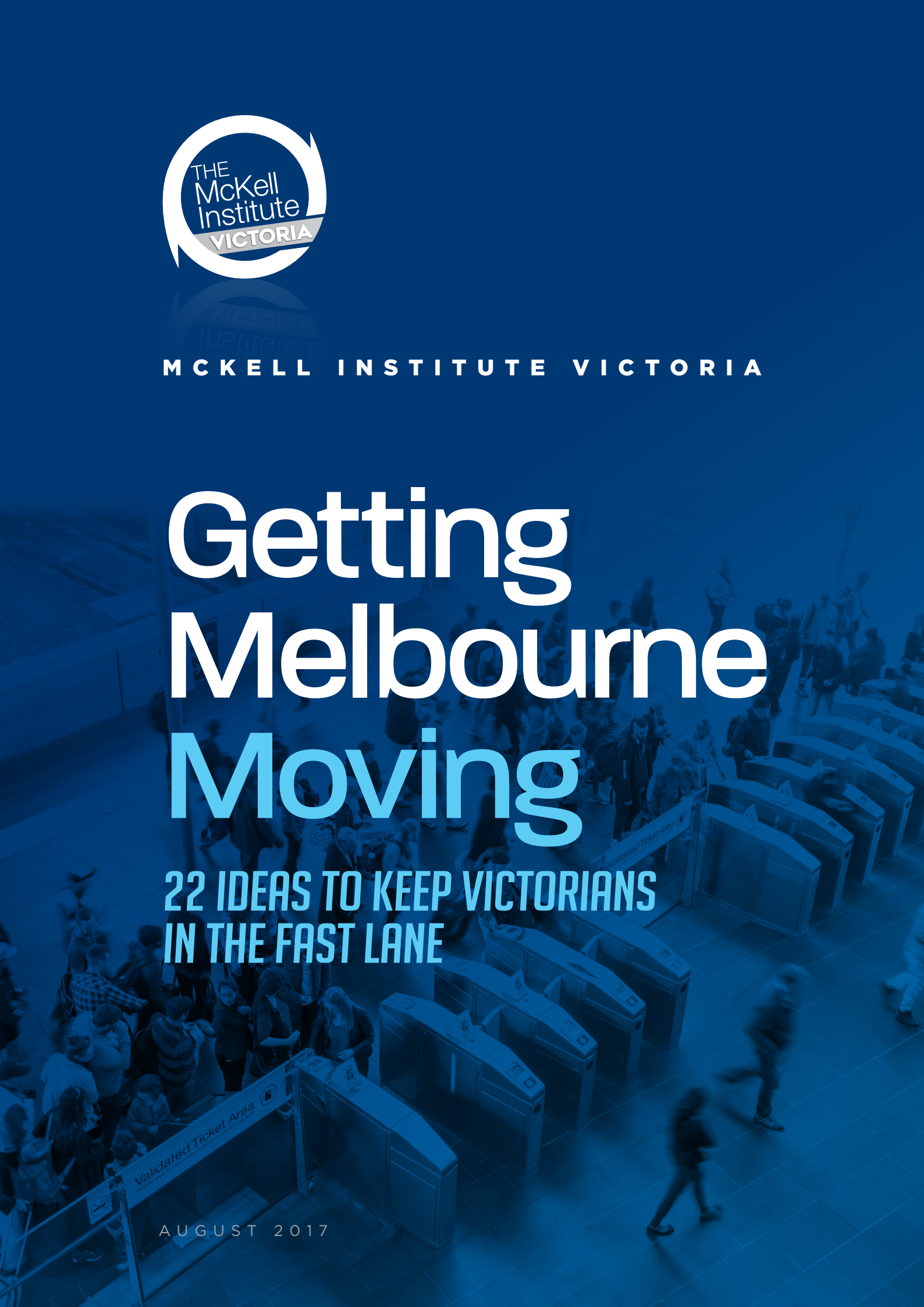
MCKELL INSTITUTE VICTORIA

Getting Melbourne Moving

22 IDEAS TO KEEP VICTORIANS IN THE FAST LANE



AUGUST 2017

About the McKell Institute Victoria

The McKell Institute is an independent, not-for-profit, public policy institute dedicated to developing practical policy ideas and contributing to public debate.

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FOREWORD

By mid-century, Melbourne is forecast to be Australia's largest city, with its current growth rate markedly higher than in Australia's other capitals. Population growth brings enormous opportunities: economic growth, the development of new industries, and the benefits of drawing the best talent from around the world. To ensure Melbourne continues to combine the best elements of a global city with an appealing lifestyle, the challenges of rapid growth need to be confronted head on.

Chief among these challenges is making sure Melbourne remains highly mobile. Other cities in Australia, notably Sydney, and elsewhere in the world have suffered from inadequate long-term planning around infrastructure and innovation when it comes to providing transport options for its populations.

These challenges need to be tackled in a creative way. The provision of more services, such as more train lines, roads, public transport services will remain important, but they are only part of the equation. In order for a modern city to thrive and remain highly mobile, innovative transportation solutions need to be embraced in conjunction with traditional provision of public transport and infrastructure.

This report tables a suite of ideas aimed at ensuring a rapidly growing Melbourne remains a highly mobile city. It argues that, beyond investing in traditional transport assets, policy makers must innovate and creatively maximise the utility of existing assets to foster a more mobile city.

Critically, this report identifies that improving mobility is about more than just tackling congestion. It can also play a role in tackling unemployment if we are prepared to focus on how our transport services could better connect disadvantaged communities with the high growth regions. This will require overhauling existing approaches to data and technology, and rethinking the role we expect different modes to play.

For Melbourne to capitalise on its future status as Australia's largest city, a proactive approach to confronting the associated challenges of growth are demanded. This report provides an important contribution to this debate.

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EXECUTIVE SUMMARY

Few Australian cities have experienced growth in population and size quite like Melbourne in recent years. With a current population of over 4.5 million, Melbourne is Australia's second largest city, with some forecasts[1] predicting this population to reach 6 million by 2031, and 8 million by 2050. In 2016 alone, over 100,000 new residents arrived to call Melbourne home.

A growing population in an increasingly global city brings great opportunities. Melbourne's growth has the opportunity to help expand its economy, aid in the development of new industries, and increase the services economy. And a growing population also brings with it cultural benefits, as Melbourne's arts and lifestyle economy will benefit with greater demand, talent and opportunities.

At the heart of embracing the opportunities that emerge from a rapidly growing population is ensuring that the growth doesn't slow down the city. While growth should be welcomed, a lack of foresight into catering for it can lead to extended commutes, and a diminished quality of life for residents.

Melbourne is facing the early stages of these challenges. The current costs of congestion for Melbourne have been estimated at $4.6 billion per year, up $1.7 billion from 1990, and predicted to rise to between $7 and $10 billion by 2030.[2]

This report tables a suite of ideas that will help Melbourne adapt to its growing future. In doing so, Melbourne can continue to service the interests of its residents, and allow them to maintain a highly mobile lifestyle that contributes to the standard of living the city is known for.

This report begins by outlining the challenge brought by Melbourne's growth and why it needs to be addressed. It then offers 22 ideas over five distinct categories that, if enacted, should see Melbourne become a world leader in innovative transportation.

Part 1 begins with three 'quick' solutions to some of the immediate congestion challenges facing Melbourne. This includes better traffic coordination and enforcement of road rules to free up traffic in the Hoddle Grid and removing barriers to tech-supported car-pooling that is gaining traction around the world. It also calls for the opening of a remote airport terminal in the Melbourne CBD to tackle growing congestion at the airport itself and as a precursor to future investments in high speed rail.

Part 2 examines the role of data in improving the operation of Melbourne's transportation networks, and advocates for collaborating with third party app companies, adapting existing infrastructure to autonomous vehicles, harnessing digital technologies to allow drivers better visibility over parking options for private vehicles, and modernising public transport ticketing.

Part 3 outlines how to make the most of Melbourne's existing transport infrastructure and assets. The provision of new infrastructure is important, but so too is maximising the capacity of what's already in place.

Part 4 argues that Melbourne must invest in a modern, right-sized fleet of public vehicles like trams, trains and buses. It argues that design competitions for buses could be explored to improve passenger comfort, efficiency and accessibility, and that technologies like 'collaborative braking' – enabling autonomous or semi-autonomous vehicles to communicate to coordinate when to brake – could be implemented to increase capacity in the train network and facilitate faster commutes.

Part 5 puts forward ways Melbourne can influence the key drivers of transport demand. A future facing city should think creatively about reducing peak demand on its infrastructure network by considering alternative hours for school or university and other public institutions. Reducing peak demand could speed up the city, shortening commutes and improving all round economic efficiency in Melbourne.

This report is intended to open the door to further conversation about Melbourne's transportation future. The ideas proposed throughout this report would help accommodate the city's booming population, ensuring the economy is supported to grow with its population, and the lifestyle advantages that make Melbourne renowned are not diminished.

INTRODUCTION

How quickly and easily we can move people around our city is not only important for maintaining the liveability that Melbourne prides itself on, it is also fundamental to the global competitiveness of our economy and ensuring equality of opportunity.

So if we are to make the most of our status as Australia's fastest growing city, we need to continue think creatively and innovatively about how we tackle some of the associated growing pains.

Significant infrastructure investment is underway to address key bottlenecks and boost capacity across Melbourne's roads and public transport networks, in particular the Melbourne Metro and Level Crossing Removal Programs. Of equal importance are upgrades to regional rail links, vital for ensuring regional cities are viable alternatives for people choosing to make Victoria their home.

The level of building is such that it not only imposes some capacity constraints on our ability to embark on further major projects in the short term, but planned works themselves will add to congestion and disruption for many commuters over the coming decade.

It is in this context, that the McKell Institute has prepared this report to put forward a range of ideas that can help get Melbourne moving faster and more efficiently. It deliberately focuses on initiatives that minimise the need for competing construction and ideally offer opportunities to mitigate some of the anticipated disruption.

In conducting this research, we identify three outcomes that that we believe policymakers need to adhere to in ensuring the right outcomes in transport policy for Melbournians and Victoria as a whole.

- **We need an integrated transport network that provides real choice.**
  The economics of transport networks overwhelmingly improves as the number of passengers or trips grow due increasing density. In contrast, growth in car travel typically leads to congestion and the need to build more roads. Consequently, many of the ideas in this report have a common goal of getting people out of their own cars and on to buses, trains or trams or using more active modes, such as cycling or walking, and participating in emerging options within the sharing economy. The emphasis on increasing and improving the alternatives to driving rather than making car ownership or usage more expensive is no mistake. We don't want to see outcomes that punish drivers who have no real other options.

- **We must embrace inclusive design that looks after all users.**
  Technology will play a key role in improving transportation outcomes, but poorly executed it could exacerbate disadvantage. We need to make sure mobility improvements work for everyone not just those with a smartphone or those who are able-bodied. Also, the more effectively and seamlessly our transport services can integrate the needs of all Victorians (both able-bodied and disabled; digital natives vs 'analog' generations) and reduce our reliance on bespoke services or infrastructure, the more affordable we can make our transport network as a whole.

- **We need a smarter, more innovative approach to data.**
  A better use of data will be central to making a better use of existing infrastructure and to making the right decisions about what to build in the future. At its simplest will be gaining a deeper understanding of where people are trying to get to and from to inform better decision-making. In many ways, the competitive advantage that the private motor vehicle has in facilitating convenient point-to-point travel over public transport is derived from the operator's knowledge of when and where they are actually trying to get to. Armed with that same data it's conceivable that public transport and multi-modal journeys could become more cost-effective and as convenient. Considerable care and effort will need to go into figuring out how we source the right data, while both safeguarding privacy and rewarding rather than stifling innovators.

PART 1:
FINDING IMMEDIATE FIXES TO CONGESTION HOTSPOTS

> We wanted to begin this report with examples that highlight how new ways of thinking can unearth solutions to some of Melbourne's more pressing congestion and mobility challenges.

