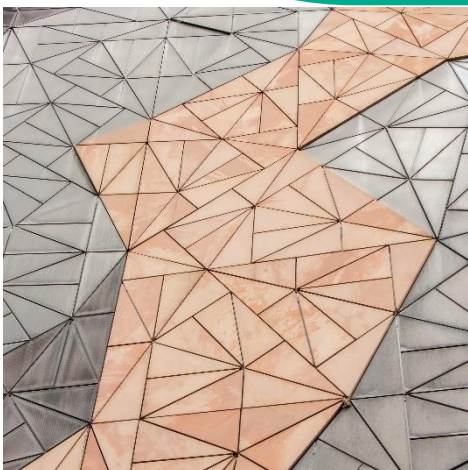


December 2022

# Get on board

Making the most of Melbourne's buses  
– discussion paper



## About us

Infrastructure Victoria is an independent advisory body with 3 functions:

- preparing a 30-year infrastructure strategy for Victoria, which we review and update every 3 to 5 years
- advising the government on specific infrastructure matters
- publishing research on infrastructure-related issues.

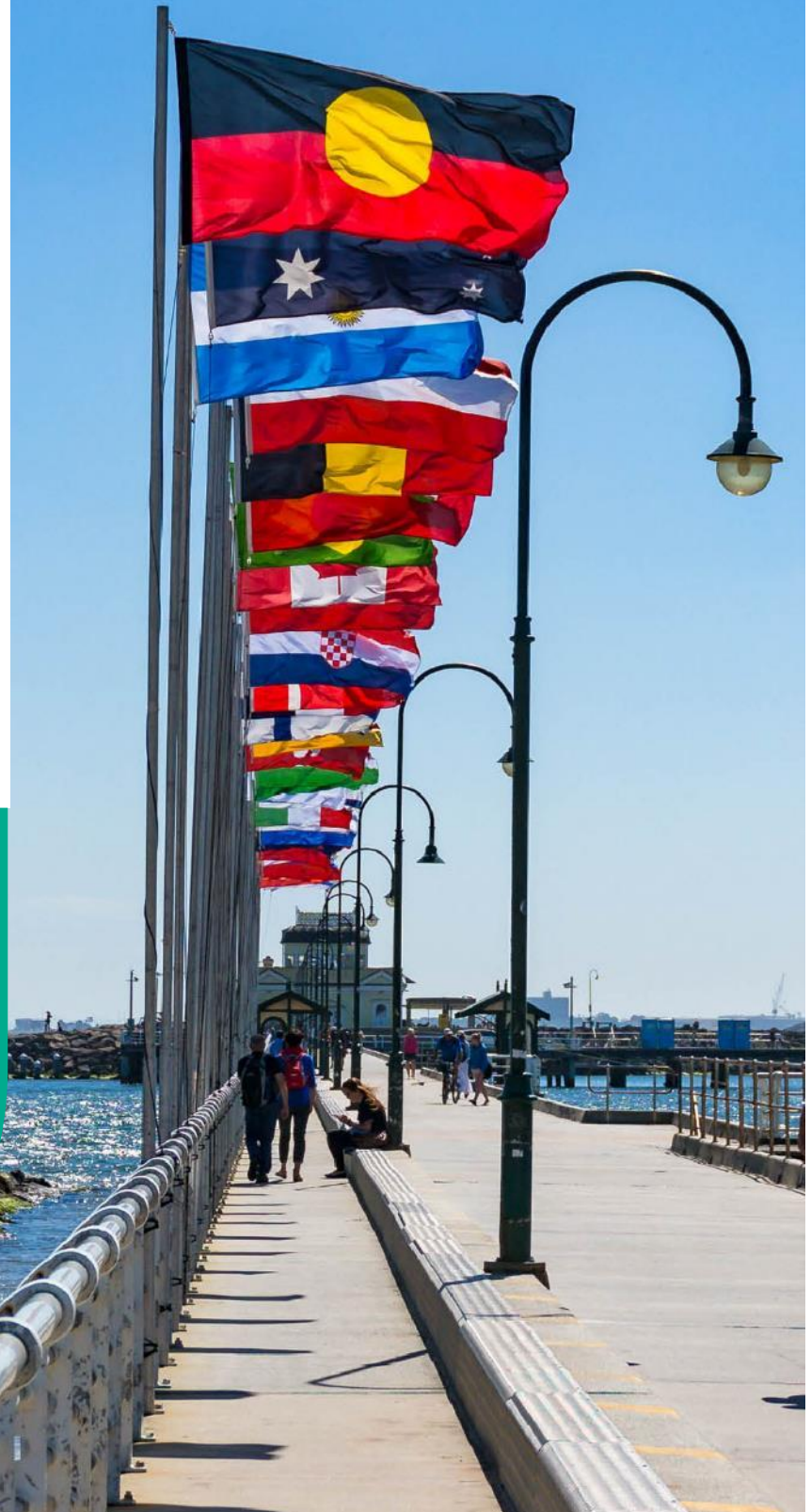
Infrastructure Victoria also helps government departments and agencies develop sectoral infrastructure plans.

Infrastructure Victoria aims to take a long-term, evidence-based view of infrastructure planning, and we inform community discussion about infrastructure provision.

Infrastructure Victoria does not directly oversee or fund infrastructure projects.

## Acknowledgement

Infrastructure Victoria acknowledges the Traditional Owners of Country in Victoria and pays respect to their Elders past and present, as well as Elders of other First Peoples' communities. We recognise that Victoria's infrastructure is built on land that has been managed by Aboriginal people for millennia.





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# Executive summary

## Now is the time for bus reform

As Victoria emerges from the COVID-19 pandemic, the Victorian Government expects population growth to resume. By 2036, the population in Melbourne's outer suburbs and new growth areas will have overtaken the total population of Melbourne's inner and middle suburbs.<sup>1</sup> Many of these suburbs have only one public transport choice: the bus.<sup>2</sup>

Billions of dollars are also currently being invested in major rail and road transport infrastructure projects,<sup>3</sup> and to get the most out of these investments, the Victorian Government will need to optimise the bus system. This means providing bus services which support travel anywhere in Melbourne, are competitive with the car, and are easy to use.

Road vehicles like cars, buses and trucks contribute almost 90% of transport emissions and without action, these transport sector emissions are expected to continue to grow.<sup>4</sup> If there is no change to travel habits and mode shift to more sustainable forms of transport, the impacts of climate change can also significantly disrupt the operations, maintenance, and investment of the wider transport network.<sup>5</sup> The shift to zero emissions buses over the coming decade<sup>6</sup> also presents an opportunity to improve the user experience and the public perception of buses, with reduced noise and pollution.

## This research aligns with and supports the Department of Transport's bus reform program

The Victorian Government has already recognised the potential for a better bus system in Victoria. *Victoria's bus plan* signals a renewed interest in substantial bus reform for the first time in a decade.<sup>7</sup> Published by the Department of Transport (DoT) in 2021, the bus plan and its committed actions are a significant first step towards bus reform in Victoria. The plan flags the government's intention to support delivery of a modern, productive, environmentally sustainable bus system that increases the number of people choosing to take the bus by delivering simple, safe, reliable and comfortable journeys. The plan also highlights improvement opportunities for the whole bus system, including the networks, bus fleet, performance, commercial, innovation and customer experience.

Infrastructure Victoria's research program on bus reform will inform and complement DoT's research and planning, alongside reform efforts of the bus industry. Our work aims to add to the evidence base on the benefits of bus reform by taking an independent and interdisciplinary approach, which will help the Victorian Government make more informed decisions on actions, priorities and investment. Infrastructure Victoria will publish our findings which will also assist in guiding policy beyond the current tranche of reform.

## The focus of our research

Our aim is to provide evidence-based research and policy recommendations to the Victorian Government on how to further improve Melbourne's bus services, and to complement DoT's bus reform work. Our research will explore and provide guidance in the following areas:

- policy and service reform to improve travel for people who use buses and to encourage new bus users
- how to design the bus system to integrate with land use planning to better support Melbourne's growth
- how a better bus system can address some of Melbourne's social and environmental challenges.

This discussion paper is an introduction to Infrastructure Victoria's program of work on bus reform in Melbourne.<sup>8</sup> Our independent and interdisciplinary approach allows us to comprehensively assess reform opportunities and pathways to improving buses. This discussion paper is designed to progress the conversation, inform future policy direction and build on our previous research on bus reform.<sup>9</sup>

Note that regional bus services, school bus services and train replacement and disruption bus services are not within scope of our current research.

## Four big challenges for buses in Melbourne

Our research has identified four major challenges facing Melbourne's bus system:

- 1. Buses are rarely a competitive travel option.** Low frequencies, limited operating hours, and slow and complex routes make buses an unattractive alternative to the private vehicle.
- 2. Victorian communities can get better value from the bus network.** While the government spends a substantial amount on operations of the bus network, there are some locations which receive limited benefits.
- 3. The existing bus network is contributing to a major equity problem, especially for outer and growth areas of Melbourne.** A substandard bus service offering can limit the opportunities to participate in work, social activities or study for those people who have no other transport options. This can lead to social isolation, financial stress, and inequality of access to jobs and services.
- 4. Customers find using the bus difficult and complex.** Perceptions and barriers to entry keep many people from using the bus at all. People who do choose to take buses are often confronted with limited real-time information, a lack of quality stop infrastructure, safety concerns, and unreliable service levels.

## Benefits of bus reform

Reimagining the bus system has many potential benefits, both for individuals and for broader society. Changes to the planning and operation of buses in Melbourne can provide more people with quicker, more reliable services, and expand their transport options. People will benefit by gaining better access to employment and education hubs, which expands their economic opportunities. Individuals benefit from the health aspects of walking to a bus stop, more choice to participate in activities, reduced congestion on the roads, greater accessibility, and more diverse transport options. Bus reform also means better access to services, community and recreation facilities, supporting a healthier, more resilient and cohesive society. A busy bus generally emits less greenhouse gas emissions for each passenger kilometre travelled than a car<sup>10</sup> and reduces road crashes.<sup>11</sup>

## About this discussion paper

This discussion paper presents Infrastructure Victoria's research on issues and opportunities for bus reform in Melbourne. It is a conversation starter to help shape our future work.

This discussion paper will inform our conversations with stakeholders to gain further evidence to develop our final recommendations on bus reform. Our next phase of work will explore the trade-offs and challenges involved in pursuing bus reform options, and develop a package of recommended reforms.

Our analysis will culminate in a final report setting out the rationale and benefits of further bus reform. The research is intended to assist the Victorian Government and industry with its current program of bus reform, as well as any future bus reform.

# Buses by the numbers

Buses service vast areas of Melbourne. Here are some fast facts about how the current bus network operates, and how it could operate in the future.

**400+**  
routes



Melbourne has over 400 bus routes, including more than 30 night routes.<sup>12</sup>

Approx.  
**120 million**  
annual boardings



Before COVID-19, the metropolitan bus network had approximately 120 million total annual boardings.<sup>13</sup> By early 2022, public transport patronage had recovered to 60% of pre-COVID levels.<sup>14</sup>

A bus every  
**30 minutes**



Average metropolitan Melbourne bus services operate every 30 minutes during the weekday peak, extending out to 51 minutes on Sundays.<sup>15</sup>

Only  
**52 kilometres**  
of dedicated  
lanes



Most of Melbourne's buses share the road with other traffic. Dedicated bus priority lanes account for only 52km of the entire network.<sup>16</sup>

**82%** of  
dwellings within  
400m of a bus  
stop



82% of dwellings across metropolitan Melbourne are within 400 metres (or a 5-minute walk) of a bus route.<sup>17</sup> But in growth areas only 25% of dwellings are within 400 metres of a public transport stop of any kind.<sup>18</sup>

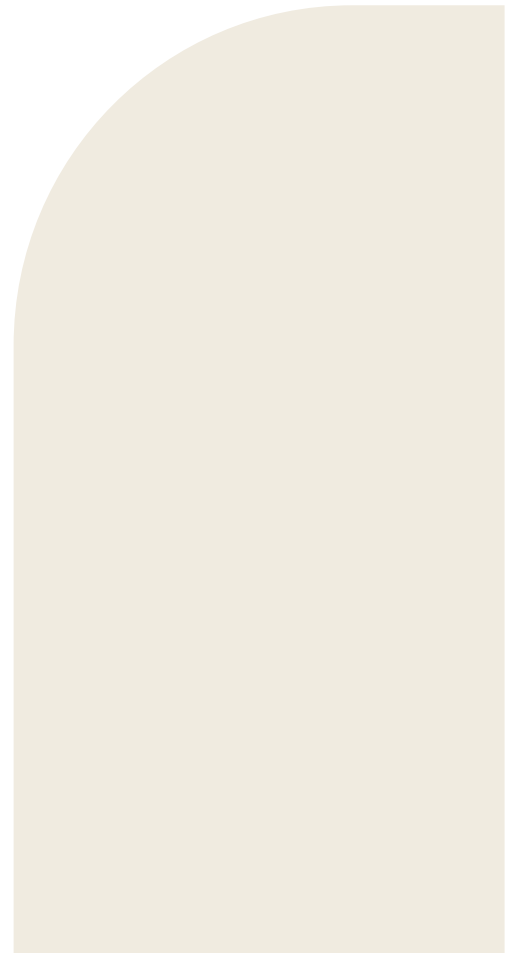
Buses will play an  
**increasingly  
important role**  
in connecting  
Melburnians



Population growth in new growth areas will far outstrip employment opportunities by 2051.<sup>19</sup> Buses will increasingly play an important role in connecting residents with jobs in other parts of Melbourne.



# Part one: Setting the scene



# 1. Introduction

## 1.1 Buses in Melbourne

Melbourne's bus network typically carries around 120 million passenger per year<sup>20</sup> on more than 400 bus routes.<sup>21</sup> Buses are the closest mode of public transport for many Melburnians, with 82% of homes being within 400 metres, or a 5-minute walk, of a local bus route.<sup>22</sup> Train and tram services have much more limited coverage, being similarly close to only 30% and 20% of homes, respectively.

Bus operations require substantial government funding. Metropolitan bus services cost the Victorian Government around \$800 million each year.<sup>23</sup> This cost represents 30% of funding for metropolitan public transport operations, though buses typically account for just 20% of public transport trips in Melbourne.<sup>24</sup>

Infrastructure Victoria's previous analysis shows that the bus system could work better for Victorians.<sup>25</sup> Improving Melbourne's bus system will take time and must account for future trends. As Victoria emerges from the COVID-19 pandemic, population growth is expected to resume. By 2036, Melbourne's new growth areas and outer suburbs will be home to around half of Melbourne's residents.<sup>26</sup> In these areas, the bus is often the only public transport option.<sup>27</sup>

To get the most out of the billions of dollars currently being invested in major rail and road transport infrastructure,<sup>28</sup> the bus system will also need to be operating at its best, connecting communities, supporting convenient travel, and maximising the use of these major infrastructure investments. The shift to zero emissions buses in the coming decade<sup>29</sup> also presents an opportunity to improve the user experience and the public perception of buses.

The Victorian Government has recognised the potential for a better bus system in Victoria. *Victoria's bus plan*<sup>30</sup> signals a renewed interest in substantial bus reform for the first time in a decade. Our intention is to inform and complement, rather than duplicate existing efforts led by the Department of Transport (DoT). Our independent and interdisciplinary approach allows us to comprehensively assess suitable pathways and options for improving buses. This discussion paper is designed to progress the conversation and inform future policy direction, building on our previous research on bus reform.<sup>31</sup>

## 1.2 Our approach

Infrastructure Victoria is taking a staged approach to our bus reform research.

### 1.2.1 Stage 1 – Early research

This discussion paper is informed by a literature review and data analysis, which brings together Infrastructure Victoria's initial findings for bus reform in Melbourne. It builds on previous research and recommendations for reform highlighted in our *Five-year focus*<sup>32</sup> and *Victoria's infrastructure strategy 2021-2051*.<sup>33</sup>

This discussion paper gives a snapshot of Melbourne's bus system, provides a framework for bus reform, and identifies four big challenges with the system, as well as instances where buses are working well. It informs our conversations with stakeholders including transport advocacy groups, local government, peak bodies, industry, bus operators and academics. We welcome feedback on any of the discussion paper content.

In particular, we invite responses to the following questions relating to this discussion paper. Feedback can be provided by emailing: [busreform@infrastructurevictoria.com.au](mailto:busreform@infrastructurevictoria.com.au)



## Discussion paper questions for stakeholders

### Network challenges

- Has Infrastructure Victoria identified the major problems or challenges with the metropolitan bus network? Have we missed anything?
- What are the barriers to addressing the challenges that we have identified? What can be done to address these challenges?
- Can you provide any evidence that would help us better understand the network challenges?

### Reform opportunities

- Are there other large reform opportunities that you can identify to improve buses in Melbourne?
- Do you think there are any constraints in implementing any of the reform opportunities that we have identified?

### Benefits of reform

- What reforms are likely to have the greatest influence on delivering economic, environmental, or social benefits for Melburnians?
- Can you provide any evidence to help quantify the benefits and inform our assessment of future bus reform options?

## 1.2.2 Stage 2 – Develop analysis and final report

In our next project stage, we will explore and analyse the trade-offs and challenges involved in pursuing bus reform options, undertake community research and develop recommendations.

Our analysis will culminate in a final report setting out the rationale and benefits of bus reform. This research is intended to inform and assist the Victorian Government and industry with its current program of bus reform, as well as any future bus reform.

## 1.2.3 Scope

This research is focused on public transport bus services in Melbourne and does not encompass buses in regional areas, which face a unique set of challenges and opportunities. However, our findings for Melbourne may also be relevant for larger regional cities such as Ballarat, Bendigo and Geelong.

Rail replacement and disruption bus services are not included as part of this research.

Our research also does not include school bus services. The use of school buses in rural and regional Victoria was part of a 2020-21 inquiry by the Legislative Council Economy and Infrastructure Committee, in which Infrastructure Victoria provided a submission.<sup>34,35</sup> Bus reform can have broader flow-on effects to the school bus network, including faster travel times and better interconnectivity between school buses and other public transport modes.

Public transport fares are also not the focus of this work, although our previous work suggests that fares are an important component part of wider bus reform.<sup>36</sup>

## Infrastructure Victoria's current program of bus reform analysis builds on our previous work

*Victoria's infrastructure strategy 2021–2051* includes recommendations to improve the bus services in Victoria. Our main recommendation is for action to reshape, reform, and expand the Victorian bus network as well as develop a 'next generation' of zero emissions, frequent, high quality bus services.<sup>37</sup> The strategy notes that a reformed bus network should be based on a hierarchy of new route classifications that distinguish between different types of public bus services. It also suggests reallocating road space for dedicated bus lanes and/or improved bus stops, to support faster travel for passengers.

In *Fair move: better public transport fares for Melbourne*, we found that relatively high bus fares discourage people from catching buses.<sup>38</sup> Our modelling showed that by making Melbourne's bus fares cheaper, around 93,000 extra people would take the bus each day—all without any changes to the existing bus network.

In *Five-year focus: immediate actions to tackle congestion*, Infrastructure Victoria recommended overhauling existing bus services, expanding successful routes and replacing poor performing routes with low cost, customer-responsive services.<sup>39</sup>

We also looked at the benefits of zero emissions vehicles and autonomous demand responsive transit (DRT) as part of our advice to the Victorian Government on autonomous and zero emissions vehicles.<sup>40</sup>

The appendix contains further background on Infrastructure Victoria's previous work on buses.



## 2. Framework for bus reform

Bus reform can mean different things to different people. To guide our thinking on bus reform, we reflect on the overarching objectives of a transport system in this section, and document some of the trade-offs involved in meeting them.

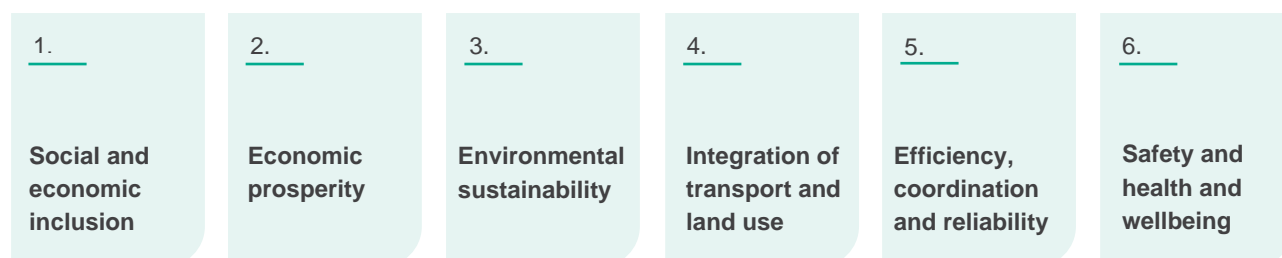
### 2.1 Objectives

#### 2.1.1 Transport system objectives

Broadly, the Victorian Government needs to plan the bus system to meet community needs. Victoria's *Transport Integration Act 2010* (Transport Integration Act) contains transport system objectives to guide transport planning in Victoria so it meets community needs.<sup>41</sup> These objectives support a 'triple bottom line' approach (social, economic, and environmental objectives) with additional objectives of transport and land use integration, efficient operation and safety.

Infrastructure Victoria uses the transport system objectives of the Transport Integration Act (below) to guide our bus reform work.

#### *Transport Integration Act 2010, transport system objectives*



For more details on transport system objectives from the Transport Integration Act, see Appendix.

#### 2.1.2 Trade-offs in meeting objectives

The Transport Integration Act provides an overarching framework to guide transport planning. However, the way in which a transport system meets the social, economic, and environmental objectives can involve trade-offs due to the finite resources allocated to public transport.

Public transport literature and practice describes this as a trade-off between two opposing purposes of patronage and coverage (also referred to as mass transit and social transit purposes). These purposes can be summarised as follows:<sup>42</sup>

**Patronage** relates to how many people use public transport. The environmental, health, and land use benefits of public transport are related to how many people use the service. Financial efficiency objectives, such as minimising government subsidy, are also related to patronage levels. For example, more passengers on a given bus service means a lower per passenger cost of providing the service.

**Coverage** relates to the availability of services across the network. Coverage of services also relates to supporting social and economic inclusion benefits of public transport, such as access to services for people experiencing disadvantage, or who cannot drive.

A system focused on patronage tends to lead to services which are frequent, fast, and relatively direct routes through areas with higher population density. These services usually cater to people who have a choice in how they travel and choose public transport because it is the most efficient option.

A system designed with coverage in mind prioritises servicing more areas including large, often lower density areas. This can mean routes are less direct, take longer and, due to the higher resources required to cover larger areas services, are typically infrequent. Coverage routes are primarily a safety net for users with limited travel options, as those with more options will typically choose other transport modes.

These characteristics are summarised in the table below.<sup>43</sup>

Characteristic	Patronage transit	Coverage transit
Typical mode	Train, light rail, bus rapid transit	Local route bus
Network characteristics	Direct service, long stop spacing	Indirect, short stop spacing
Operational characteristics	Frequent, wide operating hours	Infrequent, narrow operating hours
Ridership per km	High	Low
Societal benefits	Reduced congestion, travel time savings, agglomeration benefits, health benefits, environmental benefits	Social inclusion, equity, economic opportunity
Customer type	Choice of transport options	Limited / no choice in transport options

Source: Adapted from A Delbosc, G Currie, L Nicholls and C Maller. Social transit as mass transit in Australian suburban greenfield development, *Transportation research record*, 2016, 2543(1), 62-70.

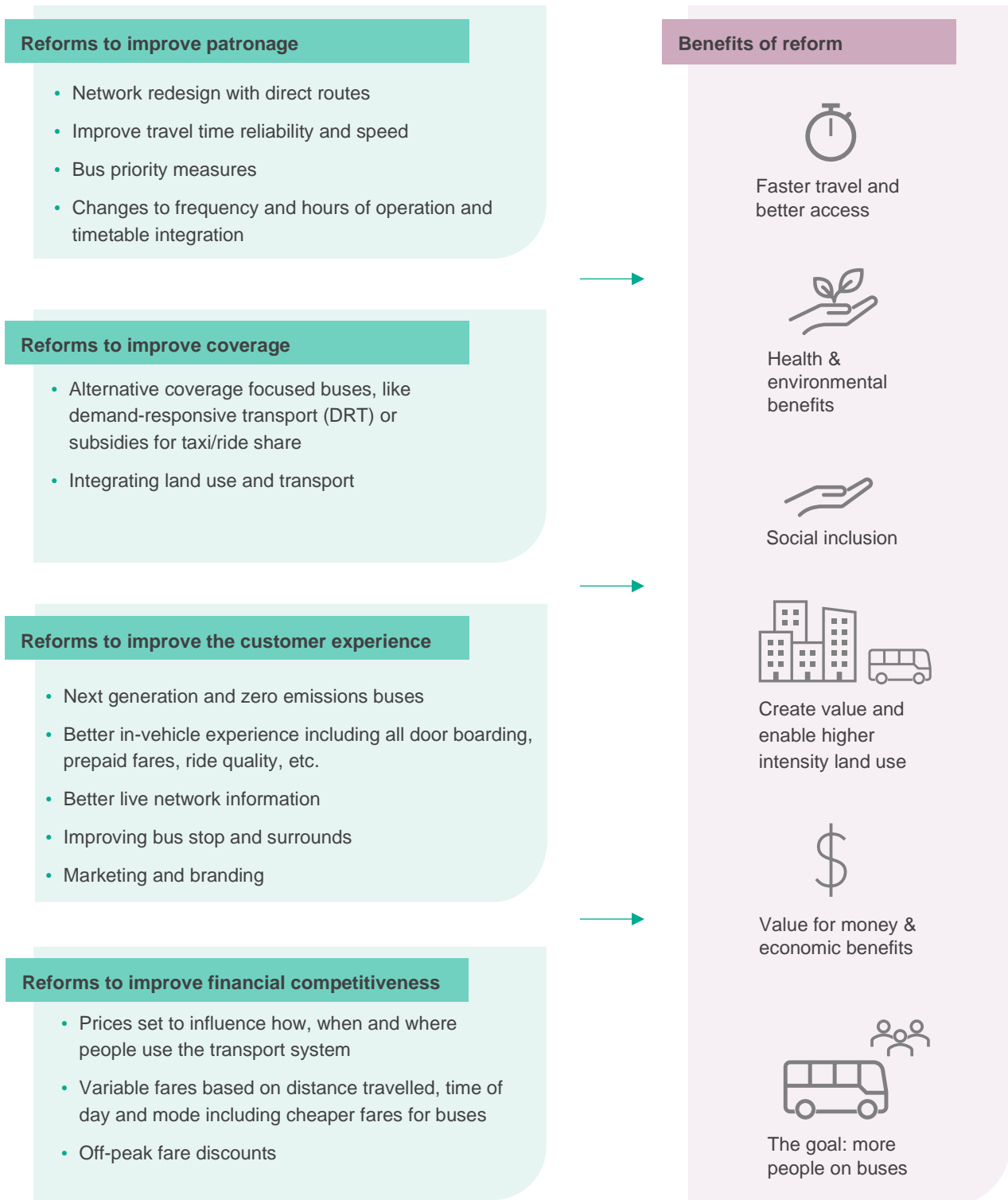
### 2.1.3 Integrating land use with transport planning

Integrating land use and transport planning as well as maximising the use of compact, dense corridors within cities can substantially mitigate the patronage versus coverage trade-off.<sup>44</sup> Higher density areas are more easily serviced by fast and direct public transport, including buses, achieving both coverage and patronage purposes.<sup>45</sup> On the other hand, lower density areas by their nature are more spread out, which heightens the trade-off between patronage and coverage given finite resources for public transport. Many high-density areas are situated along the Principal Public Transport Network (PPTN), a statutory land use planning tool designed to provide certainty to planners and the community about locations that are, or will be, serviced by high-quality transport.<sup>46</sup>

Melbourne is a large, low-density city by global standards.<sup>47</sup> While this means that the patronage versus coverage trade-off is apparent, especially in lower density areas, it is still possible to provide lower density areas with attractive public transport services.<sup>48</sup> For example, Toronto in Canada has similar low-density suburbs to Melbourne, but bus services are competitive with car travel, as routes are direct, frequent, and offer convenient interchanging.<sup>49</sup>

## 2.1.4 Reform opportunities

Opportunities for improving Melbourne's bus system have been summarised into four categories below:



## 2.1.5 Bus reform challenges

There are many benefits to reforming the bus system. However, as any changes can create disruption and trade-offs for some members of the community, implementing reforms can be challenging. Effective communication of technical issues and consultation with communities impacted by these changes can also be a challenge.<sup>50</sup>

In any bus system, with a given amount of funding, resources will be split between services which primarily respond to patronage purposes and services which respond to coverage purposes. How resources are divided between the two purposes does not have an objective, technical answer.<sup>51</sup> Instead, it should be informed by what the community, especially current and potential bus users, prioritise and value, balanced alongside an environmental, social and economic assessment.

