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A Global Review of Suburban Ring Railways to Inform the Melbourne Suburban Rail Loop Project

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PTRG PUBLIC TRANSPORT RESEARCH GROUP

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Introduction

Approach

Research Context

Comparative Performance

Discussion

This presentation outlines the results of a comparative review of suburban loop metros to inform the Melbourne SRL project

- Research aim
  - to understand SRL **planned** performance vs other loop metro **actual** performance
- Monash research
  - Student undergraduate project
  - Published ATRF 2023; November Perth WA

Fernando A and Currie G (2020) "A Global Review of Suburban Ring Railways to Inform the Melbourne" Department of Civil Engineering Final Year Research Report Monash University

Fernando A and Currie G (In Press) "A Comparative International Review of Suburban Ring/Loop Metros to Inform the Melbourne Suburban Rail Loop Project" Australasian Transport Research Forum 2023 Proceedings 29 November – 1 December, Perth, Australia

A Global Review of Suburban Ring Railways to Inform the Melbourne Suburban Rail Loop Project

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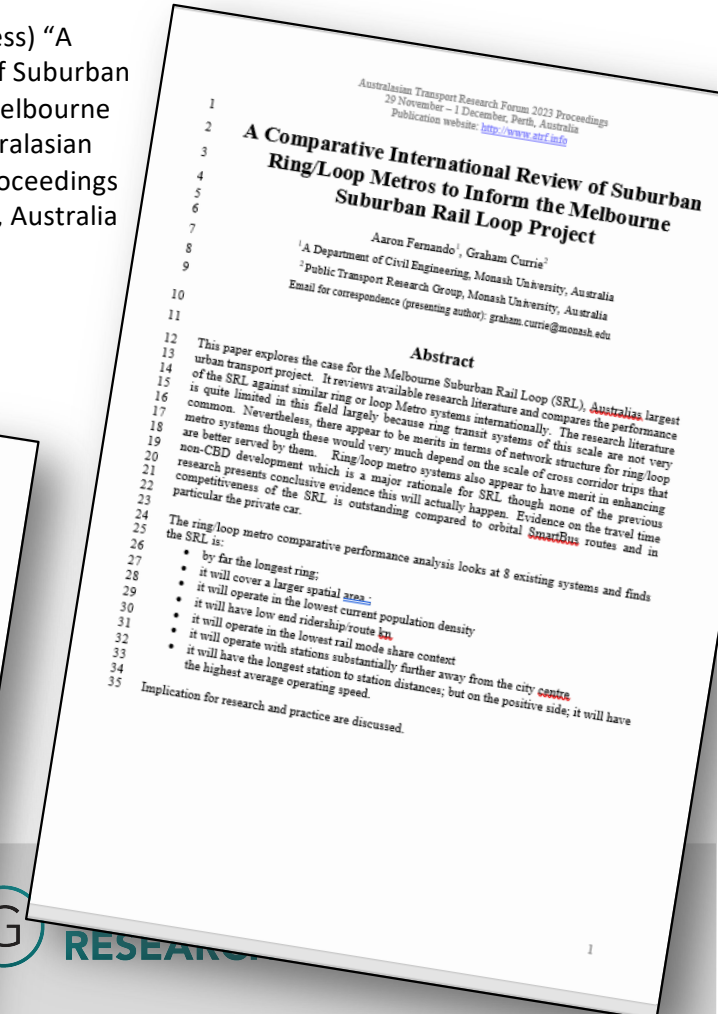
ABSTRACT: This paper compares Melbourne's Suburban Rail Loop (SRL) metrics with similar circumferential rail systems around the world to identify key planning implications and long-term impacts. Melbourne is experiencing the negative effects of urban sprawl, such as road congestion and increasing distances for journey-to-work trips. High private vehicle use is an accompanying issue, adding pressure to current road supply. The SRL aims to decrease private vehicle reliance by providing fast and reliable transit around Melbourne's suburbs. Placing the rail loop through key activity hubs will further encourage public transport utilisation. The SRL will considerably reduce Origin-Destination travel times and encourage mode shift to rail. Both population densities and rail ridership share in most cities with orbital ring rail loops are significantly higher than Melbourne. Data processing produced several graphs which plotted the SRL against other orbital loops in the world, with the SRL standing out as the longest orbital line at the furthest distance away from the inner-city. Cities with higher population densities consistently had high rail ridership share, where Melbourne, with the lowest population density, displays the lowest rail ridership share. Despite low ridership, results indicate relatively high commuter activity at stations along the SRL which is ideal for mixed-use development around these stations. To develop a transport network suitable for increasing population growth, Melbourne would need to decrease private vehicle usage by shifting travel behaviours and modal choices towards increased public transport use. As such, the SRL must be approached as a long-term project to develop Melbourne into a polycentric city focusing on re-distribution of future jobs and higher-density development at activity centres along the rail loop.

1 INTRODUCTION

The urban sprawl across Melbourne has resulted in increasing road congestion, particularly around the inner-city where economic activity is most dense. As the 34th largest city by built-up urban area (Demographia, 2020), transport plays a significant role in Melbourne's economic activity. The relatively low population density (968th in the world (Demographia, 2020)) results in longer distance-to-work trips due to the outspread sprawl of residential housing, which in turn increases [illegible] large proportion of

argued that more cost-effective solutions exist to improve public transport ridership (Rail Futures Institute Inc., 2019). Comparing the SRL to other ring-like railways in major cities around the world would provide insights on travel patterns and benefits offered by circumferential railways. Metrics such as urban densities, ridership values, and loop locations are key data points to display strong comparisons. The objective of this report is [illegible] understanding



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29 November – 1 December, Perth, Australia
Publication website: http://www.atrf.info

A Comparative International Review of Suburban Ring/Loop Metros to Inform the Melbourne Suburban Rail Loop Project

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Abstract

This paper explores the case for the Melbourne Suburban Rail Loop (SRL), Australias largest urban transport project. It reviews available research literature and compares the performance of the SRL against similar ring or loop Metro systems internationally. The research literature is quite limited in this field largely because ring transit systems of this scale are not very common. Nevertheless, there appear to be merits in terms of network structure for ring/loop metro systems though these would very much depend on the scale of cross corridor trips that are better served by them. Ring/loop metro systems also appear to have merit in enhancing non-CBD development which is a major rationale for SRL though none of the previous research presents conclusive evidence this will actually happen. Evidence on the travel time competitiveness of the SRL is outstanding compared to orbital SmartBus routes and in particular the private car.

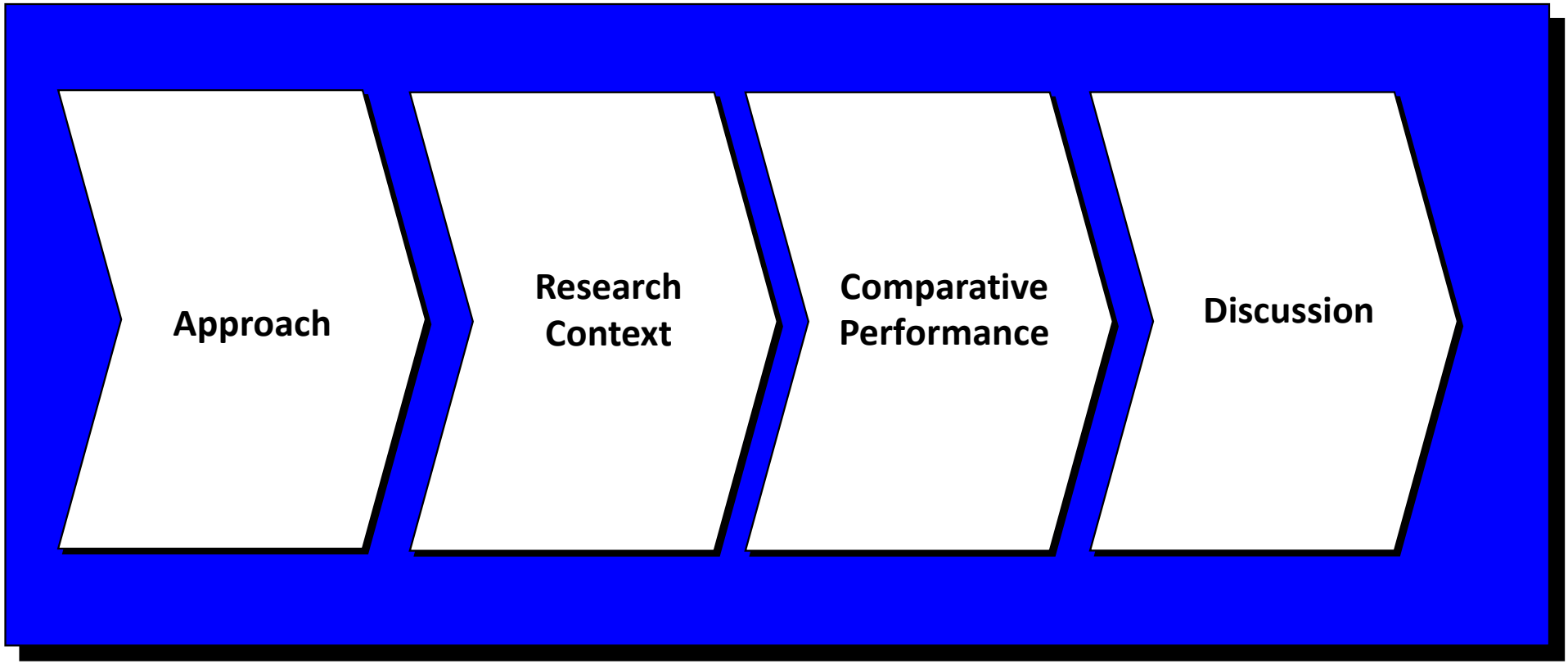
The ring/loop metro comparative performance analysis looks at 8 existing systems and finds the SRL is:

- by far the longest ring;
- it will cover a larger spatial area ;
- it will operate in the lowest current population density
- it will have low end ridership/route km
- it will operate in the lowest rail mode share context
- it will operate with stations substantially further away from the city centre
- it will have the longest station to station distances; but on the positive side; it will have the highest average operating speed.

