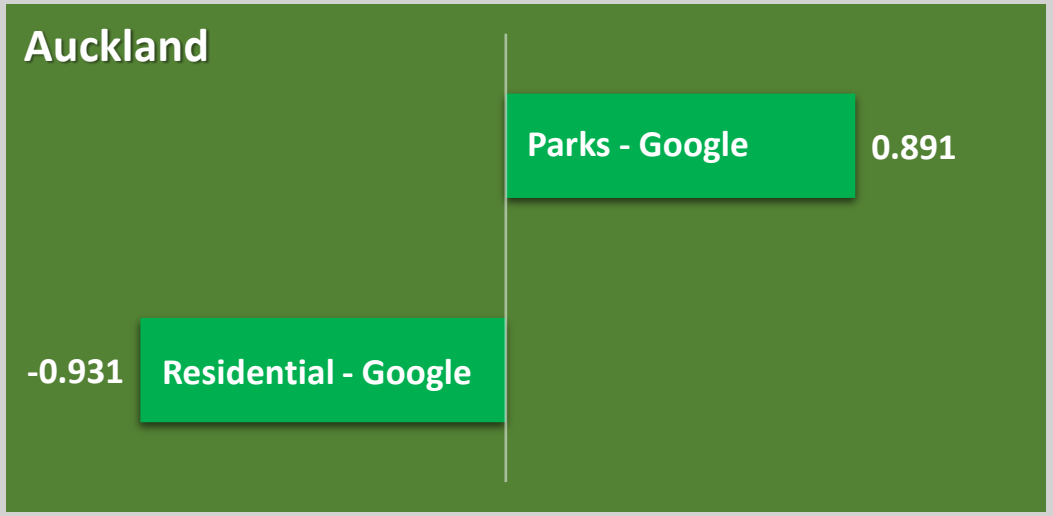
Relationship with Combined Ridership – part 3: Destinations