The current division of bus resources between coverage and patronage is not the result of an explicitly clear choice. Rather, it can be seen as a result of multiple planning and network decisions with varying objectives over a long time period.

Through the process of bus reform, it may be desirable to change the division of resources between meeting patronage and coverage purposes.<sup>52</sup> Even if community welfare as a whole increases, changes where services are reduced can significantly impact individuals. This means that reform can be challenging, making it difficult for governments to fully implement bus reforms. Building in stages of consultation throughout the reform process allows for community and stakeholders to shape reform, based on evidence. This can help to create community buy-in, build momentum for reform, and build a wider understanding of the need and options for reform.<sup>53</sup>

While funding limitations will always be a key constraint, some of these trade-offs can be mitigated through public transport fares reform as well as additional funding of buses. In some cases, bus and fares reform can enable greater patronage (as found in Infrastructure Victoria's *Fair move* research<sup>54</sup>), improve cost recovery levels and provide greater social benefits, including reduced crowding and congestion and better environmental outcomes.

# 3. Snapshot of Melbourne’s bus network

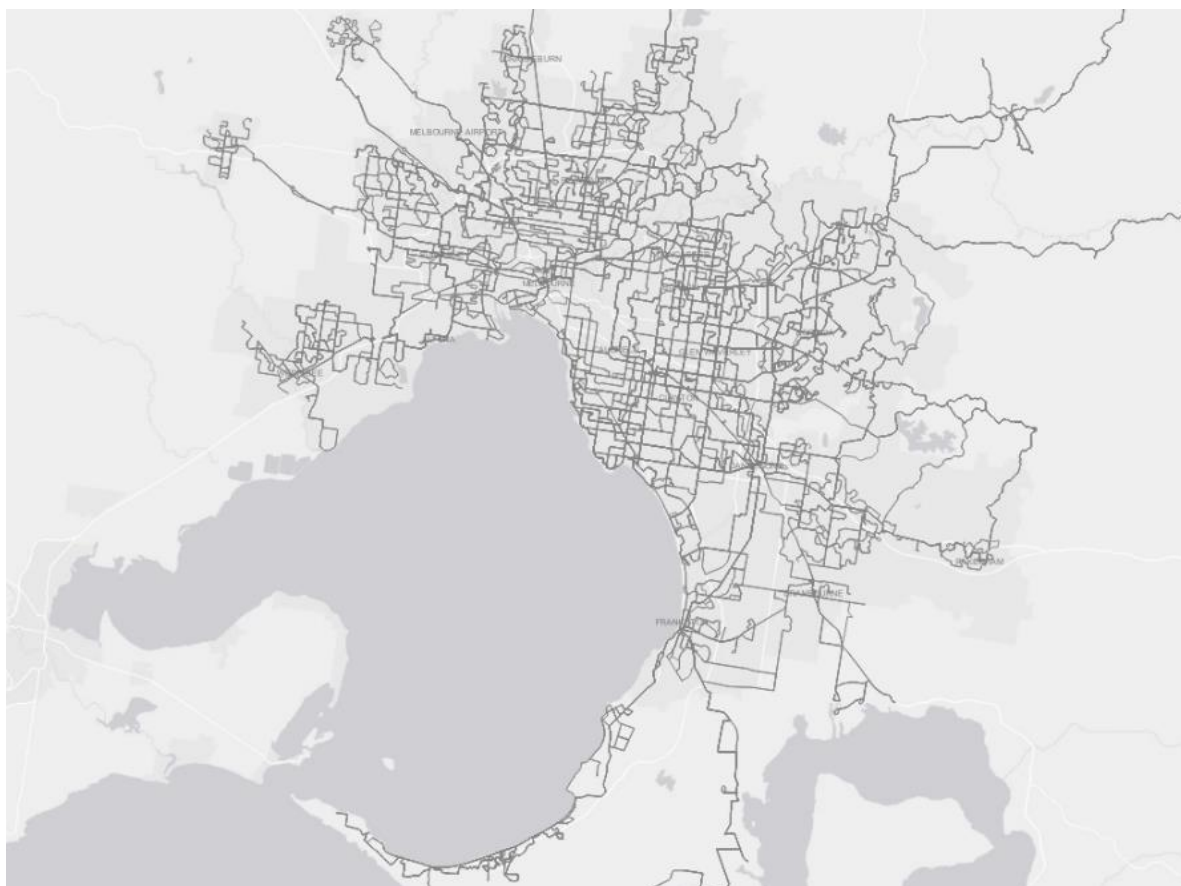
## 3.1 Melbourne’s bus network today

### 3.1.1 Size and access to the bus network

The first step to developing bus reform is understanding the role that buses play across Melbourne today. The metropolitan bus network is the largest of all public transport services in Melbourne.<sup>55</sup> With over 19,000 metropolitan stops and more than 1,950 buses, the bus is often the closest form of public transport for many Melburnians (see Figure 1). Buses are often the only readily accessible form of public transport for people living in Melbourne’s middle, outer and growth area suburbs. Around 82% of Melbourne’s dwellings are within 400 metres, or a 5-minute walk, of a bus route, compared to a far lower share of dwellings close to train (~30%) and tram (~ 20%) services.<sup>56</sup> Despite this coverage, Melbourne’s buses account for just 20% of overall public transport use in Melbourne.<sup>57</sup>

In contrast to Melbourne’s radial train and tram network which extend out from the central city, many of Melbourne’s bus routes are orbital, connecting major cross-town destinations across suburbs. The distance between radial rail lines and train stations also grows with distance from the central city, meaning that often the only viable transport choices for residents are either to drive, or to take a local bus.

**Figure 1: Metropolitan Melbourne bus routes (2022)**



Source: Data Vic, *PTV timetable and Geographic information - GTFS* [data set], <https://www.data.vic.gov.au/>, 2022, accessed 27 July 2022.

### 3.1.2 Public transport travel patterns

The metropolitan bus network operates in different urban environments: along local streets, major arterial roads and occasionally, in dedicated bus lanes. Most of the metropolitan bus network shares the road with other users. However, some routes are also supported with exclusive bus lanes and intersection bus priority signals. Buses also interconnect with other public transport options, such as train stations. Analysis of VISTA data from years 2012-20 indicated that 41% of all bus trips involved transfers to other public transport modes.<sup>58</sup>

People use Melbourne's bus network differently to the train and tram network. Analysis from *Journey to work* data by the Australian Bureau of Statistics shows the distinct travel patterns of commuters across the different modes. Figure 2 shows the origin and destination of public transport trips by mode. Train users come from all areas across Melbourne, with a high proportion heading into the central city. Tram users follow a similar pattern, coming from the outer extents of the tram network and heading towards inner Melbourne. Unsurprisingly, given the extensive coverage of the bus network, bus use is dispersed across the city. By origin, suburbs in Melbourne's north-east (like Doncaster, Templestowe and Bulleen) have the greatest bus usage for work trips across all of Melbourne. These suburbs are served by Doncaster Area Rapid Transit (DART), a bus network with high frequency services, long operating hours and priority measures like bus lanes. The data also shows that people travelling by bus go to destinations right across Melbourne, as opposed to the concentration of inner and middle Melbourne destinations for people travelling by train or tram.

#### Case study

## Manningham residents benefit from SmartBus services

Manningham municipality in Melbourne's north-east is the only local government area in metropolitan Melbourne without access to heavy rail. However, it is served by a high-quality bus service.

The Doncaster Area Rapid Transit (DART) was launched in 2011 as part of the Victorian Government's Transport Plan.<sup>59</sup> DART involved upgrades to bus services between central Melbourne and Manningham including increased hours of operation, more frequent services—particularly during off-peak periods—on-road priority measures, and park-and-ride options as well as improved accessibility.<sup>60</sup>

Rather than a single continuous route, DART is composed of four separate bus routes (routes 905, 906, 907 and 908) all with SmartBus branding, linking the inner city and Manningham via the Eastern Freeway and Hoddle Street–Victoria Parade corridors. Priority for buses during peak times has been introduced incrementally over several years in the most congested sections of these routes and has markedly improved travel times and customer experience.<sup>61</sup> Manningham now has some of the highest levels of bus mode share across Melbourne.<sup>62</sup>

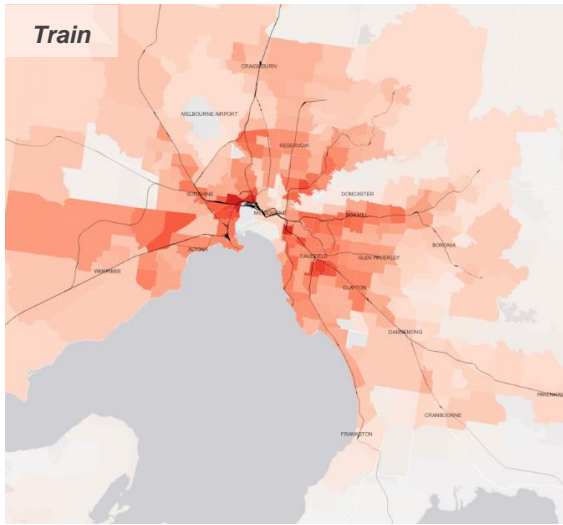


Image source (right): Infrastructure Victoria.

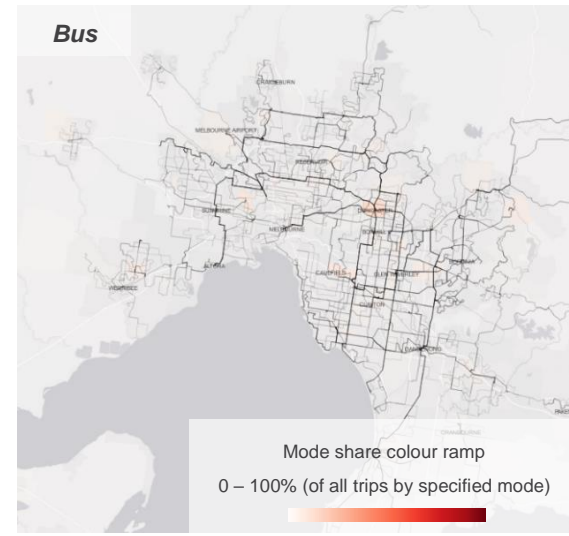
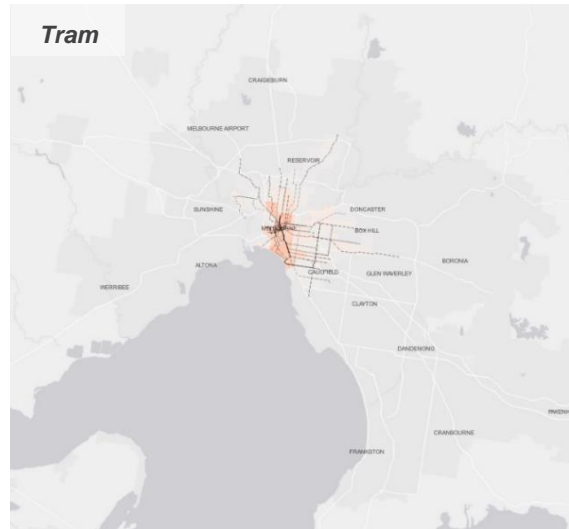
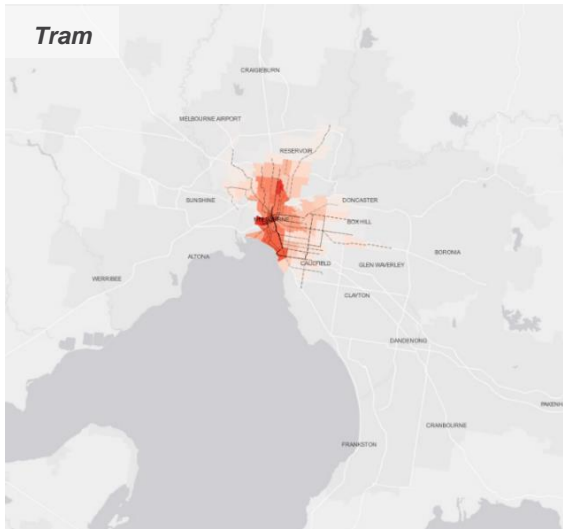


Figure 2: Train and tram use is focused on travel to inner suburbs while bus use is more dispersed

Mode share by origin



Mode share by destination



Mode share colour ramp  
0 – 100% (of all trips by specified mode)

Source: Australian Bureau of Statistics (ABS), [2016 Census - commuting to work](#) [TableBuilder], ABS website, 2016, accessed 6 June 2022.

### 3.1.3 Network hierarchy

The trade-off between patronage and coverage purposes of public transport is especially apparent for buses. Buses in Melbourne are often the only mode with services provided primarily for coverage purposes. Other modes such as heavy and light rail are primarily for patronage purposes. This differs from cities like Sydney and Brisbane where buses are commonly relied upon as a core patronage service.

There is significant variation in the types of services across Melbourne's bus network. These types of services align to varying degrees with meeting patronage or coverage purposes. DoT's *bus plan* has defined bus route categories which provide a hierarchy for categorising bus services. These are outlined in the following diagram with Infrastructure Victoria's addition of whether the services are suited to patronage or coverage purposes.<sup>63</sup>

#### Category 1: Rapid routes

##### **Bus Rapid Transit (BRT) – patronage**

Designed to deliver faster, more frequent and more reliable journeys on busy public transport corridors. Characterised by extensive on-road priority, premium stop infrastructure and a rail-like experience for passengers.

##### **Shuttle routes – patronage**

Provide direct point-to-point service, connecting rail stations with universities and other high demand destinations. Characterised by dedicated lanes, a limited number of stops, high frequencies and operating hours and stop spacing carefully designed to match market requirements.

#### Category 2: Connector routes

##### **Trunk routes – patronage & coverage**

Connect suburbs to key transport nodes and employment and shopping centres. Services are frequent and direct and feature road priority measures such as bus lanes. Trunk routes will normally operate in mixed traffic and provide greater integration between homes and destinations.

##### **Connector routes – patronage & coverage**

Provide easy access to the rail network as well as local employment and shopping centres. Service balances route directness with the need to provide catchment coverage. Diversions are minimised to ensure competitive travel times and attract mode shift from private vehicles.

##### **Neighbourhood routes – patronage & coverage**

Offer greater access while being as direct as possible and providing coverage. Services are low frequency and have a shorter span of hours but often strongly patronised.

#### Category 3: Local routes

##### **Local routes – coverage**

Provide local access for passengers. These services are targeted to provide a minimum level of service to enable access to nearby shops and services.

##### **Demand-responsive transport – coverage**

Initially trialled in two primary contexts: areas of low demand where regular bus service might not be efficient and in growth areas where road networks are still developing, and communities are in the process of settling.

Note: These align with Infrastructure Victoria's categories of bus services as listed in *Victoria's infrastructure strategy 2021-51* with rapid routes being the equivalent of 'next generation' services.<sup>64</sup> School bus services have been excluded as these are outside Infrastructure Victoria's project scope.

The current metropolitan bus network does not follow a strict network hierarchy. Although Melbourne’s buses serve a variety of purposes, including providing local access for residents, connecting major activity centres and linking employment hubs, there is little distinction (except for SmartBus services, see section below) between the different routes and their respective level of service.

The Victorian bus plan highlights that a new bus network hierarchy clearly defines the role, purpose and function of a route with a network. As part of future reform, the proposed hierarchy also provides a foundation to further define the bus tiers through service level metrics such as peak and off-peak frequencies and operating hours for each category.

## 3.2 Higher performing bus services in Melbourne

A small selection of Melbourne's bus services are already high performing, as reflected by their higher patronage levels. While many routes evolved incrementally over the years, a select few routes have undergone larger service improvements, infrastructure upgrades and local reforms. These high performing bus routes demonstrate that buses can be a viable option for everyday travel, and not just the last resort.

This section provides examples of higher quality bus services. Many of these examples are instances where certain routes or services simply perform better than Melbourne’s average bus service. Both examples provided are also from the top tier of the network hierarchy, prioritising patronage. They should not be interpreted as the *only* solution to improving bus services in Melbourne.

See Appendix for further Melbourne examples of bus reform, including more coverage-focused FlexiRide services.

### 3.2.1 SmartBus

SmartBus is a branded bus service, launched in Melbourne in 2002 and expanded to nine routes by 2010. A ‘branded bus service’ is a bus service where vehicles, stops and marketing have a distinctive visual identity. Distinctive branded bus services have emerged as a cost effective way to increase patronage through increased visibility.<sup>65</sup> This is often accompanied by a level of bus priority along routes and at intersections, though they fall short of the standards for bus rapid transit with limited dedicated right-of-way.<sup>66</sup>



**Figure 3 (right): Current SmartBus routes**

Source: Public Transport Victoria (PTV), [SmartBus network](#), Victorian Government, accessed 29 July 2022.

Melbourne's SmartBus routes offer higher frequency weekday and weekend services, generally with a maximum 15- to 20-minute wait between services on weekdays and 30 minutes on weekends. The existing routes include three orbital links interconnecting radial train and tram lines, four radial routes (which together comprise the Doncaster Area Rapid Transport connection to central Melbourne), in addition to two routes connecting several eastern suburban activity centres and Monash University. SmartBus infrastructure includes real-time passenger information displays at stop locations as well as localised bus priority measures.

The introduction of SmartBus resulted in a significant increase in bus patronage along those corridors. Many SmartBus routes in their first year recorded 20% or more growth in boardings, growing even further in the later years of operation.<sup>67</sup> Today, SmartBus services remain some of the higher patronage services across Melbourne.<sup>68</sup>

The success of SmartBus sheds light on how relatively cost-effective changes to the existing bus network can produce impressive growth in bus ridership.

### 3.2.2 University shuttles

Melbourne's university shuttles are a relatively new addition to the bus network. Prior to their introduction, the bus connection for people travelling between a train station and university campus would often be inefficient, crowded and unreliable. This was true for students at Monash University Clayton,<sup>69</sup> where the connecting bus was not integrated with trains, and could not handle the morning rush of university students and staff travelling towards the Clayton campus. Express shuttle routes have since been delivered to improve the connectivity between campus and the local railway station.

Melbourne's current university shuttle routes are some of the highest frequency and highest patronage services across the entire metropolitan bus network. The 601 (Huntingdale – Monash University Clayton) and 401 (North Melbourne Station – Melbourne University Loop) are short, direct shuttle routes connecting train stations with nearby university campuses. During peak periods, the 601 and 401 operate with 2 to 3 minutes between each service. Both routes are good examples of instances where the bus network is integrated within the wider public transport network. The services ensure that passengers travelling by train can transfer efficiently to a connecting bus service. Dedicated bus livery applied to both 401 and 601 vehicles also allow passengers to easily identify the buses.

**Figure 4: Dedicated bus livery for route 401 and 601 vehicles**



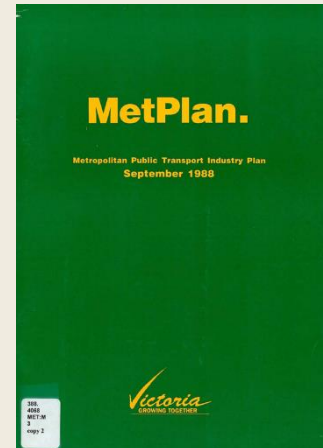
Source: Infrastructure Victoria

## Previous plans for bus reform in Melbourne

### MetPlan (1988)

*MetPlan* was a 15-year Victorian Government plan to reform public transport in Melbourne.<sup>70</sup> The plan included 'Metlink' bus services of direct orbital bus routes with high frequency service, operating every 30 minutes, or more frequently where there was demand. These were to operate on bus-only lanes on arterial roads between major activity centres and modal interchanges. High quality vehicles were proposed with passenger comfort 'comparable to that on trains.' *MetPlan* also included a call for minimum service standards and expanded operating hours for local bus networks. There were plans for demand-responsive services in areas of low demand.

The economic slowdown in the early 1990s contributed to many of *MetPlan's* proposals being suspended.<sup>71</sup> Metlink bus services were planned to be introduced by 1992. Much of the bus reform of *MetPlan* was not wholly implemented within the planned timeframe.

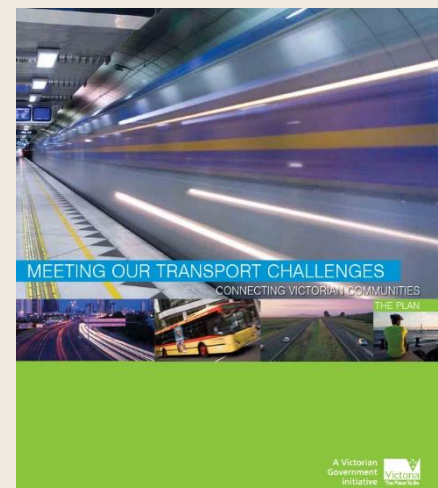


### Meeting our transport challenges (2006)

*Meeting our transport challenges* was a high-level Victorian Government transport strategy which included substantial actions to improve buses. Minimum service standards were recommended for over 250 routes. The standards specified at least hourly buses until 9pm, seven days a week.

The strategy also recommended expansion of SmartBus services with road priority and high service level standards and long hours of operation (5am to midnight on weekdays), and at least 15-minute frequencies on weekdays.<sup>72</sup> From 2006 to 2011, the SmartBus network expanded from 69km to 450 km.<sup>73</sup> While this was a large expansion, it fell short of the 900km SmartBus network by 2011 goal recommended in the strategy.

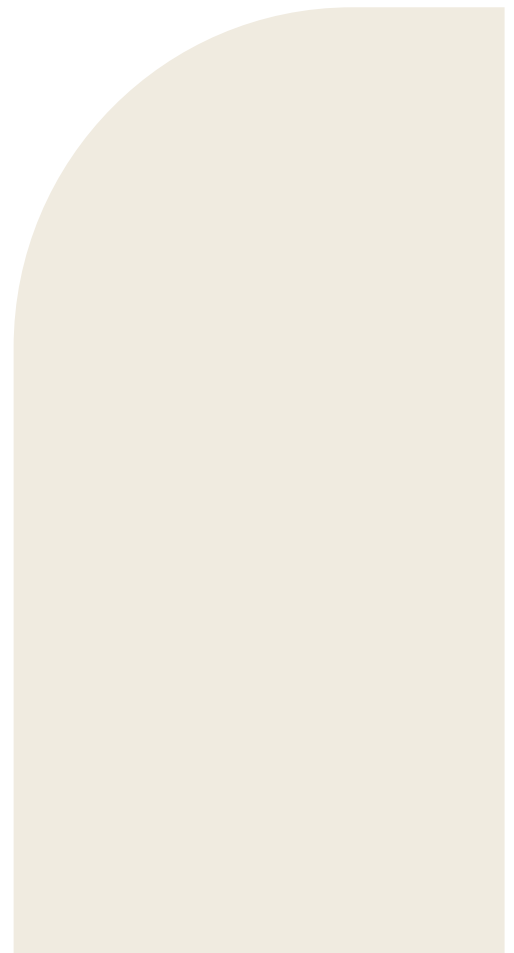
Bus service reviews for Metropolitan Melbourne were also conducted on the back of *Meeting our transport challenges* between 2007 and 2010.<sup>74</sup> Sixteen reviews were conducted, each covering around three local government areas. These reviews recommended substantial bus network restructuring and built community buy-in through staged consultation. However, there was only partial implementation of network changes recommended in these reviews after 2010.<sup>75</sup> For further details on the outcomes of the Bus Service Reviews, see the greater network efficiency box on page 38.



Further background on the history of bus reform in Melbourne is available in the Appendix.



# Part two: Melbourne's transport challenges



# 4. Making the most of Melbourne's buses

## Four big challenges for buses

Our research identified four major challenges facing Melbourne's bus network.

### Challenge 1

**Buses are rarely a competitive travel option.**

Low frequencies, limited operating hours, and slow and complex routes make buses an unattractive alternative to the private vehicle.



### Challenge 2

**Victorian communities can get better value from the bus network.**

While the government spends a substantial amount on operations of the bus network, there are some locations which receive limited benefits.



### Challenge 3

**The existing bus network is contributing to a major equity problem, especially for outer and growth areas of Melbourne.**

A standard bus service offering can limit the opportunities to participate in work, social activities or study for those people who have no other transport options. This can lead to social isolation, financial stress, and inequality of access to jobs and services.



### Challenge 4

**Customers find using the bus difficult and complex.**

Perceptions and barriers to entry keep many people from using the bus at all. People who do choose to take buses are often confronted with limited real-time information, a lack of quality stop infrastructure, safety concerns, and unreliable service levels.



## Challenges and trade-offs

Each of the four challenges listed above identify a discrete area of bus reform, but the reality of addressing each challenge is interrelated and complex. Aspiring to move away from the business-as-usual approach is a journey that involves decisions about trade-offs for the Victorian Government, operators, users of the system and the general public.

Addressing one challenge of bus reform can negatively or positively impact another; for example, additional funding of more services may help to address poor frequency and operating hours as identified in Challenge 1, but could negatively impact the value for money proposition identified in Challenge 2. Alternatively, improving the customer experience as identified in Challenge 4 could attract more passengers, improving the operating efficiency of the bus network as identified in Challenge 2.

Other bus reform trade-offs will be highlighted in the next sections of the discussion paper.

## 4.1 Challenge 1: Buses are rarely a competitive travel option

Buses are often under-used, with pre-COVID-19 data showing many bus routes had low passenger numbers, regardless of time of day or week.<sup>76</sup> When planning a trip, people decide on the most appropriate mode of transport to get to their destination. They weigh up factors like time, cost, convenience, and accessibility. In some cases, public transport can be the most attractive option, such as when travelling into the central city during peak hour. However, in most cases the private vehicle remains the most convenient solution in supporting people in getting to their destinations, resulting in continued car dominance and dependence in Melbourne.

If Victoria continues our current growth path, our modelling shows an extra 3.5 million trips will be made every day across Melbourne's roads and public transport networks by 2030, resulting in increased congestion.<sup>77</sup> Infrastructure Victoria's research into the medium and long-term impacts of COVID-19 also shows that working from home does not solve congestion.<sup>78</sup>

The cost of this congestion including time, operating costs and pollution is estimated to escalate to \$10.2 billion per year in 2030, up from \$4.6 billion in 2015.<sup>79</sup> Without action, transport sector emissions will continue to grow, with road vehicles contributing to almost 90% of annual transport emissions.<sup>80</sup> The Victorian Government's Transport Sector Emissions Reduction Pledge includes a target that 50% of new light vehicles sales be zero emissions by 2030, as well as all new public transport buses purchased from 2025.<sup>81</sup> As part of this pledge, electric buses are currently being trialled in Victoria, with initial results showing that more than 61 tonnes of CO<sub>2</sub> can be saved per bus per year.<sup>82</sup> While this will help to reduce overall emissions from the transport sector, if travel habits do not change, congestion and poor travel time reliability will remain.