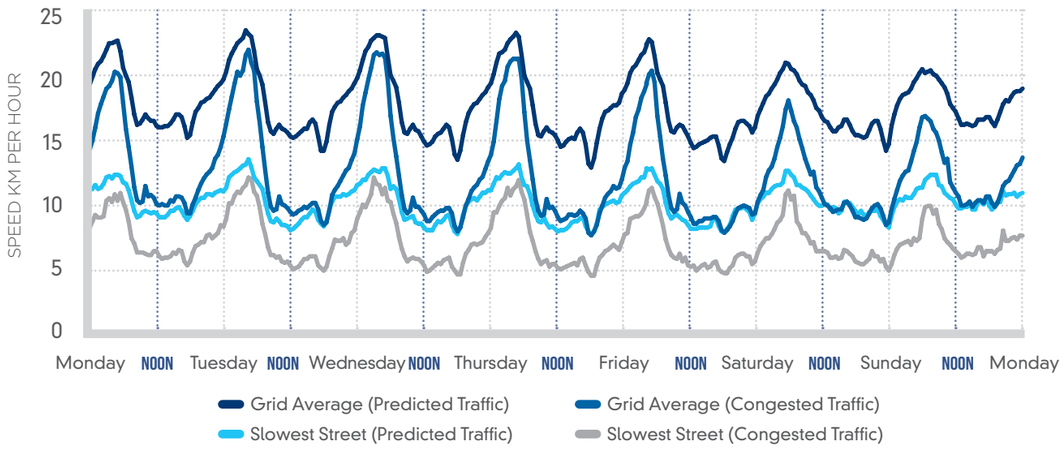
Key to this was identifying the ideas and the data that more accurately pinpoint the causes of congestion or poor network performance and therefore enable solutions that are not only more cost-effective manner than some of the more traditional responses but that can deliver results sooner.

In most cases these are not actually new ideas themselves, but adaptations of past proposals or old ideas made possible by new, proven technology whose time is finally coming.

IDEA 1:
Unblocking intersections inside the Hoddle Grid

Unsurprisingly the CBD is one of the major choke-points in Melbourne's transportation network given the disproportionate share of economic activity that it accounts for. This is of course not unique to Melbourne and in many ways congestion resulting from concentrated activity can be viewed as a by-product of a healthy, growing city economy.[3] Modelling of the main roads in the Hoddle Grid suggests there is room to improve our coordination of traffic in the CBD and help stimulate further activity and growth as a result.

FIGURE 1 PROJECTED SPEEDS ACROSS THE HODDLE GRID (KM/H)[4]



Based on the algorithms underpinning Google Maps, the slowest traffic across the Hoddle Grid in the week beginning Monday, 14 August 2017 is expected to occur at on Thursday evening at 6pm, when the average speed is expected to slow to 12.9km/h. Under extreme congestion, typical speeds could fall further to 7.7mk/h and as low 4.6km/h along eastbound along Collins St, where it would take between 47 seconds to 1 minute 18 seconds to drive just 100 meters.[5]

This wide variability in traffic flow is often caused by coordination failure, as opposed to just increased volumes, and including problematic hysteresis, a delayed domino effect that ripples throughout the entire network causing the entire system to lag behind real-time driver actions and signal changes at intersections, causing significant delays and imbalance to drivers and network operators.[6]

Traffic authorities have a range of tools at their disposal to address this challenge, with technology playing a growing part, but this is also where our road rules play a vital role in coordinating behaviour to produce an optimal outcome for the network a whole.[7]

One such road rule is Regulation 128 which is intended to prevent intersections from becoming blocked and restricting traffic flow each time it changes directions.[8]

REGULATION 128

"A driver must not enter an intersection if the driver cannot drive through the intersection because the intersection, or a road beyond the intersection, is blocked."

Melbourne's grid-based CBD makes Regulation 128 particularly crucial as its relatively short blocks can readily exacerbate the flow on impacts on congestion. However, as Daniel Bowen of the Public Transport Users Association points out, this road rule is useless if there isn't effective enforcement and the regularity with which vehicles can be seen to be blocking oncoming traffic, including trams, suggests this is the case.[9]

The main step that should be taken to unblocking Melbourne's CBD is investigating and implementing ways to improve compliance with Regulation 128. This could include an awareness campaign accompanied by highly visible blitzes, the deployment of technology such as automated cameras and digital imaging and a phased approach when it comes to the application and level of fines, to build and maintain community support for increased enforcement.[10,11]

A subsequent step could be to build on the work already undertaken as part of the City of Melbourne Walking Plan 2014-17 Melbourne, to improve pedestrian flows.[12] While there is plenty of evidence around the benefits of greater prioritization of pedestrians in the centre of cities that doesn't mean we shouldn't be mindful of adverse impacts that pedestrian behaviour can have on congestion and safety.[13,14] While jay-walking might be the first thing that comes to mind, a more obscure impact can be pedestrians that start crossing an intersection too late in the cycle, thereby restricting the flow of turning traffic. A mix of possible signalling changes, sensor technology or educational campaigns could enable improvements.[15]

Finally, with vehicles looking for parking being a major cause of traffic congestion, some of the later ideas in this report to improve parking offer longer-term opportunities to improve the efficiency of our CBDs (see Idea 6: Creating an open digital platform for parking & Idea 14: Dynamic parking restrictions).

IDEA 2:
Promoting car-pooling

Car-pooling as a concept has been around for a long time; but a number of challenges exist around information, cost-sharing and other trust issues like reliability due to its limited viability, particularly at scale.

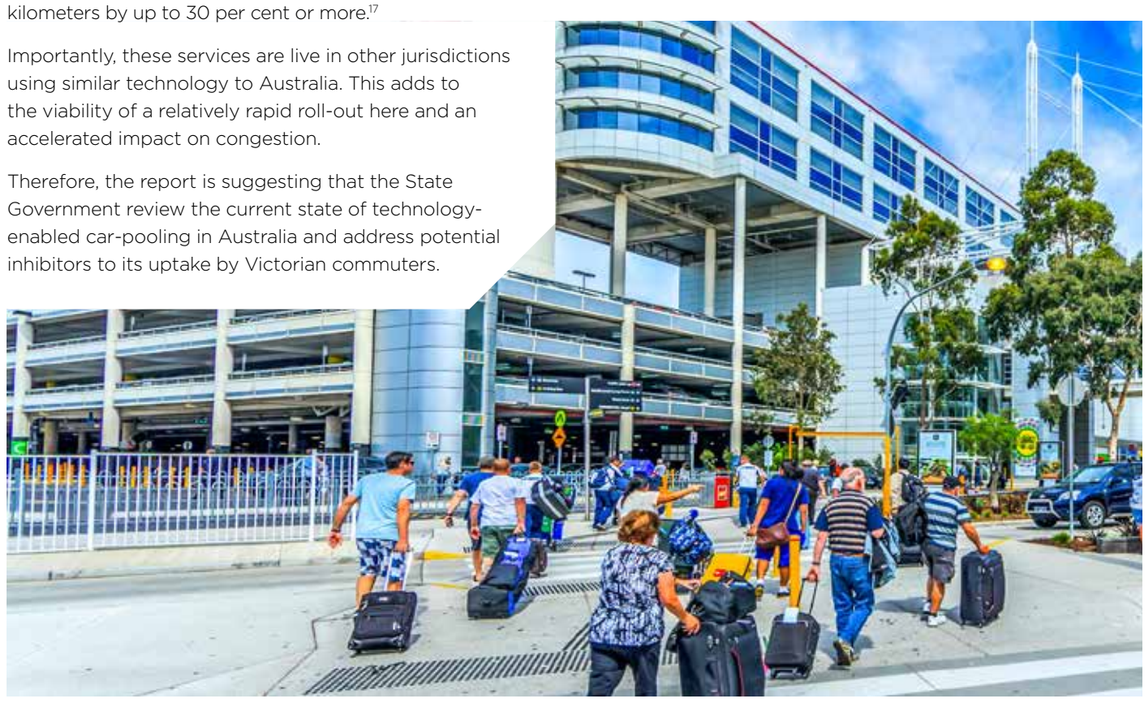
Smartphones are now starting to enable solutions to these challenges and are helping to support car-pooling at much larger numbers by developing models that allow complete strangers to car-pool safely together.

In cities where Uber's car-pooling product, UberPOOL, has been launched, car-pooling now accounts for 20 per cent of trips on the platform. In San Francisco, that number is as high as 50 per cent.[16]

This points to the very real potential for car-pooling to increase vehicle occupancy levels and reduce the number of cars on the road. This is backed up by analysis from MIT's SENSEable City Lab which found that these platforms could reduce cumulative trip kilometers by up to 30 per cent or more.[17]

Importantly, these services are live in other jurisdictions using similar technology to Australia. This adds to the viability of a relatively rapid roll-out here and an accelerated impact on congestion.

Therefore, the report is suggesting that the State Government review the current state of technology-enabled car-pooling in Australia and address potential inhibitors to its uptake by Victorian commuters.



IDEA 3:
Establish an airport terminal in the CBD

The journey to Melbourne's Airport is one of the city's most notorious routes due to its congestion challenges with both the State and Federal Government committing resources to develop a business case and strategy for building a rail link to the airport.

However, in the interim, it is estimated that a rail link would not be completed before 2027 at the earliest and that growth in traffic and aviation passenger volumes will outstrip the widening of the Tullamarine freeway by that time.[18, 19]

Furthermore, the widening will address only one of the three major bottlenecks on the landside of our city's aviation infrastructure, with the other two obstacles being unresolved: Departure Drive and Security Clearance inside the airport.

FIGURE 2 ROUTE TO AIRPORT[20]

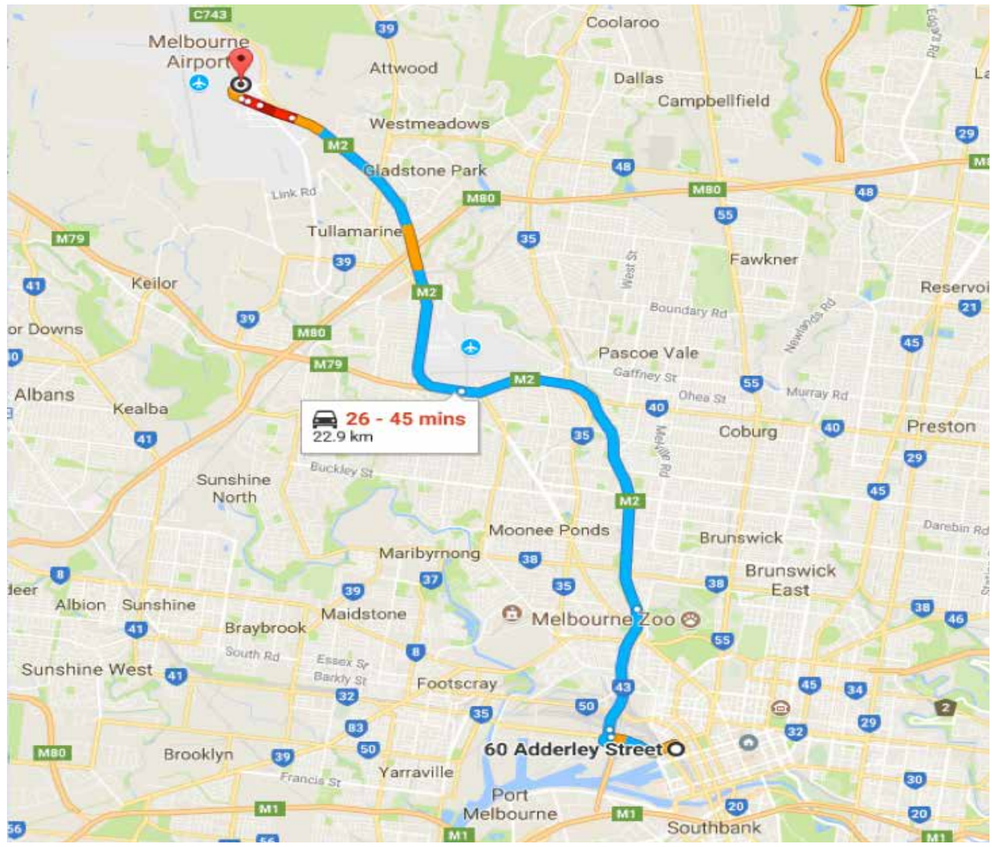
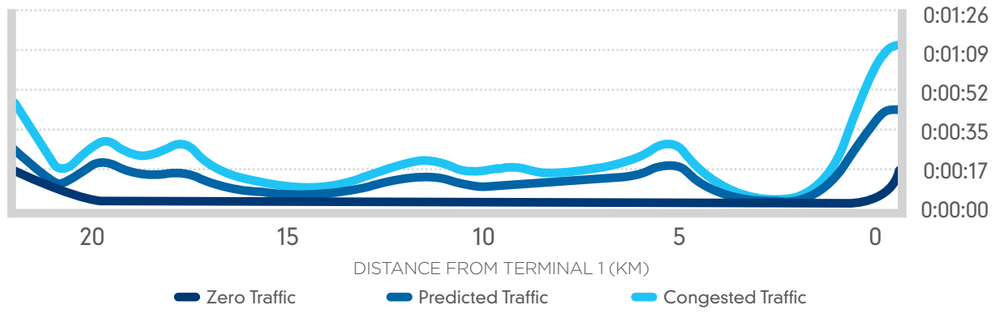


FIGURE 3
LONGEST TIME TAKEN TO TRAVEL 100 METRES AT EACH POINT ALONG THE ROUTE TO MELBOURNE AIRPORT[21]



Even with the current construction activity underway to widen the freeway, there are periods where the final 2.6km of the journey can contribute a majority of the delays in the drive from the CBD. For example, drivers departing the city at 8am on Monday can be burdened with an additional 9 minutes (74 per cent of total delay) in regular traffic and up to 19 minutes (69 per cent of total delays) in extreme congestion.[22]

In order to make the most of the widening and address the other two choke-points, the report recommends a need to double-down on using express buses. The major difference with previous proposals of this nature is that this recommendation includes security screening prior to passengers boarding the bus.