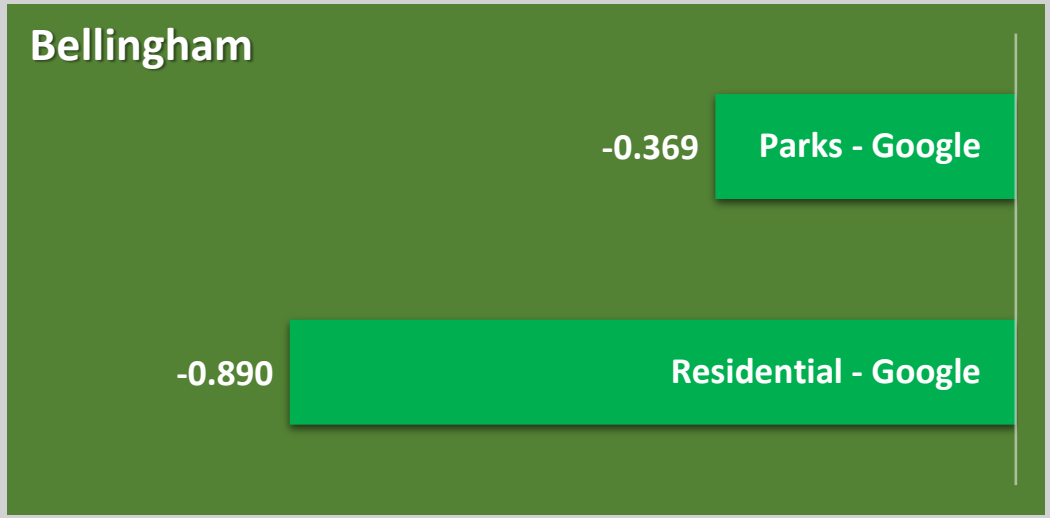


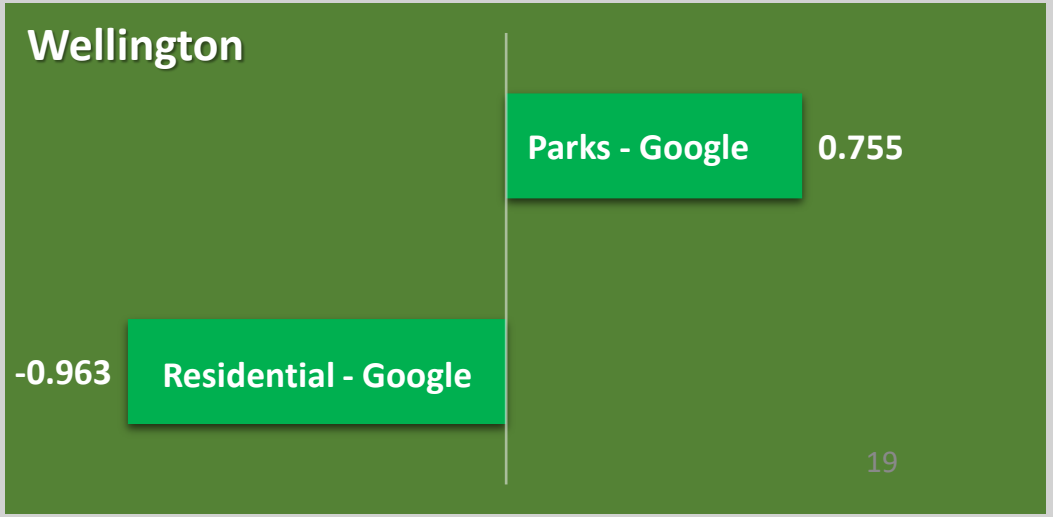
Pearson Correlation Coefficient

Relationship with Combined Ridership – part 4: Stay home