Implication for research and practice are discussed.

1

This presentation outlines comparative data and my views



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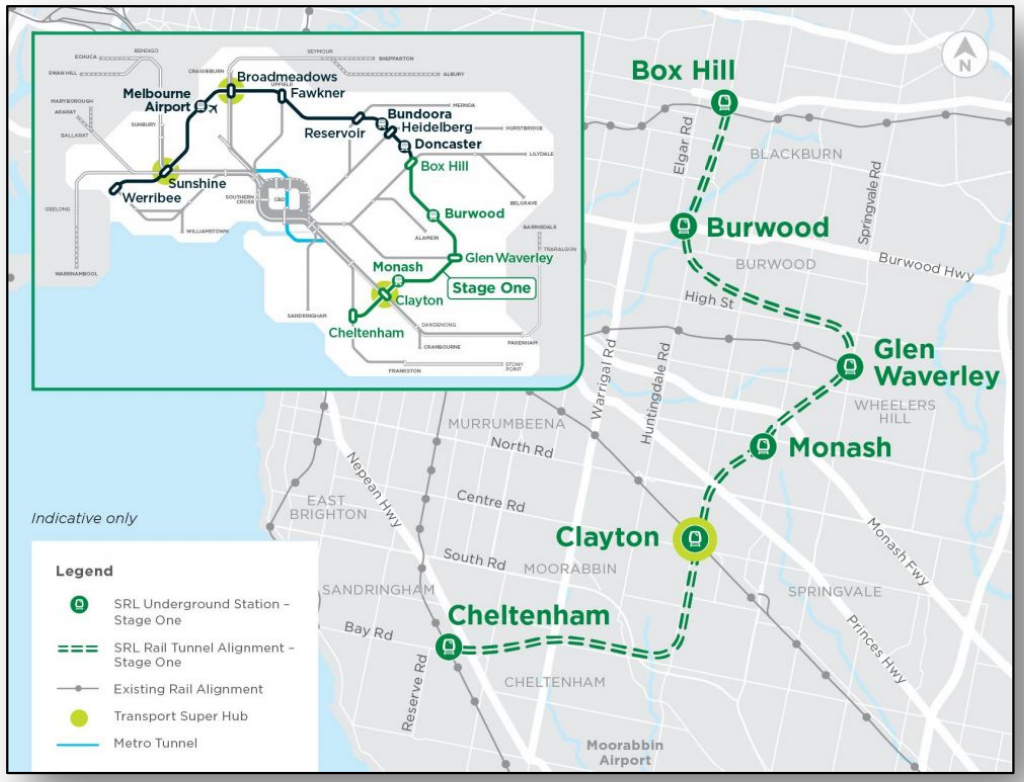
The research explored SRL/Loop Metro published evidence and comparative data on project performance

- The research explored:
  - Melbourne SRL purpose and performance
  - Published literature on loop metro impacts
    - Design/rationale
    - Improved connectivity/travel; path directness
    - Increased ridership and decreased auto use
  - Collate actual data on loop metro performance
    - Loop line length and spatial scale of city
    - Ridership rates per route km vs population density
    - Daily loop ridership by urban rail ridership mode share
    - Average station-station distances vs average speed
    - Average station to station travel time by average station distance from the city.
  - Summary and personal views on the SRL project

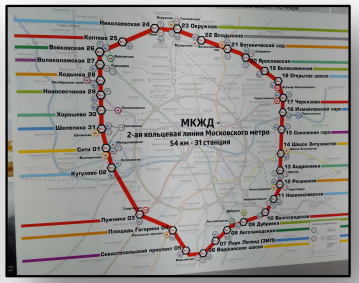
We researched SRL vs 8 existing loop metros using available data

- Compares: SRL vs global loop railways
  - Shanghai Metro Line 4 (China)
  - Moscow Central Line (Russia)
  - Berlin Ringbahn (Germany)
  - London Circle Line (United Kingdom)
  - Circle MRT Line (Singapore)
  - Beijing Line 10 (China)
  - Seoul Subway Loop 2 (South Korea)
  - Yamanote Line (Tokyo, Japan)



Comparator metros are all loops around a central core much like SRL

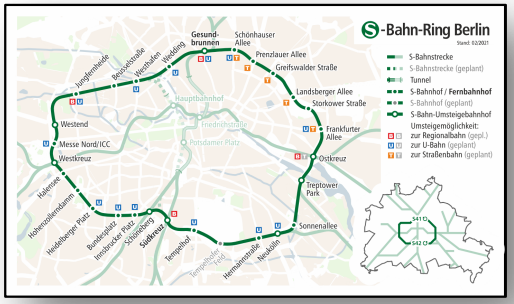
Shanghai Metro Line 4



Moscow Central Line

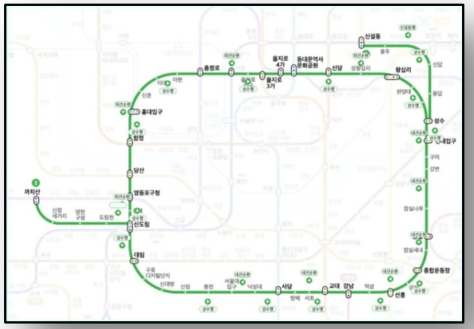
London Circle Line

Circle MRT Line (Singapore)

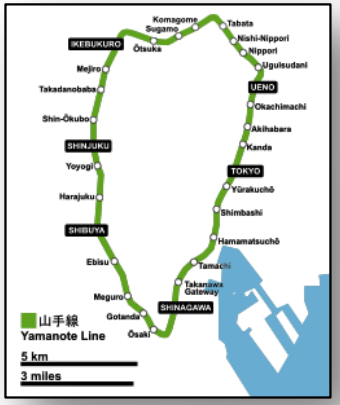


Berlin Ringbahn

Beijing Line 10



Seoul Subway Loop 2 (South Korea)



Yamanote Line (Tokyo, Japan)

NOTE: NOT TO SCALE

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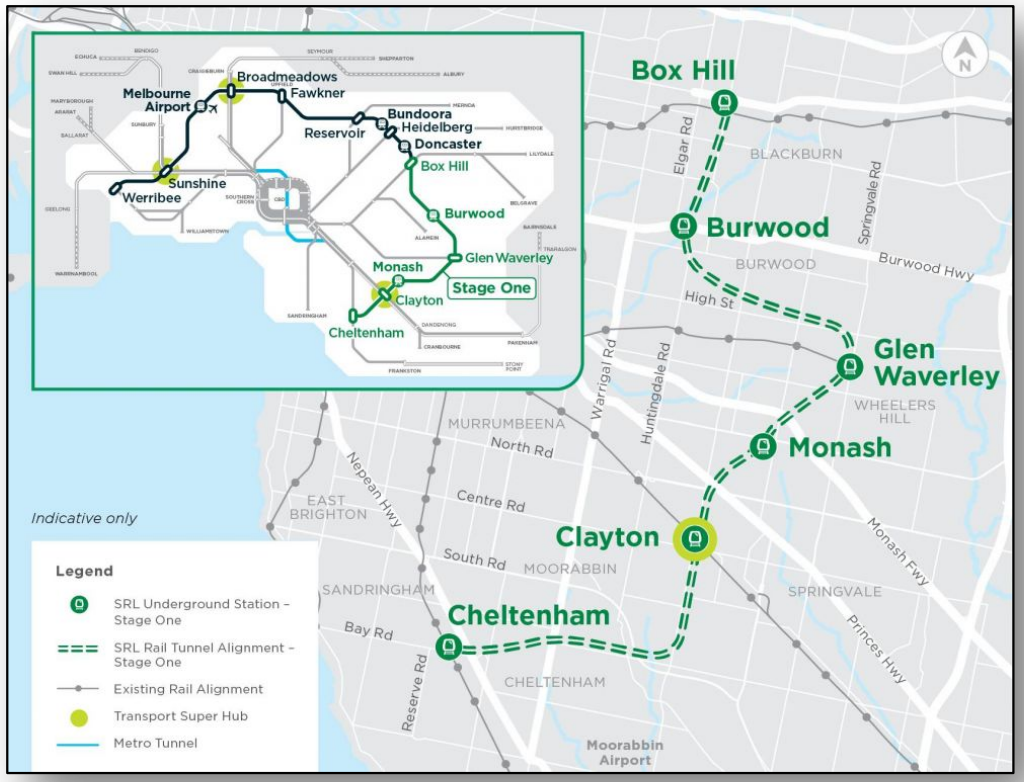
SRL is a ~90km circular metro project costing ~$125B; stage 1 opens 2035; rest 2085

- 90kms underground circular metro
- Driverless trains/ platform doors (Singapore/ Victoria Line like)
- Stage 1 commenced target completion 2035; cost $36.5B
- Targets:
  - Connect 4 NEICs
  - Rapid population growth
  - Monocentric (CBD) urban form constraints
  - Refocus population growth in middle not inner/outer suburbs
  - Inequitable access to jobs/services
- BCR 1 to 1.7



There is little research on loop rationale; SRL has strong polycentric city rationale; research supports this but in denser inner areas closer to CBD's

Research Literature – Loop Metro Design and Rationale

- Melbourne SRL
  - city-shaping/ urban planning objectives - polycentric city would require large-scale public transport connectivity to intensify activity around National Employment Innovation Clusters (NEICs) (Buxton, 2018).
  - Spiller emphasises that the SRL should aim to effectively redistribute jobs and housing to enable sustainable growth (Spiller, 2019).
- Other Loop Metro Research
  - Not much research
  - Saidi et al. (2016) review the optimal location and radius of circumferential rail lines and applies this to the City of Calgary Canada, generating an optimal ring loop of 6-9km away from the CBD (in comparison the SRL is broadly 15k-16km from the CBD).
  - Another study Saidi et al. (2014) on suburban ring lines highlighted the prominent trend of higher ridership in European and Asian cities compared to North American cities due to stronger rail links in suburban contexts.