In effect, we are calling for a new satellite terminal to be established at the CBD where domestic passengers could not only check-in for their flight but pass through security before boarding a secured bus that can avoid Departure Drive and drop passengers airside. International passengers needing to clear Customs would continue to use a regular bus service.

We estimate that this proposal would cost a fraction of what it would take to build a new train line. There are many parties that would need to work together to achieve this:

- Melbourne Airport would need to be involved in the design of the airside drop-off and pick-up arrangements and would be accommodated with access charges, just as they are currently.
- CityLink would need to be involved if traffic levels necessitate the establishment of a priority lane to ensure the reliability of the service. This would involve separate charging arrangements to justify the cost of keeping the lane clear.
- The Federal Government would need to sign off on the aviation security arrangements. Noting that this model would establish an additional buffer of security, whereby if a possible breach were detected, the buses could be isolated prior to reaching the airport and avoid the need to completely flush the airport itself.
- The owners of Southern Cross Station and the SkyBus service would also need to be involved given their current roles in the delivery of the scheduled public transport service.

Executing this proposal successfully would also buy the community time to have a proper conversation about the right way to build the rail link, including how it integrates with the rest of the state's infrastructure particularly any future high-speed rail service.

It should also improve our city's ability to establish a future airport in the South East, as mooted in Plan Melbourne 2030, since a new airport would be able to leverage this infrastructure. In the longer-term, other remote terminals could be established at key hubs around the metropolitan area to reduce the need to come through the city. Meanwhile, a minimalist way to progress on this proposal would be a few short-term trials of a premium service aimed at the airlines' corporate and business customers.

PART 2:
PROGRESSING A DATA-DRIVEN APPROACH

The better use of data will be fundamental to achieving the best performance from our current infrastructure. At a high level, data can be used in a variety of ways to improve mobility and efficiency. It can more accurately pinpoint the causes of congestion or areas of under-utilisation so that we can develop targeted solutions where they are needed.

It can further help in guiding both passengers and vehicle operators towards more efficient usage of our infrastructure (e.g. route recommendations designed for the network rather than the individual vehicle) and can aid in monitoring and assessing the effectiveness of interventions to support incremental improvement assisted by Artificial Intelligence and inform the priorities as to the developments in infrastructure that are necessary in the future.

There is already considerable consensus around this, not to mention an ever-increasing amount of data being generated by smartphones and other web-connected devices. A recent Grattan Institute study shows how data from mobile phones can be used to measure congestion hotspots.[23] The challenge often lies in identifying the right practical steps for moving forward and in acquiring or building the capability to execute.

If we want a more convenient public transport network that is a real alternative to driving, then we need a more granular understanding of user travel requirements. Ride-share operators, including Uber, are showing leadership here with their use of trip data to better match rider demand with drivers or to fine-tune recommended pick-up and drop-off points in order to deliver improved rider experience and vehicle utilisation.[24] As individual drivers, we also effectively have access to this information given we know where we are leaving from, where we are going and what time we need to be there. However, our public transport service only has retrospective access to where riders get on or off the network, and not their actual origin or destination. Therefore, it is rather difficult to expect transport planners to create a truly convenient service to get us from destination A to destination B as they are never aware of where passengers truly need to be at.

With the right approaches, there are opportunities to leverage existing data or sow the seeds for the creation of new datasets across all modes and aspects of transport, and we've focused on four specific priority areas: cycling, private motor vehicles, parking and the public transport network. In all four cases, the emphasis is on voluntary or opt-in participation to give individuals maximum control over their own privacy and a preference towards partnering with existing platforms or apps, rather than increasing regulation, as a means to faster deployment and stimulating innovation.

IDEA 4:
Partnering with existing cycling apps

Currently, there are a host of applications that exist for cyclists to track their rides or plan a route (e.g. Strava, Map My Ride, Google Maps etc.). It is recommended that the State Government should either source or develop a standard for application developers to provide trip data in a secure and anonymised way so that better transport solutions could be implemented. This data can then be utilised to determine where improvements to Melbourne's cycling network should be prioritised, and to measure the resulting impact of any investments in improved infrastructure (see Idea 12).

The value to cyclists in participating in this would be the knowledge that their involvement and usage of the applications will help to inform future policies. The value to app developers that choose to participate, is in being able to differentiate themselves from apps that don't take part and hence gain a competitive edge. However, it must be noted that there would not be any binding regulation to prevent cyclists who want to maintain anonymity from riding without using an app.

IDEA 5:
Realising the connected vehicle with today's technology

While fully autonomous vehicles tend to dominate public and media discussions around the future of car travel, within the field of Intelligent Transport Systems (ITS), there is considerable innovation underway or on the horizon before they actually come into fruition.

One of the key concepts is that of the 'Connected Vehicle'. This is a system where vehicle-to-vehicle (V2V) and infrastructure-to-vehicle (V2I) communications, enables applications such as collaborative braking across a group of vehicles enabling them to react to changes in conditions quicker than a human driver.

This system is not only expected to reduce the number of accidents, but it can also increase capacity on our roads by allowing cars to travel closer together, a concept known as 'platooning'.

CASE STUDY: SURTRAC

U.S. company Surtrac is one example, with their technology able to coordinate multi-directional traffic flow significantly. With same-day-installation of their tracking and analytical technology covering 12 traffic routes in Pittsburg Surtrac were able to **improve travel time between 17.5 per cent - 32.8 per cent, reduce vehicle stopping between 29.1 per cent - 52.6 per cent** and **lower wait times between 35.6 per cent and 47.8per cent.**[25]

As the largest economy globally, and with one of the biggest road networks, it is unsurprising that the U.S. will play a dominant role in ITS. Yet the relevant strategies of the U.S. Department of Transport appear to have a strong bias towards building dedicated infrastructure rather than leveraging existing cellular networks (despite acknowledging the latter would allow faster deployment and realisation of benefits). Further, deploying dedicated infrastructure was only expected to achieve lower costs if connected vehicles were limited to the National Highway System whereas extending to include all secondary roads would make it 2.7 times more expensive than leveraging the cellular network.[26]

In the short-term, the bigger problem with the preference for dedicated infrastructure is the reduced opportunity to progress many of the applications that don't require the same level of latency or processing power and many of these could go a long way towards tackling congestion and managing disruptions on our roads. For instance, past simulations found that even if only a small percentage of drivers notified a central transport system each time they started a journey, road use could be better scheduled to balance out the system and help those users to *halve* their travel times.[27]

That's why we are suggesting that the Victorian Government develop a strategy for accelerating the connected vehicle using today's technology and infrastructure. The strategy should principally focus on:

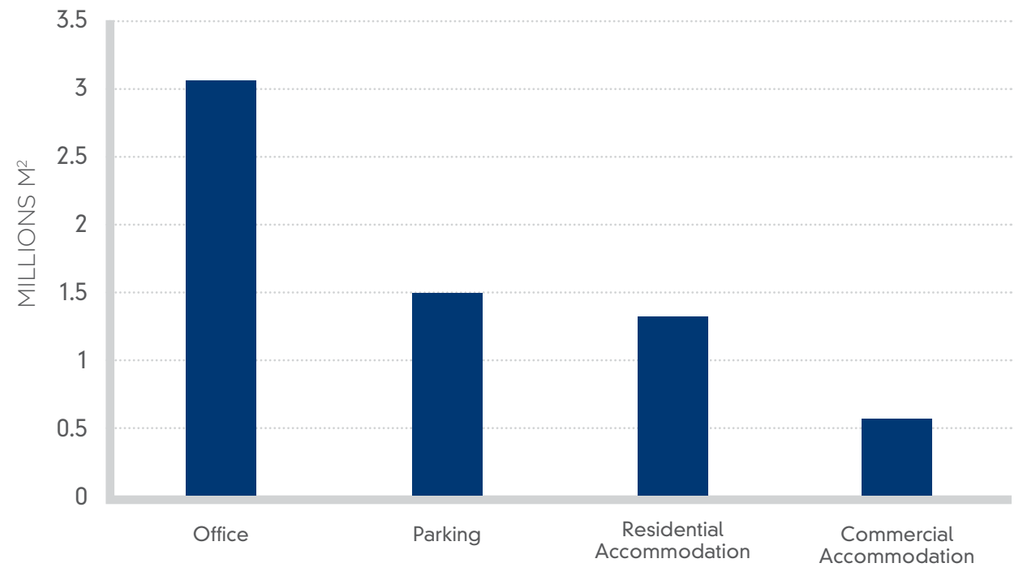
- Adopting a standardised approach for third party navigation software providers, including possible incentives, to provide data on planned journeys and real-time travel to a central authority.
- Investing in building artificial intelligence and machine-learning capabilities to use this data to optimize traffic flows across the network (e.g. traffic-light sequencing and centralised route guidance).
- Developing cases that include regular morning and evening peak traffic as well as both planned and unplanned disruptions.

The strategy should incorporate a Public Private Partnership model that allows intellectual property to accumulate in a commercial entity that is able to generate economic opportunities for Victoria. By partnering with existing players in navigation technology, and not attempting to replicate them, it will ensure the fastest possible route to market both locally and in future export scenarios. Real-time data infrastructure collection has great capability as a data source for third party innovators and government.[28] This would build on existing areas of strength and a strong local track record. For example, NSW traffic light technology is installed in 154 cities and 42,000 intersections in 25 countries.[29] The Sydney Coordinated Adaptive Traffic System or SCATS has reduced travel emissions by 7 per cent, fuel consumption by 12 per cent, delays by 20 per cent and vehicle stops by 40 per cent on average.[30]

IDEA 6:
Creating an open digital platform for parking

Parking is one of the major uses of scarce land and prime real estate in our city, with 30,000 on-street parking bays in the City of Melbourne[31] and within the CBD itself, parking consumes 1.46 million square metres in 2016, up 9.6 per cent from 2011 and second only offices as a use of space.

FIGURE 4 LAND USE IN MELBOURNE CBD[32]



It is also a major driver of traffic congestion in many cities, with studies finding upwards of 30 per cent of traffic congestion caused by motorists trying to find a parking space.[33]

There has been some innovation on the digital front with a host of councils procuring technology that allows motorists to pay for parking via their smartphones and Melbourne-based start-up Parkhound, an online marketplace that allows individuals to rent out an unused car park on short-term basis.

While many predict that autonomous vehicles will make parking obsolete and free up that land to be converted into other uses, the fragmentation and inefficiencies present in existing parking arrangements suggest there is considerable scope for improvement in the interim.[34]

This report recommends that local councils should evolve their digital solutions for parking towards a shared platform that supports payments, and ultimately bookings, from third party apps such as Parkhound. This would:

- Allow for motorists to move seamlessly about the city without the need to install multiple apps.
- Stimulate innovation in consumer-facing applications, that make it easier for motorists to find an available park.[35]
- Provide greater visibility to city planners on the current stock of parking, its impact on traffic and opportunities for improvement and could include developing business cases to unlock value in parks.

The City of Melbourne could take a lead role in developing the shared platform and establishing governance arrangements that make it attractive for other councils and even private car park operators to participate.

IDEA 7:
Wholesale public transport ticketing

With Open Data policies being adopted by governments around the world, one of the most common and valued applications has been to make public transport timetable information available for third party applications, such as Transit and Google Maps.

While impacts on ridership have varied across cities and routes, the data shows that in general the resulting innovation has made public transport more visible, easier to navigate, and plan a trip covering multiple connections.[36]

While Victoria was a late mover in opening access to its timetabling data, it still has the opportunity to be a first-mover in terms of opening up its ticketing to third-party applications and improving data on how public transport is used.