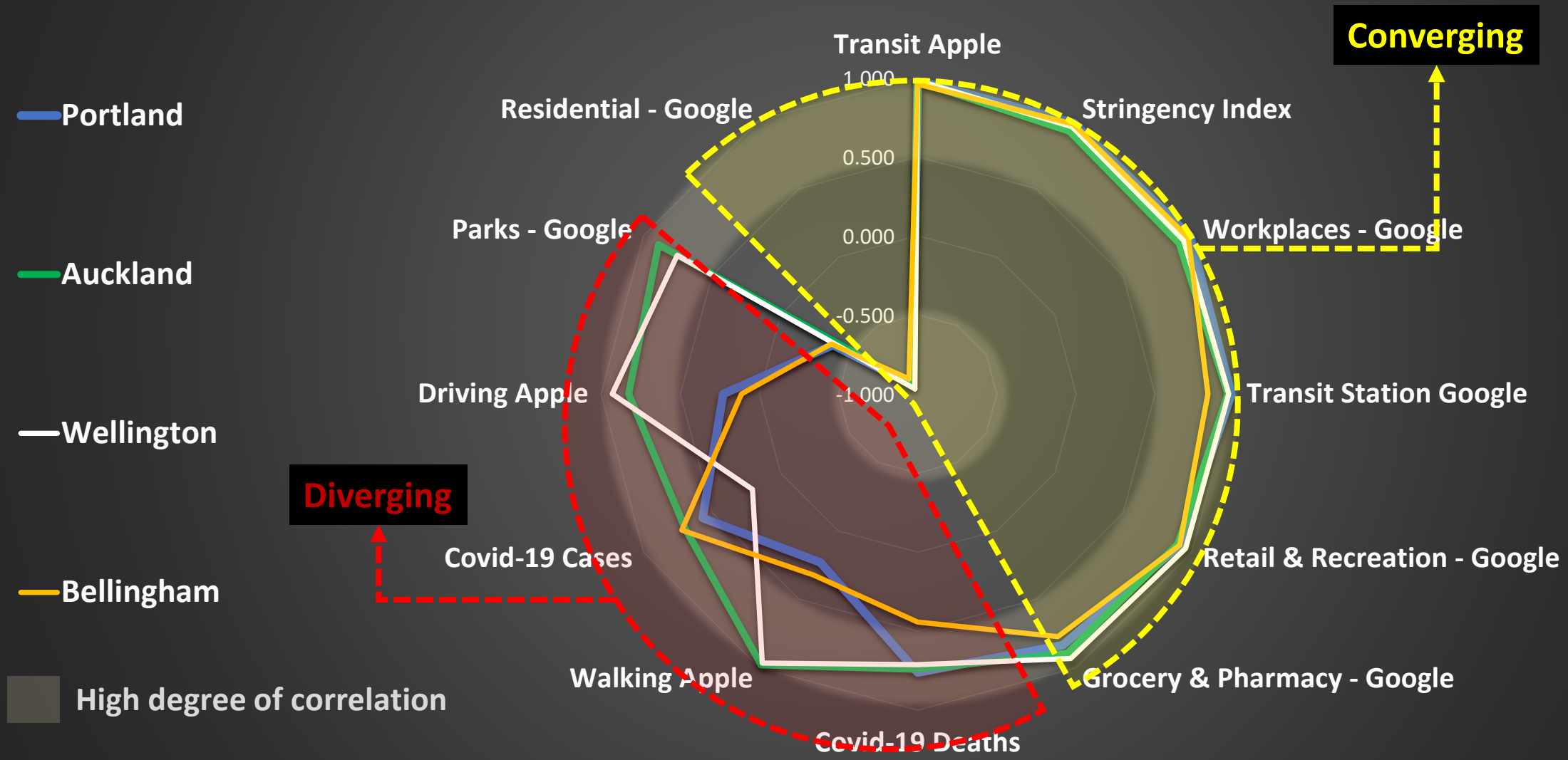






Pearson Correlation Comparison

Combined Ridership

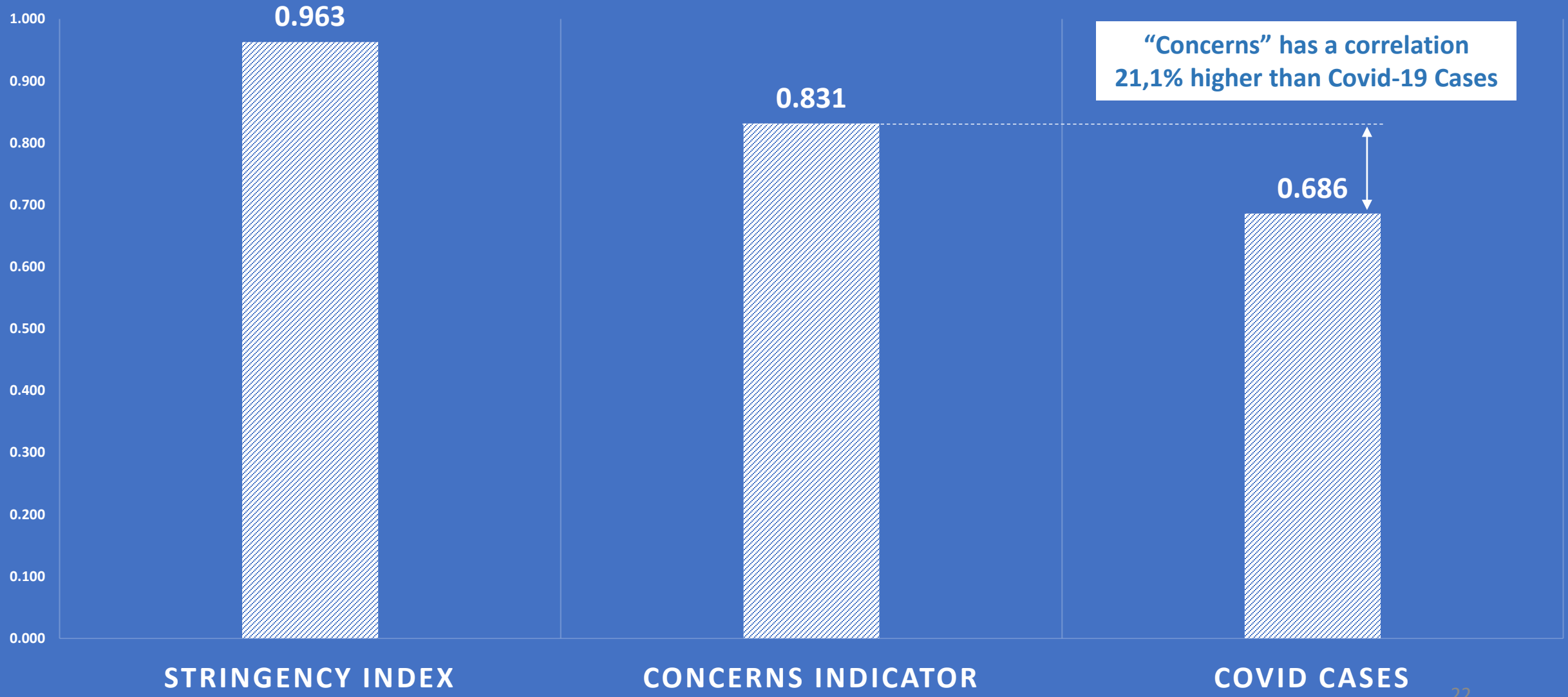


Concerns

How perceptions, fears and concerns relate to ridership recovery?