Additional pollution and congestion can also impact amenity in built-up areas, reducing their attractiveness to live or invest in. In turn, the impacts of climate change can also significantly disrupt the operations, maintenance, and construction of the transport network.<sup>83</sup> Conversely, the opportunities of quieter and healthier zero emissions buses could change the role that facilities such as bus depots play in Victoria, even releasing the ability for developments to be created above these facilities in the future.

### Zero emission buses (ZEBs)

Traditionally, buses have been powered by diesel engines. Transport is the second largest source of emissions in Victoria, accounting for 25% (22.7Mt CO<sub>2</sub>-e) of the state's emissions.<sup>84</sup> While diesel buses already produce less CO<sub>2</sub> emissions per passenger kilometre than the equivalent in private vehicle transport, zero emissions technologies could potentially eliminate operational CO<sub>2</sub> emissions from buses.<sup>85</sup> There are two primary zero emission bus technologies: battery electric and hydrogen. Battery electric buses store electricity on board and can be charged overnight or intermittently throughout the route.<sup>86</sup> Hydrogen fuel cell buses use hydrogen pumped into the bus where a fuel cell is then used to generate electricity, which is then stored in a battery.<sup>87</sup>

ZEBs are more energy efficient than internal combustion engine buses.<sup>88</sup> ZEBs can also offer a more pleasant ride for passengers. Electric motors typically vibrate less, are quieter than diesel motors, and can accelerate more smoothly.<sup>89</sup> The quieter operation and elimination of tailpipe emissions also benefits communities which buses run through, compared to traditional diesel buses which can be noisy and polluting. With these benefits, the switch to zero emission buses presents an opportunity to establish new attitudes towards buses as a favoured mode of transport.



As the COVID-19 recovery plays out and Melbourne is confronted with the return of peak hour congestion and increased variability in travel times, moving any road trips to other modes like public transport will bring about significant benefits. By mid-2022, car use across Melbourne had returned to near pre-COVID-19 levels, while the return to public transport hovered at around 63%.<sup>90,91</sup>

The metropolitan bus network has wide coverage across Melbourne, but performs poorly on patronage purposes, does not effectively compete with the private vehicle and requires significant reform to meet the aims of travel anywhere in Melbourne.

Many services also do not integrate as well as they could to enable transfers for both connecting buses and other modes of public transport (see Network harmonisation – integration with trains on page 32). Without proper integration, many people will simply choose to drive over the inconvenience of taking their local bus.

### 4.1.1 Service frequency and directness

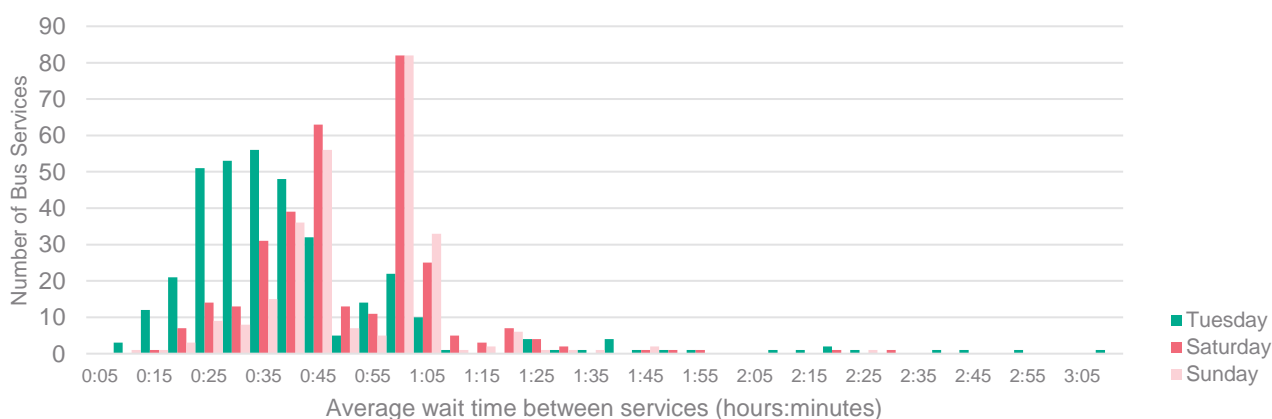
Frequency is an important factor in how well buses integrate with the rest of the public transport network and the overall attractiveness of buses. Without frequent bus services, users' activities and trips are dictated by the bus timetable. Frequency becomes especially relevant when public transport users are relying on transfers to get to their destination, with significant consequences if connecting services are delayed. While passengers dislike transferring, literature suggests that efficient public transport systems should integrate and support transfers between modes, providing citywide access that is competitive with the private vehicle.<sup>92</sup> Transfers also enable routes to be more direct and faster for those travelling along major corridors, without the need to deviate circuitously along local streets.

In their analysis of bus origins and destinations in Melbourne, researchers found that 48% of users surveyed were transferring with other modes.<sup>93</sup> Transfers between bus-train and bus-bus were more common than bus-tram. Results also suggested that an average frequency with buses every 15 minutes and at least one route with buses every 10 minutes are necessary to facilitate high transfer rates.<sup>94</sup>

For this discussion paper, Infrastructure Victoria has used General Transit Feed Specification (GTFS)<sup>95</sup> information to understand public transport service provision in Victoria. Public Transport Victoria (PTV) regularly publishes its timetable data for all modes through the DataVic portal. Data for February 2022 reveals the differences between the bus service offering on weekdays and weekends across Melbourne. Higher frequencies support the viability of public transport as an alternative to car travel. Reducing this wait time between services also improves the transfer experience between connecting services.

Figure 5 shows that while most weekday average wait times per route were 25 to 35 minutes on a typical Tuesday, weekend services are relatively infrequent with the majority of wait times in the 35 to 45 minute interval on Saturdays, and many Sunday services extending out to wait times of approximately 60 minutes.

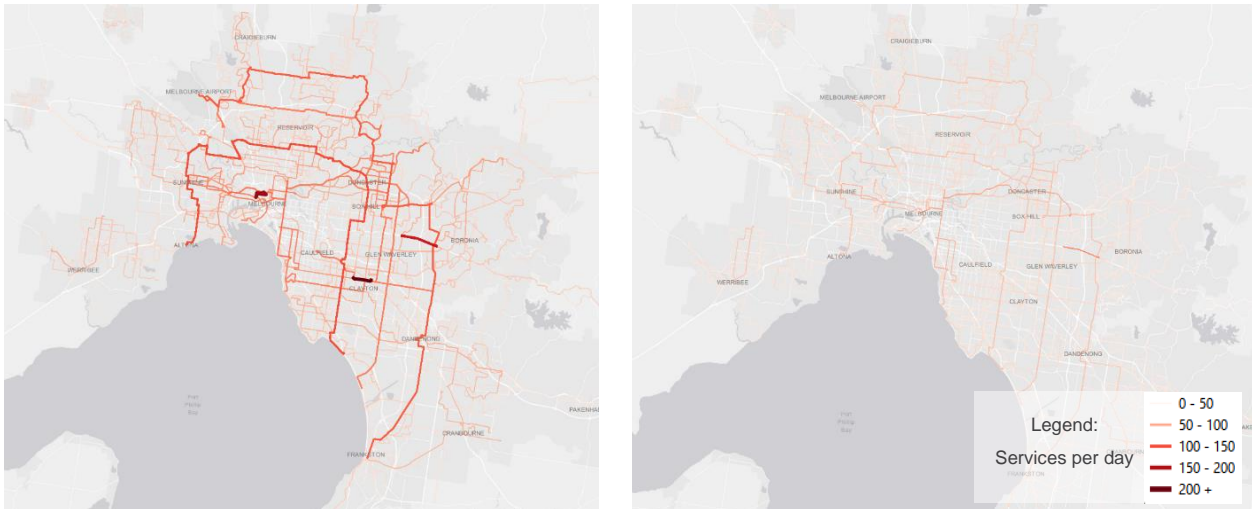
**Figure 5: Buses are far more frequent on weekdays than on weekends**



Source: Infrastructure Victoria analysis of Data Vic, *PTV Timetable and Geographic Information - GTFS* [data set], <https://www.data.vic.gov.au/>, 2022.

Figure 6 compares the frequency of buses on a typical Tuesday and Sunday. Thick red lines represent the highest frequency services while thinner lighter lines represent lower frequency services. Routes with the highest number of services per day include university shuttle services between Melbourne University and Monash University Clayton and nearby train stations. SmartBus orbital routes also show far higher frequency levels than the remainder of the bus network. While this is not in itself enough data to suggest service frequency should be increased on low patronage routes, more frequent services typically encourage more patronage.<sup>96</sup>

**Figure 6: Bus service frequencies Tuesday vs. Sunday**



Source: Infrastructure Victoria analysis of Data Vic, *PTV Timetable and Geographic Information - GTFS* [data set], <https://www.data.vic.gov.au/>, 2022.

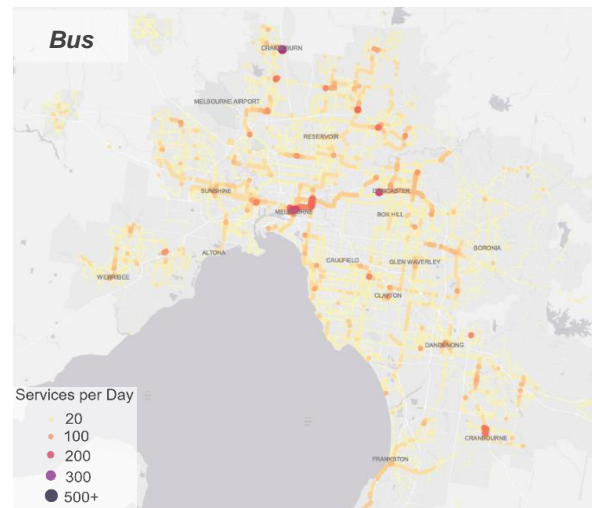
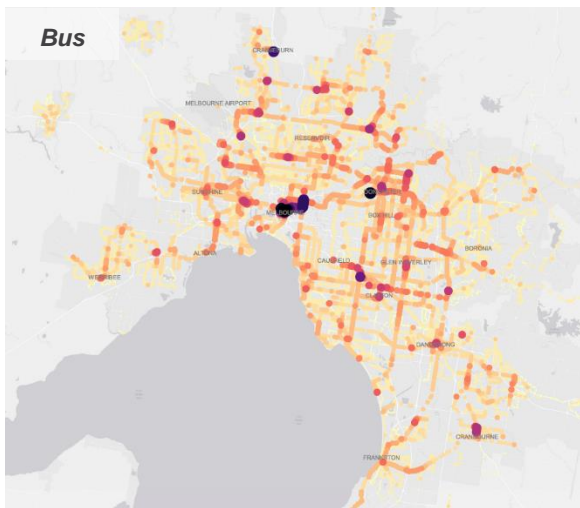
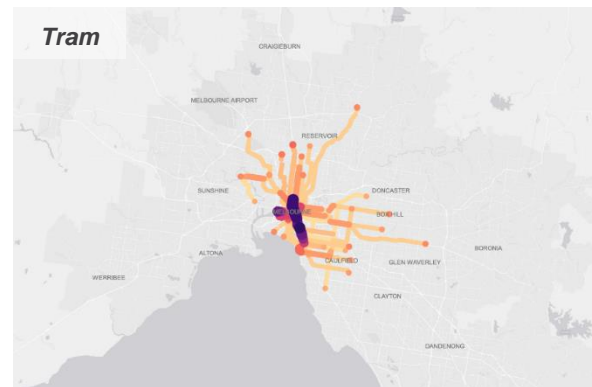
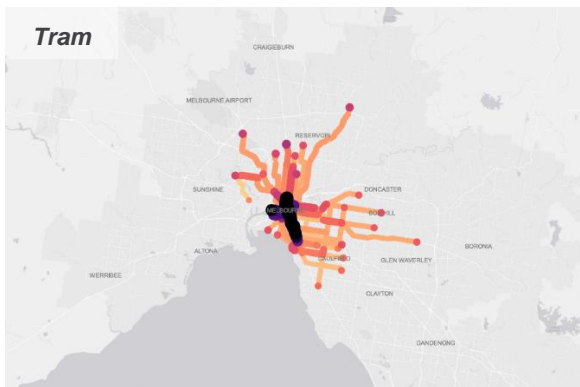
Much like the train and tram network, bus frequencies are highest during the weekday peak hours, and reduce on weekends. Figure 7 contrasts the high frequency train and tram networks with the bus network. Excluding DART services heading into central Melbourne, much of the bus network during the weekday peak is operating at frequencies lower than a comparable weekend train or tram service. The figures also illustrate many local feeder bus routes connecting up local activity centres with nearby residents fall below 20 services per day (as shown by the yellow dots). Finding a high frequency service also generally becomes harder further out from the inner city.

Figure 7: Total services per stop for train, tram and bus network

Total services by stop – Tuesday



Total services by stop – Sunday



Services per Day

- 20
- 100
- 200
- 300
- 500+

Source: Infrastructure Victoria analysis of Data Vic, *PTV Timetable and Geographic Information - GTFS* [data set], <https://www.data.vic.gov.au/>, 2022.

## 4.1.2 Reliability and congestion

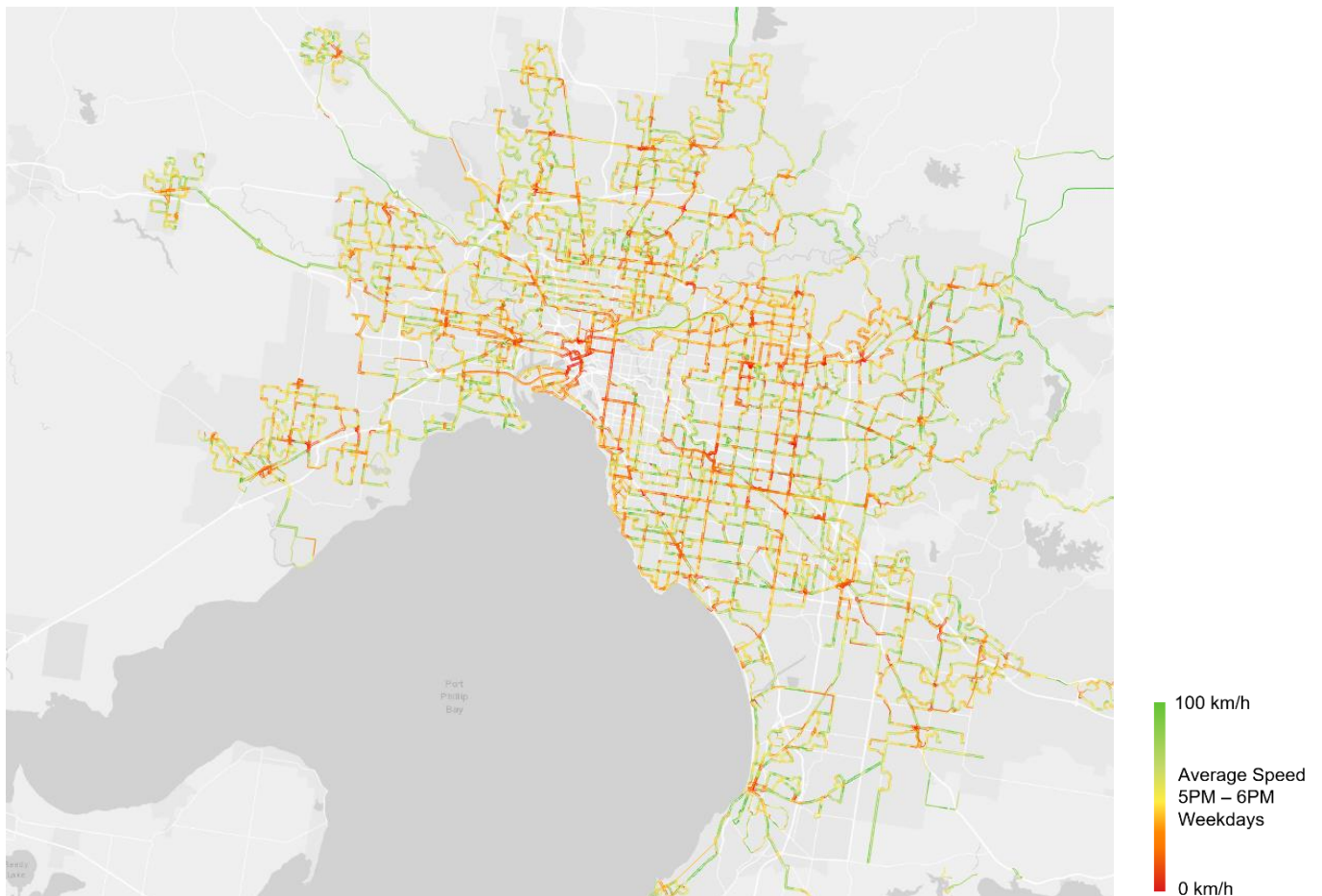
Waiting for services that are unreliable can cause frustration and anxiety, adding to overall passengers' trip times.<sup>97</sup> Bus stops generally have fewer amenity features compared to train stations (with real-time information, seating, shelters etc.) further impacting the likelihood of users' considering using the bus.<sup>98</sup> Late bus services can also lead to missed transfer connections and a mistrust of buses generally.

PTV publishes monthly operational performance data, including for metropolitan bus routes.<sup>99</sup> PTV's metropolitan bus network punctuality target is measured as 86% of services arriving at timing points within 5 minutes late or 1 minute early. Factors such as traffic congestion and increasing patronage can impact on time bus reliability. In July 2022, metropolitan bus punctuality was at 93%.<sup>100</sup>

Spatial analysis of bus speeds across the city also shows the impacts of congestion on the reliability of services. Bus services in the central city are most impacted by congestion while many bus services along radial road corridors in the middle to outer east also face high levels of delay and congestion. Congestion not only impacts bus speeds (Figure 8), but also bus travel time variability (Figure 9). Despite being along parts of the PPTN, travel time variability is especially high travelling around roads like Hoddle Street (inner Melbourne) and Bell Street (north), and areas around Werribee Station (west), Chadstone (south-east), Box Hill (east) and Doncaster (north-east).

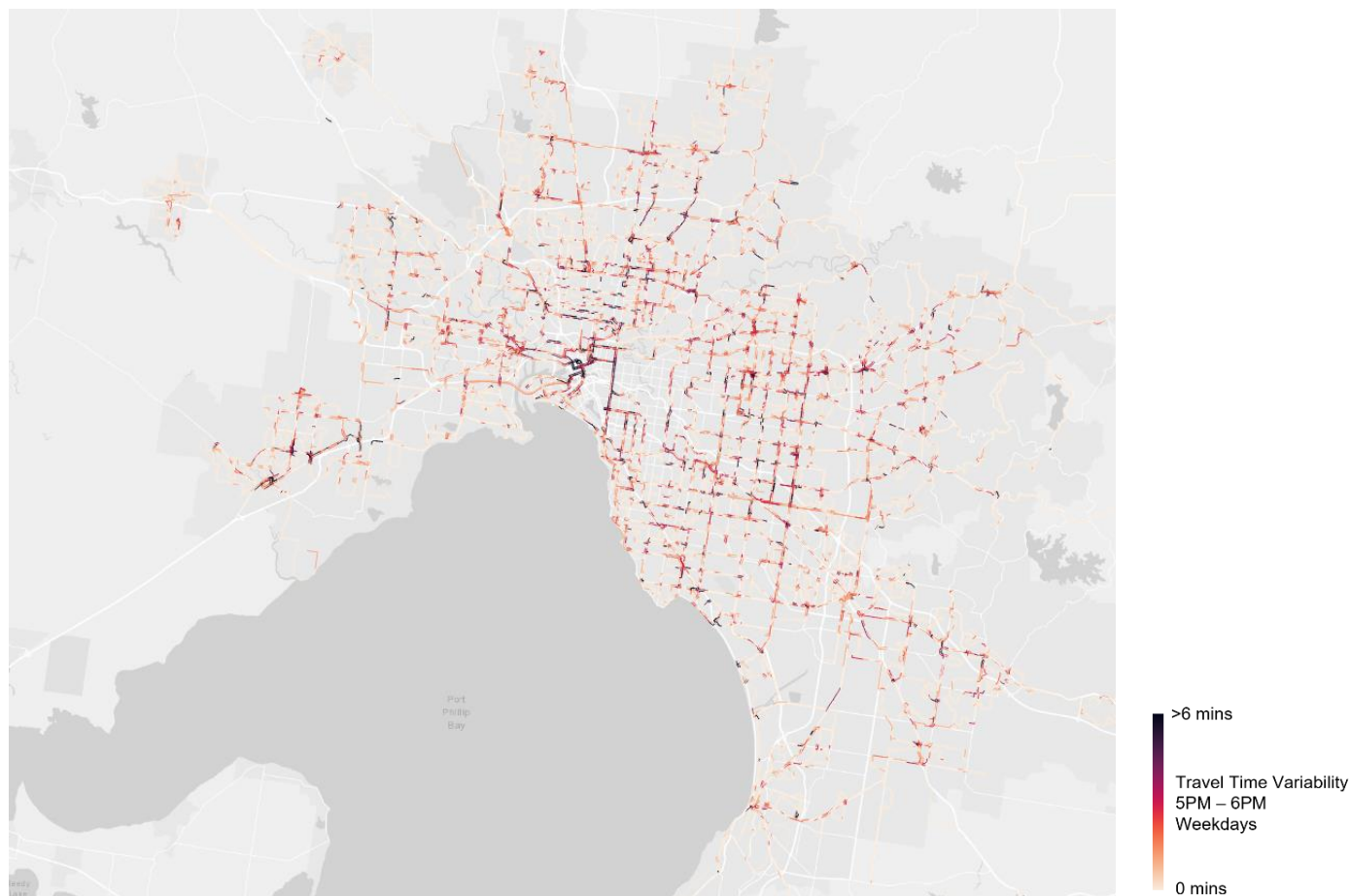
DoT analysis of road traffic speeds across the network suggests that bus speeds are up to 35% lower than the indicated road speed on the network in the morning peak.<sup>101</sup> Unlike trains and some parts of the tram network, only 52 kilometres of the entire bus network has road infrastructure priority measures like bus lanes and dedicated bus signals.<sup>102</sup>

**Figure 8: Impact of road congestion on bus speeds during weekday evening peak**



Source: Infrastructure Victoria analysis of DoT 2019-20 bus data

**Figure 9: Bus travel time variability during weekday evening peak**



Source: Infrastructure Victoria analysis of DoT 2019-20 bus data. Variability measured in minutes per kilometre.

### 4.1.3 Outdated bus service coverage targets

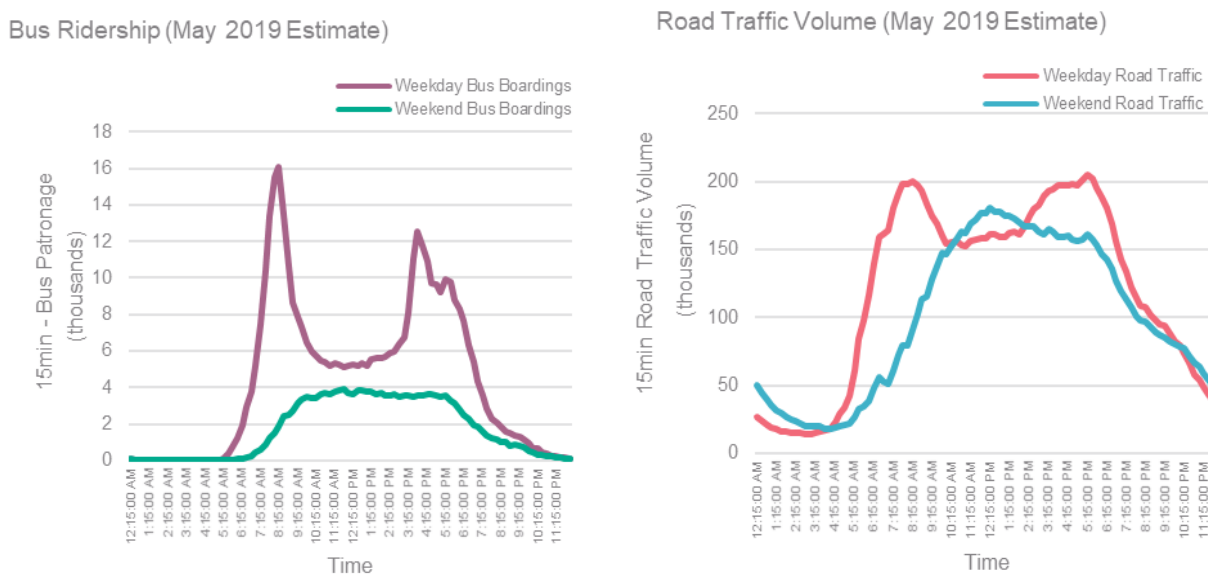
Many cities use a coverage target as a success metric of the bus system. In Victoria, reference to maximising public transport opportunities through local coverage of 400 metres maximum walking distance (or a 5-minute walk) from users' homes is made in plans as early as the 1987 *MetPlan* discussion paper.<sup>103</sup> More recently, *Victoria's bus plan* states that 80% of the urban Victorian population is within 400 metres of a bus stop.

The challenge with using this coverage metric to influence bus network design is that it does not accurately represent the service characteristics (frequency, operating hours etc.) of a bus service, and whether the actual connection being provided will be of use to residents. A measure of proximity to the nearest bus stop also does not represent how frequent a bus route is, or during what hours of the day it operates. Bus routes planned exclusively to meet coverage targets are often indirect, infrequent and unattractive to residents. A departure from simple coverage targets being the usual measure would help the design of better bus networks.

### 4.1.4 Buses for non-peak trips

Although the frequency of the bus network on weekends may suggest there is low travel demand, other modes like private vehicles remain high on weekends, especially throughout the middle of the day. As shown in Figure 10, there is also a significant opportunity to better utilise buses during the interpeak periods. Should bus services become more competitive with private vehicles, the travel demand on the roads could provide insight into the unmet travel demand for buses during interpeak and weekend periods. If the roads are busy on the weekend, there is opportunity to better shift some of that demand onto the bus network.

**Figure 10: Average daily bus ridership and traffic volumes, weekday vs. weekend**



Source: Infrastructure Victoria analysis of DoT bus data and SCATS data (Data Vic, [Traffic signal volume data](https://www.data.vic.gov.au/) [data set], <https://www.data.vic.gov.au/>, 2022, accessed 9 June 2022).

Note: the profile of road traffic volume profile has been derived from a selection of the signalised sites across Melbourne’s motorways and arterial roads.