Loops enhance rail coverage with evidence of stronger network performance compared to radial networks

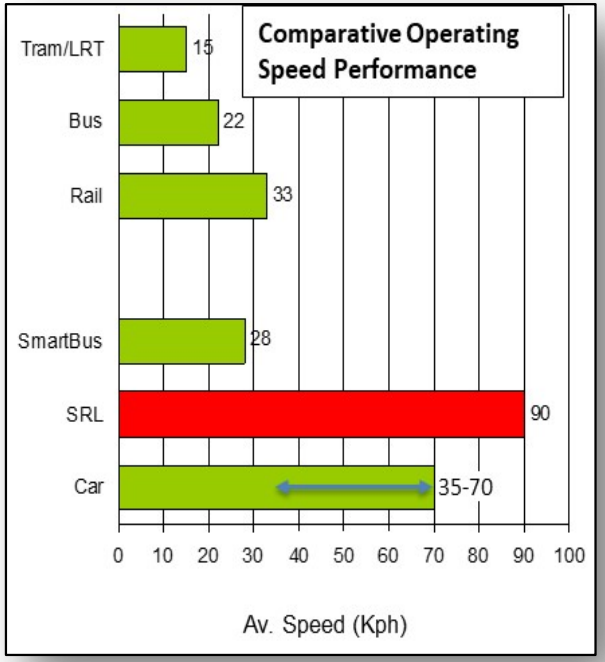
Research Literature – Improved Connectivity and Travel Path Directness

- Other Loop Metro Research
  - Circumferential rail loops = stronger connectivity through a city's network by enabling circular access around a major city hub.
  - Multiple studies have indicated that radial-based networks leading directly into a city centre cause concentrated passenger load in the city centre due to lack of rail lines orbiting circularly through surrounding suburbs (Saidi et al., 2016, Laporte et al., 1997). This is particularly evident in cities with monocentric rail transit behaviours, such as Melbourne.
  - Saidi et al., 2014) note a global rail network trends towards the development of ring line networks, where polycentric cities are often serviced by rail networks interconnected by a ring-based transit.
  - Modelling by Laporte et al. (1997) suggests that stronger connectivity and path directness is achieved using "cartwheel" networks rather than traditional radial networks ("hub-and-spoke").
  - Derrible and Kennedy (2009) model ridership for underground-only stations around the world They found statistically significant explanatory variables were network coverage, directness and connectivity. With Melbourne's monocentric travel patterns resulting in major transfer activity in CBD stations (Flinders Street, Melbourne Central, Southern Cross), integrating a circumferential rail loop to produce a rail network with multiple transfer points may prove beneficial

Research supports higher ridership with high coverage diurect and better connected rail networks support the SRL rationale

Research Literature – Increased Ridership Decreased Auto Use

- Other Loop Metro Research
  - Rail system ridership is strongly correlated with coverage, directness, and connectivity (Derrible and Kennedy, 2009), resulting in a faster/efficient route.
    - Orbital rail lines aim to decrease travel times of various routes by improving these three variables.
  - The low public transport usage for Melbourne inter-suburbs trips (bus network) may be caused by high travel-times of bus routes in comparison to private vehicle travel.
  - Loader 2011 - identifies growing residential suburbs exhibiting low public transport usage when travelling to suburban employment clusters (typically ranging between 1%-5%)
    - Comparing these metrics with PT-share to inner-city employment hubs (57%-73%) indicate the effects of travel-cost and time savings offered by a rail line to the city (petrol cost, road tolls, parking fees, congestion). The SRL may not reduce travel-cost savings to the magnitude of inner-city travel but may provide significant public transport speeds to the suburban network.
  - To contextualise this, Figure shows some simple average travel speed calculations of the planned SRL



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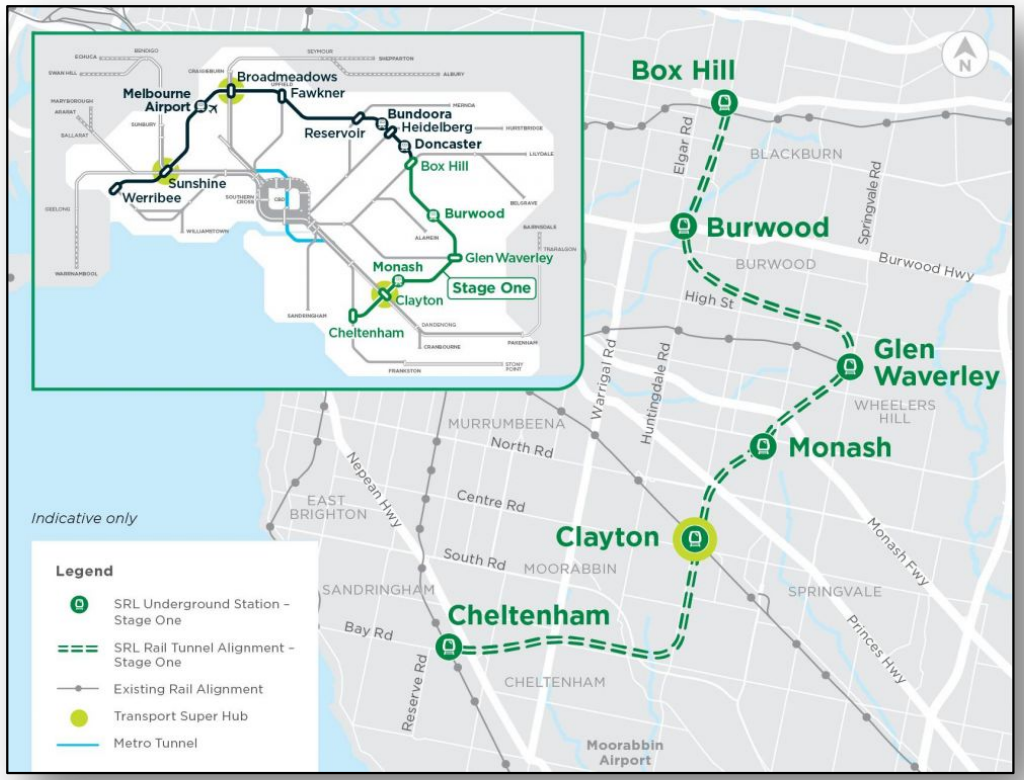
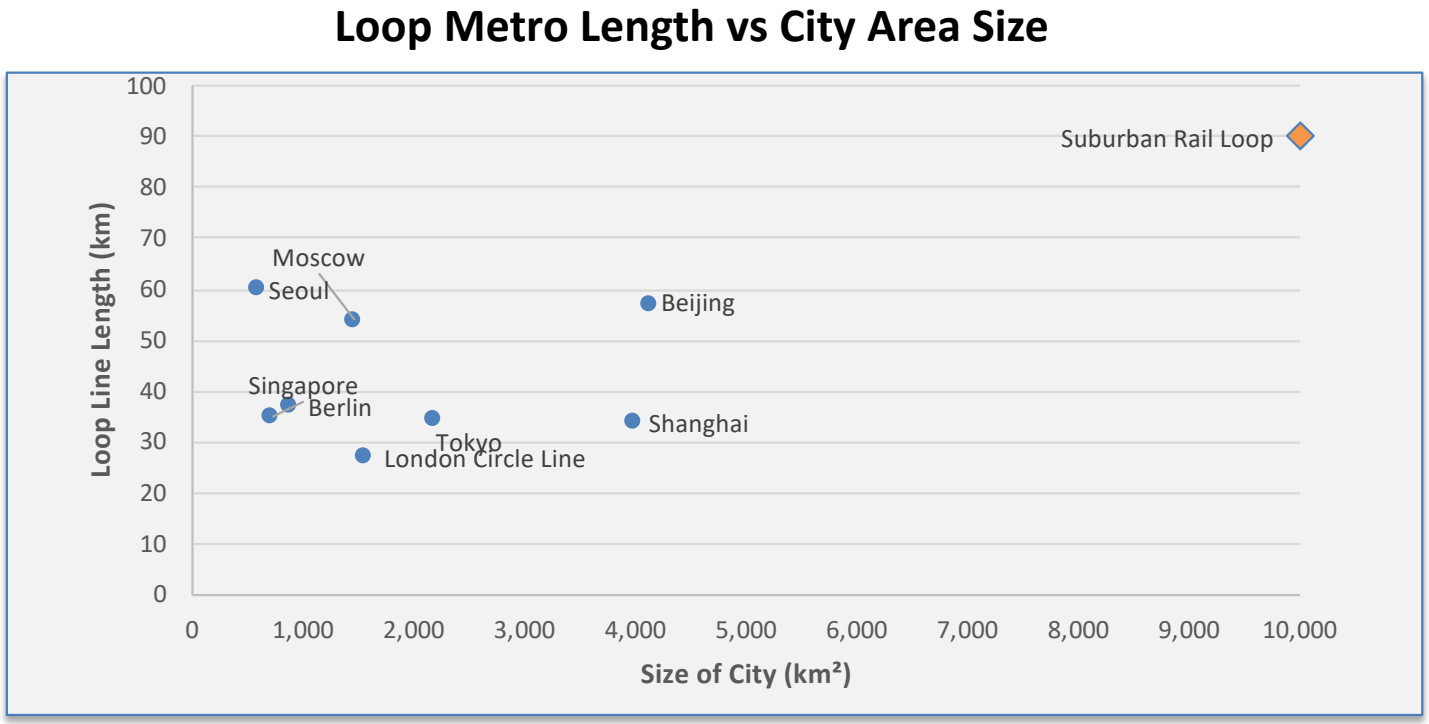
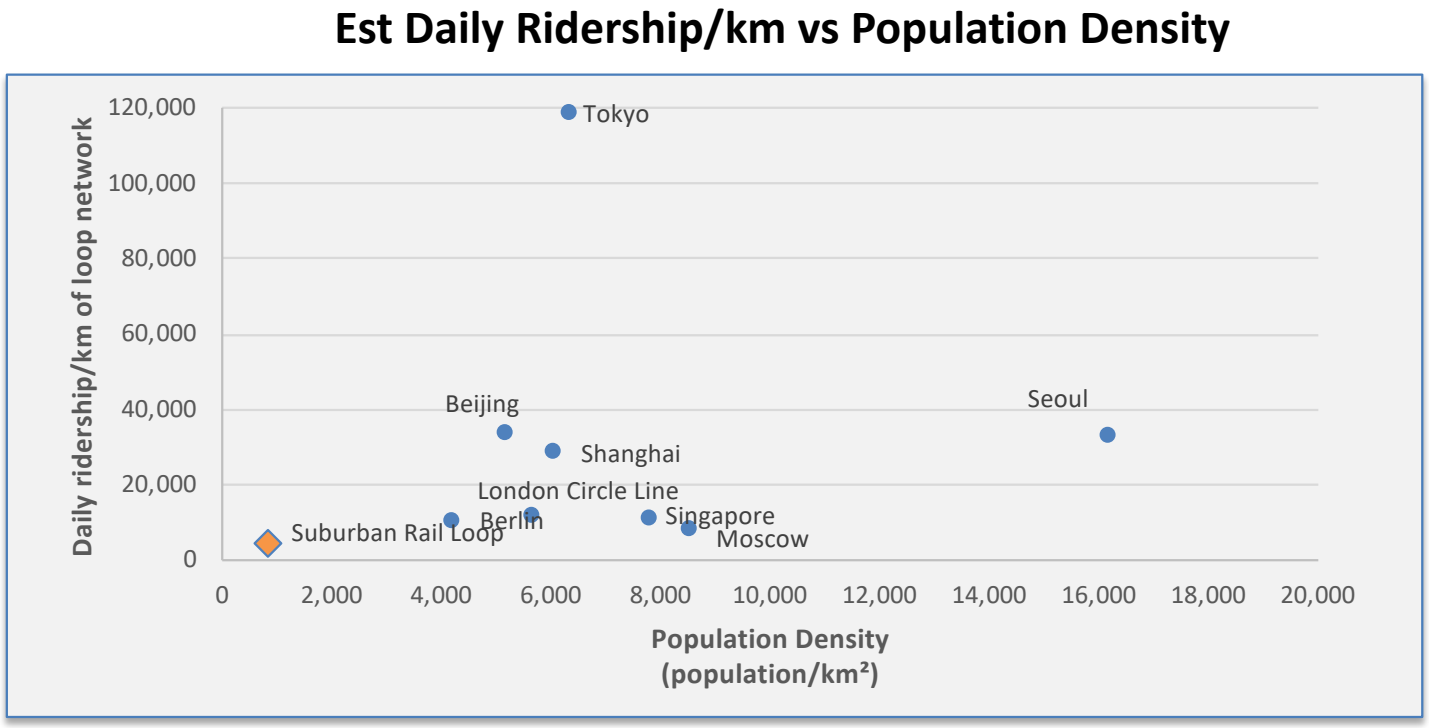