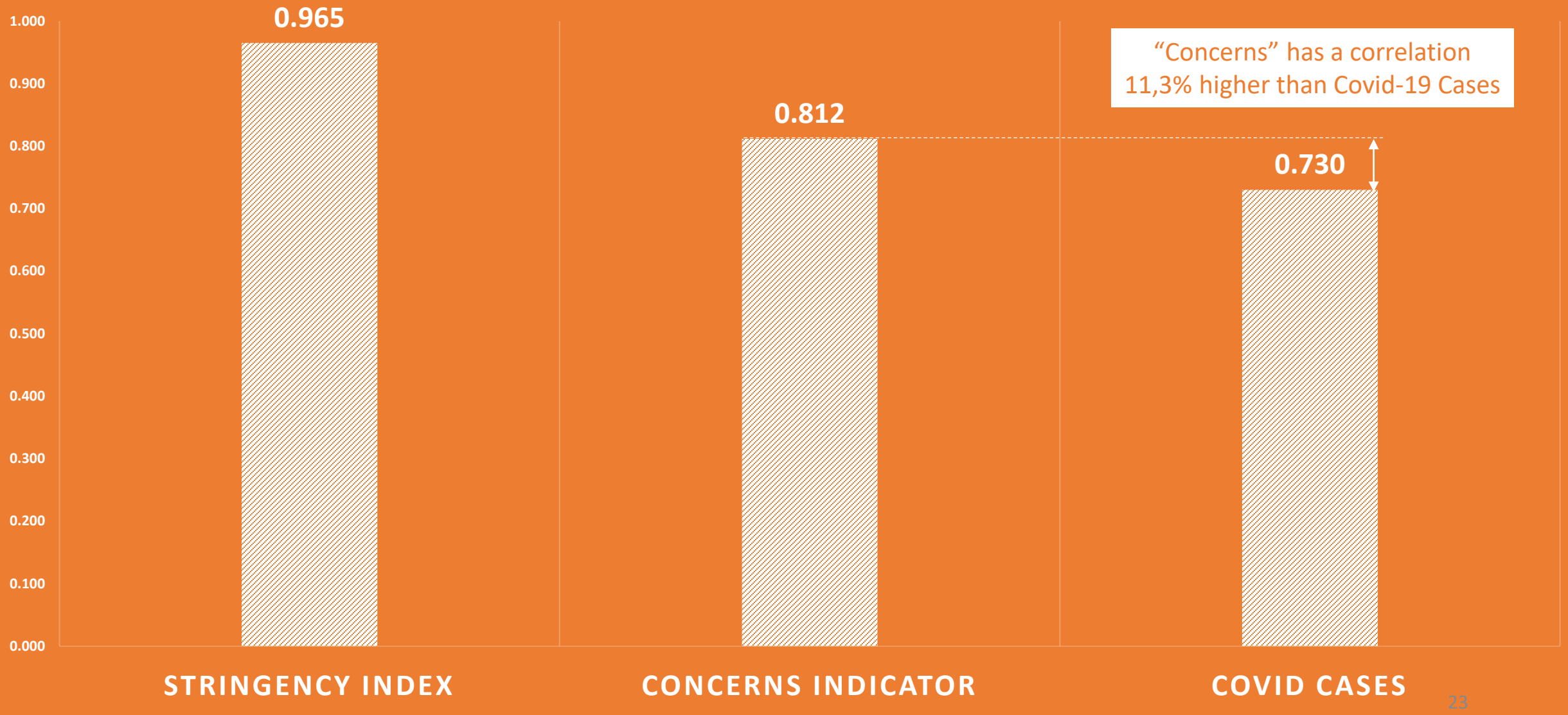
Pearson Correlation – Auckland

Combined Ridership, Covid-19 and Concerns indicator – April to September



Pearson Correlation – Wellington

Combined Ridership, Covid-19 and Concerns indicator – April to August

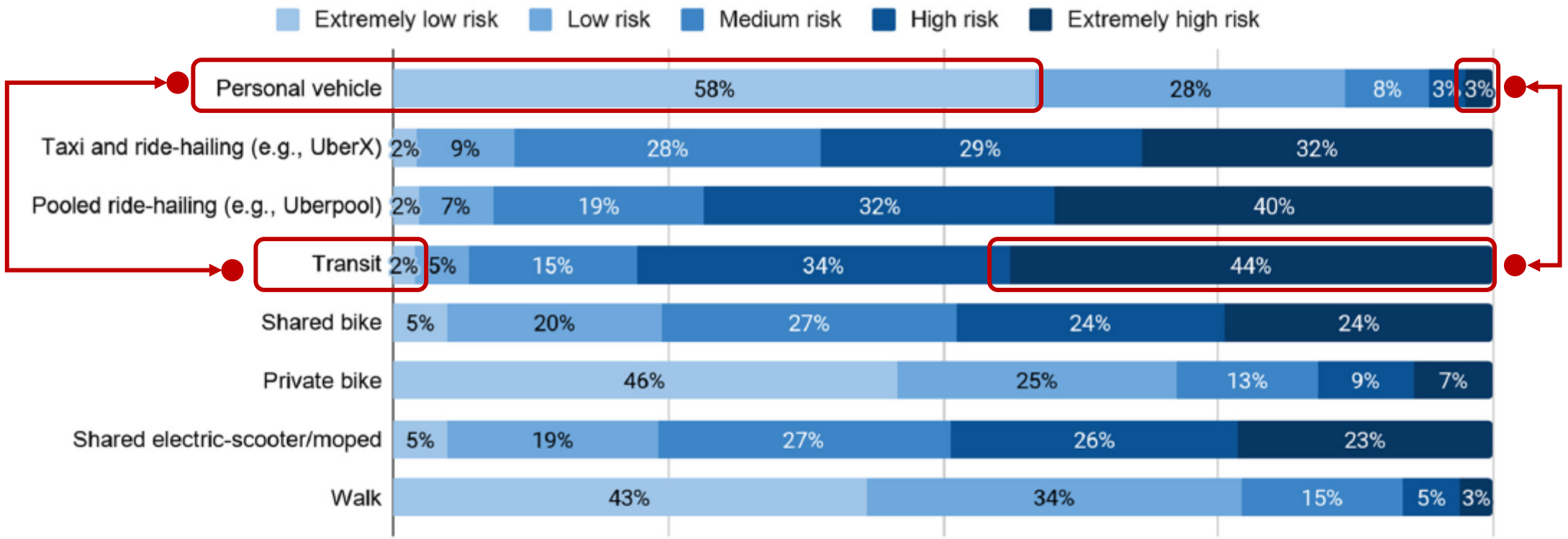


While in the U.S.

- In a statewide survey (Sept/20) from the Oregon Health Authority, **87% of respondents** from the Tri-county area stated that they are “Very or somewhat concerned about COVID-19 situation in Oregon”, and **68% were “Very or somewhat worried about becoming sick with Covid-19”**.
- A similar survey from the Whatcom Transportation Authority (WTA – July/20) pointed out that **86.6% of respondents are “extremely” or “somewhat” concerned about their personal health in relation to Covid-19**.

Risk Perception – UIC Survey 2020

Perceived risk of traveling with different modes during the Covid-19 pandemic



Source: Shamshiripour, A., Rahimi, E., Shabanpour, R., & Mohammadian, A. K. (2020). How is COVID-19 reshaping activity-travel behavior? Evidence from a comprehensive survey in Chicago. Transportation Research Interdisciplinary Perspectives, 7, 100216.