There are two main steps involved to make this work:

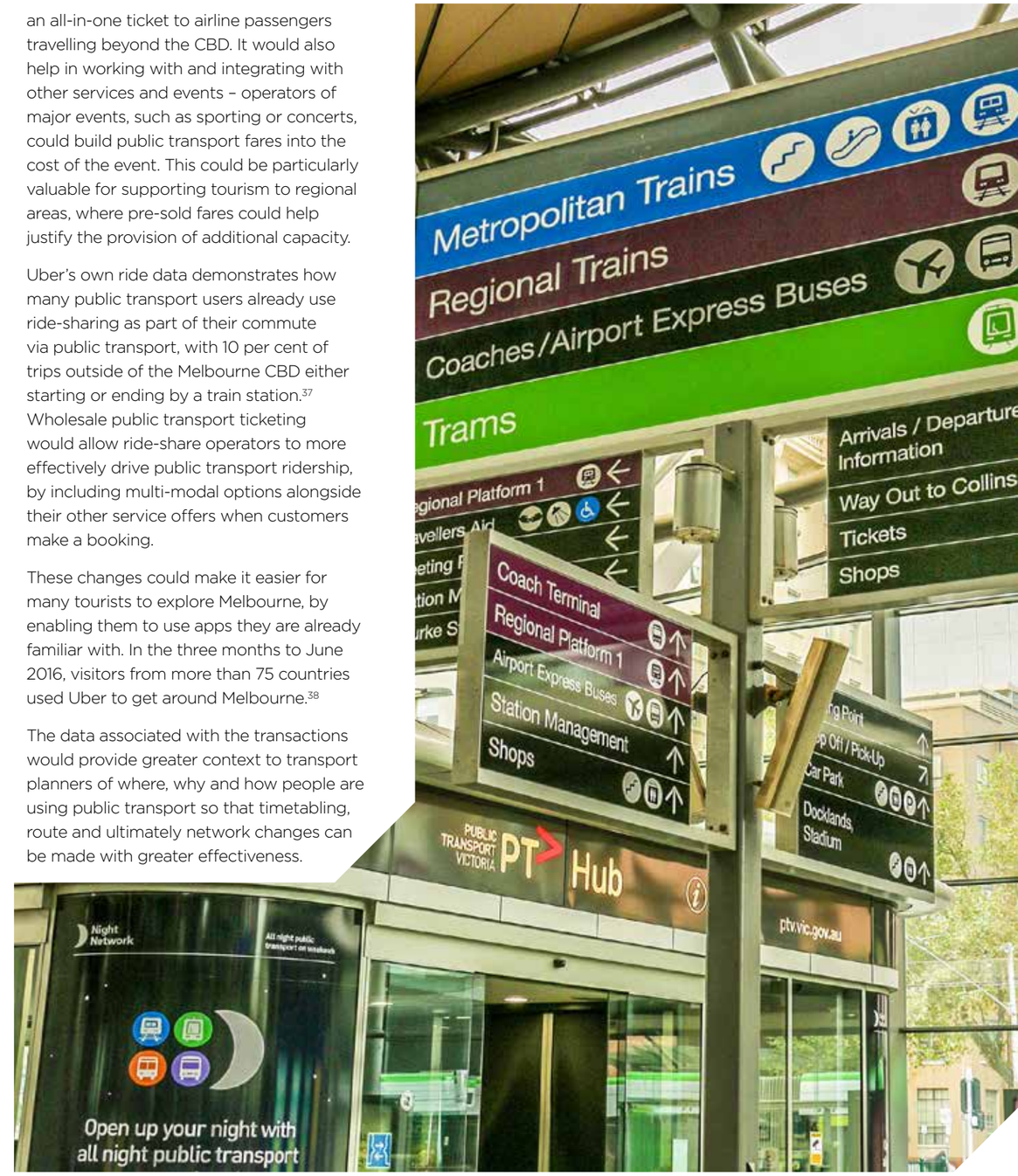
1. A restructure of ticketing operations into two separate divisions. At a high-level this would see a retail-arm that is responsible for the existing sales channels for Myki tickets including vending machines and a wholesale division, responsible for all other infrastructure (e.g. gates, touch-points on trams) and compliance.
2. The accreditation of third-party providers that can compete and innovate in how public transport tickets, or more importantly, services are sold to users of Victoria's public transport network.

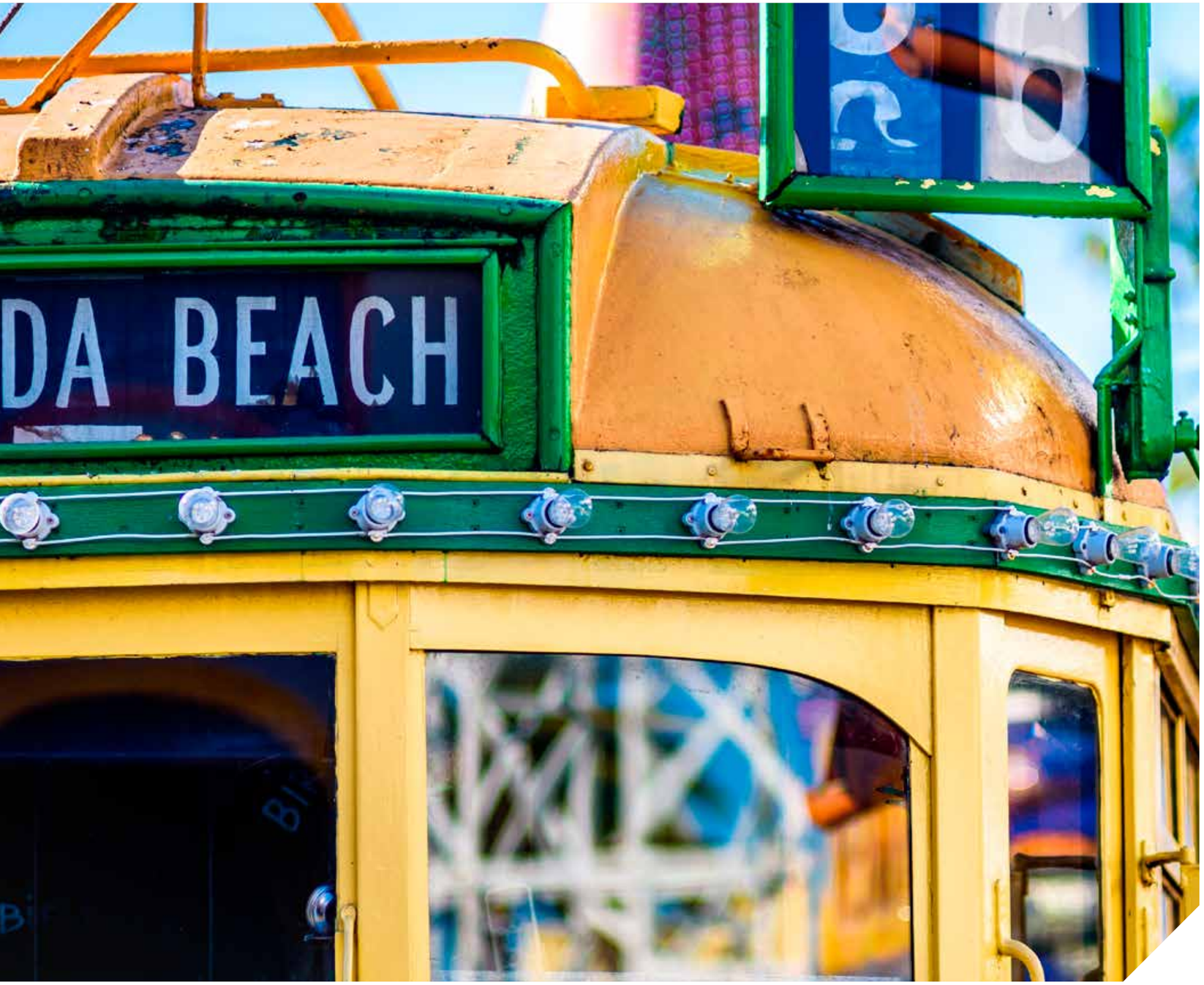
Designed properly, this approach could drive various forms of service innovation. It would help in shifting to newer technology; i.e. smartphone apps could facilitate payment for a trip alongside the route recommendation making the service more user-friendly. It would aid in integration with other modes – other transport providers could integrate one or more transport leg(s) as part of their offering. For example, SkyBus could sell an all-in-one ticket to airline passengers travelling beyond the CBD. It would also help in working with and integrating with other services and events – operators of major events, such as sporting or concerts, could build public transport fares into the cost of the event. This could be particularly valuable for supporting tourism to regional areas, where pre-sold fares could help justify the provision of additional capacity.

Uber's own ride data demonstrates how many public transport users already use ride-sharing as part of their commute via public transport, with 10 per cent of trips outside of the Melbourne CBD either starting or ending by a train station.[37] Wholesale public transport ticketing would allow ride-share operators to more effectively drive public transport ridership, by including multi-modal options alongside their other service offers when customers make a booking.

These changes could make it easier for many tourists to explore Melbourne, by enabling them to use apps they are already familiar with. In the three months to June 2016, visitors from more than 75 countries used Uber to get around Melbourne.[38]

The data associated with the transactions would provide greater context to transport planners of where, why and how people are using public transport so that timetabling, route and ultimately network changes can be made with greater effectiveness.





PART 3:
MAKING BETTER USE OF WHAT WE'VE ALREADY GOT

As Melbourne's population continues to grow it is gradually improving at maintaining sufficient infrastructure to accommodate an expanding city. However, there is plenty more that can be done to improve how the present infrastructure is utilised.

Infrastructure Victoria recommends as part of its 30 Year Strategy, that we should "Consider non-build solutions first" arguing that "Major projects will continue to be an important part of the infrastructure planning landscape, but, wherever possible, Infrastructure Victoria will look at non-build solutions first." And that "Taking steps to manage the demands placed on infrastructure and using the assets we already have more efficiently can be cheaper and better options."[39]

Heeding this advice, the bulk of the ideas in this report are aimed at non-build solutions.

Public transport

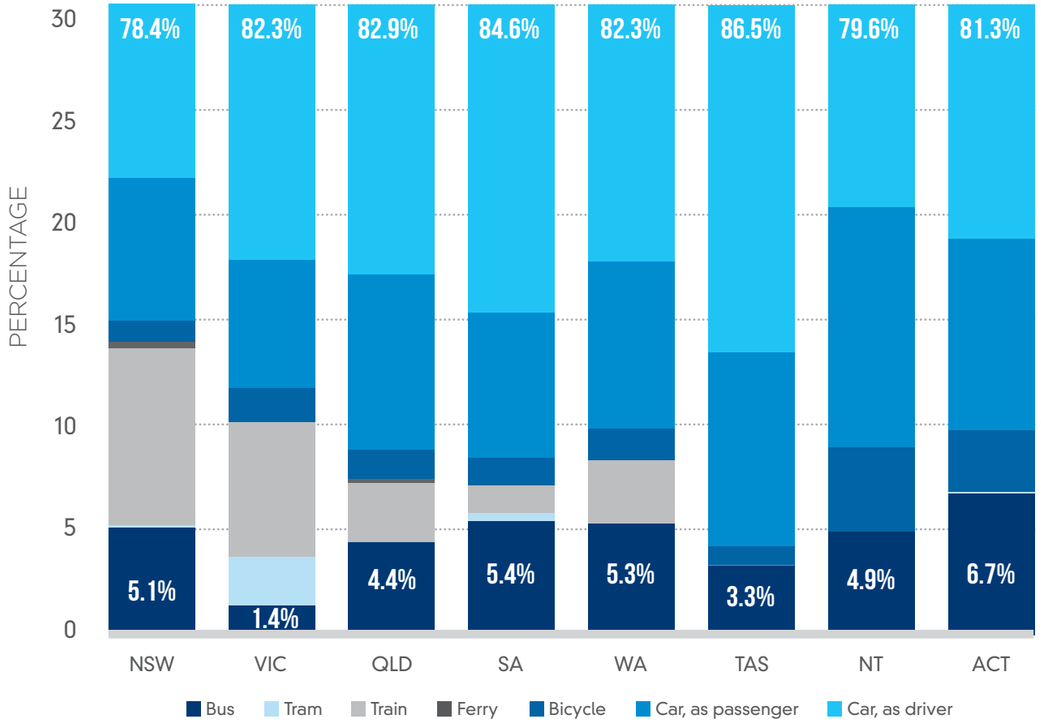
While much of Melbourne's public transport network is at full capacity and dependent upon the Level-Crossing Removal Program and the completion of Melbourne Metro for any further improvements, there are parts that are underutilized and there is potential for services to be improved using existing stock.

IDEA 8:

Experimenting towards more reliable and convenient buses

Melbourne's tram network is iconic. But the potential flipside of having the world's largest tram network might be a relative disdain for buses, with only 1.4 per cent of Victorians taking a bus to work according to the 2011 Census:

FIGURE 5 METHOD OF TRAVEL TO WORK (2011)[40]



While both trams and trains have their advantages over buses, particularly when it comes to moving large numbers of people efficiently, buses can be more suitable in other contexts. Most notably, they can be deployed quickly on pre-existing roads, and routes can be adjusted more readily in response to customer demand. For example, the costs of building a Doncaster-CBD Rapid Transit Busway were estimated to be 10 to 16 per cent lower than a heavy rail line.[41] Of course, the list of things holding back buses in the eyes of Melbournians isn't short, and has been around for a long time.

The best thing about the agility and relative cost of buses is that it makes them well-suited to pilots and trials, so we think the best way forward in improving Melbourne's bus network is through experimentation.