SRL will be the longest loop metro for the largest city area in the world by far



Source: Fernando A and Currie G (In Press) "A Comparative International Review of Suburban Ring/Loop Metros to Inform the Melbourne Suburban Rail Loop Project" Australasian Transport Research Forum 2023 Proceedings 29 November – 1 December, Perth, Australia

SRL will be the lowest ridership/km loop metro operating in the lowest density city context



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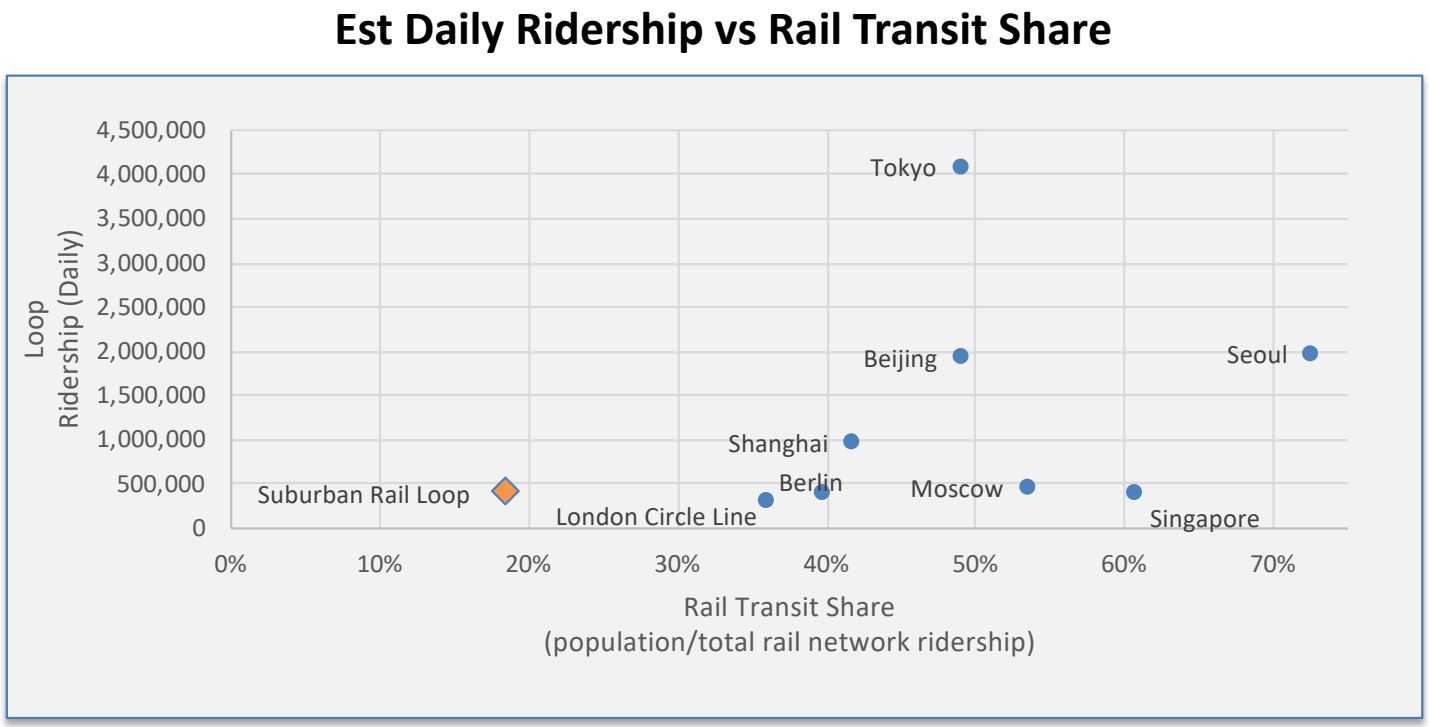
SRL will have low loop metro ridership/day operating at the lowest rail transit mode share



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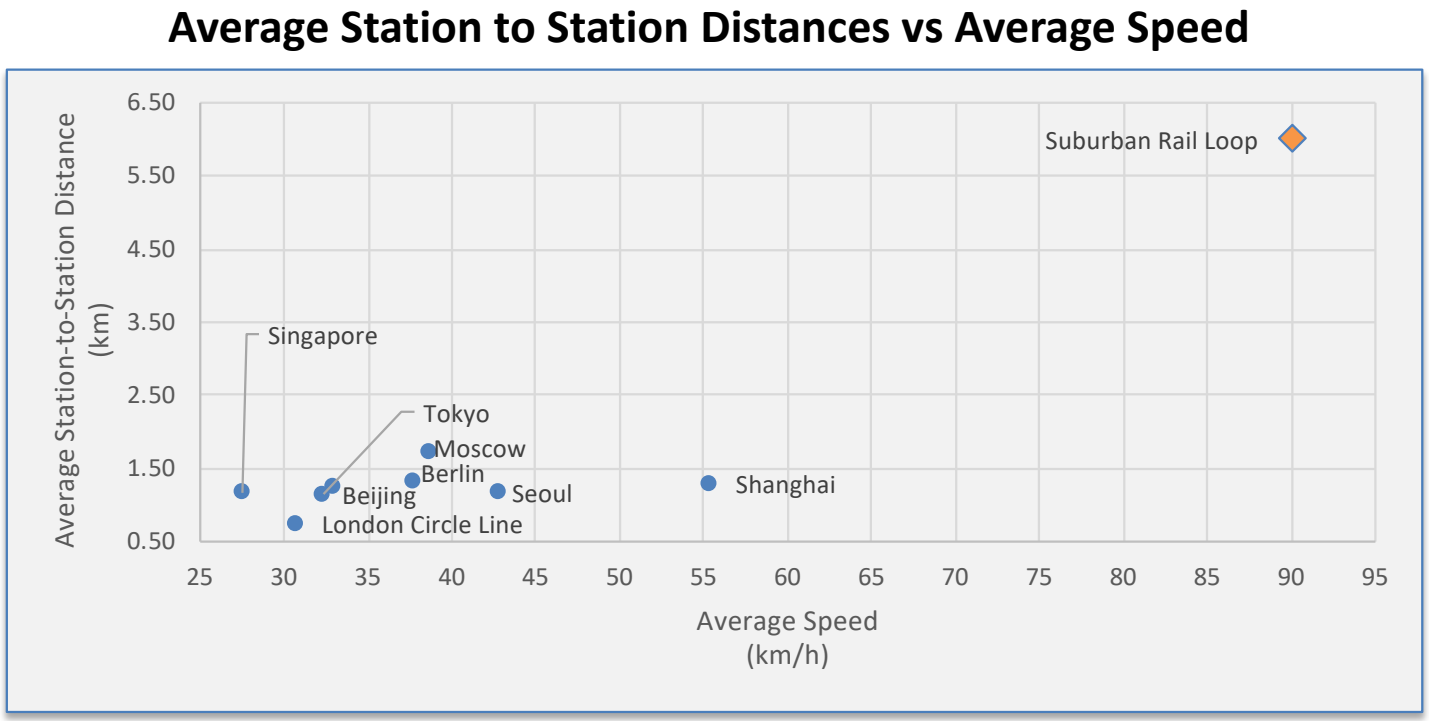
SRL has the longest station-station distances and is the fastest loop metro in the world