Key findings

GHG Emissions

Equity

Employment

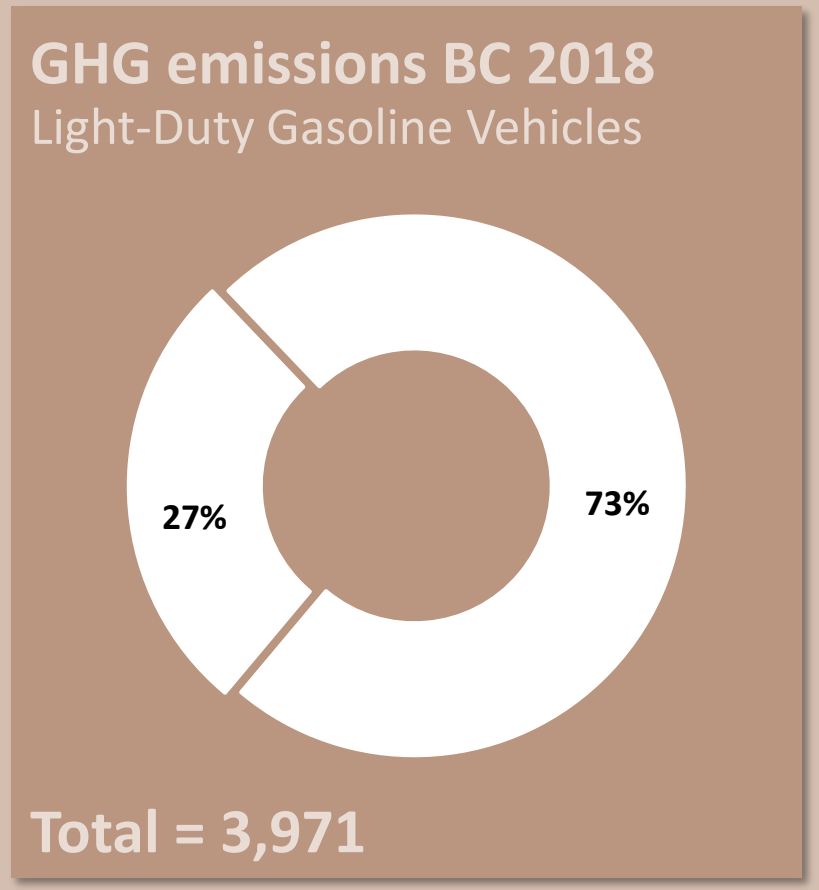
Savings in GHG emissions

867,680 tons of CO_2 *

*** Sustainable Transportation scenario - Yearly Projection**

Projections for BC

Item	Population	Yearly GHG avoidance potential
Research Sample	4,140,413	867,680
BC	5,071,336	1,062,768



Equity

- Suspending fare collection and rapidly returning service capacity to pre-pandemic levels is associated with the most resilient cities and recovery of sustainable mobility modes
- Working from home is related to socio-economic factor such as income, race, and education, among others.
- Zone Service - essential mobility, with the lowest drop among all modes and cities during the pandemic, and the best yearly recovery average compared to 2019
- Buses Resilient - lower ridership decrease, except for Portland, which presented a -1% difference, and that buses have also recovered ridership faster.
- Our findings indicate that infection concerns have significantly higher correlation coefficients with transit ridership than actual Covid-19 cases, as evidenced in Auckland and Wellington.

Employment

- Mobility restrictions and transit ridership have a high correlation with Workplaces
- Working from home can be a game changer in travel behavior
- Flexible journeys could support transit ridership recovery outside traditional peaks of commuting
- Recovering ridership is crucial to keep transit related jobs and avoid migration from collective to private modes
- Public Transit availability is related to the job market access
- Job losses in transit may cause up to 20 times more unemployment in other economic sectors

Scenario analysis - main drivers

Vehicle-Kilometer-Traveled (VKT)

Will we travel more, less, or the same?

Modal shift

How will we travel? How different modes are affected by the pandemic in different realities?

Scenario Analysis

Projections and scales definitions

Realm	How it is interpreted in our scenario analysis
Equity 	How changes in the service offer may result in accessibility problems for those who depend on public transportation. Our scenarios consider the projected net capacity for mobility and its reflection in equal mobility access, based on the pre-pandemic scenario.
Employment 	We seek to project how mobility changes will directly impact employment levels in jobs related to transportation, usually caused by service cuts due to new ridership levels.
GHG emissions 	The combination of total mobility (VKT) and modal shift directly influence emissions. We consider the result of this combination to be the main driver of GHG emissions in our scenario analysis. Technology shifts (Combustion engines versus EV) are not considered.

Scenario Scales

Better

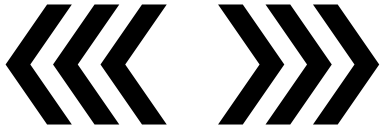
Neutral

Worse

3 Projected Scenarios
Premises

Sustainable Transportation

- ✓ **VKT:** Reductions in overall mobility pushed by technology (telework, e-commerce, etc.)
- ✓ **Modal shift:** more trips using active transportation, less driving, recovering and expansion of Public Transit offer and usage.