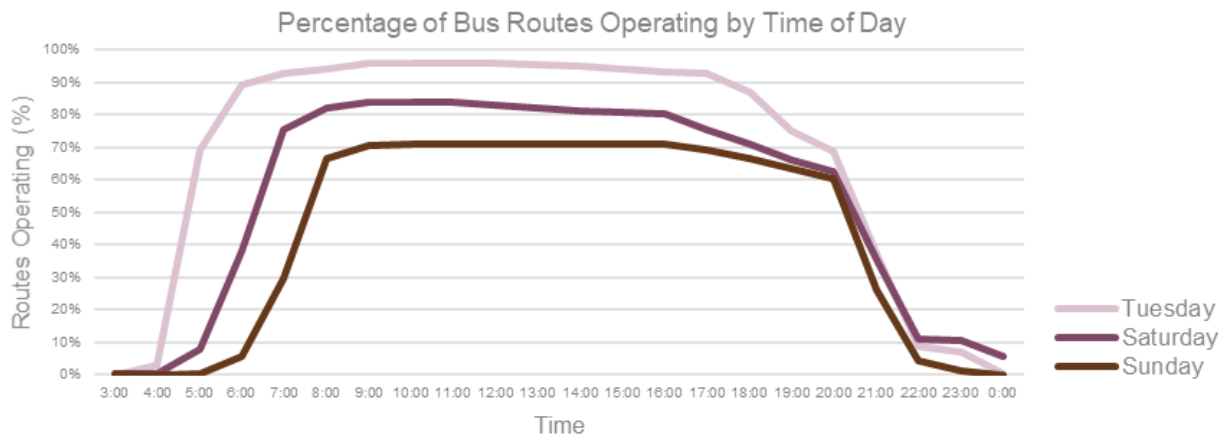
Direct bus routes ensure that travel by bus can be made within reasonable time (compared to journey time by other modes) and avoid long meandering trips on local streets. Direct routes also allow for higher frequency bus services and shorter wait times for connecting public transport services.<sup>104</sup> More direct routes tend to have higher patronage, though increasing directness of routes can also reduce service coverage overall.

#### 4.1.5 Service span

The span of service for Melbourne’s buses varies by route, day of the week and service type. Service span is especially important in ensuring travellers can get to their destinations and also return home. Longer service spans also cater for workers in industries like hospitality and retail and support shift and/or casual workers who do not travel in the typical morning and afternoon peak periods. Often located in and around activity centres and health precincts, extended bus service hours means that these workers have a viable alternative in travelling to and from work, reducing the need to supply expansive and expensive private parking infrastructure.

Timetable data (see Figure 11) shows that typical weekday services run for the longest time—approximately 16 to 18 hours each day. Saturday services fall off with most services operating at 14 to 16 hours while Sunday is even shorter at 12 to 14 hours. While there are legitimate reasons for this difference to optimise services, shorter service spans may themselves dissuade potential patrons from using bus services.<sup>105</sup>

**Figure 11: Weekday bus services run for longer hours of the day compared to weekend services**



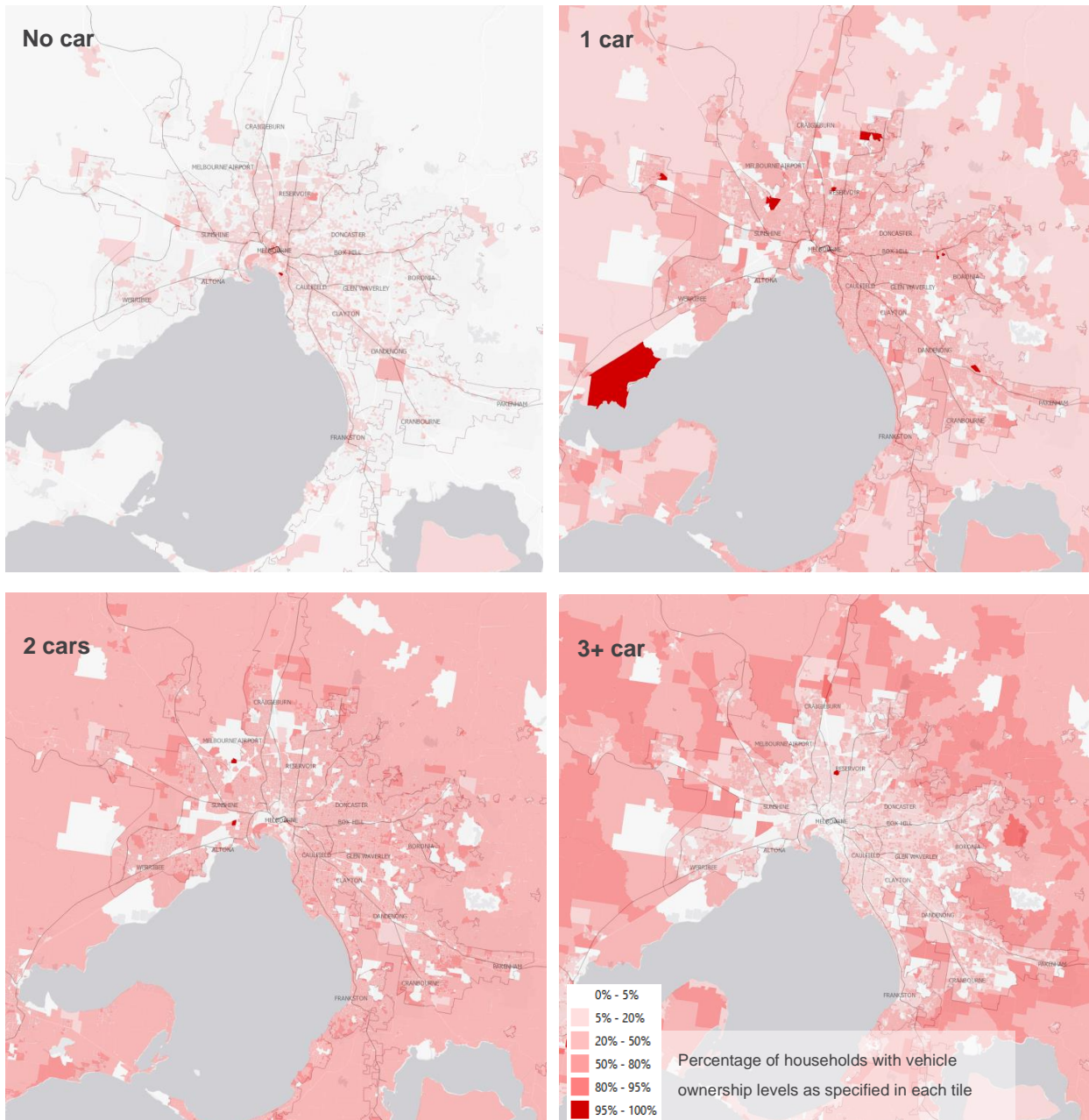
Source: Infrastructure Victoria analysis of Data Vic, *PTV Timetable and Geographic Information - GTFS* [data set], <https://www.data.vic.gov.au/>, 2022. (Data excludes Night Bus services.)

### 4.1.6 Competition with other modes

Private vehicles are overwhelmingly the most popular form of transport across metropolitan Melbourne. *Journey to work* data shows trips to around 75% of work trips to destinations across Melbourne involve the use of a car.<sup>106</sup> More recent surveys (2022) conducted by Transurban show that participants are using private vehicles even more since the pandemic than they were prior.<sup>107</sup>

ABS data also shows that the number of vehicles owned per household increases with distance to the central city (see Figure 12). While suburbs in central and inner parts of Melbourne have the highest proportion of households with no motor vehicles, middle and outer areas of Melbourne commonly have over one to two vehicles per household.

**Figure 12: Vehicle ownership per household**



Source: Australian Bureau of Statistics (ABS), *2021 Census – Transport Datapack*, ABS website, 2021, accessed 1 September 2022.

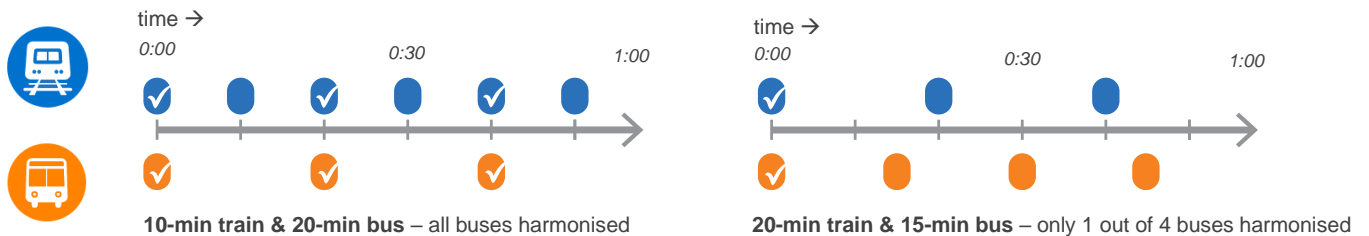
Inner and middle areas of Melbourne are served by the city’s fast and frequent train network. The high frequency tram network also largely serves inner and middle parts of Melbourne. Apart from some key rail lines, outer and new growth areas of Melbourne are served almost exclusively by bus. These same areas also have some of the highest car ownership rates, contributing to higher costs of living in areas where people are less well off (see Challenge 3 for further detail). This presents a major opportunity for an improved bus service offering to compete with and attract users away from driving, including to/from train stations. Improved buses can also provide more travel choice for those who do not have easy access to a car.



### 4.1.7 Network harmonisation – integration with trains

Coordinating bus and train timetables delivers easier transfers for users and helps achieve an integrated transport network. Buses are also an alternative to park-and-rides at train stations. To achieve strong service coordination, frequencies must align.<sup>108</sup> For example, Figure 13 shows that while 10-minute train services can harmonise with 20-minute bus services, a 20-minute train service does not align with a 15-minute bus service, leaving only one of every four buses per hour meeting the connecting train.

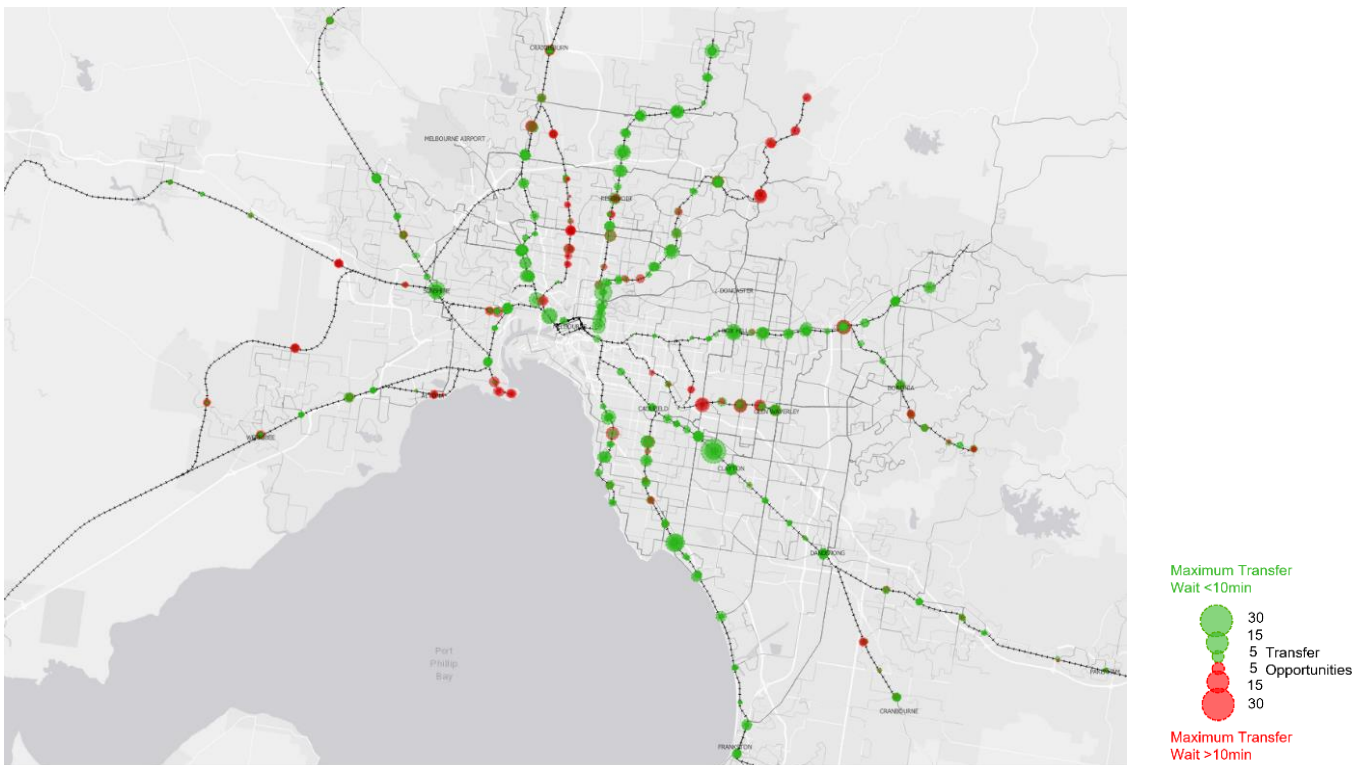
**Figure 13: Examples of harmonisation between train and bus over 60 minutes**



Source: Infrastructure Victoria, 2022

The Victorian Auditor General’s Office’s (VAGO) analysis of network harmonisation in 2014 found around 45% of Melbourne’s bus timetables do not harmonise with the train network.<sup>109</sup> In recent years, timetable changes have improved the coordination of services, especially for trips heading into the city in the morning peak and returning in the evening peak. Infrastructure Victoria’s analysis of 2022 public transport timetable data shows that there is still an opportunity for stronger coordination between services, especially on weekends. Figure 14 shows the harmonisation between morning bus arrivals connecting with inbound trains, represented by a coloured circle. Red circles indicate a maximum wait time of over 10 minutes (identified as a factor to facilitate high transfer rates<sup>110</sup>) while green indicates a maximum wait time of under 10 minutes. The number of bus services is represented by the size of the circle. Overlapping circles indicate that there are multiple bus routes connecting to the stations.

**Figure 14: Weekday morning peak bus arrivals connecting with inbound trains**



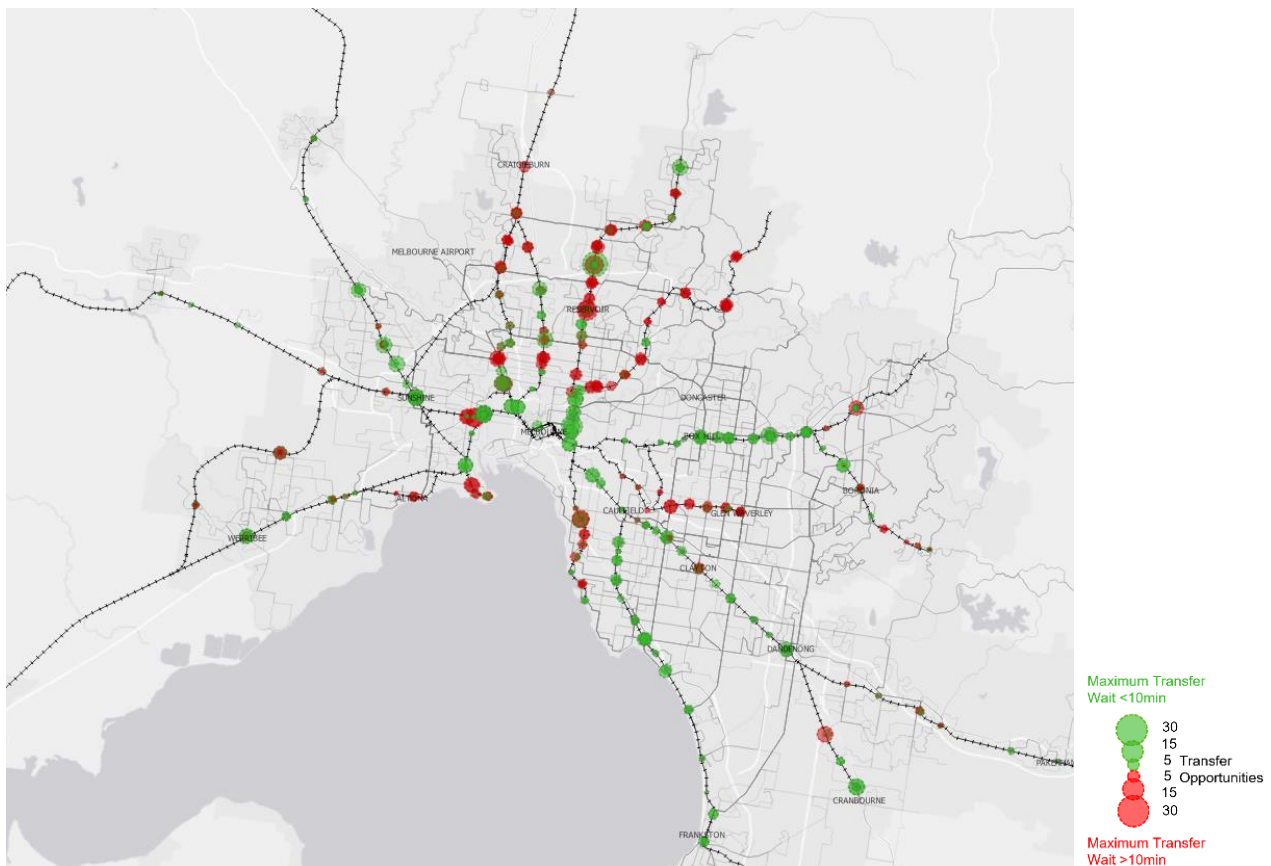
Note: data for Lilydale station was not available due to Level Crossing Removal Project works. Source: Infrastructure Victoria analysis of Data Vic, *PTV Timetable and Geographic Information - GTFS* [data set], <https://www.data.vic.gov.au/>, 2022.

Figure 15 follows the same concept, using Saturday timetable information for bus arrivals connecting with inbound trains (between 11am and 1pm, one of the busiest for travel periods of the day). Both figures illustrate opportunities in numerous areas across both weekday and weekends in which bus arrivals could be better optimised for bus transfers and trains.

Bus services cater for a large proportion of off-peak shopping and social trips as well as trips to access services.<sup>111</sup> This means that the bus network not only needs to cater for peak central city users, but also those travelling during the interpeak and on weekends.

It should be noted that with limited bus services, and some routes intersecting with multiple train lines, it is not always possible to fully harmonise bus services. The challenge of harmonising services is also reduced as the network transitions to providing more ‘turn up and go’ services for both rail and bus, leading to reduced at-stop or station wait times.

**Figure 15: Saturday (11am-1pm) bus arrivals connecting with inbound trains**



Note: data for Lilydale station was not available due to Level Crossing Removal Project works. Source: Infrastructure Victoria analysis of Data Vic, *PTV Timetable and Geographic Information - GTFS* [data set], <https://www.data.vic.gov.au/>, 2022.

## 4.2 Challenge 2: Victorian communities can get better value from the bus network

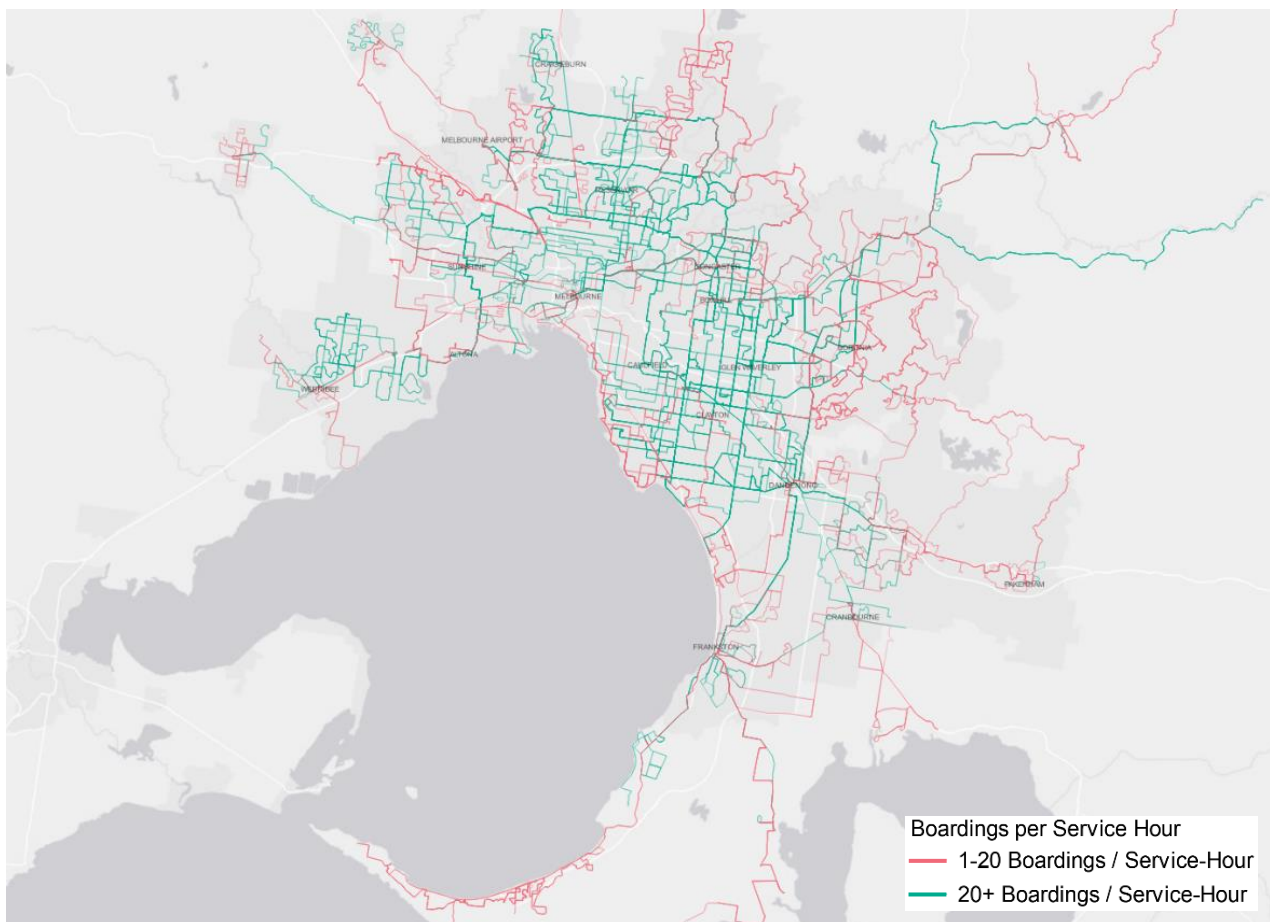
The second challenge is poor value for money from the bus network. While the government spends a substantial amount on operating the bus system, there are some areas in which the benefit is limited. While bus reform can lead to additional funding of services, the network may also benefit from reviewing the efficiency of existing services. The challenge for government is prioritising service improvements for communities of highest need and reviewing parts of the network where the benefit to customers is limited (such as routes with duplication or competing public transport modes).

### 4.2.1 Services being used efficiently

Infrastructure Victoria conducted analysis using a benchmark of 20 boardings per service hour as a general measure of economic viability. This benchmark factors in the benefits of taking a bus trip (improved health, social inclusion, reduced congestion, reduced emissions) against the costs of providing a bus service.<sup>112</sup>

As shown in Figure 16, the routes that fell below the benchmark often served sparsely populated areas with a high proportion of car ownership or were infrequent services along meandering routes with a limited span of hours. Using pre-COVID data, we found that only 54% of routes were operating above this benchmark, suggesting that there are many areas where the bus network is not operating efficiently. As part of future stages of Infrastructure Victoria's work on bus reform, there is an opportunity to look more closely at the types of benchmarks used to determine an efficient network, factoring in all the social benefits.

**Figure 16: Boardings per service hour by bus route (2019-2020)**



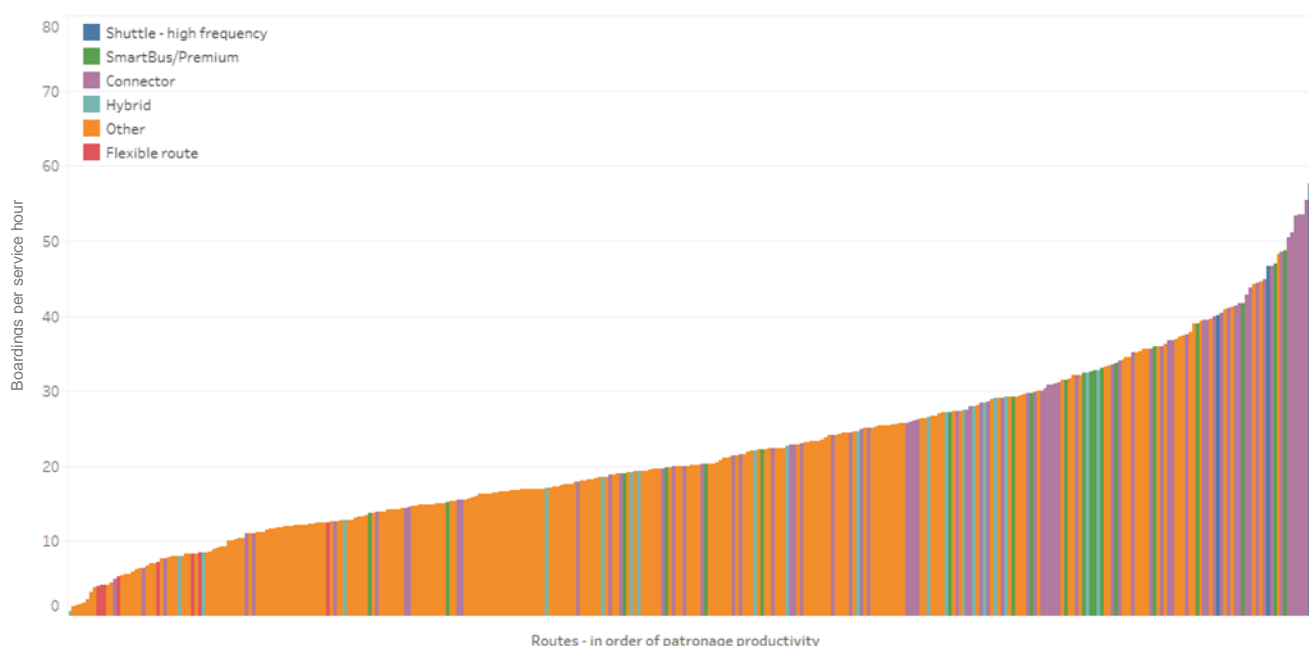
Source: Infrastructure Victoria analysis of DoT 2019-20 bus data

Patronage can also be assessed by looking at boardings by *type* of service. As shown in Figure 17, routes attracting the largest number of boardings commonly include university shuttles, SmartBus and connector services.

Figure 17 also illustrates the large differences in bus productivity by route by the different service offered, with flexible route/on-demand services recording the lowest route productivity and shuttle, SmartBus and connector services generally performing above 20 boardings per service hour. University shuttle services are by far the most productive bus routes due to a combination of demand, well-suited scheduling, direct routes between desirable origins and destinations and high patronage.

For other service types, there is large variability in the productivity of ‘regular local bus services’ indicating a mismatch in levels service provision and patronage.