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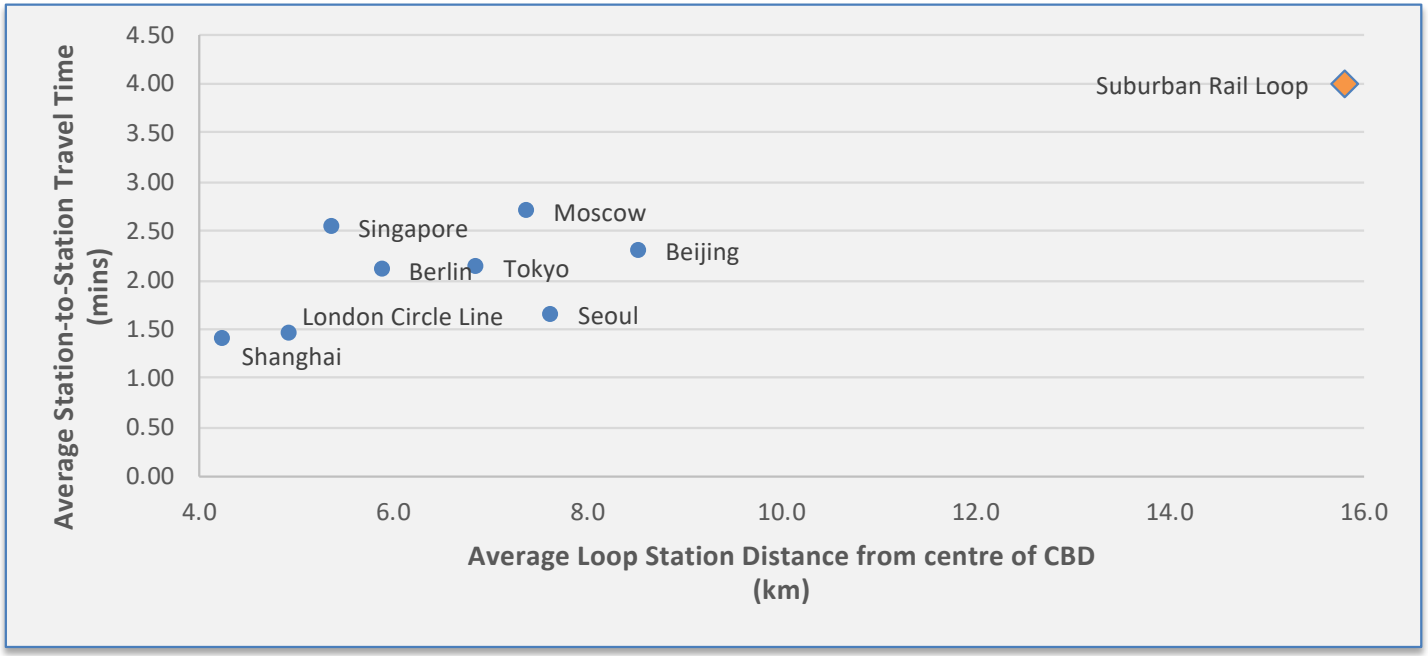
SRL has the longest station-station distances and stations are located further from the CBD than any loop metro in the world

Average Station to Station Distances vs Station Distance from CBD



Source: Fernando A and Currie G (In Press) "A Comparative International Review of Suburban Ring/Loop Metros to Inform the Melbourne Suburban Rail Loop Project" Australasian Transport Research Forum 2023 Proceedings 29 November – 1 December, Perth, Australia

We conclude SRL is the largest loop; operating in the most challenging ridership conditions but at the highest speeds

Key conclusions of the comparative analysis:

Melbourne SRL is:

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- it will cover a larger spatial area ;
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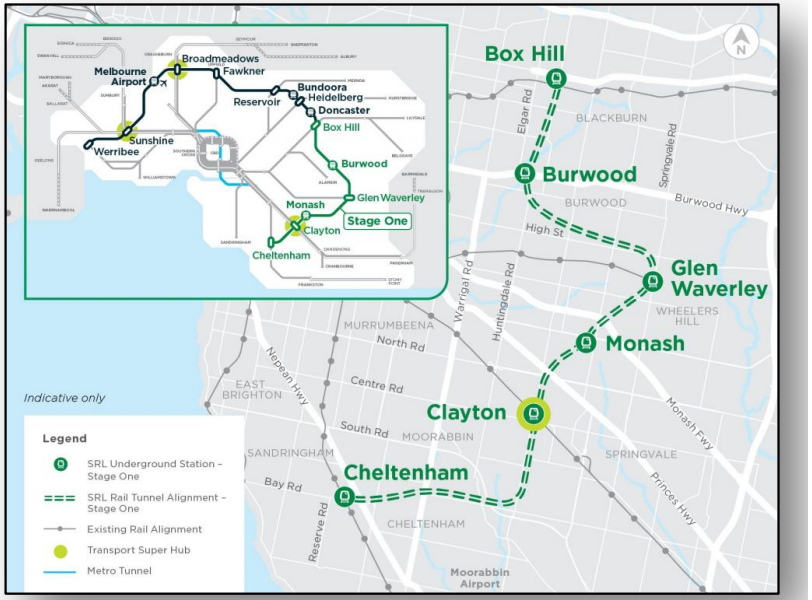

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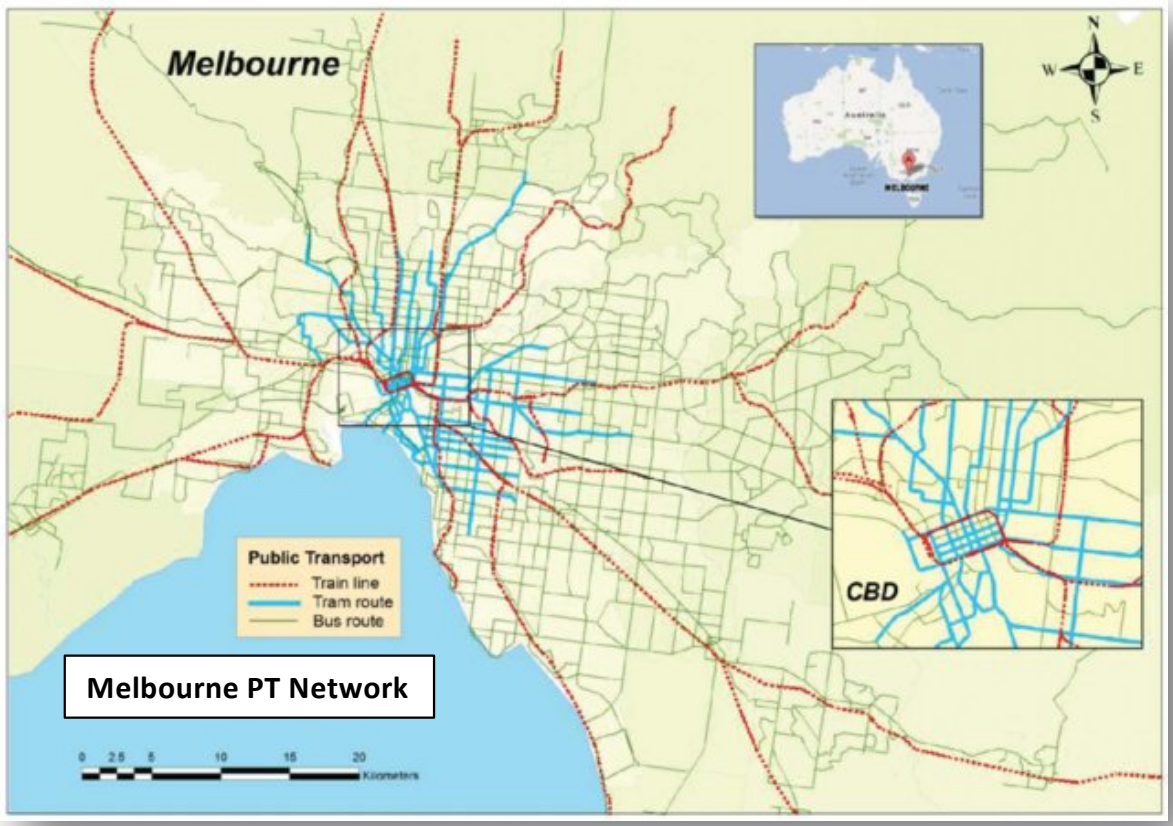
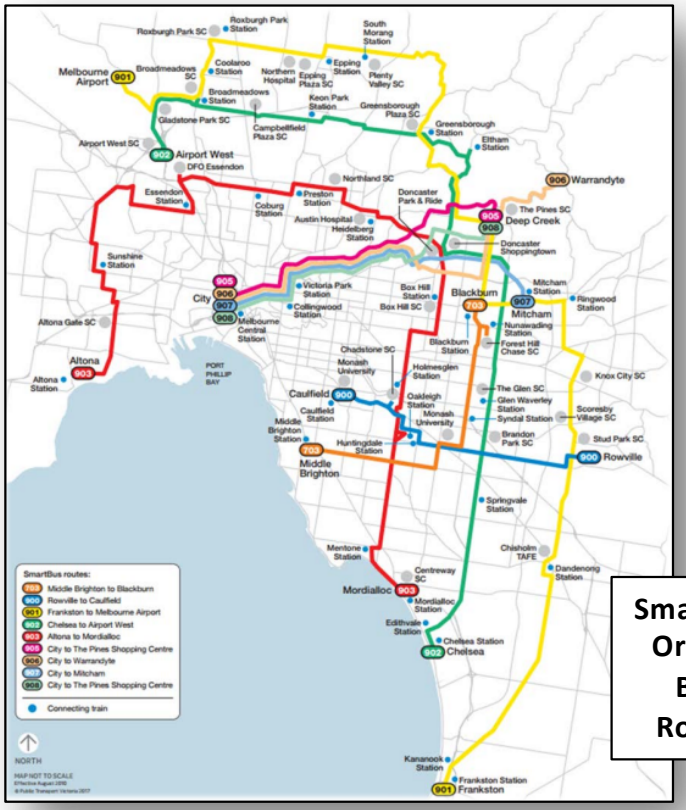
Melbourne has long had a significant cross corridor PT problem – SmartBus was the last solution tried to address this…