Business As Usual Bounceback

- ✓ **VKT:** Slow return to pre-pandemic levels with absolute growth in overall mobility
- ✓ **Modal shift:** Return to pre-pandemic levels, with a slow return of Public Transit service capacity and usage

Greater auto dependence

- ✓ **VKT:** Rapid increase in overall mobility. Tech trends like telework revert to pre-pandemic levels.
- ✓ **Modal shift:** more trips by private motorized vehicles, less active transportation trips, reduced usage and supply of Public Transit

1 Sustainable Transportation

Projected Scenarios

MODAL SHIFT

VKT

Realm	Short term	Medium & Long term	Rationale
Equity 			Technology for remote working and studying becomes more accessible and subsidized when necessary. The service level of public transit is quickly restored and improved. Free fare policies gain wider adoption with different specifications, but especially for essential workers, low-income users, or those who cannot telework. The financial, geographical, and structural dimensions of accessibility are improved for a growing segment of society who use sustainable transportation modes.
Employment 			Public transit supports economic recovery by preserving and enabling new jobs as service levels are quickly restored and improved. Flexible working arrangements become common, allowing for optimization of public transit commuting (less crowding and a more uniform service level, especially during off-peak operations).
GHG emissions 			Part of the rapid expansion of online work, education and e-commerce will remain in place, boosted by technology, and yielding a reduction in overall travel. Users that shifted to private vehicles during the pandemic will again switch to sustainable transportation modes, and new users will be attracted to these sustainable modes, drawn by their improved accessibility, affordability, and infrastructure. The net result will be reduced VKT and more people traveling by sustainable modes, yielding lower GHG emissions.

2 Business As Usual Bounceback

Projected Scenarios

MODAL SHIFT VKT

Realm	Short term	Medium & Long term	Rationale
Equity	☹	😐	In the medium and long term public transit capacity will be restored, without big changes in affordability or accessibility, trending toward the pre-pandemic status quo. Free fare, special treatment for essential workers, or for those excluded from telework will not become part of the policy agenda. Until service levels are fully restored, users will experience less accessibility and longer journeys. This may result in some permanent ridership losses.
Employment	☹	😐	There will be significant job and financial losses among transit operators that are highly dependent on fare revenues, including dramatic service cutbacks. Gradual recovery will eventually bring employment back close to previous levels. Further growth of sustainable transportation modes beyond pre-pandemic levels is unlikely. Recovery will be uneven from place to place and this could constrain employment levels both within public transportation and beyond the sector.
GHG emissions	☹	☹	Travel to remote locations for work, study, or and shopping will return to pre-pandemic levels without any substantial variation in modes used. Until the public transit system is fully recovered, there will be high use of private vehicles, and some of these private vehicle drivers will not return to public transit or will ride less than before, even though modal share should gradually return close to current levels. The same will happen with VKT, with an increase in emissions especially until public transit is fully restored or even later.