**Figure 17: Metropolitan bus weekday boardings per service hour – August to November 2019**



Source: DoT internal analysis

## 4.2.2 Changing travel patterns and value for money

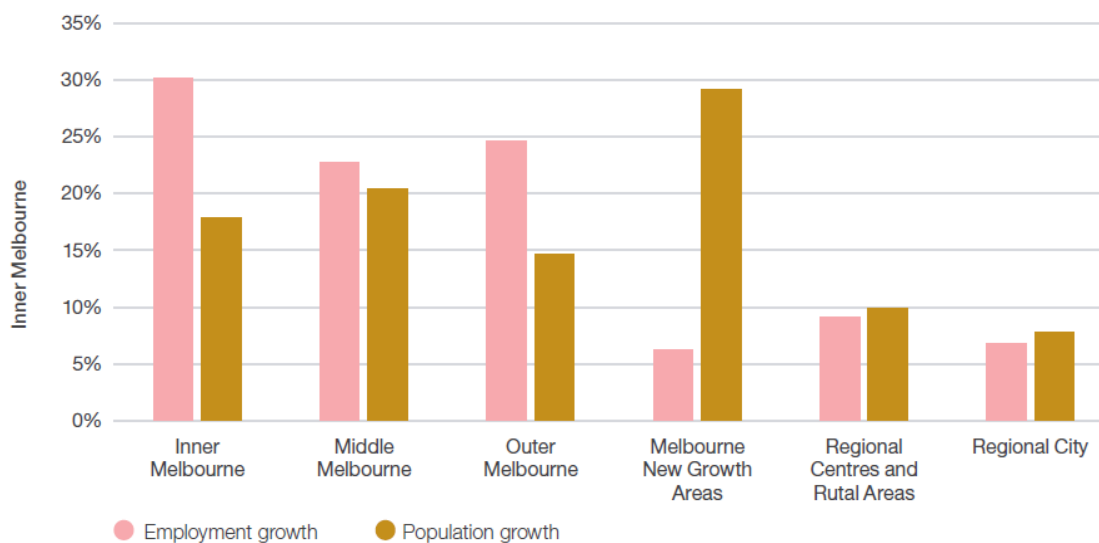
COVID-19 caused a sudden and pervasive change to travel patterns and behaviour. Research conducted by Infrastructure Victoria in *The post-pandemic commute – the effects of more working from home in Victoria* found that working from home for part of the week could result in more people choosing to live in Melbourne’s outer and growth areas.<sup>113</sup> This change offers the impetus to provide high quality public transport service for residents making trips both for work but also local trips for retail, social and recreational purposes.

Although it is difficult to provide the same level of public transport in outer areas of Melbourne with lower densities and wider areas to cover, these areas are expected to grow in both population and job opportunities, further exacerbating the transport service provision challenge. By 2036, the population in Melbourne’s outer suburbs and new growth areas will have overtaken the total population of Melbourne’s inner and middle suburbs.<sup>114</sup>

Analysis conducted for *Victoria’s infrastructure strategy 2021-2051* shows that while inner Melbourne employment is expected to grow more than its population, population growth in new growth areas will far outstrip employment opportunities by 2051. If this future plays out within the next 30 years, residents of new growth areas will need to increasingly rely on transport connections to inner, middle and outer parts of Melbourne where employment growth is stronger. The distance between radial rail lines and train stations

grows with distance from the central city, meaning that the only viable transport options for residents are either to drive, or to take a local bus.

**Figure 18: Comparison of employment and population growth projections (2018 to 2051)**



Source: Infrastructure Victoria, *Major transport program strategic assessment report*, 2021.

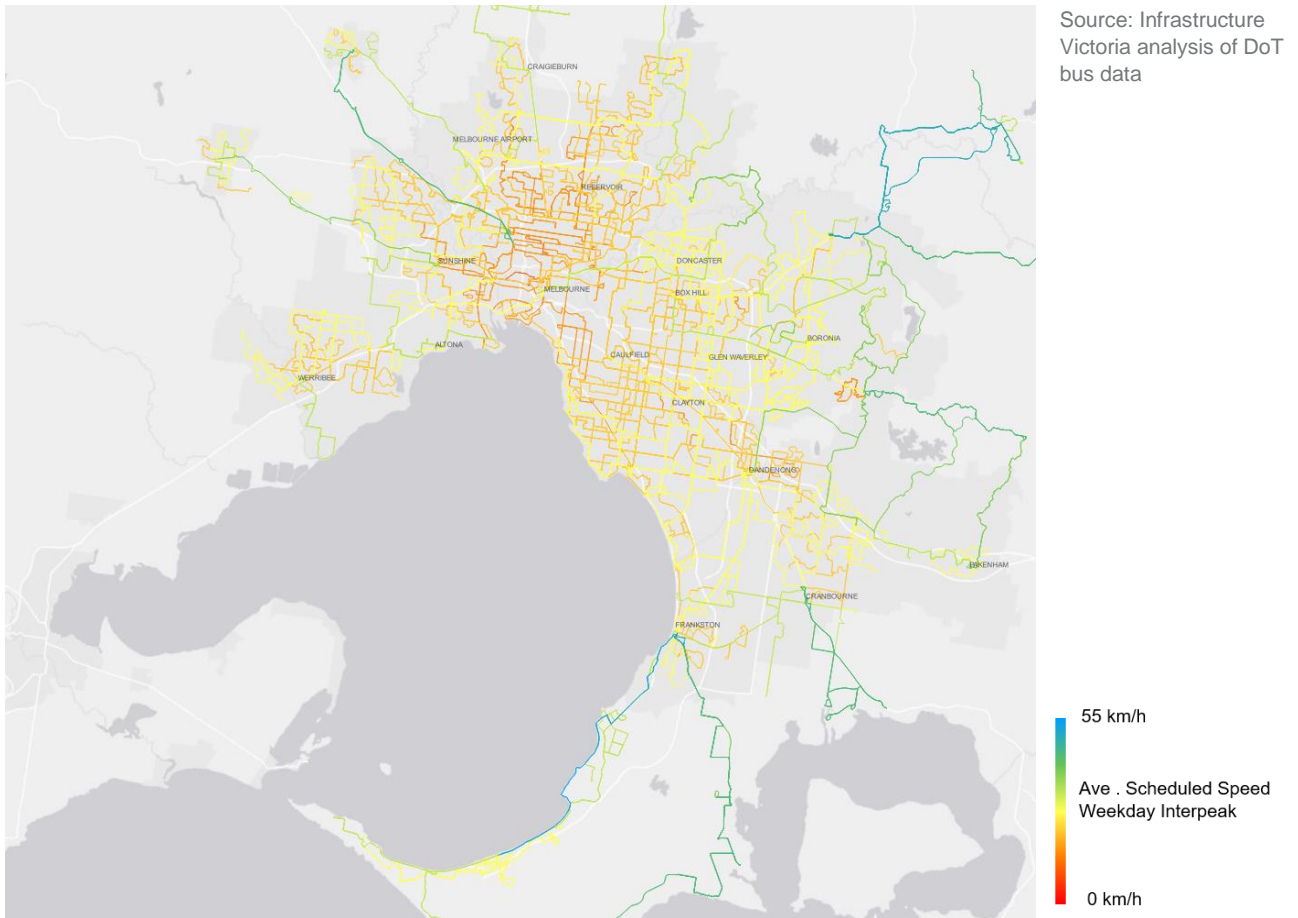
New transport infrastructure also has the potential to shape new travel patterns. Major projects such as Metro Tunnel, West Gate Tunnel, North East Link Program, Melbourne Airport Rail and the Suburban Rail Loop are currently being developed and built across metropolitan Melbourne. The bus network can play a role in boosting the economic benefits (for example, through greater patronage<sup>115</sup>) and may also help to facilitate further activity in adjacent land use to these projects through last mile bus connections. However, these benefits will not be realised if the status quo of Melbourne’s large and complex bus network continues to play out. If the bus system status quo remains, many bus routes along and around these major projects will simply continue to underperform. This would inhibit expanding catchments of potential passengers, and not make the most of new expensive infrastructure (or the existing bus network).

### 4.2.3 Operational flexibility and performance

As highlighted above, the distribution and frequency of Melbourne’s bus network has lagged behind the changing patterns of population and employment, particularly in growth areas.<sup>116</sup> Studies of rider preferences reveal that service frequency remains one of the main target areas for improvement in Melbourne’s growth areas, where buses are often the only public transport offering.<sup>117</sup>

Current franchising agreements for Melbourne’s bus network contain state-set targets based on service delivery and punctuality<sup>118</sup> that have contributed to timetable generation where average end-to-end route speeds are considerably lower than equivalent private car travel speeds for the same period—a conservative practice to factor in excessive road congestion to reduce the likelihood of a ‘late’ running bus. This can also lead to excess idling time at timing points (locations along a bus route where service arrival and departure times are measured against the timetable), reducing the competitiveness of buses as a viable alternative to the car. Figure 19 shows interpeak scheduled travel times for bus routes across Melbourne. Areas in inner and middle parts of Melbourne typically run with average bus speeds below 15km/h—far less than typical posted road speeds in the area (acknowledging that average speeds will have to factor in intersections and bus stops).

**Figure 19: Interpeak scheduled travel time for bus routes**



The legacy of early private operations remains entrenched through historic bus routes that are slow to realign to reflect the shift of people, preferences and key attractors over Melbourne’s development. While bus operators have great knowledge of their routes and passengers, there remains considerable scope for improved collection of this data and more effective use of it by bus planners to deliver even more efficient bus operations.

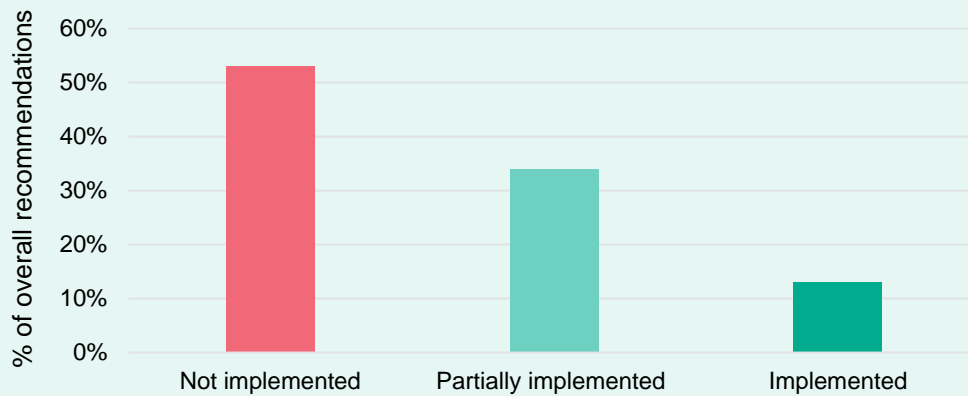
## Changes to the bus network for greater efficiency and value for money

Between 2007 to 2010, the Victorian Government conducted 16 Bus Service Reviews (BSRs) across all metropolitan local government areas. The BSRs contained feedback from over 200 workshops with local communities, designed to establish a consensus and set priorities for future bus improvements. Over 3,000 members of local communities attended the workshops and made submissions.

The BSRs contained over 300 recommendations across 400 metropolitan bus routes. Recommendations ranged from route design, changes to operating hours and changes to frequency of bus services.

Overall, 13% of all BSR recommendations have been fully implemented. A further 34% have been partially implemented, with the remaining majority of recommendations not implemented. *Victoria's bus plan* highlights reform objectives around simplicity, reliability, better performance and delivering better value for money. Implementation of bus reform is another opportunity to revisit network challenges highlighted as part of the BSRs to improve bus services across Melbourne.

**Figure 20: Status of BSR recommendations, 2022**



Not all recommendations as part of the BSRs will cost the government more to implement. Route realignments can be applied for more direct travel, duplicative services redirected, and frequencies adjusted to match the operating hours and travel needs of local catchments.

The BSRs are a useful resource in planning future stages of bus reform. Despite being over 10 years old, many of the fundamental priorities (like servicing major activity centres, providing alternatives to private vehicles, supporting access to jobs and education) remain today.

*Source: Expert bus advisory team analysis, Movement & Place Consulting*

## 4.3 Challenge 3: The existing bus network is contributing to a major equity problem, especially for outer and new growth areas of Melbourne

Public transport plays a major role in providing an affordable travel option for all residents in Melbourne. For those experiencing disadvantage and who cannot easily afford to own a car, dependence on public transport is not a choice but a requirement to participate in society—a dependence that the bus network is currently struggling to meet.

Many parts of Melbourne have no access to the city's higher frequency tram and train network, particularly in the suburbs of middle and outer Melbourne, including the growth areas. As highlighted in the first problem, the only public transport service in many of these locations is the bus. In these areas the bus plays a vital role in enabling access to employment, education, health and social opportunities for the community. However, bus services in these areas can be infrequent and have limited operating hours. If the bus service is not convenient, families can be forced into car ownership (as shown earlier in Figure 12). This lack of choice adds to the cost of living and contributes to locational transport disadvantage.<sup>119</sup>

For some people, locational disadvantage is compounded with personal and economic disadvantage.<sup>120</sup> Growth areas like Hume and Whittlesea local government areas (LGAs) have long been identified as areas at greatest risk of compounding locational, personal, and economic disadvantage, and can be more challenging to serve compared to higher density areas.<sup>121</sup>

Personal disadvantage ranges from mobility affected by age (including youth), disability, language barriers and poor health. Economic disadvantage, due to low incomes, means that transport is prohibitively expensive for some households. Analysis of 2020 ABS General Social Survey data suggests that 158,000 Melburnians always or often have difficulty getting to the places needed.<sup>122</sup> A bus system that does not meet the needs of a community can result in significant unmet trips. Given that a large share of service kilometres of the bus network pass through areas of greater transport disadvantage in metropolitan Melbourne, improving these very services is a major opportunity in meeting the unmet travel demand and in turn, reducing transport disadvantage and social exclusion for the most vulnerable people in these communities.

### 4.3.1 Social exclusion in Melbourne

The concept of social exclusion is used to understand issues and responses to people who fail to participate fully in society. While social exclusion can be linked to factors like unemployment, poor health or low levels of education, there is also a link between transport and social exclusion.

Transport has wide social purposes which enable people to access essential services, attend jobs, learning and healthcare facilities, purchase goods, and socialise. Accordingly, the transport services offered in a city need to meet a wide range of purposes. Research conducted in Melbourne, suggests that the desired span of hours for local bus operations should be at least 6am to 9pm.<sup>123</sup> This level of minimum standard enables access by vulnerable users and allows them to undertake most of their activities, most of the time.

The 2006 Victorian Government's *Meeting our transport challenges* (MOTC) acknowledges the wide range of uses of the bus system and recommended implementation of a social safety net of minimum bus service levels of at least hourly, and 6am to 9pm hours of operation.<sup>124</sup> The table below and Figure 21 shows an analysis of the routes that currently meet the MOTC criteria, while Figure 22 shows average weekday bus stop wait times across Melbourne. Though wait times along corridors like Hoddle Street, around Monash and Parkville (university shuttles) are typically below 5 minutes<sup>125</sup>, many parts in Melbourne's outer and growth area suburbs typically have wait times above 30 minutes. In some cases, average wait times at bus stops can exceed 60 minutes, breaching the MOTC minimum bus service levels.



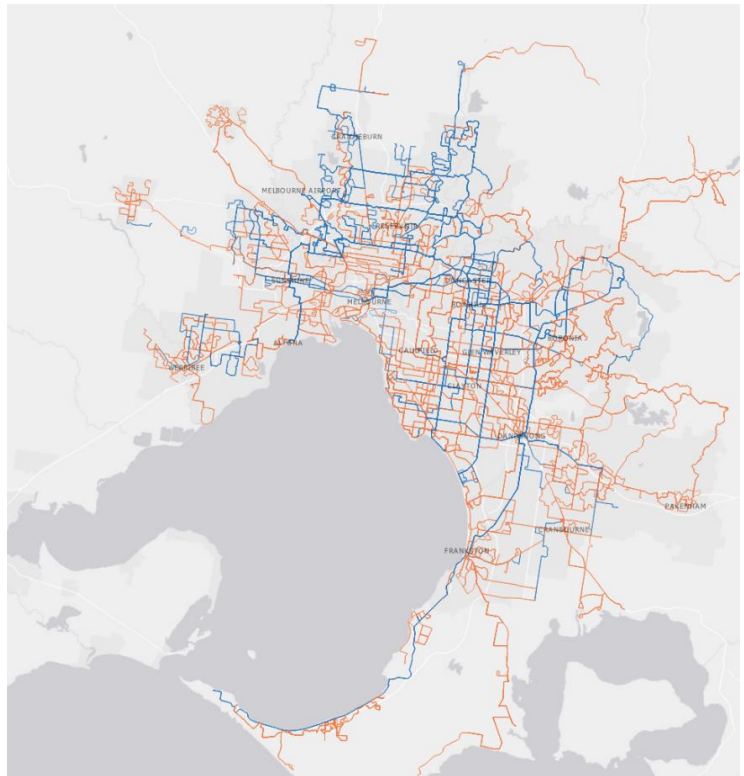
## Minimum service levels – 2006 MOTC (excluding Night Bus)

	<i>Services from at least 6am to 9pm weekdays</i>	<i>Services from at least 8am to 9pm on Saturdays</i>	<i>Services from at least 9am to 9pm on Sundays</i>	<b>Number of bus routes that meet all criteria</b>
Number of surveyed routes that meet criteria	62%	65%	28%	<b>25%</b>

**Figure 21 (right): Bus routes that meet the MOTC minimum service levels (service span)**

Meets MOTC Minimum Service Levels (Service Span)

- No
- Yes

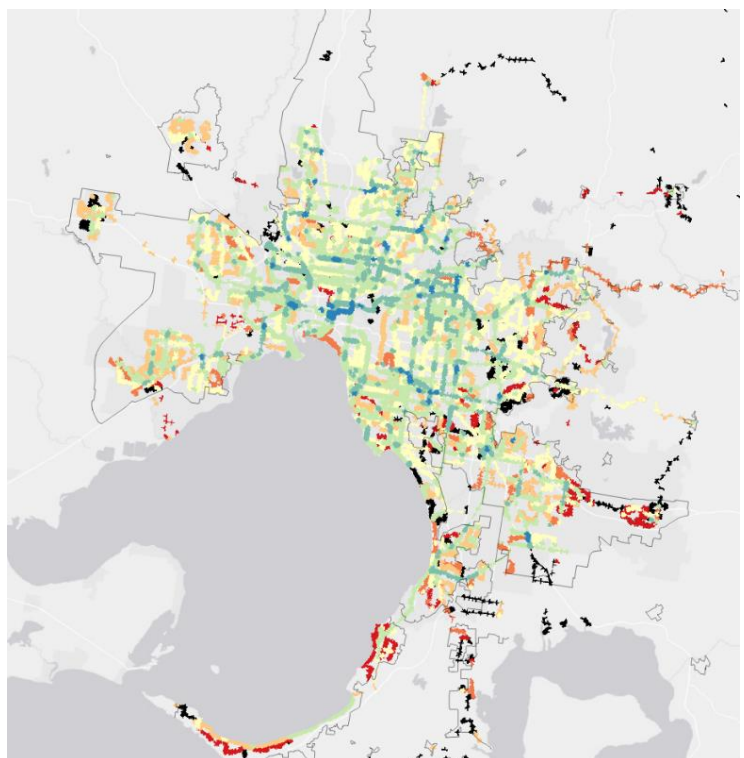


Note that analysis has only considered surveyed routes (those for which timetable data has been published through GTFS).  
Source: Infrastructure Victoria analysis of PTV timetable data for 2022.

**Figure 22: Average weekday bus stop wait times (minutes) and 400m walking catchment**

Average Stop Wait Time (mins) 6AM-8PM Weekdays

- 0 - 5
- 5 - 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- 60 +



Note, all areas coloured in the figure represent locations within a 400m catchment of a bus stop. Average stop wait time is defined by any service stopping.  
Source: Infrastructure Victoria analysis of PTV timetable data for 2022.

### 4.3.2 Transport disadvantage

Transport disadvantage is a multi-dimensional concept,<sup>126</sup> touching a range of factors shown in the following table. Each of these factors has then been further expanded upon in relation to bus reform across Melbourne’s metropolitan network.

Transport disadvantage factor	Description	Relation to bus reform
<b>Spatial</b>	Where people have long or near-impossible journeys to access their destination	Gaps may exist in the network where bus services could run or be rerouted for more direct service
<b>Temporal</b>	Where people cannot access locations they need to at certain times	Existing bus services may have ceased on a late evening or Sunday
<b>Personal</b>	Including physical impairments or personal safety concerns	Accessibility upgrades to vehicles or physical bus stop infrastructure may be required
<b>Financial</b>	Where costs of travelling are prohibitively high	Public transport fare reform such as cheaper bus fares or off-peak discounts may be required
<b>Environmental</b>	Where people suffer from negative externalities of transport, such as localised noise and air pollution or vehicle collisions	A transition to zero emissions buses and better road infrastructure (including bus lanes) could mitigate negative externalities
<b>Infrastructural</b>	Where transport infrastructure creates a physical barrier, dividing a community	Improved route design, signalised crossing opportunities and providing links between people, jobs and services will assist in connecting communities, rather than dividing.

Source: Table adapted from G Currie and A Delbosc, ‘Transport Disadvantage: A review’, in G Currie (ed), *New perspectives and methods in transport and social exclusion research*, Emerald Group Publishing, 2011, p 17. Far right column ‘Relation to bus reform’ authored by Infrastructure Victoria.

Any one of the transport disadvantage factors above can be identified in Melbourne. Some of the most prominent factors are discussed in the sections below.

### 4.3.3 Limited travel choice

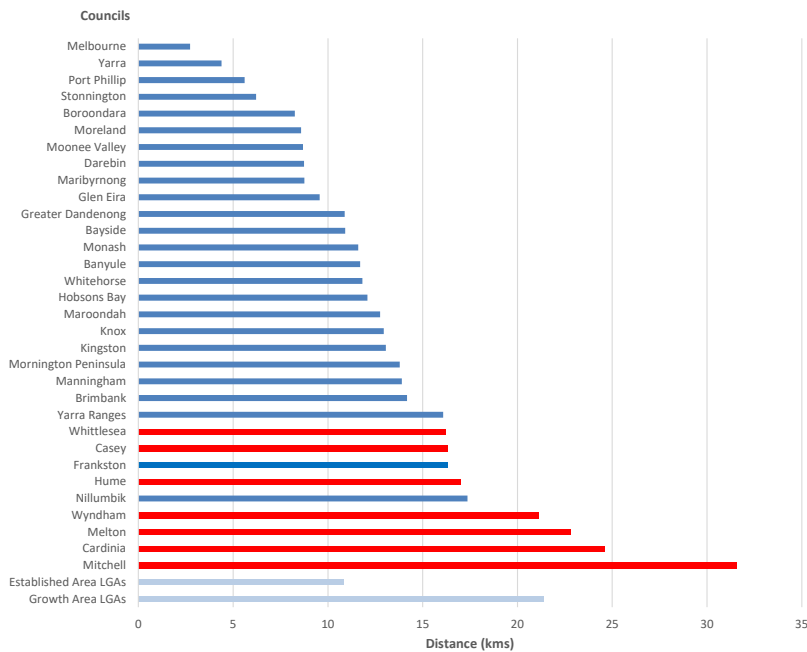
For many people in Melbourne, the most viable way to access jobs and other opportunities is by car. For those on lower incomes, the reliance on car travel, and associated costs, can cause financial stress. This is exacerbated as the costs of travel increase due to higher petrol prices. The lack of transport options for people reduces their ability to participate in work and social activities.

“Voluntary” car ownership means that there are adequate substitutes for gaining access to facilities, and that the car is not a necessity. Conversely, “forced” car ownership means that there are no alternatives.<sup>127</sup>

Many people in Melbourne’s growth areas face exactly this situation of forced car ownership, and this is evident in the comparatively high rates of car ownership (see analysis in Section 4.1.1 Competition with other

modes). Approximately 82% of growth area residents used their own cars to travel to work in 2016 compared to Melbourne's average of 71%.<sup>128</sup> This is compounded by the fact that growth areas and outer suburbs are generally poorly served by public transport.<sup>129</sup> Figure 23 also shows that growth area residents also typically travel further to access jobs than the remainder of Melbourne.

**Figure 23: Median distance travelled for residents' journey to work across Melbourne, 2016. Growth area councils shown in red.**

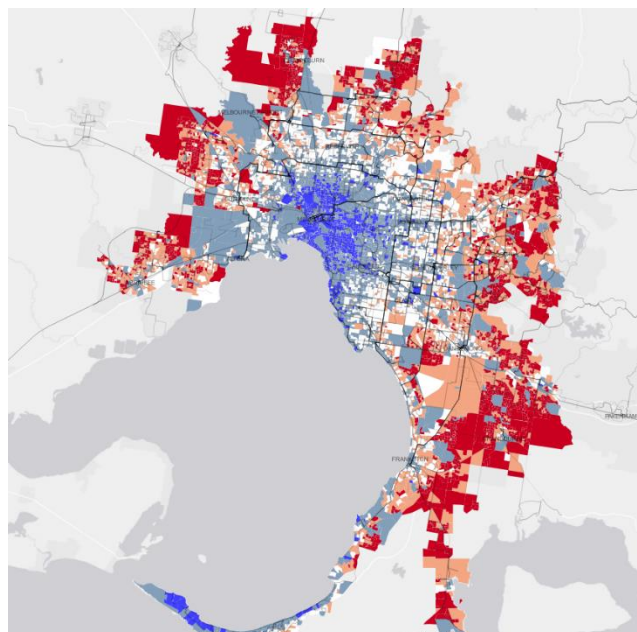
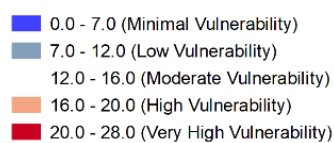


Source: Infrastructure Victoria analysis of Australian Bureau of Statistics (ABS), *2016 Census - commuting to work* [TableBuilder], ABS website, 2016, accessed 6 June 2022. Adapted from VAGO.

The 'vulnerability assessment for mortgage, petroleum, and inflation risks and expenditure' (VAMPIRE) index shows that many areas poorly serviced by the bus network including outer and new growth areas are classified as areas of 'high' to 'very high' vulnerability (see Figure 24).<sup>130</sup>

In summary, many growth area residents are characterised as high vulnerability, high car ownership, longer distance travellers with limited public transport choice compared with their inner city counterparts.

**Figure 24 (right): VAMPIRE for Metropolitan Melbourne, SA1 (2016)**



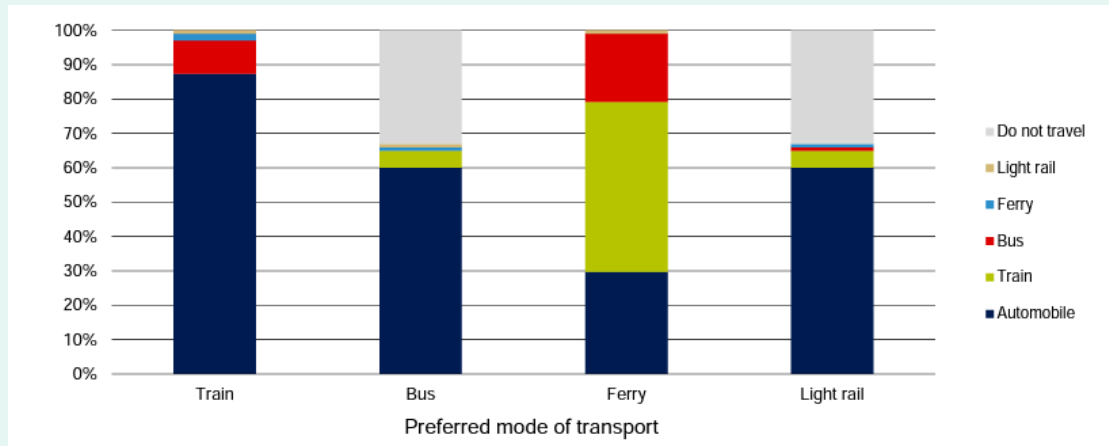
RMIT, *VAMPIRE for Australian Capital Cities (SA1)* [data set], <https://aurin.org.au/>, 2016, accessed 1 August 2022.

## What would people do if the bus did not exist?

The NSW Independent Pricing and Regulatory Tribunal (IPART) conducts research on how people respond to fares and substitute between transport modes as an input into their fare optimisation model.

This model also provides insight into what people do if they don't use their preferred mode of transport. Results are shown in Figure 25. For each preferred mode of transport, the stacked bars show the distribution of transport modes that people substitute for their trip.