Some of the initiatives that should be trialed include:

- **Giving buses priority at traffic lights** – the reliability and speed of bus services could be improved by giving them priority as they approach intersections. The real-time traffic management system in Bordeaux, France known as GERTRUDE, has been doing this since the 1980s and has become an export business for the city itself.[43]
- **Creating priority lanes for buses or high-occupancy vehicles** – providing priority on major arterials is another way to improve the reliability and travel times for buses, helping to make them more attractive than driving your own car. In areas where the number of buses may not justify the space, the lane could be made available to high occupancy vehicles, taxis and ride-share vehicles with passengers.
- **On-demand booking for buses** – in areas or times of the day with low passenger numbers, on-demand booking of buses could be more efficient than some of the circuitous routes that currently occur in suburban areas. This could also apply to disruptions, where smartphone bookings allocate people to the right bus or vehicle that can be more dynamically-routed rather than all replacement services following the same route.

To maximise the chances of success, these experiments should be transparent (e.g. community input and publishing of results), well-targeted (e.g. at specific geographies or time-of-day) and be data-reliant, which on-demand is particularly well-placed to support.

CASE STUDY: NSW ON-DEMAND TRIAL

New South Wales is for on-demand trialing in Australia, the state government having recently sought expressions of interest for on-demand bus, train and even ferry services, with the goal of beginning the trial by the end of this year. The opportunity to accumulate transport data in such a new and rich way could lead to invaluable upgrades to the transport network to the benefit of commuters and government greatly.[44]

IDEA 9:

Improving first and final mile connections to Melbourne's train network

One of the major outcomes of improving Melbourne's bus network should be creating better First and Final Mile connections with the train network. Providing more convenient options to get to a train station is a crucial ingredient to increasing public transport usage.

Making it easier for cyclists to use public transport is another way to boost public transport usage. Of course, bicycles on peak train services can reduce capacity for other passengers, posing a challenge for any initiatives that don't involve bike racks. Better integration with bike-sharing offers some opportunity for improvement as seen in Hangzhou, China.

In the mean time, ride-sharing has organically established itself as an additional tool that public transport networks can use to improve first and last mile connections. For instance:[45]

- In outer London, nearly a third of Uber trips end within 200 metres of a tube or train station in the morning rush hour.
- Upon the introduction of London's 'Night Tube' service, the number of Uber trips near Night Tube stations in outer London rose by 66 per cent.
- In the Netherlands riders are using Uber at both ends of their rail journey between cities.
- In Melbourne itself, Uber estimates that as much as 10 per cent of trips outside of the CBD start or end near a train station.

One of the benefits of the proposed ticketing arrangements under Idea 7 is that it will enable a more seamless experience for people making multi-modal trips that includes ride-sharing, as well as promoting the partial usage of public transport. It is understood that it will take time to introduce major changes to the ticketing system, so in the interim we should identify and address potential impediments that might be limiting the usage of ride-share and bike-sharing in this way, and to look at possible trials that leverage ride-sharing's complementary nature towards mass transit.

CASE STUDY: HANGZHOU, CHINA – POPULATION 8.1 MILLION

Hangzhou have deployed 67,000 shared bikes and 3,000 docking stations as part of an integrated transport system that supports 230,000 daily bike journeys.

Underpinning its success has been flexible payment options: the option of renting a bike using the same smart card as for public transport and a cash-deposit for tourists and others without a smartcard. so much so that Hangzhou has been transformed into a premier global mountain biking destination.[46]

Cycling is free for the first hour or more if a participant is integrating their journey with public transport in Hangzhou.[47]

CASE STUDY: ALTERNATIVE TO PARK-AND-RIDE IN SUMMIT, NEW JERSEY

The New Jersey town of Summit might have only 22,000, but they find themselves spending 15 to 20 minutes looking for a car park before catching a 45-minute train ride to New York City. Instead of building yet another car park at a cost of $10 million, the town is partnering with Uber to trial a subsidy that encourages people to catch a ride-share for the same cost as parking for the day.[48]

IDEA 10:
Faster vehicle loading and offloading

One detail that is often forgotten in transport conversations is the essential role vehicle dwell times play in determining the performance of the network. The longer it takes for passengers to embark or disembark, the less capacity and more congestion we can end up with.

FIGURE 6 PEAK LOAD FACTORS DURING EVENING 2016 vs 2015[49]

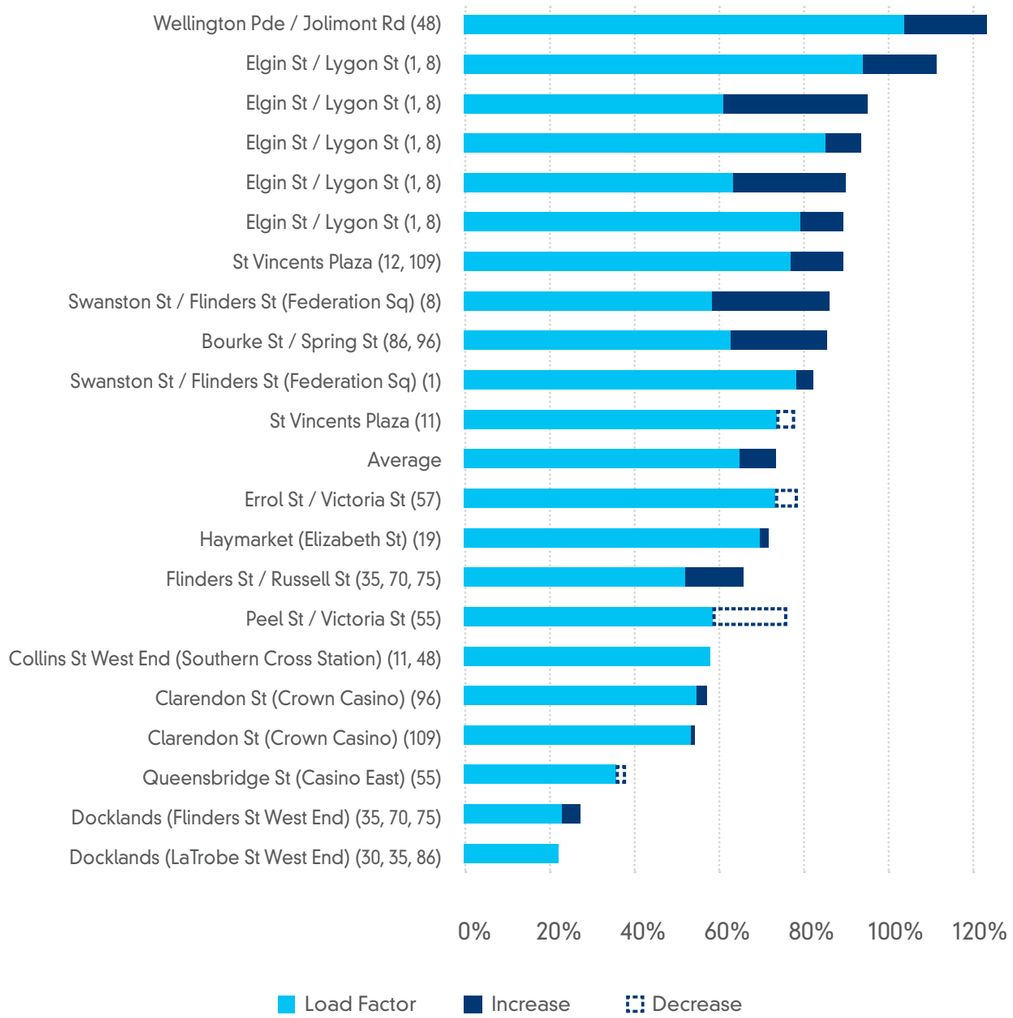
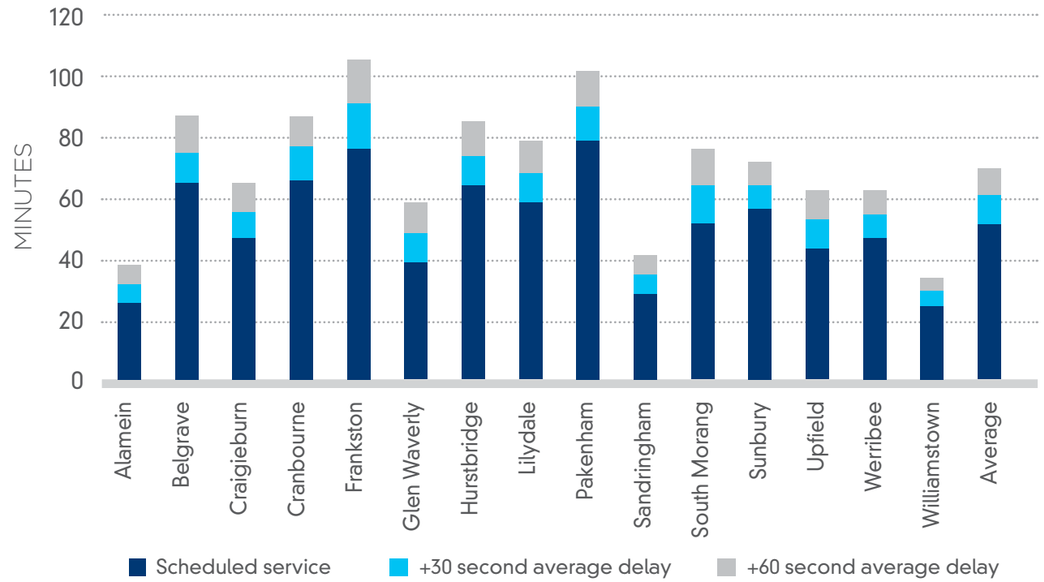


FIGURE 7 POTENTIAL IMPACT OF INCREASED DWELL TIMES ON INDIVIDUAL TRAIN LINES[50]



From an engineering perspective, having minimum, maximum or adaptive wait times for vehicles to remain idle at a stop before departure can prove very effective if services are predictable and frequent.[51] Passengers on the other hand should be continuously educated about the constant evolution of the transport network on an individual and herd basis. Behaviour such as encouraging passenger flow into the centres of the carriage rather than bulking at doorways and giving way rather than trying to enter or exit the vehicle en masse in unison are crucial behaviours in determining dwell times.[52]

Evolving ticketing technology has the ability to affect dwell time from an engineering and behavioural perspective, and should be embraced with appropriate safeguards. Rather than tapping on/off when on the vehicle, dwell time can be drastically slashed by removing the need to do so entirely. Hence the decision to remove the need to touch-off when people are getting off trams.

This could be extended to passengers boarding trams via the installations of touch on points conveniently at busy tram stops.

As seen with train stations and BRT bus stations, the loading areas are cordoned off by infrastructure requiring a ticket to enter thereafter to access the service. Cordoning and ringing stations over a greater perimeter with an increased number of entry and exit points could become more commonplace throughout the public transport network to avoid lengthy bottlenecks and clustering forming at vehicle doorways.[53]

A great example of how new ticketing and payment processes can improve dwell times is in the on-demand environment itself. Where the smartphone-based apps allow passengers to quickly exit a vehicle without having to deal with the financial transaction. This gets people to their destination quicker, allows drivers to get to their next job sooner and frees up the curb for another vehicle.

IDEA 11:
Develop a train network of super-stations

As commuters, we often sense the train network as congested because of how crammed our carriage is, but in many cases the overriding constraint is the lack of capacity on the tracks or at stations for additional trains. Indeed, that is what the Metro Tunnel project and Level Crossing Removal Program are seeking to address.

Yet even with those projects completed and much needed capacity unlocked, there will still be parts of the network that are relatively congested and other parts that are underutilized simply because varying demand across regions or different times of the day make it almost impossible to fully balance the load.

For instance, in the morning it is the inbound tracks that are highly congested (and ironically slowest, as many outbound trains run empty without stopping back to the start of the line). In the evenings it is the reverse, with outbound tracks congested and inbound relatively free-flowing. On the platforms, scores of passengers heading home from the city loop will occupy space and impede the boarding of a departing train because they are waiting for a subsequent service. Further down the line, both trains will pass multiple stations with platforms that are 99 per cent empty almost all the time. If we are prepared to think creatively, about how to use more of our networks efficiently, there should not only be opportunities to unlock even more capacity but to even shorten travel times between many parts of the network.

The largest opportunity lies in transition to a network of super-stations that act as transit hubs for consolidating passengers from smaller stations and an improved bus network (see Idea 5: Experimenting towards more reliable and convenient buses) and transporting those passengers via express services to other Super-Stations on the network.

This would allow people to reach more of the metropolitan network in a shorter timeframe, particularly outer suburbs to the city or from one train line to another. Critically, by shifting more of the passenger transfers away from the city loop and the inner-city we can improve dwell times and further increase capacity in those high-traffic areas.