Melbourne PT Network

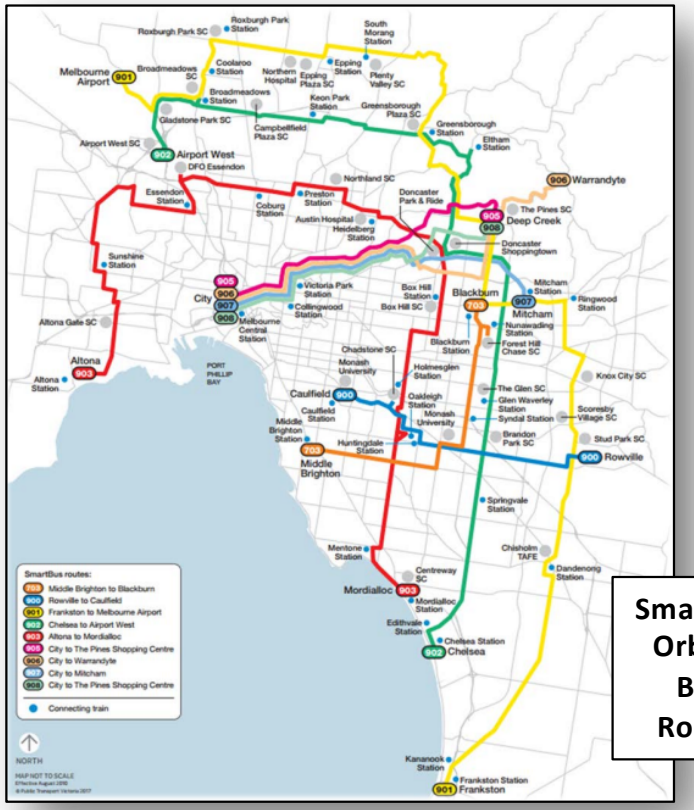


SmartBus Orbital Bus Routes

…alas SmartBus, despite priority measures is quite slow and uncompetitive with car

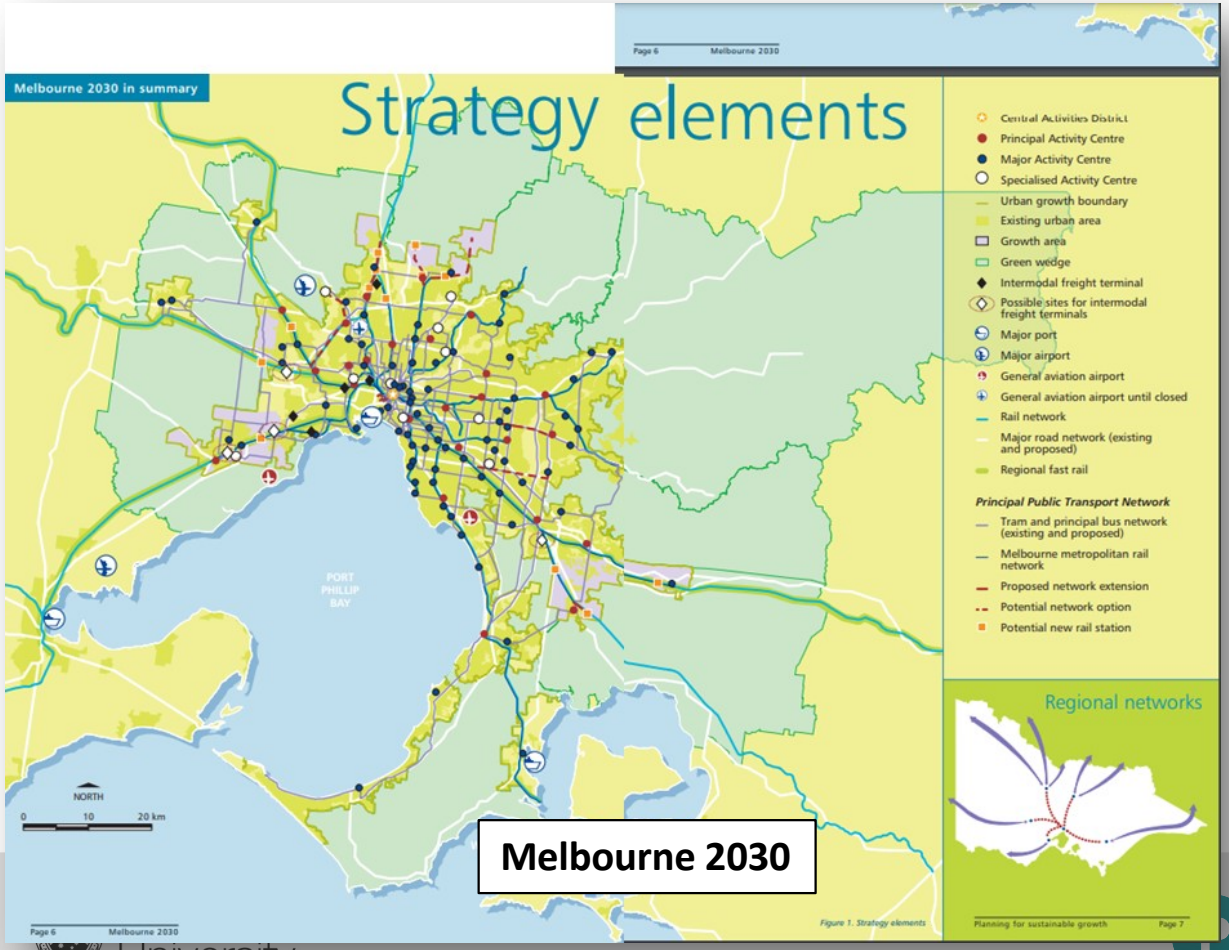
SmartBus vs Car

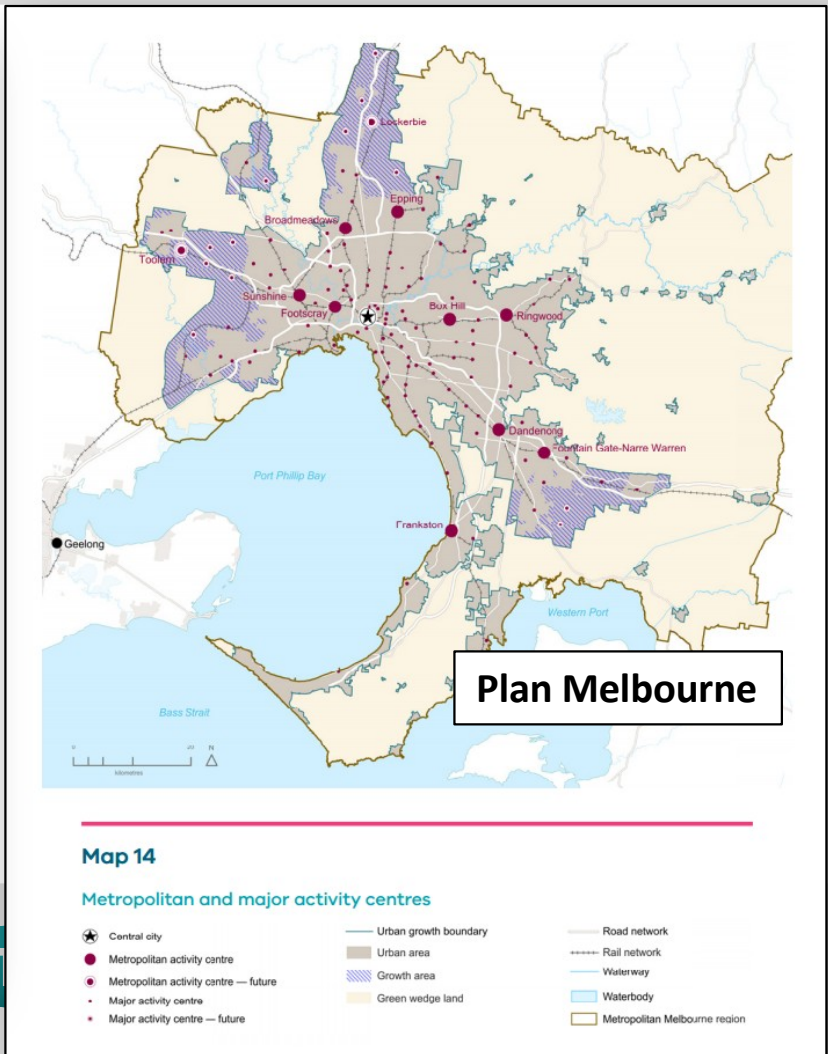
Route	SmartBus		Car	
	Travel Time (hrs, mins)	Speed (kph)	Travel Time (hrs, mins)	Speed (kph)
901: Frankston to Melbourne Airport. Length 113.6km.	4hrs	28kph	1hr 4min	71kph
902: Frankston to Melbourne Airport. Length 77.8km.	3hrs	26kph	1hr 4min	71kph
903: Frankston to Melbourne Airport. Length 85.6km.	3hr 50 min	23kph	1hr 4min	71kph