**Figure 25: What people do if they don't use their preferred mode of transport**



While almost all train users substitute using private vehicles, on average, a third of bus users would not travel at all. This suggests that if the bus was not available, a third of existing users would no longer make their trip, potentially limiting their active participation in society and access to jobs, education, social opportunities.

Although this research is based on data from NSW, it also provides insight into potential issues with Melbourne's buses.

Source: Independent Pricing and Regulatory Tribunal (IPART), *Elasticities: Final Report – Information Paper 9*, NSW Government, 2016

### 4.3.4 Transport challenges in Melbourne's growth areas

The provision of transport in new growth areas of Melbourne, especially through expansion of the existing bus network, is an issue that has also been highlighted by RMIT researchers. Despite the well-established process of developing Precinct Structure Plans (PSPs) and planning bus-capable roads, with an indication of where bus routes may go, the current process does not guarantee a timely provision of bus services or guarantee their funding.<sup>131</sup>

Currently, there is no measure within PSPs that can ensure the provision of public transport services by any particular time. Often, this means that the necessary street connectivity for public transport provision often does not exist when residents begin to move in or is built much later than it is needed.<sup>132</sup> Many growth area residents spend upwards of 15 hours per week commuting, mostly by private vehicle.<sup>133</sup> Bus routes leading to activity centres and train lines, providing an integrated transfer with other modes, are often not adequately provided in the few first years of growth.<sup>134</sup> The lack of frequent and direct bus services means that residents remain car dependent.<sup>135</sup> Moving to a new environment provides the opportunity for residents to change their travel habits, provided that alternative modes of transport are available.<sup>136</sup> Without good alternative transport options in Melbourne's new growth areas, longer term entrenched car dependency will soon follow.

## Wyndham growth area network reform

Between 2006 and 2021, the population of Wyndham local government area more than doubled from approximately 115,000 residents to 290,000.<sup>137</sup> This growth placed considerable pressure on the existing transport infrastructure and services, leading to government investment in renewal of road infrastructure, including the Western Roads Upgrade Project as well as completion of the Regional Rail Link and associated new stations at Tarneit and Wyndham Vale in 2015.<sup>138</sup>

Large scale bus reform in Wyndham in 2015, along with improved connectivity to the newly opened railway stations, has been attributed to continued increases in bus patronage, with upward growth of 25% on weekdays and as much as 40% on other days (population growth of 35% over the same period).<sup>139</sup>

The new network reconfigured existing bus routes, removing some poorly performing routes, straightening trunk routes and increasing frequencies where possible, with daytime frequencies for trunk bus routes increasing from 40 minutes to 20 minutes.<sup>140</sup>

Bus routes in Wyndham have historically been well harmonised with the existing railway network, reflecting the high rate of interchange at stations<sup>141</sup> and reforms following 2015 have maintained this scheduling during peak times.

Image source: Infrastructure Victoria

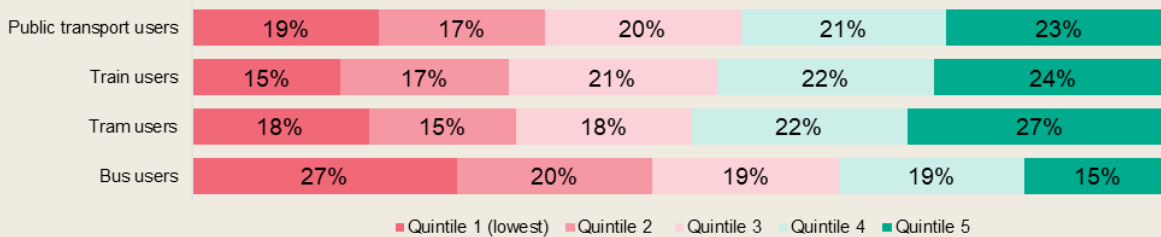


## Bus user demographics and the impact of COVID-19

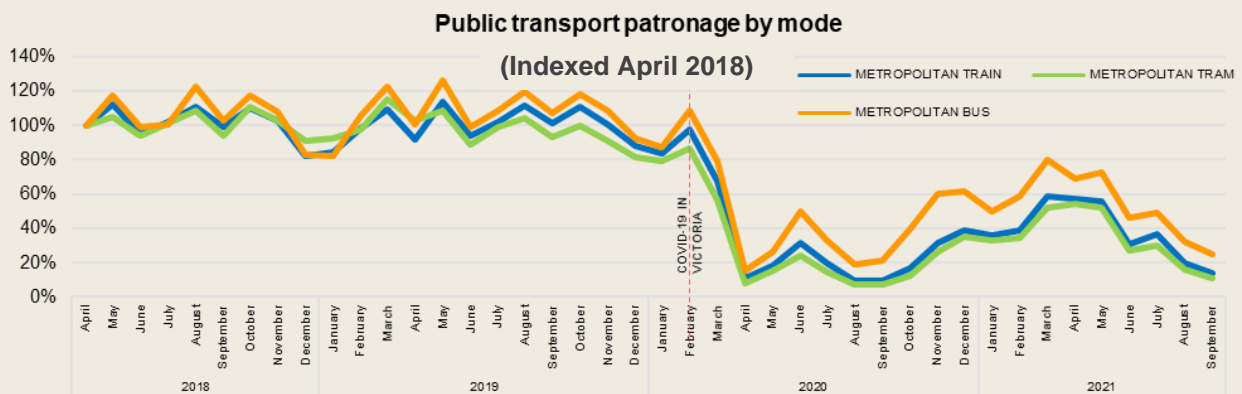
The Victorian Integrated Survey of Travel and Activity (VISTA) is an ongoing survey of household travel activity in metropolitan Melbourne. Respondents provide detailed household information as well as detailed personal travel information in the form of a travel diary for a single day, listing all travel activities and their purpose. Data for the 2012-2018 period provides a cross-section of over 65,000 Victorians from over 25,000 households.<sup>142</sup> This data has been key in developing the Victorian Government’s understanding of demographics, trip patterns and the relationship between mode and income.

Due to its relatively large sample size, VISTA data helps us understand the types of travellers who typically use a public bus (distinguished in the survey from school bus). When examined in comparison to other public transport modes such as tram and train, public bus users tend towards a lower personal income with 47% of bus users in the lowest two income quintile groups (see figure below). While trains and trams have higher rates of high-income users overall, buses are currently disproportionately used by those on low incomes.

**Income levels vary by mode of transport - buses are disproportionately used by those on low incomes**



Source: Public Transport Victoria (PTV), *Victorian Integrated Survey of Travel and Activity* [data set], Victorian Government, 2018.



Source: Data Vic, *PTV Timetable and Geographic Information - GTFS* [data set], <https://www.data.vic.gov.au/>, 2022, accessed 27 July 2022.

Patronage for all public transport modes declined significantly during the early months of the COVID-19 pandemic, however metropolitan bus demonstrated both a smaller relative decline during periods of lockdown and faster patronage rebound than other public transport modes, including train and tram. This pattern during periods of lockdown perhaps reflects the three main profession types listed by bus riders outside of not employed or studying (48%): retail (11%), accommodation and food services (5%), health care and social assistance (4%), with the latter three listed among essential services.

## 4.4 Challenge 4: Customers find using the bus difficult and complex

Melbourne's bus system is often negatively perceived by the general public. The reputation of buses being unreliable, infrequent, indirect, slow and inefficient fails to create a positive culture around buses.<sup>143</sup>

Unlike Sydney or Brisbane where buses provide a core mass transit service, Melbourne's train and tram network fulfills this role for most of the inner and middle suburbs of Melbourne. This leaves the bus network to serve the remaining gaps across Melbourne and as such it is often seen as the public transport mode of last resort. This negative perception can reduce the chances of new users considering buses as part of their journey.

High barriers to entry are also a common feature of bus journeys across metropolitan Melbourne. From a complexity perspective, real-time information for buses is far below the standards of Melbourne's tram and train network. While recent improvements like real-time departures, delays and occupancy level information have improved the user experience for a select few bus routes, other bus routes and services lack this basic real-time information. In addition to digital access, physical access to buses and bus stop infrastructure is also a significant barrier (like available kerb and pedestrian crossings), especially for those with mobility challenges.<sup>144</sup> Safety on public transport also plays a major factor in whether travellers use services available to them, or take other modes, like the private vehicle.

### 4.4.1 What people think about buses

Community views on buses are mixed. Internationally, bus vehicles and services, compared to other public transport modes, are generally criticised as being less reliable, uncomfortable, infrequent, having worse aesthetics, and being less innovative and modern.<sup>145</sup>

Bus users in Melbourne have similar complaints of infrequent services, limited operating times (for example, ending before 9pm), indirect and confusing routes, and lack of bus lanes.<sup>146</sup> When compared to other modes of public transport, Melbourne bus services are less preferred due to the higher levels of uncertainty about when a bus will arrive, and routes being confusing to navigate, especially for unfamiliar trips.<sup>147</sup> Views on bus services are shaped by experiences and preconceptions. People who use buses typically have more positive views of bus services than people who do not use buses.<sup>148</sup> Melbourne public transport users rate the most important attributes of services as: safety, reliability, frequency, and availability (when and where needed).<sup>149</sup> When these attributes are met, users have positive views on buses.

A 2021 survey of Victorians for Sustainable Cities found that poor frequency was the most substantial issue users had with buses.<sup>150</sup> People also identified other issues including the absence of a bus service, poor connections, unreliability, and poor bus stops. One survey participant noted that:

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**'...buses are incredibly infrequent and poorly connected to trains, especially at night. There are times I could walk home faster from the train station (30+ mins) than wait for the next bus but it's unsafe, so I call a taxi or Uber.'**<sup>151</sup>

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User perception research undertaken by PTV in 2016 found that there are negative perceptions about buses in Melbourne compared to other modes.<sup>152</sup> This includes negative perceptions around the convenience of the service itself. Compared to other modes of public transport, Melburnians were less familiar with where buses go, view buses as less reliable and less frequent, and do not trust buses to get to where they need to go.

In 2022, Roads Australia surveyed around 800 Melburnians on their attitudes and use of buses.<sup>153</sup> This work found that on average people agreed that overall, buses were worthwhile, helping to improve road congestion, accessing opportunities, and reducing social isolation.<sup>154</sup> Social approval for buses was found to

be weaker in Melbourne than other Australian cities. Again, this could be due to Melbourne's strong tram network.

Service attributes which Melbourne respondents rated as highly important, but were performing badly, highlighted familiar items such as frequency, reliability, safety at night, and cleanliness.<sup>155</sup> Attributes which were of importance and rated as performing well included feeling safe on the bus during the day, easily getting on and off the bus, onboard comfort, and being able to easily purchase a myki card.

#### 4.4.2 Accessibility requirements

While standards and policies such as being within 400 metres of a bus stop ensure that residents have a nearby service, the journey to reach that bus stop can also present a major barrier or challenge to entry for metropolitan bus services. This journey of physically accessing the bus stop impacts the experience of users.

A survey and review of bus stop data undertaken by Victoria Walks highlights the challenging environment that many can face when travelling to a bus stop in metropolitan Melbourne. The survey found that poor bus stop facilities and poor walkability of the surrounding environment further contributed to a negative experience.<sup>156</sup> Audits found that 64% of bus stops had no formal crossing nearby while more than one third of stops had no ramp access (kerb ramps or driveways) within 50 metres.<sup>157</sup>

The research also found that, given bus stops are commonly located on main roads to ensure efficient bus operations, people are usually left to negotiate crossing of roads with high traffic volumes and speeds. The trade-off here is that running services along high-speed roads benefits on-board travel times while buses running along local roads (quieter and typically more pleasant environments for users waiting at bus stops) may be highly circuitous and indirect, as highlighted in Challenge 1.

If using a bus for a return trip, the journey almost always involves crossing the road the bus travelled along. Results also highlighted that 95% of stops on roads with a speed limit of 60km/h or more did not have a signalised crossing within 20 metres of the bus stop.<sup>158</sup>

**Figure 26: Bus stop placement and accessibility**



Source: Victoria Walks, *Getting to the Bus Stop*, 2021.

While street kerbs were present in 94% of Victoria Walks' access audits, over a third of bus stops did not have any ramp access onto the kerb within 50 metres. This makes getting to the bus stop a major challenge for those with limited mobility, in wheelchairs, mobility scooters or pushing prams with no opportunity to cross.<sup>159</sup>

Under Australian law, public transport networks are required to be fully accessible by 2032.<sup>160</sup> Inaccessible public transport is a barrier to full participation in communities for people with disability, older Victorians, those with injuries or chronic health conditions, or people pushing prams, trolleys, walking frames and luggage.<sup>161</sup>



### 4.4.3 Real-time passenger information systems

Bus users also face challenges once reaching a bus stop, including competing space between the bus stop, footpaths and street environments, inconsistent service information and varying configuration of bus stop infrastructure.<sup>162</sup> Inconsistent information provided to users at the bus stop also impacts their confidence and experience of using the bus. This can also lead to travellers making trade-offs about their trip, favouring the certainty of taking their car over the uncertainty of when their bus will arrive.

International synthesis of bus improvements also highlights high quality signage and information and real time information being some of the most cost-effective bus improvements.<sup>163</sup>

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‘Calling a car through Uber takes a few taps of a finger. Using a bus can involve navigating inaccurate schedule information, using websites that don’t have bus maps, and looking for a bus stop that doesn’t even have the route number on it.’

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Although based on research from the United States, comparisons are consistent with user reported experience of buses in Melbourne. Original quote source: S Higashide, *Better buses, better cities: How to plan, run, and win the fight for effective transit*, Island Press, 2019.

Without real-time information, many users are left uncertain as to when the bus will arrive. Even for regular users, real-time information that helps to take into account delays caused by congestion and poor weather helps to lead to better informed users, helping to save time.<sup>164</sup> Having simple indicators like a countdown timer can also help the wait feel shorter.<sup>165</sup> Accurate real-time information also helps transport operators to track performance and travel demand to help plan future network improvement strategies.

### 4.4.4 Rail design and bus interchanges

As bus reform opens the door to buses accommodating more trips to more destinations, transferring and interchanging will inevitably increase. As mentioned earlier, VISTA data from years 2012–20 indicates that 41% of all bus trips involve transfers to other public transport modes.<sup>166</sup> The user experience of utilising multiple modes for trips must be optimised by making transferring an easy experience for all users.

Research highlights the importance of safe connections for walking and cycling to public transport stations, as well as enabling access and integration of emerging modes like e-scooters and rideshare.<sup>167</sup> The Victorian Government also highlights the importance of providing functional and safe movement within public transport interchanges (Objective 4.3.1) as part of its Urban Design Guidelines for Victoria, including providing safe pedestrian paths separated from vehicle lanes.<sup>168</sup> Guidance from the Australian Government on interchange infrastructure also highlights the need to coordinate transfers between different operators, minimise the distance between boarding points, provide high quality visual and audio alerts and the importance of wayfinding strategies and plans.<sup>169</sup>

### 4.4.5 Safety around buses

Providing better buses in Melbourne means addressing perceptions of safety for bus users both on board but also at stops and interchanges. The size and form of Melbourne’s bus system presents numerous challenges that must be considered. Most bus stops are stand-alone flags on roadsides where passing traffic may be infrequent, particularly at night.

A survey arranged by Monash University into perceptions of safety in 2010 revealed that 40% of young people felt unsafe using public transport at night and 20% of respondents felt unsafe waiting at a bus stop at any time of day.<sup>170</sup> Earlier studies suggested that young women tend to feel more unsafe on public transport than young men. One 2018 survey by University of Melbourne recorded that 80% of female students had experienced victimisation on public transport over the preceding three years.<sup>171</sup> From VISTA data, 53% of respondents who used the bus identified as female.<sup>172</sup> While a program similar to the progressive rollout of

Protective Service Officers (PSOs) at stations on Melbourne's train network since 2012 may not be viable for Melbourne's much larger and less patronised buses, there are other opportunities to boost safety across the bus network.

The TramLab Toolkit for improving the safety of women and girls on public transport was released in 2020, acknowledging the complexity of facilitating safe public transport journeys and that no stand-alone initiative is sufficient.<sup>173</sup> This toolkit was developed alongside public transport providers, women users and key stakeholders. Areas of focus are gender-sensitive public communication campaigns, staff training for awareness on gender issues, placemaking, safety and data collection through a gender-sensitive lens.<sup>174</sup>

The toolkit features several practical infrastructure-based interventions to improve gender-sensitive design and promote greater safety for women and girls at public transport stops. Design interventions centre around areas like:

- policy frameworks to prioritise budget for projects that include women-focused planning and design
- traffic calming to prioritise safety and comfort for active transport
- increasing the *quality* of lighting and vegetation but also maintaining sightlines.

The toolkit also describes how public transport stops can be designed to maximise passive surveillance by creating an environment that people want to be in. It also suggests that where possible, real-time customer information such as vehicle arrival and departure times can minimise the uncertainty and lengthy wait times for customers,<sup>175</sup> including at night. Many principles of design from the TramLab team are highly relevant to the bus network.

## What we've heard – perceptions of Melbourne's bus system

Many stakeholders have spoken to us about the importance of improving the bus network.

In developing *Victoria's infrastructure strategy 2021-2051*, we asked Victorians about their views on what would make buses more attractive. We also looked through the submissions to our draft 30-year infrastructure strategy,<sup>176</sup> as well as publications from various community and advocacy groups and local councils on the topic of bus reform.

Better service **frequency** was the most commonly identified as a way of improving the bus network. Groups like BusVic, the Public Transport Users Association (PTUA) and the Victorian Council of Social Services all advocated for higher frequencies, with services operating every 10-30 minutes.

**Connectivity** and **direct routes** also featured heavily in the survey responses, submissions and publications. Stakeholders mention two ways to improve connectivity. Firstly, as stated by the PTUA, 'routes themselves should be focused on railway stations and on other major trip generators currently unreachable by rail or tram (such as Monash University and many suburban shopping centres)'.<sup>177</sup> Secondly, connectivity could be improved through better coordination between bus and train/tram timetables. On directness, some survey respondents highlighted that they didn't mind having to walk further if it meant they could have more frequent services on less circuitous routes. Additionally, like frequency, directness is considered a key method in improving the service quality to be comparable between trams and buses, with the PTUA stating that 'most routes should be direct and 'tram-like' running primarily along arterial roads rather than winding through back streets as many currently do'.

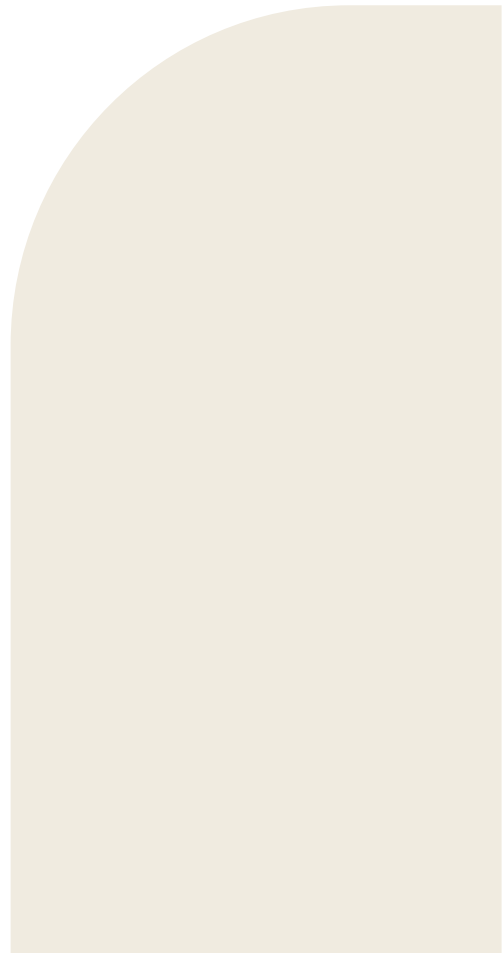
The way in which **shorter operating** hours negatively impact the attractiveness of Melbourne's bus network is explained by advocacy group Transport for Everyone: 'Bus services are also limited with most local routes ceasing shortly after 9pm. Four-hour gaps between when regular buses stop and Night Network services start are common in suburban areas. Poor service lets night-time workers and customers down. Young people, in particular, keep the night-time economy running; with poor evening public transport, many without cars resort to high taxi/uber fares to/from work. This reduces incentives to work and makes sourcing staff harder'.<sup>178</sup> **Bus priority** measures were also strongly supported, including new bus lanes, upgrades to traffic signals and clearways in peak hour to support bus movements.

### Key discussion paper questions

- Has Infrastructure Victoria identified the key problems or challenges with the metropolitan bus network? Have we missed anything?
- What are the barriers to addressing the challenges that we have identified? What can be done to address these challenges?
- Can you provide any evidence to help us better understand the network challenges?



# Part three: Opportunities and benefits of reform



# 5. Opportunities for better buses

## 5.1 Possible range of reform opportunities

This discussion paper highlights four big challenges faced by buses in Melbourne: competitiveness with private vehicles, value for money of the network, equity and access and usability of buses. Development of a bus reform plan provides government with a range of small to large improvements to help address these challenges. Through our literature review, we have identified some of the commonly cited opportunities for bus reform in Melbourne, which will help to frame our final recommendations.

### **System reforms to better meet patronage purposes include:**

- network redesign with more legible and direct routes<sup>179</sup>
- improving travel time reliability and speed, including through road priority measures<sup>180</sup>
- increasing bus frequency<sup>181</sup>
- expanding and aligning hours and days of operation of bus services<sup>182</sup>
- timetabling reforms such as rapid running (services that no longer slow down or wait at bus stops if they are running ahead of schedule)<sup>183</sup> and better integration with other public transport modes.<sup>184</sup>

### **System reforms to better meet coverage purposes include:**

- alternatives to coverage-focused buses for low patronage areas such as demand-responsive services or subsidies for other services<sup>185</sup>
- integrating land use and transport.<sup>186</sup>

### **Reforms to improve the passenger experience and perceptions of buses include:**

- better in vehicle experience including all door boarding<sup>187</sup>, low floors<sup>188</sup>, prepay fares, cleanliness, safety, ride quality and comfort<sup>189</sup>
- improving bus stops and surrounds, including safer and better access, more bus shelters, seating, and better physical integration to support interchanging with other modes<sup>190</sup>
- better network information including live bus tracking<sup>191</sup>
- marketing and branding of bus services<sup>192</sup>
- zero emission buses.<sup>193</sup>

### **Public transport fare reform includes:**

- changes in fare prices that are set to influence how, when and where people use the transport system
- variable fares based on distance travelled, time of day and mode: cheaper fares for buses
- off-peak fare discounts to help alleviate demand during the busiest morning and afternoon peak periods.

Note that while public transport fare reform can also contribute to achieving both patronage and coverage reforms for buses specifically, our report *Fair move* highlights the value of fare reform in improving to the efficiency and equity of the wider transport network.<sup>194</sup>

These possible reforms are not exhaustive and are presented as conversation starters which we will explore further in future stages of our work. Our consideration of reforms options will not necessarily be limited to those listed above.

### Key discussion paper questions

- Are there other large reform opportunities that you can identify to improve buses in Melbourne?
- Do you think there are any constraints in implementing of any of the reform opportunities that we have identified?

## 5.2 Benefits of bus reform

This section highlights some of the possible benefits of a better bus system in Melbourne. These are presented as possibilities, noting that the actual benefits of reform will be determined by the exact package of reforms and broader policy settings, including transport network pricing.

In later stages of our project, we will explicitly quantify the benefits of bus reform in Melbourne. We will cover the broad social, environmental, economic, and financial benefits on offer.

### 5.2.1 Faster travel and better access

Better bus services in Melbourne could provide people with quicker, more reliable, and expanded transport options. People will benefit from better access to employment and education opportunities which expands their economic opportunities. It also means better access to services, community, and recreation opportunities which helps create a healthy, resilient, and cohesive society.

Bus reform could improve travel times. A study of bus network redesign in Melbourne which refocused the network on frequent and interconnected routes found that average travel times of bus users could be reduced by over 10%, and that this could be delivered within existing resources.<sup>195</sup> This suggests network redesign could create over \$100 million annually of value in travel time savings for existing bus users.<sup>196</sup>

### 5.2.2 Health and environmental benefits

When people choose to use the bus for a trip instead of driving there are benefits to the individual as well as broader societal benefits. Individuals benefit from the health benefits gained from incidental exercise through a walk to the bus stop, which also has the broader societal benefit of reduced health system costs.<sup>197</sup> One study values the health benefits (both to the individual and society) of walking to access a bus stop at around \$3.25 per bus trip.<sup>198</sup> This implies that the walking (physical health) benefits from Melbourne's bus services are currently of the order of \$195 million annually.<sup>199</sup> More people using the bus instead of driving would heighten the total value of this benefit.

There are also environmental benefits that accrue from more people catching the bus rather than driving. A busy bus emits less greenhouse gas emissions per passenger kilometre travelled than a car.<sup>200</sup> Even if all buses and cars were electric, an electric bus would still be less energy-intensive per passenger kilometre.<sup>201</sup> Other societal and economic benefits of more people on buses and out of cars include the reduction in congestion on roads, reduction in local air pollution, and the reduction in road crashes.<sup>202</sup>

### 5.2.3 Social inclusion

For some people, buses are the only option to travel longer distances. This could be due to lack of financial resources for car ownership and/or a lack of other public transport options in their local area. For this group of people, buses provide essential access to services such as health and education, as well as to travel to employment and other events in their community.

In this situation, buses provide a vital lifeline, the absence of which increases the risk of social isolation. Improving buses so they more effectively perform this function reduces social isolation, which enhances economic, health, safety, and community cohesion outcomes.<sup>203</sup> This would be particularly impactful in communities with poor public transport access, including those in outer areas of Melbourne.

### 5.2.4 Land use

Like other public transport modes, good bus services can integrate with land use to create value. Bus rapid transit can increase connectivity to a similar extent that light rail can, and enable higher intensity land uses such as denser housing or commercial buildings.<sup>204</sup> This has many benefits, including lower resource and energy use, agglomeration economies, and infrastructure efficiencies.<sup>205</sup>

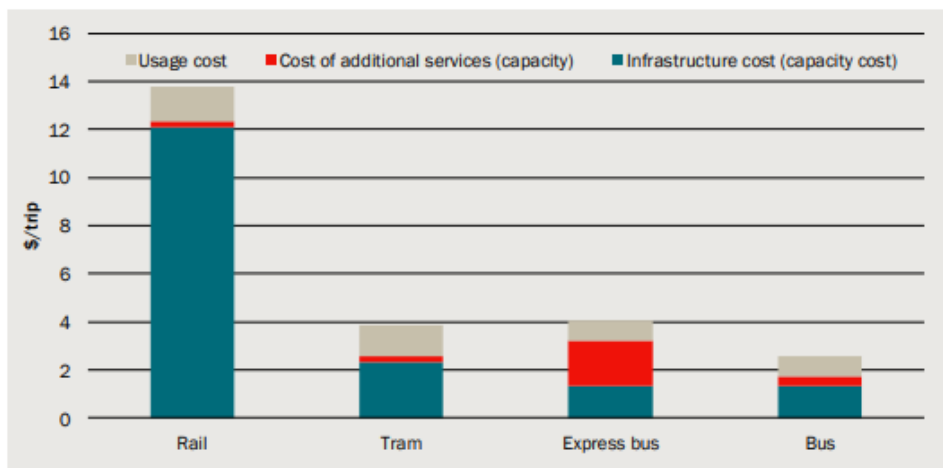
As Melbourne’s population continues to grow, a better bus system also has a role to play in meeting many aspects of *Plan Melbourne*, including providing more households access to jobs and services, providing access for activity centres, precincts and growth areas, and creating a more productive and sustainable city.