3 Greater auto dependence

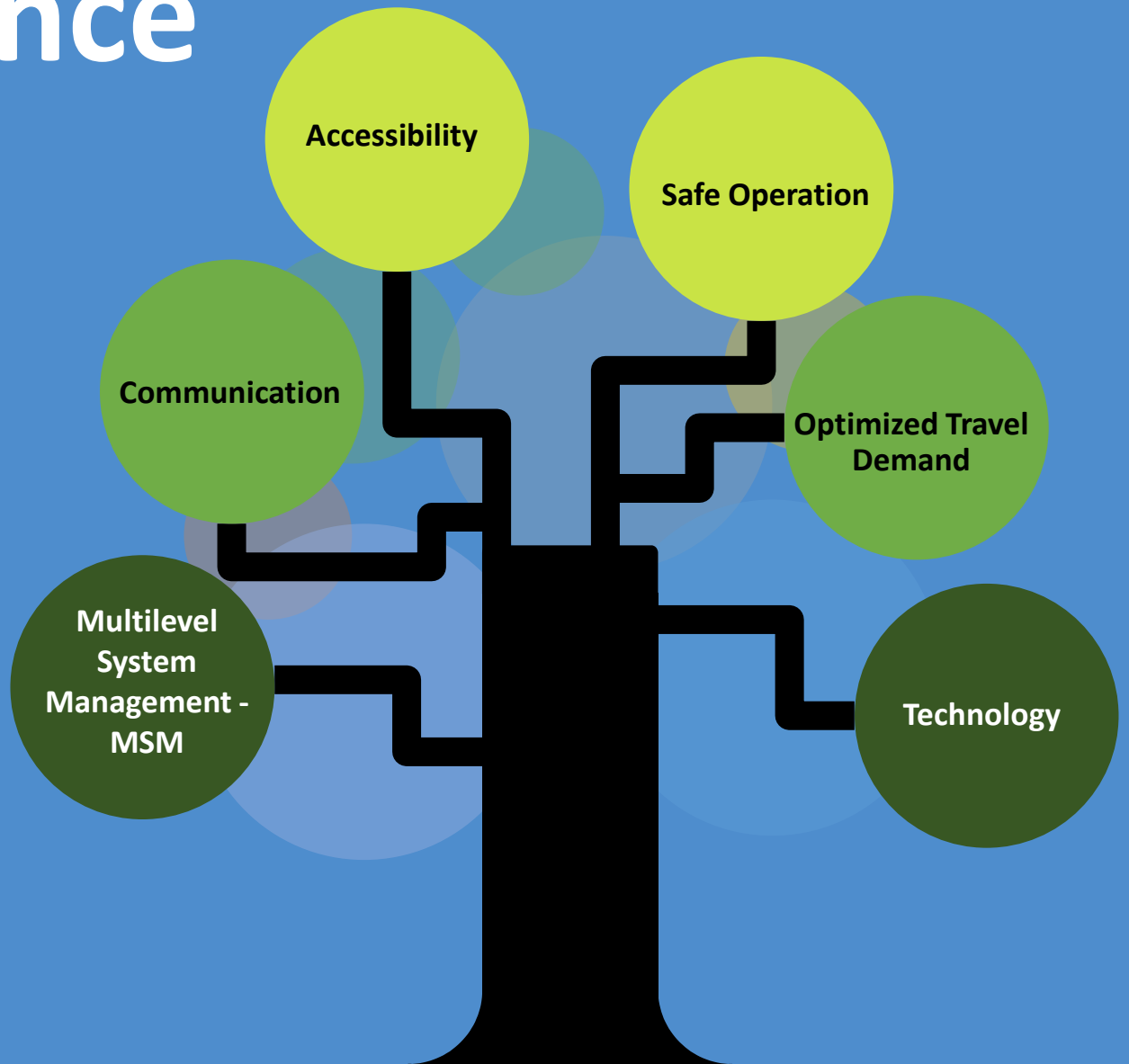
Projected Scenarios

MODAL SHIFT VKT

Realm	Short term	Medium & Long term	Rationale
Equity	☹	☹	Many places will not recover transit ridership, especially due to big disruptions in public transit. This will impact accessibility, affordability, and it will also increase the budget pressures on individuals who have shifted from transit to private vehicles. Those who cannot afford a car will have less access to places, with longer journeys, fewer route options, and likely more expensive travel options than currently. Public transit's reputation will be damaged for a long time to come, and ridership may never go back to pre-pandemic levels leaving those without access or ability to drive a private motor vehicle behind.
Employment	☹	☹	As transit systems tend not to fully recover, there will be permanent reductions in services offered. This will cause extensive direct and indirect job losses with wide ranging economic effects. The unemployed will face new challenges to access prospective jobs, as there will be reduced transportation options. Commercial activity will be negatively impacted by both higher transportation costs for employees without transit access, and by less exposure to pedestrians and cyclists due to limited active transportation.
GHG emissions	☹	☹	As the net capacity in public transit will be reduced, current pandemic mobility trends will continue over the long term, with higher increases in private vehicle usage. Remote activities enabled by ICT will return to pre-pandemic levels and remain a privilege for a few, with a low impact on overall mobility. It will take longer for active modes to recover, and part of active mobility will shift to private vehicles. VKT will increase quickly, and so will GHG emissions thanks to more travel and a greater reliance on private motor vehicles.

Transit Resilience Roadmap

Core Concepts:



Transit resilience roadmap

Recommended strategies and tactics

Recommended strategies and tactics		Short term	Medium & Long term	Potential / Impact		Example[38]
				GHG Mitigation	$	
Multilevel System Management (MSM) - P	Develop technical standards for hygiene, sanitization, and cleaning measures on all shared vehicles	■		★★★	$	5, 7, 19
	Define technical parameters for internal capacity under different restriction levels	■		★★★	$	5, 8, 6
	Define operational parameters for each restriction level, detailing who will be allowed to use transit and the potential funding sources in case fare collection is suspended	■		★★★	$ - $$$	12, 13
	Bundle transit with other sectors in pandemic recovery programs	■	■	★★☆	$ - $$	
	Develop a policy framework that can:					
	• Promote and encourage the use of ST Modes (walking, biking, and public Transit)		■	★★★	$	1, 8, 12
	• Discourage car and motorized trips where alternatives exist		■	★★★	$ - $$$	1, 12, 17, 18
	• Increase the usage of micro-personal-mobility like e-bikes and e-scooters		■	★★★	$ - $$	1, 18, 9
	• Fast-track programs for urban space reallocations like "slow street" / "safe street"	■		★★☆	$	17, 1, 14
	• Long term ST oriented redesign and repurposing of streets, curbs, and other public spaces		■	★★★	$$$	1, 8, 12, 17
	• Investment in infrastructure to support Sustainable Transportation modes		■	★★★	$$$	12, 1, 2, 4
	• Optimize Travel Demand (as detailed in the specific topic below)	▭	■	★★★	$ - $$$	18, 13, 1, 17
	• Create an integrated regulatory framework for Mobility Open-Data	■		★☆☆	$	12, 2
	• Enable multimodal operation including new mobility modes in an inclusive and supportive way	▭	■	★★★	$ - $$$	12, 1, 18, 9
	• Accelerate the transition to electric vehicles/fossil-fuel-free vehicles		■	★★★	$$$	12

P

Legend:

■ > 50% implementation
▭ < 50% implementation

★☆☆ Good
★★☆ Better
★★★ Best

$ Minor investment
$$ Medium investment
$$$ High investiment

[38] Please check the example number in Appendix 3. Not all examples are listed here, for more information please check Appendix 3.