There are of course trade-offs for operating a network in this way. It could increase the time taken to travel short distances by train, particularly where track duplication doesn't exist and access to some smaller stations might come via travelling back on the return leg (putting that underutilized track for the other direction to use). However, in the outer suburbs, any 'backtracking' would be more than offset by the faster services between super stations. This would also require many passengers who currently don't have to change trains at all to make a transfer.

The parts of Melbourne that would have the least to gain from this would be the inner-city areas, but it's worth recognizing that they also have better access to alternatives, whether it be tram, buses, riding or walking. Ultimately, this approach would make better use of what trains do best – which is to move large numbers of people over long distances – using the other modes to connect people more efficiently for the last mile, as per previous ideas in this section.

As Melbourne grapples with solutions to the chronic unemployment facing parts of the wider metropolitan area, a public transport network that can provide fast and affordable connections to jobs on the other side of the city is likely to be an important part of the answer.

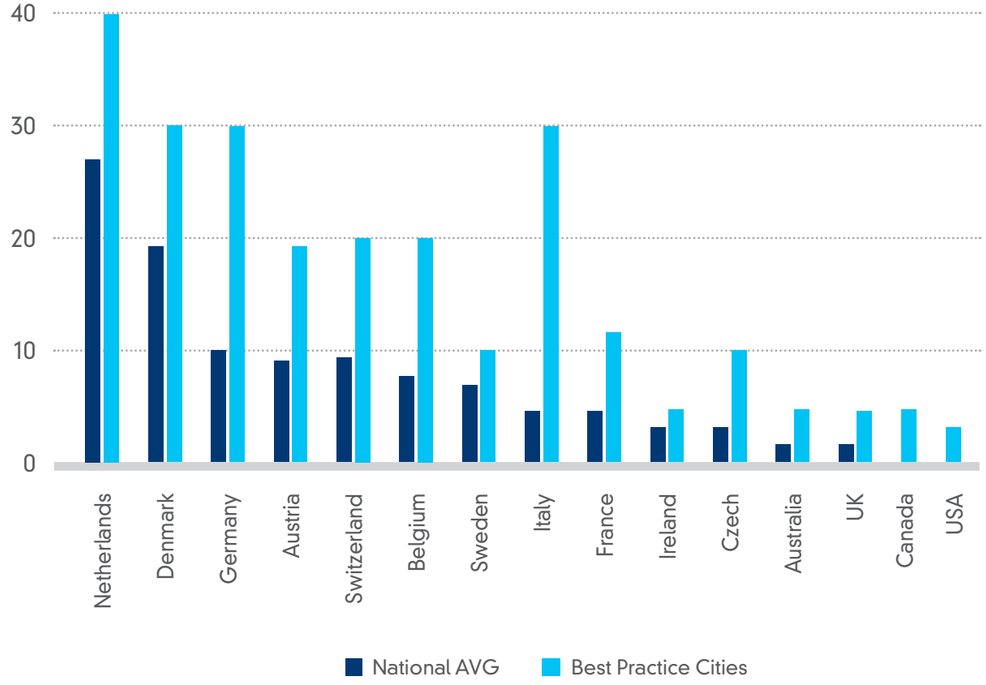
It could also be used to serve regional communities; many of whom have rail services that currently get stuck behind metropolitan trains and share many metropolitan stations.[54] By connecting V/line to express metropolitan services at the end of the line, we could deliver faster services even without track duplication and redeploy the diesel trains to boost the frequency of regional services themselves.

Cycling

With its ability to effectively tackle congestion, the obesity epidemic and climate change, all at incredibly low cost compared to other modes of transport, it should come as no surprise that cycling is facing a global renaissance. Unfortunately, Melbourne and Victoria at large, are lagging the rest of the world as it advances, with a cultural and policy funding mix that is failing current cyclists and disincentivising potential newcomers. This has improved in recent years, but will only continue to do so if the policy climate is more favourable.

Though behind in cycling participation, Australia and Victoria can take stock of the effective mechanisms that have been used around the world and adapt the approaches of other nations to meet local needs. Key to increasing participation is the ability to make cycling accessible and safe regardless of skillset across leisure riders, workers and professionals within an integrated public transport system.

FIGURE 8 MODAL SHARE OF CYCLING COMPARED TO AUSTRALIA[55]



IDEA 12:
Make cycling safer

The cost of driving a car is six times higher than cycling when accounting for construction, maintenance, health and environmental effects.[56] With regards to human cost, cycling significantly increases safety for all transport users.[57] Despite this, strategies to communicate to the public the safety of cycling is not cutting through, with 80 per cent of people wanting a complete separation of bicycles from vehicles.[58] European cities are a leading example of how considered planning can result in soaring participation. As Figure 8 shows, in 2009, many cities had 10-20 per cent of journeys being made by bike, while Australia languished at less than 2 per cent, the City of Melbourne reaching a comparative rate a full 8 years later. With 40 per cent of Australians travelling less than 10km to reach their workplace, the potential to significantly improve participation is high.[59] Shifting the burden of proof onto drivers has also shown to be very effective in lessening collisions with cyclists;[60] with a recent Monash University study reporting 87 per cent of near-collision events were the result of the driver, regulatory change should be considered.[61]

Infrastructure investments are also an important tool in increasing cycling participation.[62,63] This could include anything from building cycling superhighways, increased segregation or shared roads where cyclists have right of way and cars must drive at lower speeds (e.g. 20kph).[64]

Of course, this report is aimed at projects that don't require a major construction project, and it's almost tempting to make an exception for cycling infrastructure given how much cheaper it can be to construct compared to roads. For instance, Florida's Department of Transport has previously reported that 1 mile of 12-foot wide bike paths can be constructed at one sixth the costs of a two-lane road and a tenth of the cost of a four-lane road.[65] Meanwhile, in Oregon USA, US$60 million spent over the years on their bicycle network equates to only a single-mile of urban freeway.[66] This report recommends consideration be given to how we can increase the pool of funding available to invest in expanding cycling infrastructure across Melbourne, including encouraging crowd-funding for individual projects by offering to match funds raised, voluntary registrations (with funding allocated to routes based on traffic) or user-pays revenue generated via contributions linked to office bike racks in CBD offices.

IDEA 13:
Promote efficient bike-sharing

According to Associate Professor Pradeep Varakantham at the School of Information Systems at Singapore Management University, there are 1,139 bike-sharing systems across the world and growing.[67] In Australia, inner-city cycling is quickly being disrupted into a sector where ownership is no longer paramount and short-term leasing and sharing of bicycle fleets dispersed around high population areas are used for either common transit routes or more bespoke ones.[68] The ramifications of this are enormous.

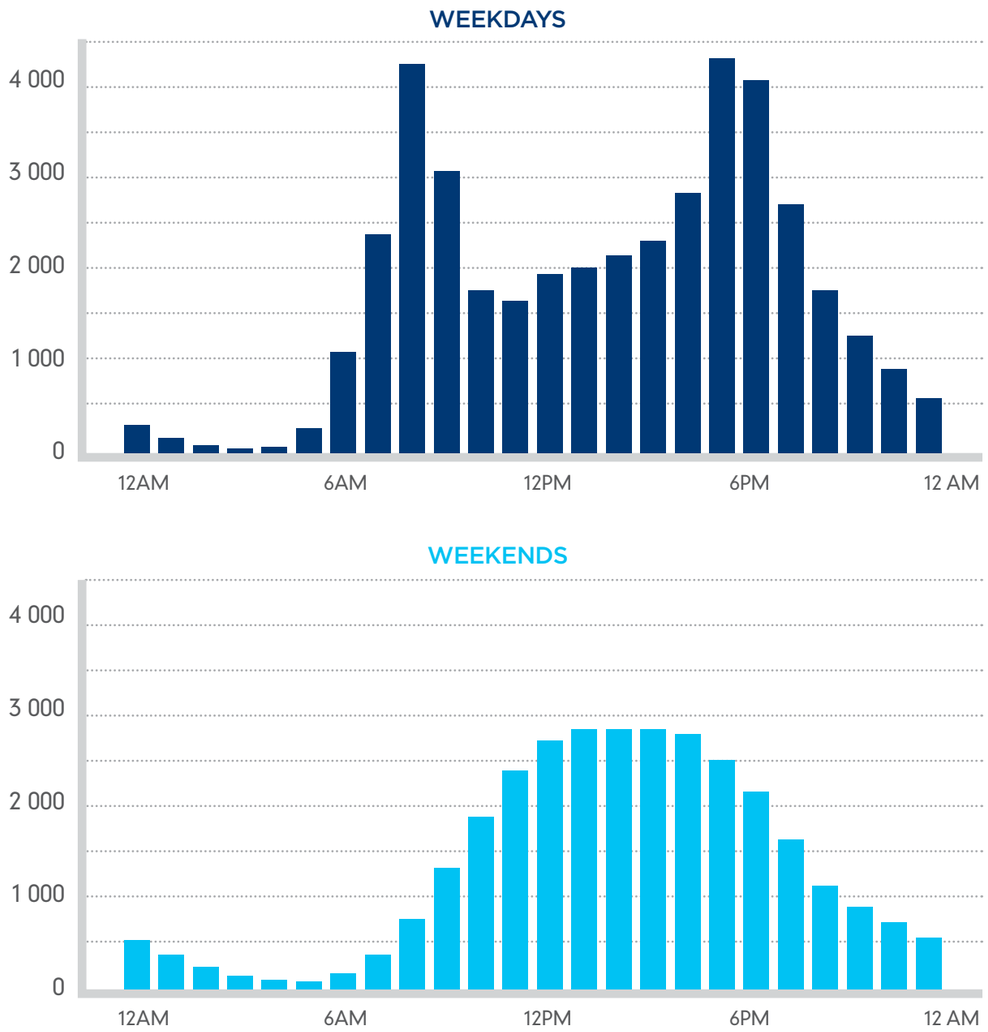
People will feel less burdened to cycle by the upfront costs of researching a bike to purchase, combing through and comparing the limitless amounts of models, associated gadgets, clothing, professional advice and insurance. They can simply just get on and go for small dollars at a time. Governments and companies such as oBike and Melbourne Bike Share have opened up capacity to the masses in ways that were not possible previously and both government and business should look to work together.[69]

There can be adverse consequences to bike-sharing if done poorly, which can lead to an oversupply of bikes clogging up streets in dense piles creating hazards. Poor quality control of bikes can increase running costs and weaken participation rates over safety concerns.[70]

Policymakers can avoid these issues if they prioritise users when rolling out docking stations. If docking stations are not part of the bike-sharing system, policymakers should harness Big Data to incentivise the user to leave the bike in a high frequency area for a reduced fare, or something similar.[71]

For bike-sharing to have an impact on peak congestion, greater attention needs to be given to making the service better suited to the requirements of commuters. While it might seem logical that many commuters are likely to own their bikes, it's also plausible that some would-be cyclists would value access to a low-cost service that reduces their worry of their bike being stolen during the day or even having to maintain the bike themselves. Melbourne Bike Share's $60 annual plan with unlimited 45-minute rides meets those requirements, however, unless you live close enough to one of its bike-racks it is simply unlikely to be convenient enough.

FIGURE 9 NEW YORK CITY BIKE TRIPS BY HOUR OF DAY[72]



There is a strong likelihood that Melbourne's bike share patterns would follow those of other cities and bikes could go relatively unused after hours, in this case, it raises the question of why a pricing model can't be developed that allows commuters to keep a bike at their home overnight, provided it's available for usage by others during the day and over the weekend. As more commuters sign-up for this option, this should in turn guide the roll-out for future bike racks, allowing the capital cost of constructing new racks to be avoided until there is a user-base to justify it.

FIGURE 10 NUMBER OF CYCLING TRIPS TO WORK IN EACH STATE AND TERRITORY IN 2011[73]

CASE STUDY: BORDEAUX FRANCE

Plagued by 30-years of congestion and poor air quality Bordeaux chose to embark on a massive cycling program in 1997 to alleviate further congestion caused by the installation of 44km of tram track in the City, its centre completely inaccessible to cars that spilt off along adjacent routes for the construction period, stifling urban movement for five years. Until 2010, the City lent 4,000 bikes for free from periods of one week to a year and was so successful that it remains in place now as a more commonplace bike sharing scheme – VCUB with 1,700 bikes and 166 docking stations throughout the City and surrounds. A reduction in car use by 40 per cent, a nine-fold increase in cycling and a 1 per cent and 2 per cent increases in public transport and walking respectively demonstrate how effective bicycle cities can be in alleviating congestion during long periods of infrastructure related congestion.[74]

Road

So far the ideas this report has put forward to tackle road congestion have focused on the better use of data and technology to coordinate improved traffic flows and car-pooling.

Of course, considerable work and thinking being done around how we can use price signals to more effectively allocate space to vehicles, both when they're moving and parked.