### 5.2.5 Value for money and economic benefits

Better buses could create a more financially sustainable system. Bus reform in some circumstances has resulted in faster travel times and higher patronage while keeping operational costs steady.<sup>206</sup> However, in considering this benefit, it is also important to value the social inclusion benefits of buses providing a safety net, as explained above.

Capital and operating costs for bus services can also be relatively cheap. Previous Infrastructure Victoria work found the cost to government of an additional trip on a bus to be lower than rail and tram, and express buses to be similar to trams.<sup>207</sup> As illustrated below, this is due to buses having lower infrastructure costs.

**Figure 27: Public transport marginal cost per trip**



Source: The CIE and Jacobs, *Estimating the social marginal cost of public transport in Victoria – Final Report prepared for Infrastructure Victoria*, 2020.

While bus services can be cheaper to provide, we also acknowledge that high quality bus services, such as bus rapid transit, requires capital investment and ongoing funding. Even so, when compared with light rail, bus rapid transit typically has significantly lower capital costs to provide similar transport capacities (in some circumstances).<sup>208</sup> Additionally, the greater modularity that bus rapid transit offers through incremental implementation is also a benefit. This means the extent, and therefore costs of a project can start relatively small and scale up with demand.<sup>209</sup> All these factors suggests that in general, buses can be a cost-effective way of providing mass transit in certain situations.

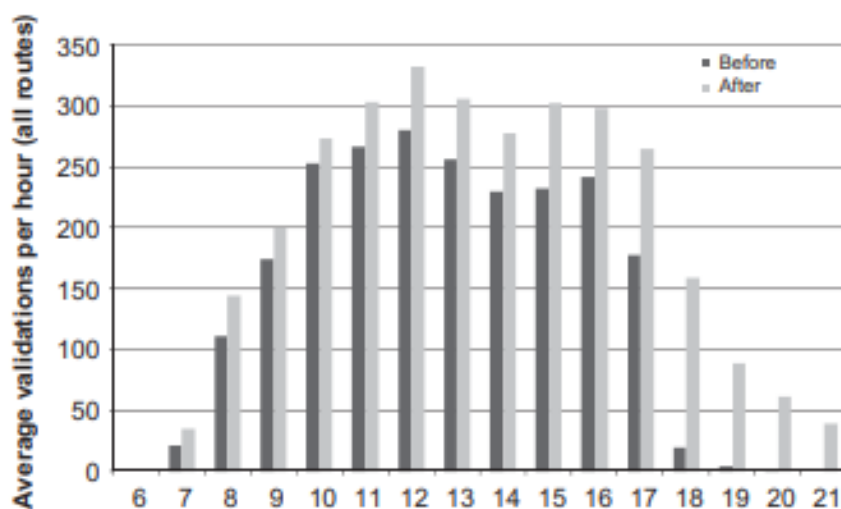
## 5.3 The goal: getting more people on buses

Overall, many of the benefits of bus reform including benefits to health, environment, social inclusion, land use, and value for money, flow from getting more people on buses.

Literature on bus reform identifies improved reliability, faster travel times, increased frequency, and network simplicity as methods to increase bus patronage. A meta-analysis found that increasing services on a route, such as increasing services from a bus service every 30 minutes to every 15 minutes, typically increases patronage by around 17%. A halving of travel times (through bus priority measures, for example) typically increases patronage by around 15%.<sup>210</sup>

Expanding hours and days of operation can also increase patronage. For example, an earlier round of bus reform in Melbourne in 2006 extended the span of some Saturday services to 9pm, which previously ended before 6 pm. This resulted in an increase in patronage on these services throughout the day, suggesting that the expanded operating hours later in the day enticed people to use services earlier in the day.<sup>211</sup> This is shown in Figure 28.

**Figure 28: Saturday bus boardings before and after extending hours of operation**



Source: C Loader and J Stanley, 'Growing bus patronage and addressing transport disadvantage—the Melbourne experience', *Transport policy*, 2009 16(3), 106-114.

A case study for reform on a smaller scale is Selandra Rise in Clyde North, an outer greenfield area of Melbourne. In planning the bus service for the new residential area, patronage goals were prioritised over coverage goals. The service was consequently more direct in its connection to a train station and activity centre than is typical in a greenfield area. This emphasis on patronage was at the expense of coverage, meaning that people had to walk further to the bus stop than if the bus took a less direct route. An evaluation of the performance of this service found that the rate of passengers per kilometre was around 40% higher compared to conventional coverage-focused services in greenfield areas.<sup>212</sup> Bus users were also willing to walk up to 1km for the better bus service, further than the typical 400 metre catchment.

Another example is the bus network reform in Brimbank in 2014. Reform involved more direct and frequent services, better connections with trains, buses finishing later at night, Sunday services on all routes and better connections to key local destinations. As there was only limited additional funding available for reform, cost effectiveness while also meeting community needs was a key objective. In the six months following implementation, there was a 10% increase in patronage, attributed to both an increase in service levels as well as improved network design.<sup>213</sup>

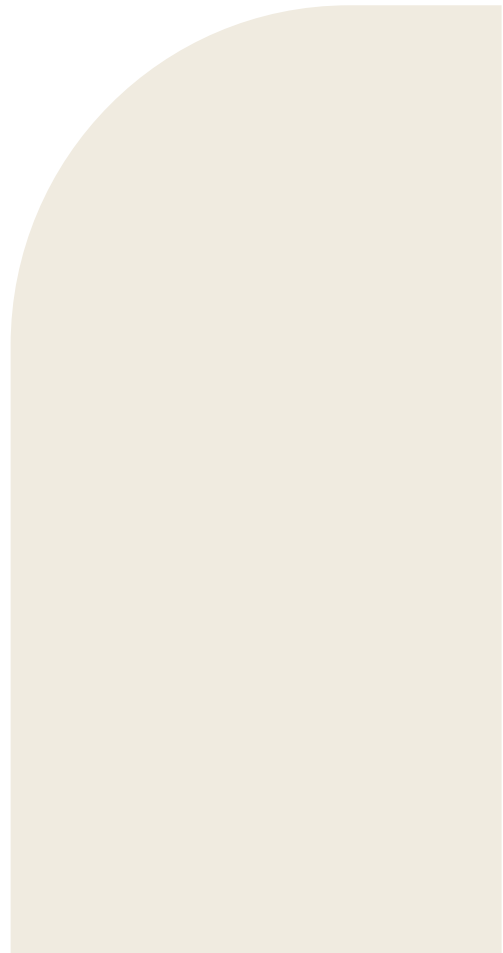
### Key discussion paper questions

- What reforms are likely to have the greatest influence on delivering economic, environmental, and social benefits for Melburnians?
- Can you provide any evidence to help quantify the benefits and inform our assessment of future bus reform options?





# Appendix



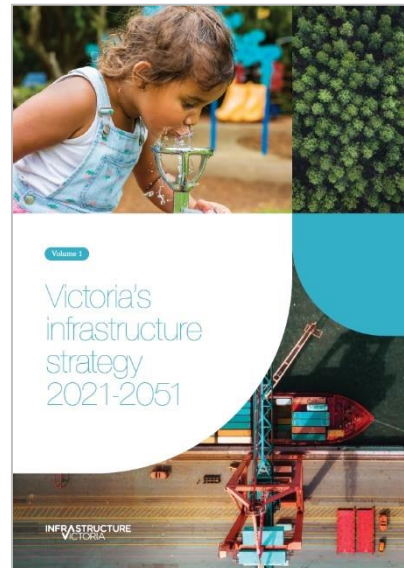
# Previous Infrastructure Victoria work

Infrastructure Victoria's current program of bus reform analysis builds on our previous work on buses. Our previous work on buses is outlined in this appendix.

## Victoria's infrastructure strategy 2021—2051

The release of *Victoria's infrastructure strategy 2021—2051* came with a suite of recommendations designed to improve the bus service offering in Victoria.

Our main recommendation was for action to reshape, reform, and expand the Victorian bus network as well as developing a 'next generation' of zero emissions, frequent, high quality bus services.<sup>214</sup> Reforming bus networks is a particular priority in Melbourne's north-west and south-east, so people can connect to the Sunbury, Cranbourne and Pakenham train services proposed to use the Melbourne Metro Tunnel.<sup>215</sup> Similarly, the opening of the Eastern Express Busway in the mid-2020s provides an opportunity to introduce the 'next generation' bus service across the Doncaster area, which could then be used as an approach for improvements on other corridors.



The strategy notes that a reformed bus network should be based on a hierarchy of new route classifications that distinguish between different types of public bus services: 'Next generation', connector, and local.<sup>216</sup> It also suggested reallocating road space for dedicated bus lanes and/or improved bus stops to support faster travel for passengers.<sup>217</sup>

The strategy also recommended actions to improve the accessibility of buses for all users as many bus stops do not currently meet accessibility standards. Modern low floor buses are more accessible for people with disabilities but need to be supported by upgrades to bus stops and kerbs to allow people to get on and off services easily. Improved clearance around bus shelters and better footpath access to stops across and along roads will improve safe access.<sup>218</sup>

Another series of recommendations in the strategy focused on customer experience, ticketing and fares, including development of open access ticketing platforms to integrate public transport with new mobility services, off-peak fare discounts and cheaper bus fares.<sup>219</sup> Infrastructure Victoria recommends much lower bus fares to encourage more people to use buses. Generating extra patronage would strengthen the case for better, more frequent services.<sup>220</sup> In turn, better bus services can more easily attract more passengers at a lower price.

A final group of recommendations called for better connections between homes and jobs, connecting growing suburbs with National Employment and Innovation Clusters (NEICs) and major employment centres, expanding outer suburban and growth area bus networks and linking outer suburbs to rail with next generation buses.<sup>221</sup>

In this discussion paper, we build upon the evidence base originally put forward in Victoria's infrastructure strategy. To provide targeted insight into quantifying the benefits of bus reform, this report goes further into the context of Melbourne's bus system, the growing challenges ahead and guidance on next steps to reform Melbourne's metropolitan bus network.

## **Fair Move: better public transport fares for Melbourne and Five Year Focus: immediate actions to tackle congestion**

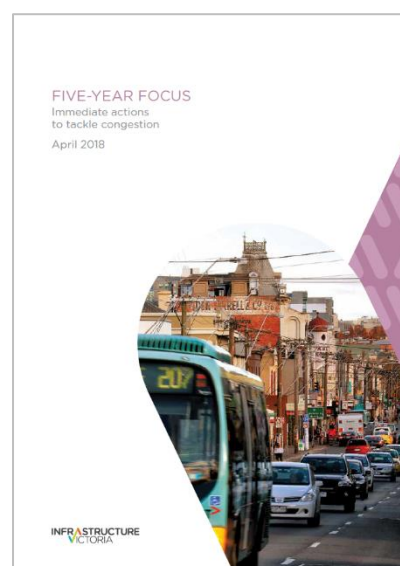
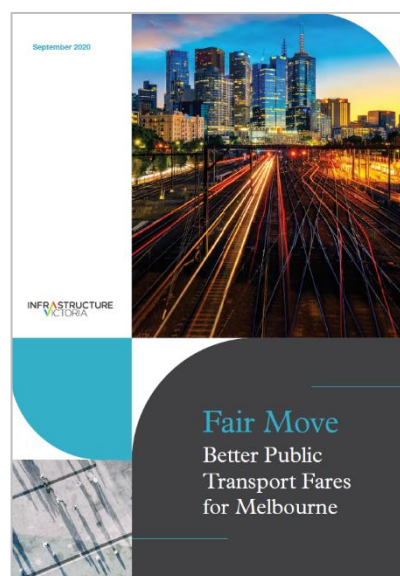
Infrastructure Victoria's *Fair move* and *Five year focus* publications highlighted solutions for the wider transport network to reduce congestion and create a fairer transport pricing system. This also formed the evidence base for specific bus reforms, including an overhaul to existing bus services, expanding successful routes and replacing poor performing routes with alternatives such as on-demand bus and ride sharing offerings.

In *Fair move* (2020), our modelling showed that relatively high bus fares discourage people from catching buses. Melbourne's bus system is currently underused. Many buses run largely empty and can provide extra journeys with low infrastructure costs and high social benefits, such as greater accessibility and reduced congestion and emissions.<sup>222</sup> Infrastructure Victoria's modelling showed that by making Melbourne's buses cheaper, they could carry around 93,000 extra people each day without any changes to the existing bus network. We also estimated that 70% of bus routes run at below a third of their capacity during the morning peak.

In *Five year focus* (2018), Infrastructure Victoria recommended overhauling existing bus services, expanding successful routes and replacing poor performing routes with low cost, customer-responsive services. To achieve this, we called for a systematic review of all poor performing routes to identify opportunities to reprioritise services, introducing alternative public transport services such as on-demand bus and ride sharing, and establishing arrangements to integrate them into the public transport mix.

We also recommended extra bus services in areas of high demand. Two examples of this included more direct and frequent shuttle bus services between Parkville and Victoria Park Station in Abbotsford, and additional services to the Monash and La Trobe National Employment and Innovation Clusters. In late 2021, the Department of Transport introduced this new connection between Parkville and Victoria Park Station, known as Route 202.<sup>223</sup>

We also called for increased services on Doncaster bus routes and maintaining bus priority along the Eastern Freeway during disruptions as North East Link is built.



## **Advice on automated and zero emissions vehicles infrastructure**

In 2018, Infrastructure Victoria provided advice to the Victorian Government on what infrastructure is required to pave the way for highly automated and zero emissions vehicles. With a shift towards autonomous and zero emissions vehicles, the advice discussed and quantified the significant benefits for the economy, community and the environment. Benefits included reduced congestion, improved accessibility, lower disadvantage, improved road safety, lower greenhouse gas emissions and higher economic growth.

The advice contained 17 recommendations, all of which were tested against seven possible future scenarios. Recommendations ranged from updating Victoria's roads and road space allocation, future-proofing of transport projects, boosting ICT infrastructure and data sharing capabilities, and considering the impacts on energy, waste and planning sectors. The advice also considered the role of buses in supporting travel patterns in future scenarios, including the benefits of transitioning to new technologies like autonomous demand-responsive transit (DRT).



# Objectives of Victoria's Transport Integration Act 2010

See below for a summary of all objectives in Victoria's *Transport Integration Act 2010*.

## **Social and economic inclusion**

- Enabling access to social and economic opportunities

## **Economic prosperity**

- Enabling efficient and effective access for people and goods to employment, markets and services
- Reducing costs and improving timeliness
- Fostering competition by providing access to markets, facilitating investment in Victoria and supporting financial sustainability

## **Environmental sustainability**

- Protecting, conserving and improving the natural environment
- Minimising harm to the global environment, including minimising transport related emissions and pollution
- Promoting forms of transport which have the least impact on the environment and reduce greenhouse gas emissions

## **Integration of transport and land use**

- Enabling access to social and economic opportunities
- Reducing the need for private motor vehicle transport
- Improving amenity of communities

## **Efficiency, coordination, and reliability**

- Facilitating network-wide efficient, coordinated, and reliable movements of persons and goods at all times
- Balancing efficiency across the network so as to optimise the network capacity of all modes of transport and reduce journey times
- Providing predictable and reliable services and journey times

## **Safety and health and wellbeing**

- Supporting safety health and wellbeing

For full Authorised version of the *Transport Integration Act 2010*, see: <https://www.legislation.vic.gov.au/in-force/acts/transport-integration-act-2010/073>

# History of bus reform in Melbourne

## Pre-1990

- Private motor vehicle use has dominated transport in Melbourne from the 1950s. In the 1970s, numerous private bus companies failed, and the government took over operation of some of these services. This meant there was a mix of government and privately operated services with private operators receiving government subsidies.<sup>224</sup>
- In 1983 separate government transport agencies were amalgamated to form the Public Transport Corporation, which in Melbourne traded as 'The Met'.<sup>225</sup>
- 1988's *MetPlan* was a 15-year government plan to reform public transport in Melbourne.<sup>226</sup> The plan included 'Metlink' bus services of direct orbital bus routes with 20 minute frequencies. These were to operate on bus-only lanes on arterial roads between major activity centres and modal interchanges. High quality vehicles were proposed with passenger comfort 'comparable to that on trains'. *MetPlan* also included a call for minimum service standards and expanded operating hours for local bus networks. There were also plans for demand-responsive services in areas of low demand.

## MetPlan proposed Metlink network

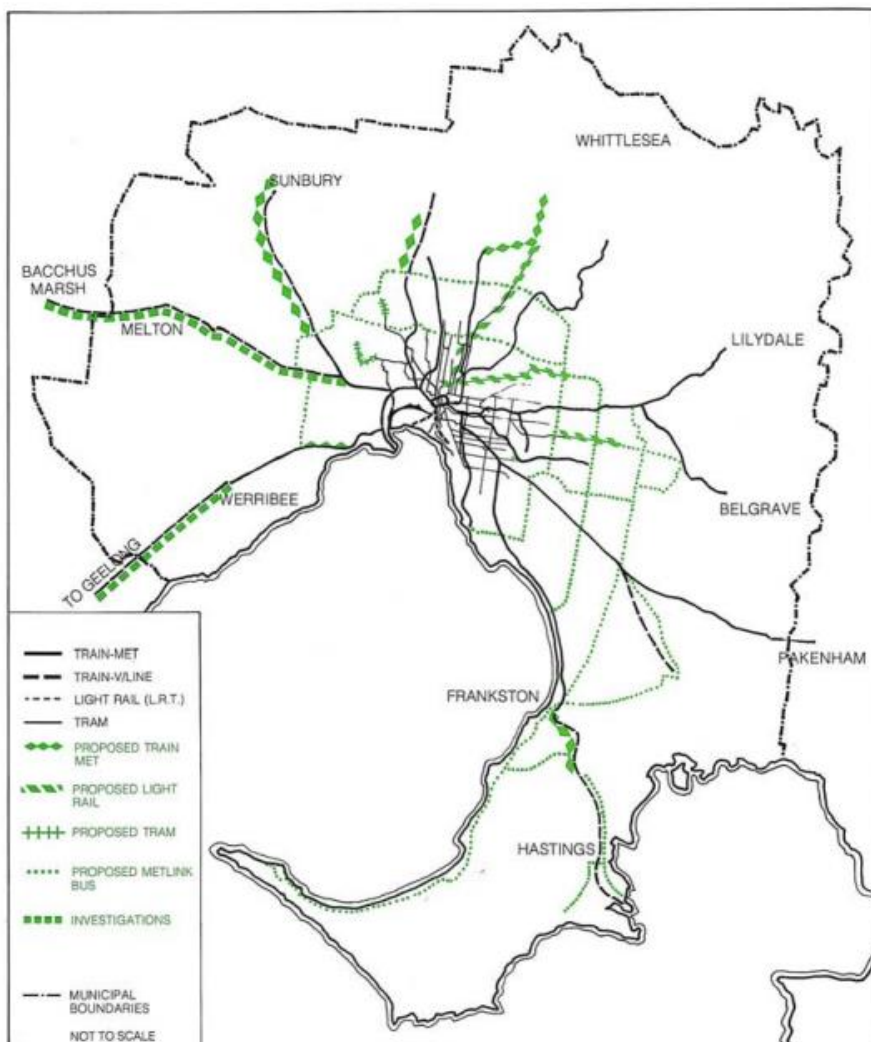


FIGURE 3.2 MetLink Bus Proposals

Source: The Met, *MetPlan: Metropolitan Public Transport Industry Plan*, Victorian Government, 1988.

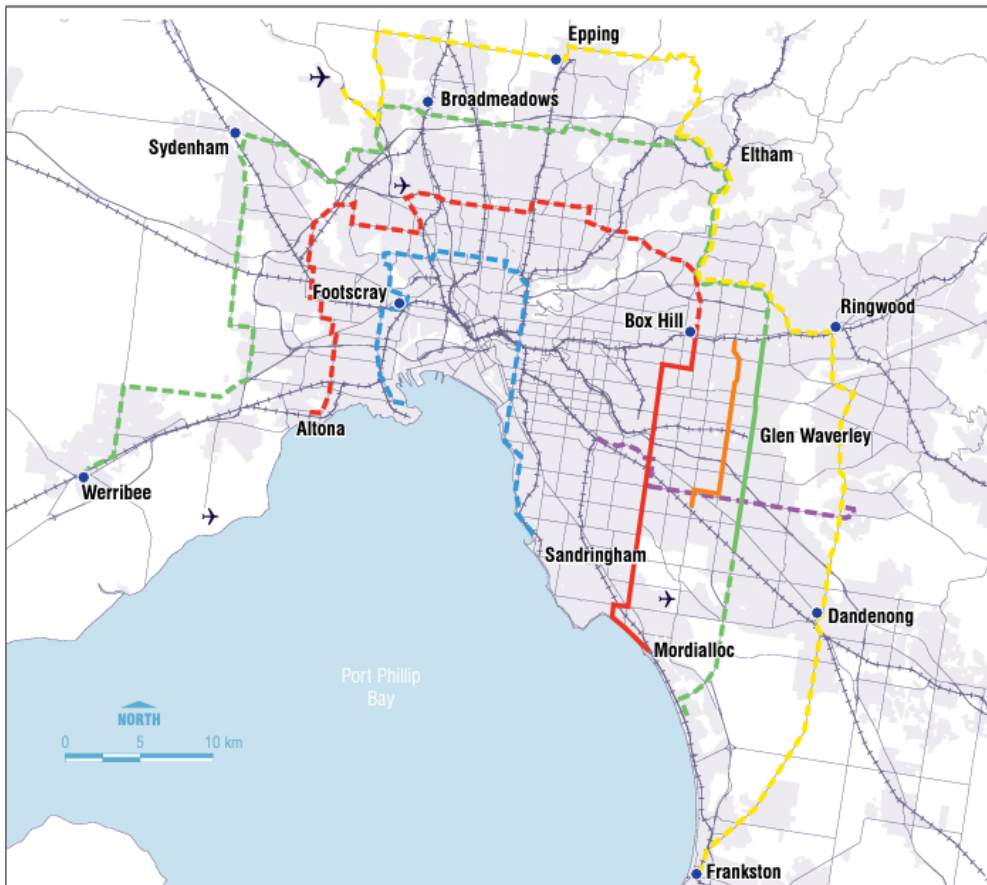
## 1990s

- Economic slowdown in the early 1990s contributed to many of *MetPlan*'s proposals being suspended.<sup>227</sup> Metlink bus services were planned to be introduced by 1992. Much of the bus reform of *MetPlan* was not wholly implemented within the planned time frame.
- While some Metlink-like services were introduced, they differed from the plan as they were not direct. Melburnians would have to wait until the 2000s for the Metlink vision to come into fruition in the form of SmartBus.<sup>228</sup>
- In the climate of economic slowdown and rising government costs, the government commenced the Public Transport Reform Program, designed to improve the efficiency of the Public Transport Corporation. From 1993, the Corporation's workforce and cash operating subsidy were more than halved.<sup>229</sup> The remaining government run bus operations were privatised.<sup>230</sup>
- Privatisation and cuts to bus funding had mixed results on services. Frequencies on some routes reduced and most Sunday services were removed.<sup>231</sup> However, on some high demand routes, off-peak frequencies were increased as well as hours of operation expanded.<sup>232</sup>
- Bus patronage declined over the 1990s despite population growth and patronage growth on other public transport modes.<sup>233</sup>

## 2000s

- In the early 2000s, routes branded as SmartBus were piloted. SmartBus services aimed to provide premium bus services with tram-like frequencies and operation hours on weekdays. Traffic priority, real-time information at stops and onboard, and distinctive branding for bus vehicles and stops were also part of SmartBus services (see Section 3.2.1 for more about SmartBus).<sup>234,235</sup>
- Prior to Metlink being founded in 2003, there was no consistent bus stop signage across Melbourne (some stops were denoted by painted utility poles) and very few stops had a timetable display case. Metlink undertook reform to all public transport services by unifying branding and providing signage and route information across the entire bus network.<sup>236</sup>
- A new tranche of transport reforms were set out in 2006's *Meeting our transport challenges*. The high-level transport strategy included substantial actions to improve buses.
- The reforms called for minimum service standards for buses and expanded SmartBus services.<sup>237</sup> New minimum service standards were recommended for over 250 routes. The standards specified at least hourly buses until 9pm, seven days per week.<sup>238</sup> *Meeting our transport challenges* recommended expansion of SmartBus services with road priority and high service level standards with long hours of operation (5am to midnight on weekdays), and at least 15-minutes between services on weekdays.

## Meeting our transport challenges' proposed SmartBus network



### SmartBus Routes

#### Existing SmartBus routes:

- Springvale Road
- Blackburn Road
- Warrigal Road

#### Future SmartBus routes:

- Blue Orbital
- Red Orbital
- Green Orbital
- Yellow Orbital
- Caulfield to Rowville via Wellington Road

- Existing urban area
- Major road
- Rail network
- Transit City
- Airport

Source: Department of Premier and Cabinet (DPC) and Department of Infrastructure (DOI), *Meeting our transport challenges: connecting Victorian communities – The Plan*, Victorian Government, 2006.

- From 2006 to 2011 the SmartBus network expanded from 69km to 450km. While this was a large expansion, it fell short of the 900km SmartBus network by 2011 recommended in *Meeting our transport challenges*. The expanded SmartBus network was enabled by a commitment of \$1.4 billion in funding over 10 years.<sup>239</sup>
- The implementation of minimum service standards was fast and widespread. For example, in 2001, Melbourne's largest shopping centre Chadstone was served by a single route on Sundays, operating every 70 minutes. By 2011, ten routes served the centre on Sundays with 30 to 60 minutes between services.<sup>240</sup>
- After a period of static patronage from 1987 to 2005 on buses, patronage started to grow from 2006.<sup>241</sup> Patronage grew by over 34% from 2006 to 2011.
- Bus service reviews for Metropolitan Melbourne were conducted on the back of *Meeting our transport challenges* between 2007 and 2010. 16 reviews, each covering around three local government areas each were conducted. These reviews recommended substantial bus network restructuring and built community buy-in through staged consultation.<sup>242</sup>
- Upgrading bus services from Doncaster to CBD (Doncaster Area Rapid Transit) was also flagged in *Meeting our transport challenges*. \$360 million in funding to implement this was committed in 2009, as part of the Victorian Transport Plan. Upgraded services commenced in 2010 with bus lanes, extended operating hours, and up to 7-minutes between services in peak hours.<sup>243</sup>



## 2010s to present

- There was partial implementation of network changes recommended in the Bus Service Review after 2010.<sup>244</sup> The Bus Service Review did not explicitly consider operational efficiency or value for money, meaning that many changes required additional funding. This may have contributed to recommended changes remaining unimplemented.<sup>245</sup>
- Some ad-hoc bus network reform was implemented. For example, in 2014 the bus network in Brimbank was overhauled with more direct services, improved integration with other modes, and extended operating hours.<sup>246</sup> The changes to the network only partly reflected recommendations of the Bus Service Review.
- University bus shuttles were introduced to connect train stations to university campuses. This included routes 401 (introduced in 2008) and 601 (introduced in 2011) which provide direct and frequent services to University of Melbourne and Monash University respectively. At peak times these routes have high frequencies and they are amongst the most highly patronised services in all of Melbourne's bus network.<sup>247</sup>
- From the mid-2010s, the SmartBus brand was diluted with instances of regularly liveried buses running on SmartBus routes and SmartBus liveried buses running on non-SmartBus routes.<sup>248</sup>
- In 2021 *Victoria's bus plan* was released.<sup>249</sup> The plan included six objectives for reform including making the network simpler, faster, and more reliable. The plan signalled a renewed interest in significant bus reform for the first time since 2006's *Meeting our transport challenges*.