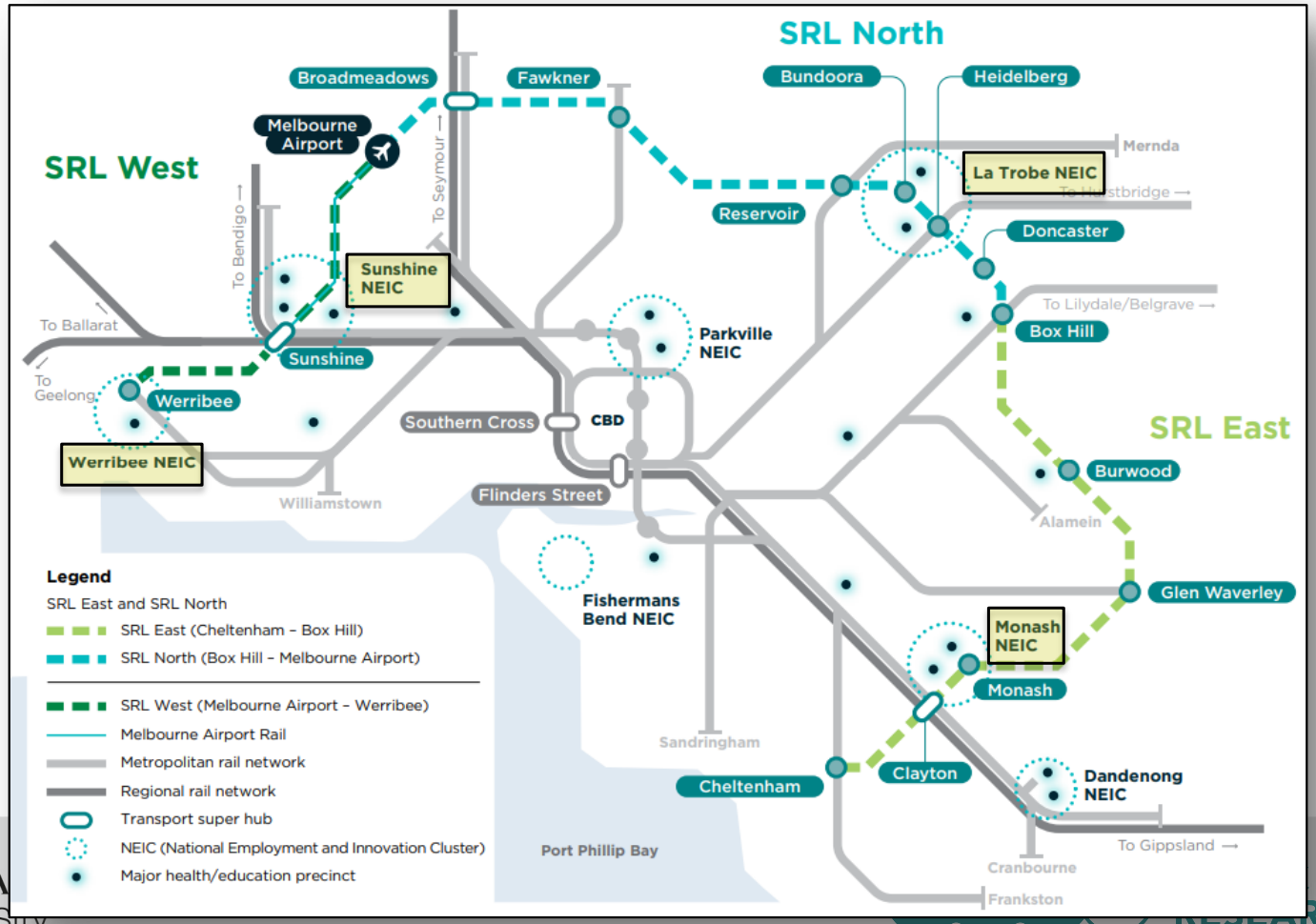
SmartBus Orbital Bus Routes

Melbourne plans have always sought to decentralise; but have failed due to poor investment (in sustainable transport)

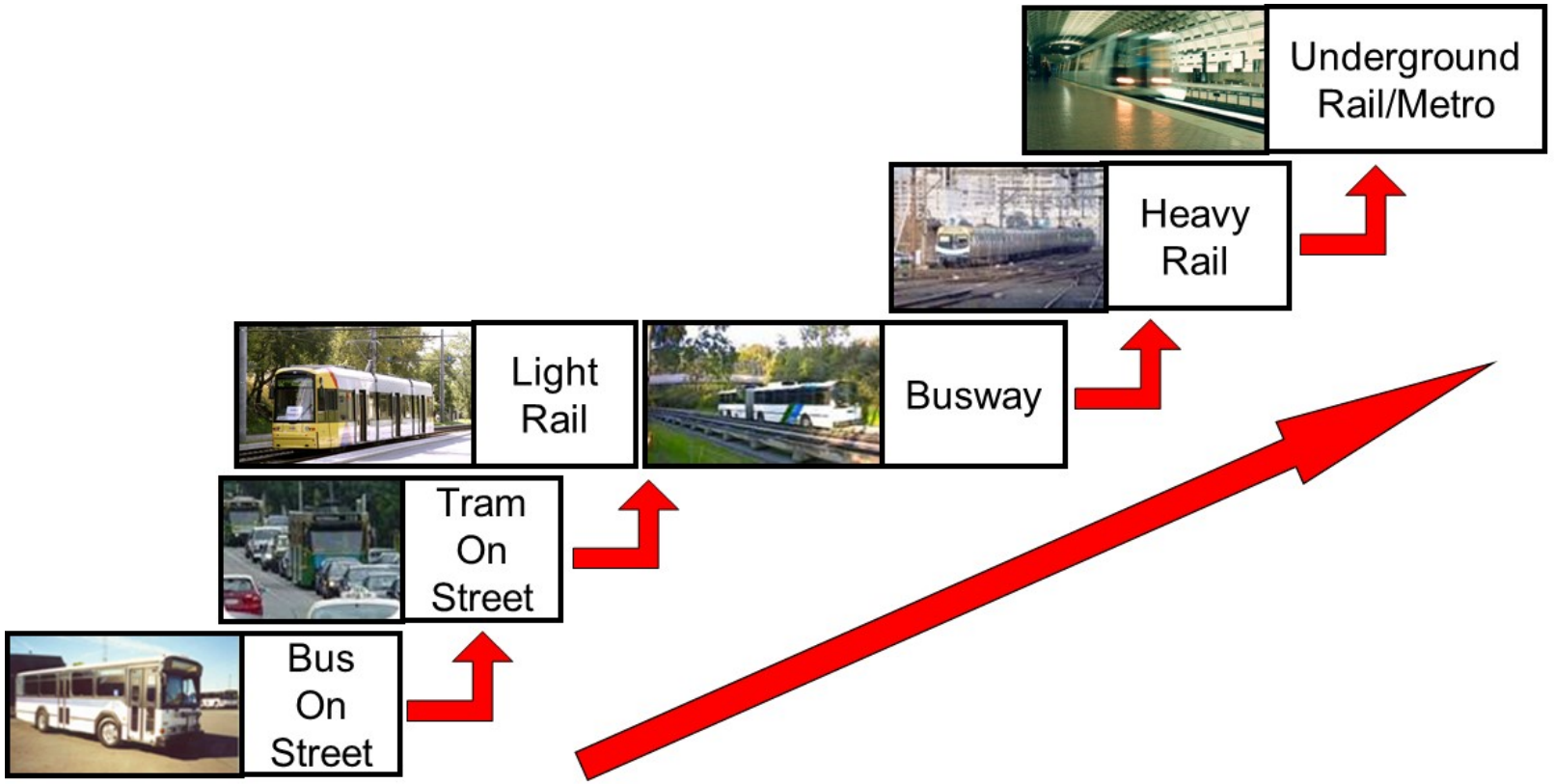




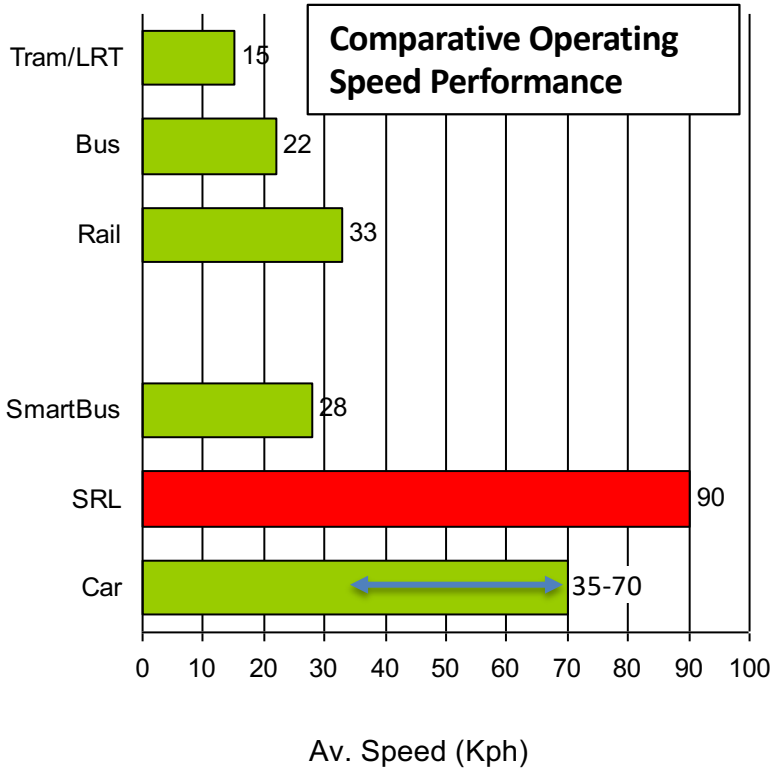
SRL aims to achieve this and link 4 of the new National Employment and Innovation Clusters

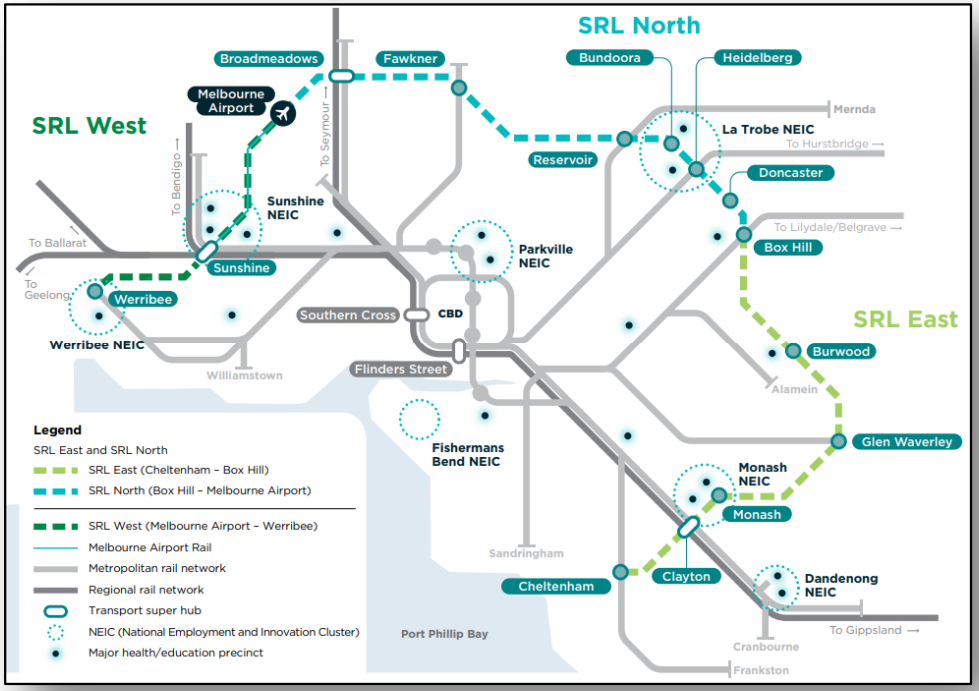


Metros are a significant quality upgrade above on-street bus…SRL is VISIONARY in this sense; its got great development potential but very high cost



Its also very competitive with the car; something bus even SmartBus cannot achieve





However the development impacts will be …..MASSIVE; are residents ready for this? and what about FUTURE residents who will outnumber them?