IDEA 14:
Dynamic parking restrictions

The demand and need for parking varies considerably throughout the day, particularly in high traffic areas like the CBD. While councils, like the City of Melbourne, do their best to align parking restrictions to meet a variety of needs, their efforts are hampered by the need to keep parking signs simple enough for motorists to understand. Furthermore, restrictions are not necessarily planned well in-advance and therefore are not able to respond to an evolving city. The result is an ongoing mismatch between the availability of parking spaces and demand. Close to 30 per cent of congestion is caused by motorists looking for a park; this includes truck drivers with deliveries that are forced to circle city blocks in search of a loading zone and thus can significantly reduce productivity and increase the costs of pick-ups and deliveries.[76]

A more dynamic approach, that utilises technology and enables users to bid up the price of a parking space can better ensure this scarce space is used more efficiently and reduce the impact on traffic. This could entail a number of booking options, made either individually or collectively, and covering single or multiple parking spaces.[77] Potential applications of this could include:

- Couriers collectively reserving more loading zones for morning drop-offs and afternoon pick-ups and less zones the rest of the time.
- Taxis and ride-share operators could reserve additional space for pick-ups in peak periods.
- Removalists reserving a loading zone when moving someone in and out of an apartment.
- Retailers narrowing the parking windows to support drop-in traffic or restaurants reserving spots for delivery pick-ups in the evening.

Coupled with *Idea 3: Creating an open digital platform for parking*; this could help unlock existing private inventory or even stimulate better design of buildings and loading docks.

FIGURE 11 MELBOURNE CBD PARKING SIGNS[75]

IDEA 15:
Trialing road user charges

Road-pricing is widely-recognised as an effective mechanism to reduce congestion and is likely to play an increasing role in most major cities around the world. But without the right data to inform its design, road-pricing risks being too blunt an instrument that penalises people that have limited alternatives.[78] Hence our emphasis on improving the availability and quality of data, as well as the capability to process it. Utilising data to improve our network can be a precursor to introducing a more holistic pricing regime that is capable of being finely tuned.[79] However, in the interim there are likely to be narrow or isolated applications where it could be appropriate to be more innovative with road user charges.

One such example could be in association with the allocation of priority lanes for buses (see *Idea 5: Experimenting towards more reliable and convenient buses*), where the aim is to ensure buses get an uninterrupted movement; not necessarily keeping it fully clear of other vehicles (and therefore underutilized when there isn't a bus). An option to improve the economic viability of a priority bus service is to allow other vehicles to travel in it provided they are either high occupancy, including car-pooled vehicles, or willing to pay a toll that is set according to real-time traffic flow (similar to the Express Ways operated by Transurban in Virginia, U.S. which adjust pricing dynamically in order to maintain a minimum flow of traffic).[80]

PART 4: INVESTING IN A MODERN, RIGHT-SIZED FLEET

> Beyond reorganising how we can utilise what is already available, there are further opportunities to increase capacity or improve service by upgrading or innovating with the vehicles that are currently used on the networks.

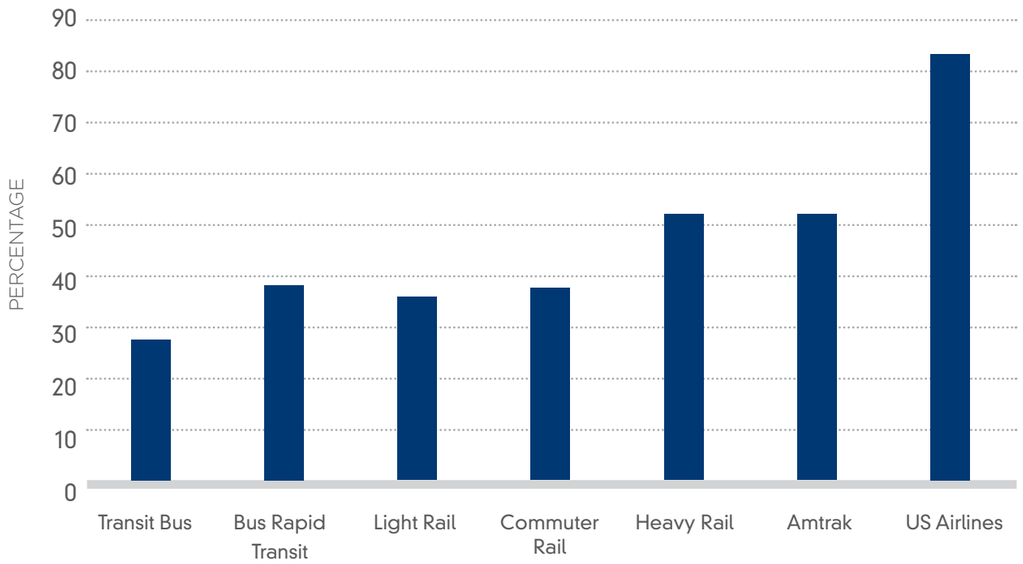
This is perhaps most evident with the changes to Melbourne's trams over the years; with the introduction of articulated and double-articulated trams that can fit more passengers, and the removal of steps to improve accessibility for people with wheelchairs and prams, as well as elderly Australians.

This section looks at opportunities that either might be made possible because of innovations that are on the horizon, or seeks to draw from what has worked in other areas successfully, including aviation.

IDEA 16:
Develop a strategy for 'right-sizing' our public transport vehicles

While larger vehicles can help increase capacity during peak periods, there are circumstances where 'bigger is not always better'.[81] For instance, during off-peak periods, large vehicles with few passengers can significantly increase the average cost per passenger. Additionally, heavier vehicles take longer to start and stop, lengthening travel times and increasing safety risks together with the fact that heavier vehicles often exponentially add to wear and tear of our roads.[82]

FIGURE 12 AVERAGE LOAD FACTORS ACROSS TRANSPORT MODES[83,84,85,86]



In looking to the aviation sector, its significantly higher operating cost has always faced pressure to achieve higher load factors and this has increased moreover since deregulation introduced greater competitive forces. One of the most successful strategies to improve load factors on flights has been the shift towards narrow-body aircraft for short-haul routes, as this allows sectors to be added or removed in line with passenger demand. It also gives the operator greater flexibility to shift capacity to other parts of its network. This approach has been a major component of the current transformation program that Qantas is undergoing, where its 'right-sizing' initiative has reduced costs and improved load factors by allocating the right aircraft to the right route.[87]

As part of its future planning, it is recommended, that Transport for Victoria should include a *'right-sizing'* strategy for the fleets operating across its network. While the logic and concept applies to all modes, the application to buses is perhaps where the greatest opportunity and benefit can be derived in the short-term. This will be particularly significant if it is implemented concurrently with *Idea 5: Experimenting towards more reliable and convenient buses*.

For instance, if there was a need to experiment with a more frequent service along a particular route, the cost of running a trial with smaller buses would be significantly less than trialing with larger buses. For example, if an experiment was run on a bus that travels every 10 minutes up and down Springvale Road between Edithvale and Nunawading, it would cost 27 per cent less to use smaller buses.[88] This does not include the increased wear and tear on the roads caused by heavy vehicles. Of course, if passenger volumes grow there will come a point where it will make sense to upgrade to a larger bus, in which case the smaller buses can be redeployed to another experiment, a lower demand route or on-demand services.

From a job creation point of view, one of the additional benefits of using smaller vehicles to introduce network expansions is that it will also lead to more jobs being created for every dollar spent, since wages make-up a higher share of the costs. Up to 1.4 times more jobs would be created from every dollar spent operating small buses instead of large ones.[89]

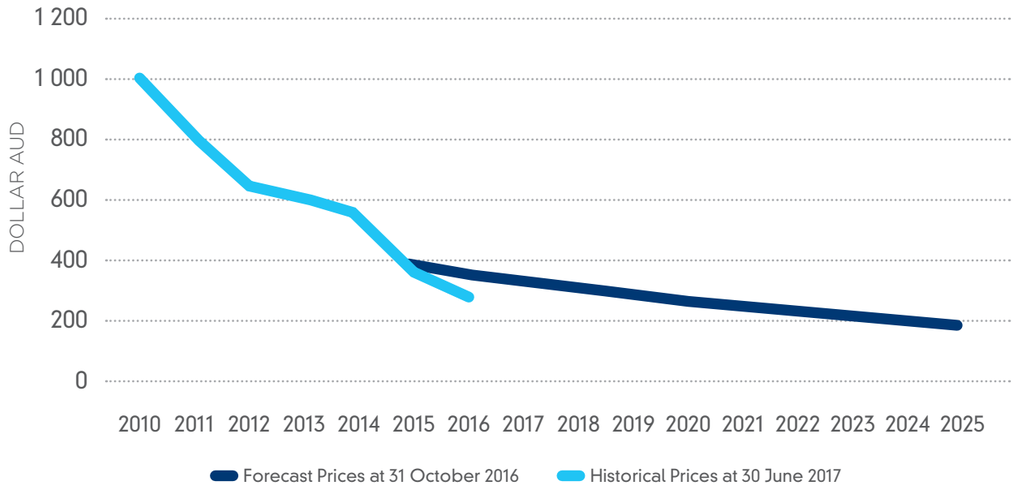
CASE STUDY:
HONG KONG'S PUBLIC LIGHT BUS

These mini-buses are designed to go to more infrequent and hard to reach areas that a larger vehicle cannot do economically or spatially. The buses are only able to hold 16 passengers, allowing public light buses to have higher-frequency and more efficiency, responding quickly to market demand and a more direct route for the last mile of travel.[90]

IDEA 17:
Transition plan for electrification

Advances in battery technology continue to beat forecasts significantly, with prices lowering more than 50 per cent in the last four years. The significance of this price signal has been demonstrated with traditional motor company Volvo, announcing in recent weeks that from 2019 all vehicles it produces will be either fully electric or hybrid. The momentum behind electric vehicles appears to be increasingly unstoppable.[91]

FIGURE 13 BATTERY PRICES FALLING FASTER THAN EXPECTED (USD/KWH)[92]



One of the advantages anticipated, of a shift away from private motor vehicles towards shared vehicles, including ride-share, is the faster adoption of newer technologies, including battery-powered vehicles.[93] For the public transport network there is value in developing a transition plan for the move to electrification, given the many benefits that electric vehicles offer. Their lower operating and maintenance costs (that offset the higher upfront capital cost)[94] and increased space which can increase capacity and/or comfort are among these benefits. Additionally, electric vehicles have quieter engines leading to increased passenger comfort and reduced noise pollution for the local environment. There is also a considerable reduction in local air pollution hence the ability to leverage renewable resources and the improved acceleration compared to combustion engines, allows for faster travel times.

Given trams and metropolitan trains are already electrified, buses are once again the obvious place to start especially since existing battery technology is already well proven here. But there is also the potential for regional trains to adopt this, ahead of plans for track electrification that includes either hybrid diesel/battery locomotives or fully electric locomotives with batteries for providing power on non-electrified parts of the track.[95]

IDEA 18:
Open design competition for buses

The challenges facing buses in Melbourne are such that it is highly unlikely that the attitudes towards them would change if there is anything short of a full make-over.

Hence, this report suggests that in addition to the experimentation proposed and the opportunities presented by both smaller and electrified buses, the State Government must conduct an open competition with a series of proposals to improve the design of buses. The proposals should seek to address better accessibility, comfort, right-sizing, electrification, waiting times and finally road side infrastructure (e.g. bus stops and integration with train stations).

Increased engagement from the community and policy actors is crucial in harboring policy longevity.[96] The competition process should build on the Government's experience in stimulating innovation via its Public Private Partnerships in construction and more recently the rolling stock train program where 65 trains have been ordered with a minimum local content build of 60 per cent and a requirement that 15 per cent of all employees must be apprentices, cadets or workers from disadvantaged backgrounds out of the total 1,100 jobs that will be generated from this project.[97]

Given Victoria's existing capabilities in the manufacture of buses, the process should ideally seek to strengthen the local ecosystem and supply-chain, including battery technology, and be aware about future export opportunities.

IDEA 19:
Collaborative braking on trains

One of the most promising concepts in Connected Cars and Intelligent Transport Systems is that of *collaborative braking*. This is when vehicles communicate with one another wirelessly, either directly or via road-side infrastructure, to coordinate braking with sensitivity and timing that is impossible to do through human drivers (e.g. due to slower reaction times or impeded vision from vehicles ahead or turns in the road). The anticipated opportunity created by collaborative braking is that it would allow vehicles to travel closer together, in what is known as platooning, without compromising safety and therefore increase capacity on our roads.

While there have been many simulations and controlled pilots, with potential increases in road capacity estimated at up to 80 per cent (from 2,200 vehicles per hour to 4,000)[98] and huge improvements in communications technology, there is still considerable advancements to be made before seeing this on roads.

Ironically, proponents often use trains themselves as a metaphor for platooning given how close carriages are to one another, as well as how coupled cars communicate to one another to determine how hard each engine works and the force applied to individual brakes based on the train's load and track conditions.