# Future opportunities in bus technology and infrastructure

Developments in technology are creating opportunities to improve the experience for bus users. This section outlines some of the emerging technologies which have implications for public transport bus services.

## Information and Communications Technology (ICT) in vehicles

A range of information and communication technologies are being applied to bus vehicles. These include automated announcements, automatic passenger counting, GPS tracking, advanced camera systems, and real-time information.<sup>250</sup> These technologies can improve passenger experience by making more relevant information available such as the real-time location of a bus, so they know when it will arrive and how crowded the bus is expected to be. These technologies can also help bus authorities plan and manage their network with accurate and rich information.

## On-demand services

On-demand bus services have existed in some form for several decades, with ongoing presence in Melbourne's eastern suburbs since first trials of 'Tele-Bus' in Croydon and Chirnside Park began in 1977.<sup>251</sup> New routing technologies, the ubiquity of smartphones, and taking on the lessons of the past, offers an opportunity to improve on-demand services.<sup>252</sup>

Melbourne's existing on-demand buses, FlexiRide, connect 'hub' locations such as shopping centres and railway stations with a surrounding service area for a defined period over the day and week. Of the six existing FlexiRide Service areas, four are located in established suburbs in Melbourne's outer east, with one in the Melton South growth area and the other on the Mornington Peninsula.

## Public Transport Victoria FlexiRide bus



Source: Ventura Bus Lines

FlexiRide buses only run if a booking has been made by a user and there are no fixed routes.<sup>253</sup> Most services operate smaller buses to save on costs and have made use of online platforms both for advertising and connecting with prospective users. FlexiRide can be booked by calling a hotline or through the FlexiRide mobile phone application.

There are many examples of on-demand service trials not generating enough patronage to warrant permanent funding.<sup>254</sup> On-demand bus services are most successful when they target locations where conventional public transport service levels are low or during off-peak times where frequency of conventional bus services is generally lower and also focus on a many-to-one trip design (many origins to a single destination).<sup>255</sup>

On-demand buses offer a method to provide low demand areas a public transport option, instead of fixed route services. With this option, the planning of fixed route services could be more focused on patronage purposes, rather than on trying to imperfectly meet both patronage and coverage purposes.

### Zero emission buses (ZEBs)

As featured in the breakout box on page 23, the transition from traditional diesel bus engines to zero emissions technologies could eliminate all operational CO<sub>2</sub> emissions.<sup>256</sup> Introduction of either of the two primary zero emission bus technologies (battery electric and hydrogen) can also lead to various benefits including:

- greater energy efficiency compared to internal combustion engines <sup>257</sup>
- a more comfortable ride for passengers, with less vibration and smoother acceleration <sup>258</sup>
- reduced noise impact and elimination of tailpipe emissions for communities which buses run through.

### Zero emissions bus (ZEB)



Source: Ventura Bus Lines

On the other hand, ZEBs have some challenges including that ZEB vehicles are more expensive to purchase, though this may change as ZEB technology matures.<sup>259</sup> A transition to ZEBs would also require new investment in infrastructure for charging or refuelling, requiring changes to depots and possibly additional space to accommodate charging.<sup>260</sup> The strain on the electricity grid from electric bus charging is an emerging issue, as charging depots require substantial amounts of electrical power to run.<sup>261</sup>

The Victorian Government has set a target for all public transport bus purchases to be zero emission vehicles from 2025. Other programs include the delivery of Victoria's first fully electric bus depot with charging facilities for 27 buses by early 2024. Other trials of hydrogen and electric buses across Melbourne and regional Victoria are also underway.<sup>262</sup> This will assist in reducing transport sector emissions and improve people's health.<sup>263</sup> Transition of the fleet will ultimately provide cleaner and smarter buses, utilising Intelligent Technology Solutions (ITS) to improve network operations and reduce congestion.<sup>264</sup>

### Eastern Express Busway

The Eastern Express Busway will be built as part of the North East Link project. The project will be Melbourne's first dedicated busway, with an expected completion in 2028.<sup>265</sup> Eleven kilometres of bus-only lanes will be built alongside the Eastern Freeway running from the Doncaster Park & Ride towards Hoddle Street.

The busway will enable buses to travel at 100km/h and avoid congestion at existing on and off ramps, reducing peak hour trip times by up to 30%.<sup>266</sup> The busway will also improve reliability and support better frequencies with a bus on average every minute in the peak. As part of the project, bus priority will be integrated with a fast-tracked Bulleen Park & Ride facility will be constructed.

### Artist's impression of the Eastern Express Busway and bicycle 'superhighway', Kew



Source: Victorian Government, '[Victoria's Big Build – Eastern Express Busway](#)' [website], accessed 29 August 2022.

### Trackless trams

An emerging set of technologies come together under the term 'trackless trams'. Trackless trams are similar in appearance to light rail vehicles but operate with rubber tyres on roads like a bus.<sup>267</sup> A trackless tram service combines the operational characteristics of bus rapid transit—road-based public transport with its own right of way—with the higher passenger capacity of a light rail service. Trackless trams can have step free access at bus stops, similar to trams, which supports universal access and reduces boarding and alighting times. Trackless tram vehicles are powered by electric batteries and can have varying degrees of autonomous driving. Autonomous optical guidance systems, train-like bogies with double axles and special hydraulics and tyres can provide a smoother ride experience for passengers.<sup>268</sup> Existing operational trackless trams in China have up to five cars with a capacity of 500 people.<sup>269</sup> There are no operational trackless trams in Australia, though there are various proposals for the technology, including in Melbourne.<sup>270</sup>

A purported advantage of these vehicles is that while they provide ride quality and capacity similar to light rail, the infrastructure costs and disruptions are claimed to be less. This is attributed to trackless tram routes and stations being able to be retrofitted onto existing roads, in as rapidly as a weekend according to some claims.<sup>271</sup>

This technology is still emerging and there is contestability in the purported advantages of trackless trams. For example, as these vehicles are heavy, some roads could require substantial strengthening to accommodate them, increasing the complexity and expense in implementation.<sup>272</sup> Another criticism is that trackless trams do not substantially improve on a well implemented and operated bus rapid transit system, and instead are more of a rebrand of existing bus technology.<sup>273</sup>

## Automated buses

Vehicle automation is another emerging technology with opportunities for buses. As part of our advice to the Victorian Government on autonomous and zero emissions vehicles, we looked at future scenarios where buses were replaced with a fleet of automated Demand-Responsive Transport (DRT) services. Our modelling showed that with DRT, accessibility improved for residents of outer areas, with non-driving adults the largest beneficiaries.<sup>274</sup>

While this technology will take decades to mature, and for adoption to become widespread, there are already some trials happening across the world.<sup>275</sup> So far, many trials have been limited to low speed and less congested conditions, as well as having a driver onboard in some cases to respond to emergencies.<sup>276</sup>

Over the past five years Singapore has trialled small scale automated buses performing fixed route and on demand functions. These trials use smaller vehicles seating 10 to 26 passengers.<sup>277</sup> Trials are also ongoing in Perth, Australia with Intellibus offering short sightseeing journeys on an electric automated mini-bus.<sup>278</sup>

Rotterdam begun trialling their autonomous bus ('ParkShuttle') as early as 1997, running it as a permanent revenue generating service since 1999 (although on dedicated sections of road). The shuttle service fulfils the last mile connection between a metro station and business park, providing frequent services. The third generation of the shuttle includes a route extension and is proposed to drive in mixed traffic along sections.<sup>279</sup>

Automated buses are a potential solution to improve bus service viability in sparsely populated areas. Automated buses can potentially have operating costs 40% to 60% lower than buses with drivers.<sup>280</sup> This idea has gained traction in Japan where regional buses serve as the only connection to larger towns and community services for elderly residents.<sup>281</sup>

The concept of a fleet of small automated vehicles, similar to today's rideshare services but automated, could also be a future option to serve low demand areas and take passengers the 'last mile' from trunk public transport services.<sup>282</sup>

# Lessons in reform

Before Melbourne implements more major bus reform of its own, there are lessons to be learnt from other cities in Australia, and across the world. The following section highlights experiences that could be emulated and also those to avoid.

## Lessons from past reforms – Australia and New Zealand

Bus reform can be challenging. Different stakeholders, communities and users often have a different perspective on what the bus system should do and the types of reform necessary. Reform will also be disruptive, but if designed, consulted-on and implemented well, reform will lead to long-term accessibility, equity, and environmental benefits.

### Systematic planning of bus reform

While many cities seek to achieve integration between transport and land use, the policy and guidelines in place often fall short of full integration. Bus systems also need to be planned systematically, as parts of integrated, hierarchical multi-modal transit networks. Best practice in modern bus planning also points to the strengths of connected networks, converting long single seat routes to journeys that may require more transfers, but also open up more travel opportunities.<sup>283</sup>

#### Strong systematic planning in Auckland

Auckland, New Zealand provides a good example of systematic planning with strong links between transport and land use. Auckland Transport's *Integrated Transport Assessment (ITA) Guidelines* is a direct response to the transport and accessibility issues facing the Auckland region today—a result of incremental land use and transport decisions, often made in isolation from each other.<sup>284</sup>

Any project or property development is required to demonstrate how it will achieve an integrated transport outcome. The preparation of the ITA considers the transport effects of a new development proposal, placing emphasis on safety, efficiency and accessibility to and from the development by all transport modes. This ensures that appropriate thought is given to zoning and land use proposed so that integrated transport and land use outcomes occur.

### Customer focused planning and consultation

Cities that base network reform on what customers need and want are the ones that achieve successful bus reform.<sup>285</sup> In a move away from traditional transport planners exclusively planning bus routes with lines on maps and following roads, customer-focused planning focusses on attracting riders by choice, understanding travel demands from all modes. This ensures that success of the network is about accessibility, not only about maximising patronage.

Customer-focused planning ensures that travel demands caused by emerging trends (such as workforce casualisation and longer business operating hours) are met by the transport network. This includes matching bus service span and frequency to the operating hours and customer needs of activity centres. Using tools like accessibility-based planning (a measure of how far you can go within a certain time using the public transport network) to assess how well a network operates to get people between places.

## Reform of choice by Christchurch's community

Prior experience from a failed implementation of a bus lane along a notorious major congested corridor in Christchurch led to a program of *Two Futures, One Choice* – a twelve-month transport strategy with strong community input. The Christchurch City Council recognised that if they did not have a plan with community endorsement, they would not be successful in any future implementation.

This led to a five-year program of service and infrastructure improvements, including network simplification, frequency improvements, new orbital routes, supporting infrastructure and real-time information.<sup>286</sup> Every bus improvement implemented since was linked back to the strategy.

Building on the success of *Two Futures, One Choice*, Christchurch began developing its Urban Development Strategy, looking into how the city will grow, land availability, impacts of zoning and population growth and how the public transport network would be built to support it.<sup>287</sup> Through analysis of travel patterns and an understanding of what places to connect to others across the network, implementation of the strategy led to patronage doubling in approximately six years.<sup>288</sup>

The successful implementation of bus reforms is attribute to the strong community and stakeholder buy-in in developing the strategy.

### Too much, too soon – problems of non-staged reform

Staged implementation provides opportunities to test bus reform and refine the final approach. With each stage, benefits of reform like faster travel times, more travel choice and greater accessibility can be demonstrated to the community. Communities are then able to slowly familiarise themselves with new networks and experience the benefits of reform.

## The weight of reform in Canberra

The introduction of Canberra's light rail system presented an opportunity to restructure the existing bus network. The proposed bus network removed duplication and complexity, bringing a modern connected network with fewer routes, more transfers, and rapid routes connecting to the city and activity centres.

This meant some bus users would have negative outcomes including longer walks to bus stops and removal of some services. Strong community opposition followed with a large number of complaints and petitions against the new network.

This ultimately caused the government to reverse many of the changes. Canberra's case study serves as a cautionary story of trying to implement a large reform without a comprehensive, staged consultative process.<sup>289</sup>

### Risks of cost-neutral reform

Few bus networks have so much to spare where changes can be made without affecting people.<sup>290</sup> Cost neutral reforms also impose costs on some users (e.g. those that lose a bus service or must walk longer distances) and provide limited opportunity to grow patronage. Experience suggests that it is difficult to improve buses without additional funding, and a cost neutral approach can often result in community opposition.

## Reform reversal in South Australia

The objective of Adelaide's bus reform was to address duplication and improve the network but with a revenue-neutral outcome, amongst other public transport budget cuts. Following announcement of the plan in 2019, consultation started on a hierarchical bus network with substantial changes, including:

- simplified routes
- consolidation of routes (increasing walking distance for some customers)
- closure of 1,000 bus stops
- cuts to night services (including complete removals)
- introduction of on-demand services to fill gaps in the network.

The proposed plan was withdrawn two weeks into the consultation period following public backlash.<sup>291</sup> A lack of customer appreciation for what the reform was trying to achieve translated to lack of community support while public transport funding cuts led to too many losers from reform.<sup>292</sup>

The reversal of the proposed reform also increases the difficulty of implementing any future reform without preconceived negativity from the challenges of 2019.<sup>293</sup> This Adelaide case study serves as a warning that it is difficult to successfully implement bus reform in parallel with cuts to public transport budgets.

## Lessons from international reform

While bus reform has taken place in many cities across the world to different extents, there are often parallels in challenges and lessons learned, particularly in the low-density cities where patronage decline has coincided with increased private vehicle ownership.

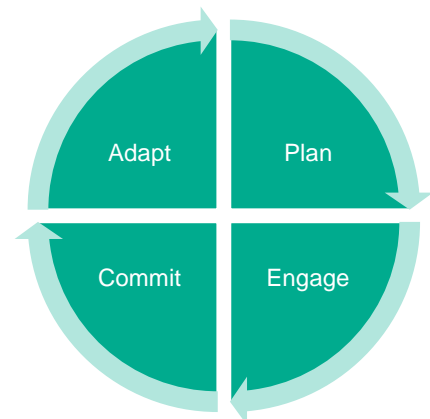
Master planning has guided bus reform in cities such as Seattle and Curitiba to different extents. Both cities developed masterplans with clear objectives down to the system planning level with a defined role for buses.

Cities like San Francisco and Houston both undertook strong community engagement as part of their public transport reform programs, with both cities recognising the importance of tackling community concerns around transport access and disadvantage in a clear and transparent way.

Some aspects of bus reform can be implemented over a single term of government. However, facilitating behaviour change and mode shift are long-term tasks which require building of public confidence in the bus system and institutional commitment to the reforms over longer time horizons.<sup>294</sup>

Finally, responsiveness to change is fundamental in maintaining a high-quality bus system. This responsiveness can mean adapting the bus system in response to demographic change over time. In the case of Houston, population and employment changes shifted focus away from the inner city. In Curitiba, services were adapted to meet increased demand on bus trunk routes of cities. Adaptation requires flexibility in how bus services are delivered and the layout of the bus network.

The following section outlines some of the cities mentioned above and their lessons of reform in further detail.





# High quality buses around the world

## Curitiba, Parana, Brazil

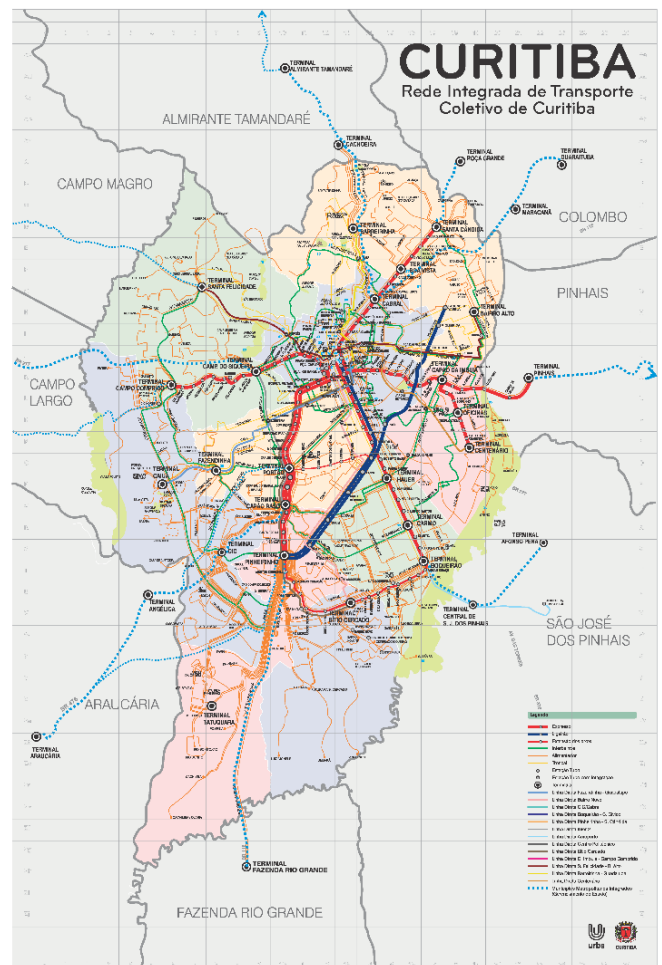
The Brazilian city of Curitiba is an example of an established high-capacity bus network supporting transport-oriented development. The Integrated Transit Network (RIT) is a system of high-frequency, high-capacity buses forming the 'trunk routes' of a trunk-and-feeder bus system running in segregated median flow lanes.<sup>295</sup>

The RIT system was conceived by the Institute for Research and Urban Planning of Curitiba in response to the city's masterplan of 1966 and was incrementally expanded and developed over the following decades. The initial plans for development of light rail in the 1970s proved too costly so the RIT system instead introduced rapid bus transit with off-board ticketing at accessible bus stations and bi-articulated buses with multiple doors<sup>296</sup>.

The network is composed of several tiers of buses, as illustrated, ranging from express radial routes with limited stops to direct radial routes down to feeder services. While Curitiba's RIT has to this point substituted for light rail and metro, in recent years it has reached its capacity.

### Curitiba Integrated Transit Network map (right)

Source: URBS, *Curitiba Rede Integrada de Transporte* [website], accessed 31 August 2022.



## Houston, Texas, USA

Houston is a fast-growing, low density city in Texas, United States with more than 2.3 million residents. The METRO transit agency runs an established park-and-ride bus system and high performing light rail linking the city, a major hospital and nearby neighbourhoods. There was, however, considerable scope for bus reform with bus patronage declining by almost 20% between 2007 and 2011.

Prior to the staged bus network changes, proponents argued that the fundamental problem with the bus system was not a money problem but a focus problem.<sup>297</sup> The bus network had not been adjusted to address significant demographic changes across the city, with suburbanisation of lower-income household and relocation of jobs away from the traditional city centre.<sup>298</sup> There was also a problematic focus on addressing individual user concerns that detracted from overall network improvement.<sup>299</sup>

The reform essentially saw a budget-neutral network redesign, shifting services away from the radial network focused on the city centre to a connected grid network of higher frequency routes with 80:20 ridership to coverage priority. While this resulted in a decrease in coverage for some areas, it allowed buses to be used to increase frequency on other routes.<sup>300</sup>

METRO undertook wide-scale community engagement which addressed the main issue of disadvantages to some users honestly and directly, stating that its goal was to 'boost declining ridership'.<sup>301</sup>

The outcome of these reforms was significant increase in patronage, particularly on weekends. Bus ridership was reported to increase by 3% on weekdays, 13% on Saturdays and 34% on Sundays in the first year of operation.<sup>302</sup>

## Seattle, Washington State, USA

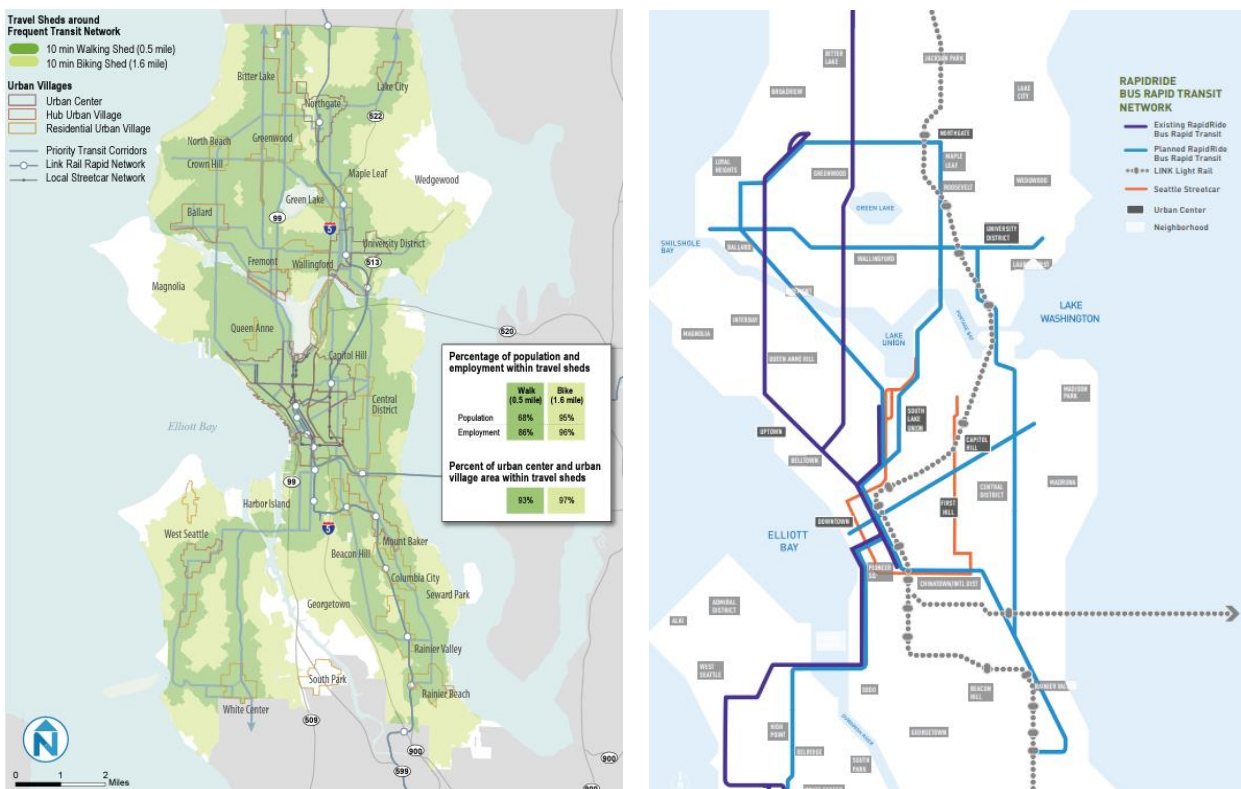
Seattle is credited as having one of the more successful bus-based transit systems in the USA. The greater metropolitan area is serviced by six high-capacity, high-frequency RapidRide bus lines with widely spaced stops, separated bus lanes and other measures to maintain reliable service.<sup>303</sup> Seattle has limited light rail infrastructure and no metro rail system, so buses perform a central public transport task with the established park-and-ride system and supporting local routes.

The urban public transport coverage rate is high with 64% of residents within 10 minutes walking distance of public transport with frequency of 10 minutes or less. Only one quarter of commuters to the city centre arrive by car, a low figure in comparison to other cities in the US, with significant growth in jobs in recent years not resulting in an equivalent increase in car traffic to the city centre.<sup>304</sup>

The government of Seattle developed and adopted the Seattle Transit Master Plan in 2012 that identified six major priorities over a 20-year time horizon, the first of which is to *Continue Implementation of Bus Rapid Transit Network and Priority Bus Corridors*.<sup>305</sup>

The vision for these transit corridors is that they will provide a top quality network that carries high volumes of travellers, operates at speeds competitive with any other mode and runs on facilities that allow high levels of reliability and protection from congestion.<sup>306</sup>

### Transit network catchment area and RapidRide network maps



Source: Seattle Department of Transportation (SDOT), *Transit Master Plan – Final summary report*, 2016.

## San Francisco, California, USA

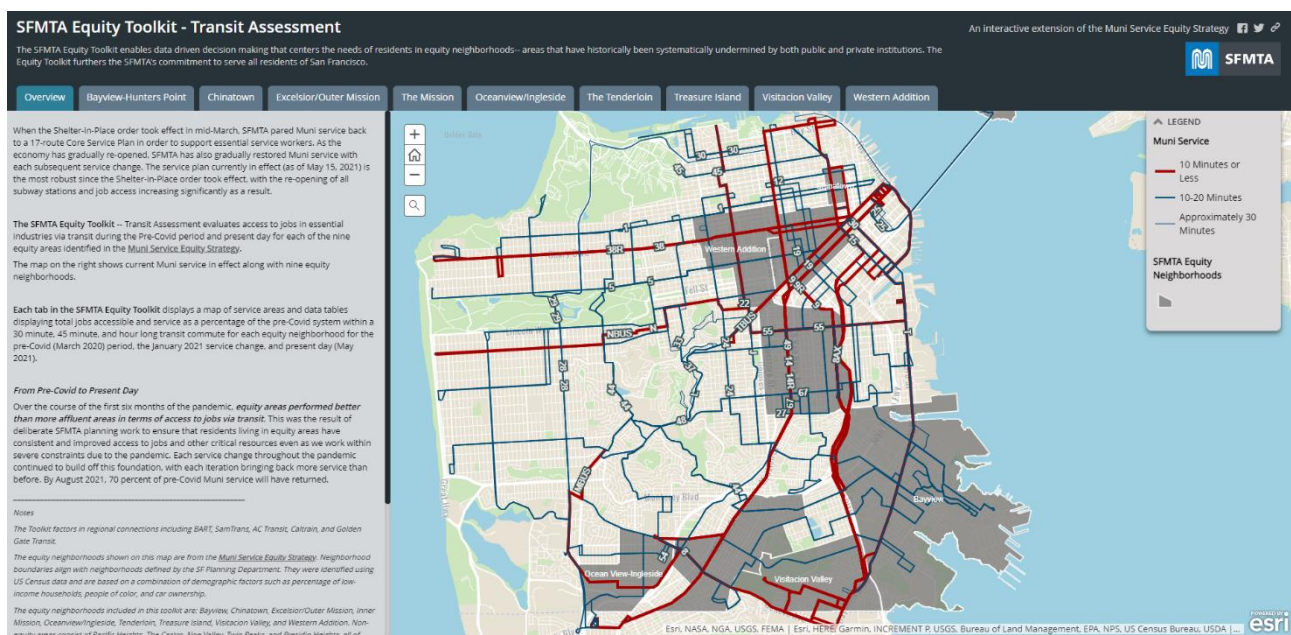
The San Francisco Municipal Transportation Agency (SFMTA) was formed in 1999 through a series of mergers of different transport agencies overseeing bus, trolley, rail operation and taxi regulation. SFMTA developed its Transit Effectiveness Project and Transit First policy<sup>307</sup> to increase the role of public transport and active modes in San Francisco<sup>308</sup>.

In May 2014, the SFMTA Board of Directors adopted the Muni Service Equity Policy to work towards addressing transit performance disparity. The policy was developed by an equity working group composed of advocates focused on seniors, people with disabilities, affordable housing, equity/social justice and public health.<sup>309</sup>

The Muni Service Equity Strategy translated the goals of the equity policy into a system of identifying key neighborhoods where transit needs were highest. The neighborhood selection methodology used criteria either specified in the equity policy or determined in consultation with the equity working group, including concentration of low-income households, concentration of residents who identify with a race other than white, private vehicle ownership and concentration of affordable and public housing developments.<sup>310</sup>

Assessment of transit service equity for target neighbourhoods is published openly by SFMTA through an online portal which also tracks the impacts of network changes on access over time.<sup>311</sup>

### SFMTA Equity Toolkit – Transit Assessment, interactive tool screenshot



Source: SFMTA, [SFMTA Equity Toolkit – Transit Assessment](#) [website], accessed 31 August 2022.

# Endnotes

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