Clayton Railway Station
Melbourne

Nagoya Railway Station
Japan

But planning of SRL has been weak; its in no city or rail plan; its not good practice for city planning…

…also VAGO identified weaknesses in the business case; limited exploration of alternative mode options

FIGURE 2C: **Assessment of SRL business case content**

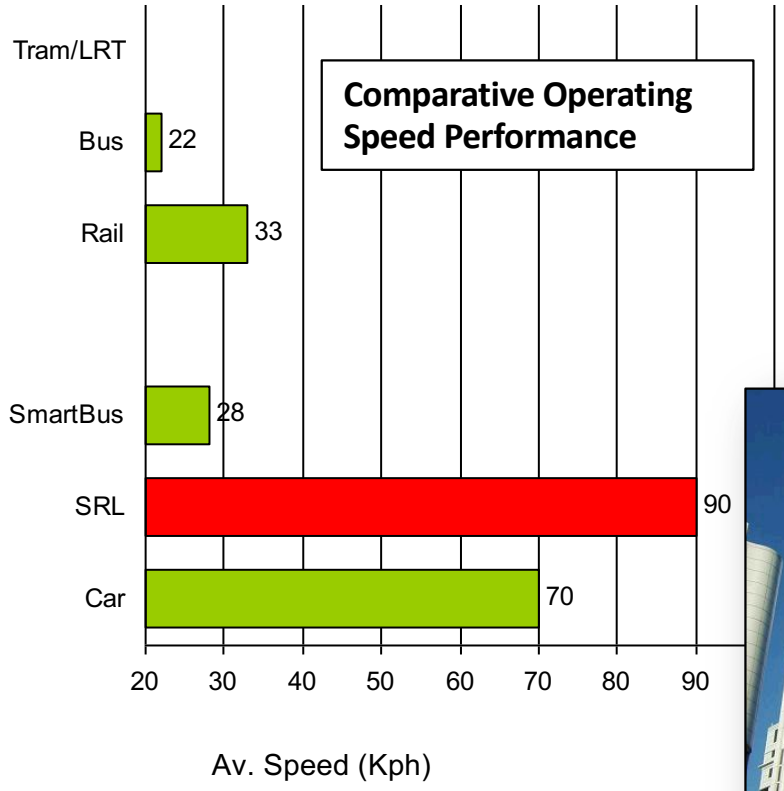
Business case content areas	Assessment
Problem definition and evidence	A
Case for change (benefits)	A
Options assessment	R
Economic analysis and presentation of results	R
Delivery case	A

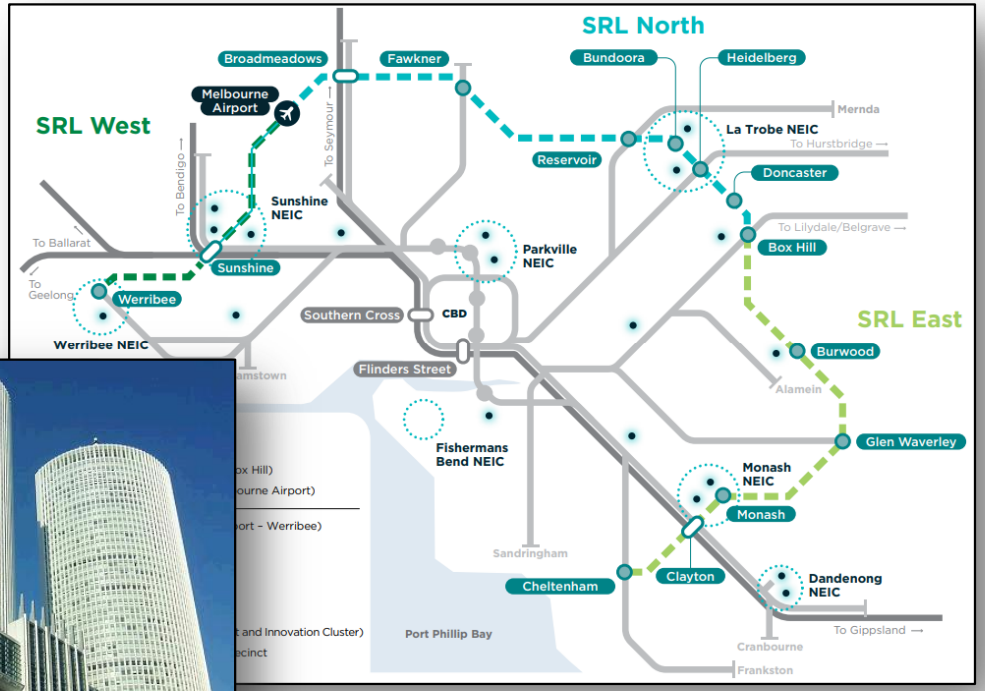
Note: We have used a green (G), amber (A), red (R) scale, where:
G = no or minor departures from relevant guidance and/or expected processes
A = some departures from relevant guidance and/or expected processes
R = significant departures from relevant guidance and/or expected processes.
Source: VAGO.

In summary:

- the high-level problems and benefits articulated in the SRL business case lacked necessary and sufficient supporting evidence
- a narrow set of options were considered and analysed both before and as part of the business case development
- the economic analysis does not cover the entire SRL program and lacks consistency with the guidance in key areas.

Overall I think this is a VISIONARY project, its an AMBITIOUS, STEP CHANGE idea with much potential to create desired change - BUT not good planning…





…and its the largest loop in the world; operating in the most challenging ridership conditions but at the highest speeds

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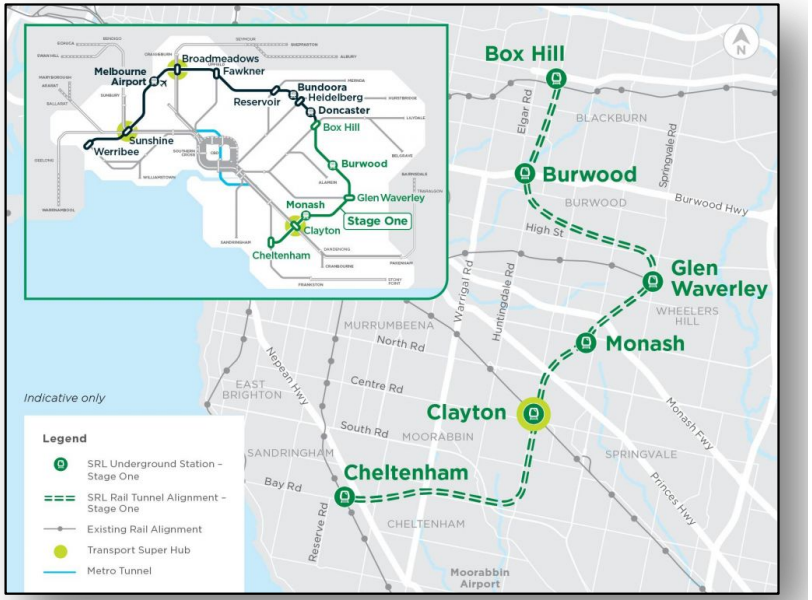

Please reach out for more information

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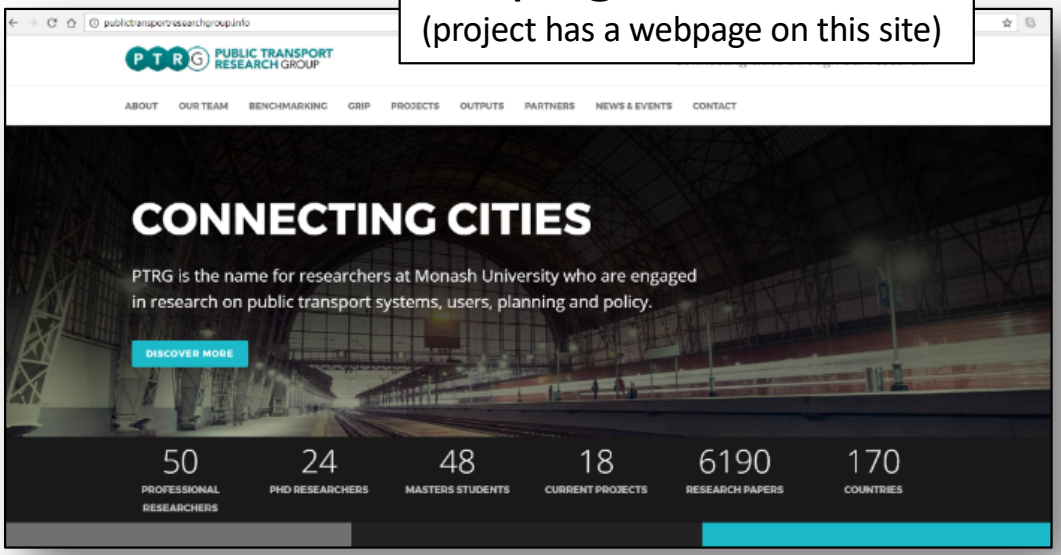
W: ptrg.info
(project has a webpage on this site)



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RT5 – Long term impact of COVID-19 on Travel Behaviour

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