However, a major difference, is that unlike connected cars on a road, coupled trains cannot join or separate a platoon whilst in motion. This impedes their ability to travel closely on tracks that are capacity constrained but they are able to move apart when space allows it.

Another noteworthy difference is the 'open' nature of our roads which makes it significantly harder to trial and deploy collaborative braking, since connected cars would need to accommodate and work with other vehicles that can't 'collaborate'. In contrast, the train system

is a closed network which makes it possible to control which vehicles are on the track and in turn makes it more feasible to deploy such technologies sooner.

The potential applications in being able to use wireless technology to platoon multiple trainsets, includes reducing the number of stops that individual services need to make outside the city loop, enabling a faster service. This can be achieved by moving short trains in platoons through the city, but then separating them out and alternating which stations the separated trains stop at.

It must be noted that the recent shutdown of Metro Train services due to a fault in the computer control system[99] is a reminder of the increased vulnerability of the transportation systems to technology failure. While some advocates for automation focus on the opportunity to reduce labour costs, this report cautions against the complete replacement of labour and points to these technology risks as a demonstration of the value in pursuing automation as a complement to labour that helps to increase workforce productivity.

PART 5:
INFLUENCING THE DRIVERS OF DEMAND

A key driver of peak traffic congestion in any city, is the regular working hours that much of the population embrace. The traditional 9-5 work pattern has proliferated to most industries, and is particularly the case with most state institutions. This structure results in school, childcare, and other vital services catering to this work pattern. Increasingly, however, many Melbournians work irregular hours outside of the traditional daily pattern. This section explores the impact that government policy could have on congestion in Melbourne, if it aims to shift peak demand.

IDEA 20:
Promoting flexible workplace practices

According to academic research and Infrastructure Victoria's 30-year strategy, technology and digitisation can significantly help workers and the economy ameliorate the necessary disruption of Melbourne's infrastructure programs that will take decades to come online in accordance with modern sustainability goals.[100,101] With the supply issues of Melbourne's transport network being addressed, demand side policy responses to congestion and population growth should also be examined to increase existing network utility and longevity. Some of the issues that must be considered are flexi-work and reforming operating hours in public and private sectors. It is suggested that peak hour commuting would be less severe if there is a decrease in the requirement of employees and employers to transport en masse within an exceedingly narrow and antiquated timeframe in a globalised world.[102]

Flexible work can relieve significant commuter stress; research illustrates that workers value the time of day they travel 2.4 times higher than the actual travel time on a given journey.[103] Engaging in flexi-work reform and optimizing worker conditions at the core has shown to deliver a strong relationship between employers and employees along with increased profitability and productivity. This effect decreases when businesses simply focus on cutting costs and neglecting employee input and wishes.[104]

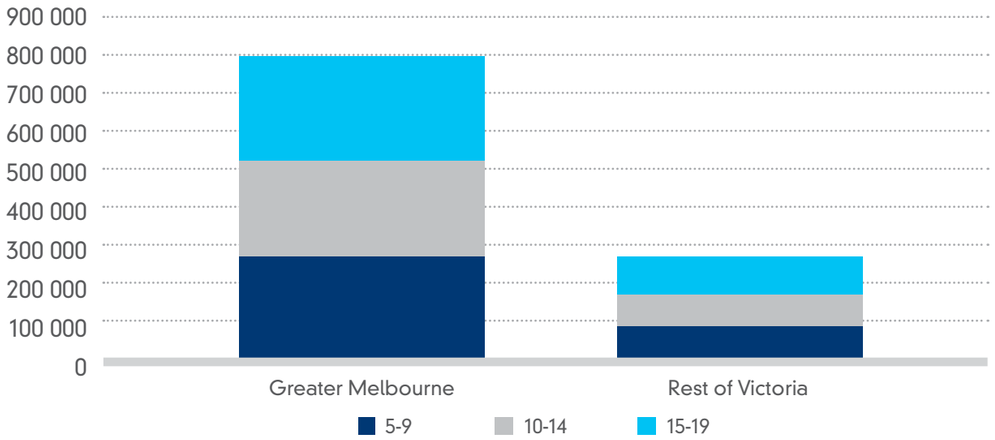
The Government will benefit from adapting their workplaces to meet the needs of a 21st century workforce by considering employee wellbeing as a central component. If workers do not understand the nature of their new roles or operating times clearly, then productivity can face significant roadblocks. Techniques such

as performance appraisal have been shown to be effective in getting workers to focus on outcomes, rather than simply working longer hours, often at no cost, which is a risk with flexi-work that must be avoided.[105] Californian research has demonstrated that 3.30 per cent of workers were less likely to depart before peak hours, 4.11 per cent less likely during peak hours, and 7.41 per cent more likely afterwards if they were given the option to do so, and that similar programs encouraging flexi-work should be examined.[106] In addition, shifting operating hours between 30-60 minutes in either direction of the traditional 9-5pm working week could potentially relieve the need for surge capacity on the transport network significantly, without removing the ability for CBD workers to agglomerate and share their knowledge.

The Victorian Public Sector Commission and the government should be commended on their proactive approach to flexible work arrangements, instilling rights in all public workers to flexi-work by default, with management required to refuse such an option, rather than approving a flexi-work request, as was prior practice. This new system is contextualised into the operational role of the worker and has found much higher levels of engagement and trust between workers and management.[107] Importantly, flexi-work reduces peak hour surge and increases worker empowerment, productivity and job satisfaction. The reluctance bosses have in embracing flexi-work arrangements over fears that they cede too much control to workers is misplaced and the benefits of flexi-work should be communicated to them more succinctly to encourage take up rates.[108]

IDEA 21:
Staggering school and university hours

FIGURE 14 SCHOOL-AGED POPULATION[109]

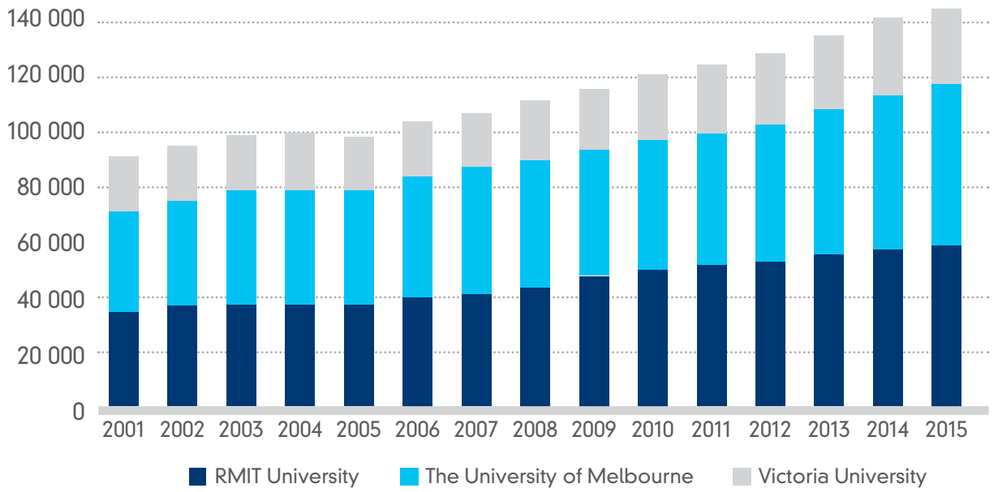


Victoria has close to one million primary and secondary students and teachers, almost a quarter of the state's entire population, who are also bedded down by clustered, blunt and archaic travel routines that are also seen in the workplace. Already more varied in their operational hours, opportunities exist in the education sector to pursue their variability further, while also benefiting school learning outcomes and teacher wellbeing significantly.

While many students already arrive at school between 30-60 minutes prior to 9am, particularly secondary students, the cohort-flow through the network is still extremely large during the peak morning surge. While they do avoid nightly peak, there is an ability to thread the needle to move starting times forward, past the 9am peak by 30-60 minutes, finishing eight hours later.

A change in student timetables apart from benefitting the transport network significantly, emphasises the need for student programs that should be more appropriately designed around their evolving circadian rhythm, which drastically changes in their formative years, often requiring longer periods of sleep in a pattern that encourages later evenings and mornings. The American Medical Association and American Academy of Pediatrics reports that 32 per cent of U.S adolescents are failing to reach the standard 8 hours of sleep per night, though they should be receiving 8.5-9.5 hours of sleep per night to achieve optimal health and learning outcomes.[110] A study of 8 U.S high schools found that the schools with the latest start times had the best results in grades, behaviour, incidences of depression and the rates of falling asleep in class. Further, road safety and car crashes surrounding schools fell by 13% during the study.[111] Removed from a cycle of sleep deprivation and associated behavioural problems, teachers and parents stand to benefit greatly from changing school hours, provided they have the support they need with regards to before and after school services. This may call for a local approach where local communities, principals and teachers are empowered to change school times to suit their own specifications. To reflect this potential industrial change, the changing nature of operating hours should be included in future EBA negotiations.

FIGURE 15 UNIVERSITY STUDENTS AT INNER CITY CAMPUSES[112]



Universities also have a significant role to play, with a 4.4 per cent increase in student numbers taking Victoria's higher education totaling close to 380,000 university students, not including VET. RMIT, The University of Melbourne and Victoria University account for 150,000 domestic and international students, their campuses located within proximity to areas of population boom and the CBD. Shifting the commute for one third of these students, would be the equivalent of removing a full crowd at the Docklands stadium and from the CBD during peak hours

IDEA 22:
Growing regional Victoria

Diverting more population growth towards regional Victoria is another option to help alleviate the pressure on Melbourne's infrastructure.

This is a strategy that has been attempted with mixed success in the past; however, this does not mean that is must not be pursued again but that there is a need to become more open and transparent in understanding what works and why it works. It must be noted that growing regional Victoria should not be relied upon as a panacea to Melbourne's congestion woes.

Fundamental to any attempt to grow the regions must be a coherent economic strategy that demonstrates the prospects of employment for people contemplating where to live.

Beyond simply building on the existing economic strengths of individual regions, we see three major levers that could be used to encourage migration to regional communities:

1. Direct investment (e.g. local infrastructure projects) sustained over a long enough period to attract private sector investment and draw initial migrants.
2. Enhanced connectivity (e.g. via improved rail connections) to connect regional communities to jobs in Melbourne and regional employers to Melbourne's deeper labour market.
3. Develop sector migration strategies in industries where regional workforces or regional living can have a comparative advantage (e.g. public sector, call centres, university towns).

The *Regional Rail Revival* package is a great example of the first two in action with the $1.6 billion worth of upgrades creating more than 1,000 jobs in the process.[113] It builds on the earlier $550 million *Regional Fast Rail Project* which included a $300 million redevelopment of Spencer Street (Southern Cross) station, Fast Rail links and 29 additional two-car diesel trains that helped boost regional VLine passenger numbers by more than 15 per cent from 2006-09.[114,115,116]

The Rail Futures Institute takes this approach to the next level with its *InterCity* proposal to explicitly use increased investment in "faster, more frequent and more reliable rail services" as a mechanism for redirecting population growth to regional centres.[117]

Of course, funding and planning for the new high speed rail services is not without its challenges, hence the emphasis we have placed in our interim solution for Melbourne Airport that would allow the opportunity for any airport rail link to be properly considered as part of Victoria's broader, integrated rail network.

Further, given the localised benefits to regional communities of any major investment, we think a public conversation about how best to include value-capture in the financing will not only help to ensure a fair outcome across the state but might be what's needed to bring this sort of project to life.

CONCLUSION

The wide-ranging recommendations and ideas in this report highlight the complexity of modern-day transportation systems in cities like Melbourne and the many moving parts that need to work smoothly together in order to get everyone to their destination safely and on time.

It also demonstrates that while we are right to call for improved planning and a clearer longer-term plan to build the infrastructure we will need into the future, that we need to continually look at our own behaviour and what we can do both individually and collectively to improve the efficiency and fairness of our transport in this city.

As a city, it is time for Melbourne to gain a much stronger appreciation of the impacts that poor coordination has on congestion as it will lead us towards solutions that can not only maintain or improve our quality of life, but without the tax bill that comes with defaulting to building a new freeway.

This is where data will play an ever-increasing role in helping us to precisely identify the capacity constraints across the city and perhaps more importantly, the underlying behaviour driving increased traffic or congestion. Improving our capability to work with data will allow us to respond more quickly to emerging problems and tackle the real problems not the one those that most visible.

Which brings us back to population growth, the issue that has driven this topic to the forefront of the public debate. it is important to appreciate just how big an impact poor coordination has on traffic, and how easily it can outstrip the impacts of population growth as a driver of congestion. Harnessing the creative ideas put forward in this report, Melbourne will be in a much better position to harness its population growth, keep the city moving, and ensure it remains the dynamic and liveable city that we all want it to be.

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