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	Short term	Medium & Long term	GHG Mitigation	$	Example[35]
vehicles in public transit		■	★★★	$$$	12
	■		★☆☆	$ - $$	7, 12, 8, 1
ions and Technologies	■	■	★☆☆	$	1
P O	■		★★☆	$$	5, 13, 16, 2, 10, 19
	▭	■	★★☆	$ - $$	15, 4, 18, 13
	■		★★☆	$	16, 13, 4
reventive barriers)	■	■	★★☆	$	16, 3, 15
ble and allowed	■		★★☆	$ - $$	18, 8
(see Communication topic)	■		★★☆	$ - $$	3, 8, 18, 3
y	■		★☆☆	$ - $$	1, 12
munication topic)	■		★★☆	$ - $$	1, 8
	▭	■	★★☆	$ - $$	1, 12
	■		★☆☆	$	16, 5, 1, 14, 13
	■		★★☆	$	13, 14, 6, 19, 16, 4, 7, 15
demand-responsive options	■	■	★★☆	$	7, 13, 14, 4
ion system		■	★★★	$ - $$$	18, 1, 9
P O	■		★★☆	$ - $$	2, 14, 13
	■	■	★★★	$	1, 18, 15
Implement Fast-track programs for urban space reallocation like "slow street" / "safe street"	■		★★☆	$	1, 17
Consider targeted or comprehensive free fare programs	▭	■	★★★	$ - $$$	19, 2, 10, 3, 15, 7, 14, 6

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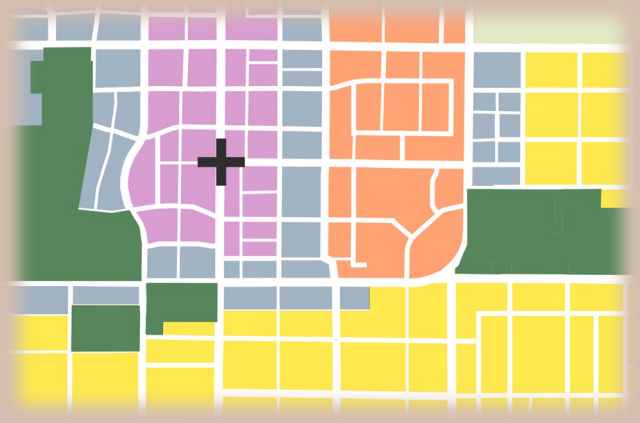
Multilevel System Management "MSM"

Optimized Travel Demand

Managing influence factors

- Reducing trips
- Better demand distribution

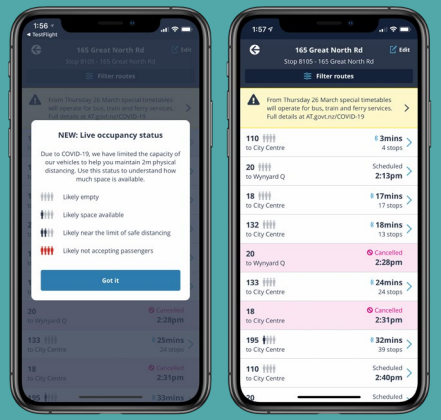
Sustainable Transportation and the multimodal urban mobility



Land use

Technology

Defensive Technology



Attractive Technology

Open Data

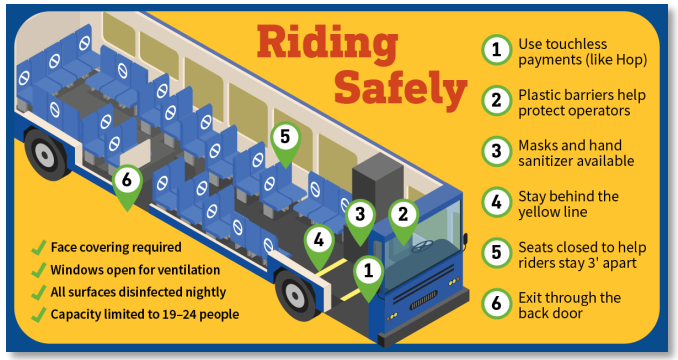
Accessibility

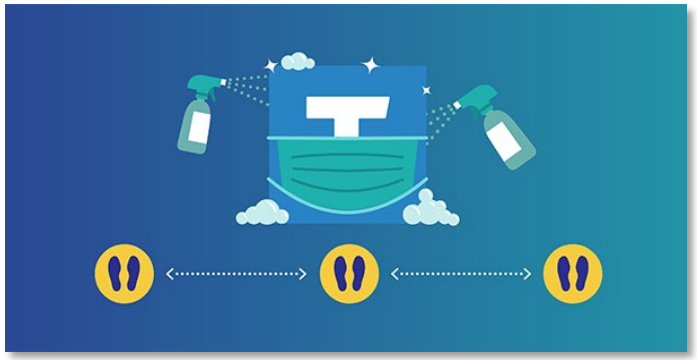
Socio-economic factors

Service adjustments

Essential Services

Safe Operation





Meeting safety standards

Fast and efficient adaptations

Communication

- Fight perceptions with data
- User-friendly & multi-channel
- Supportive communication
- Transparency

Insight summary

Literature listed in Appendix 3 - Resources

Word Cloud powered by wordart.com

Sources: OECD, UITP, WHO, CUTA, APTA, McKinsey Company, Transit Center, WSP – Australia, King County Metro, GTRC – Greater Richmond Transit Company (Virginia), Capital Metro – Austin, BC Transit, and TransLink.

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