INFRASTRUCTURE VICTORIA
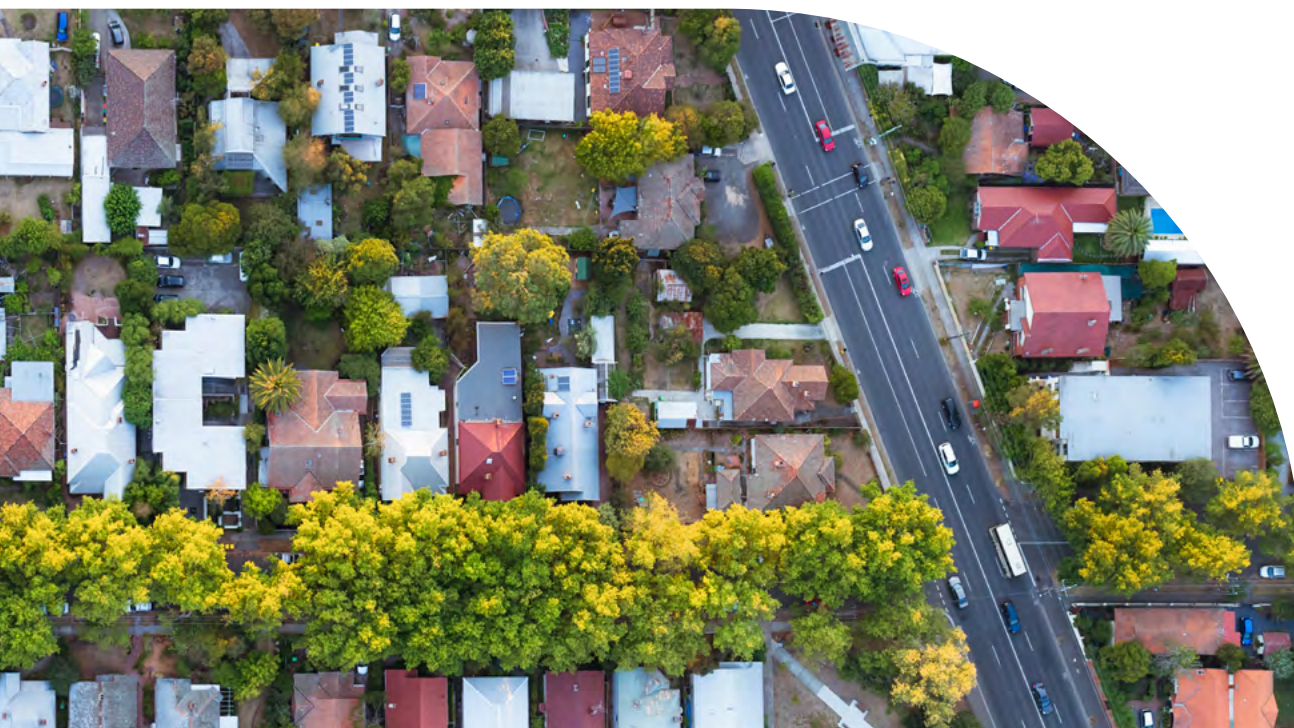
The post-pandemic commute

The effects of more working from home in Victoria

November 2021

Acknowledgements

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Executive summary

The COVID-19 pandemic wrought sudden and pervasive changes throughout Victoria. Many Victorians rapidly adapted to movement restrictions by using remote working technologies to work from home. Some employers and workers discovered these newfound capabilities had many advantages. This report considers the consequences for where Victorians may live, and how they might travel, if working from home behaviours persist well beyond the pandemic recovery period.

Infrastructure Victoria has previously examined the short-term effects of relaxing movement restrictions as Victoria lifted lockdowns. That report, *Transporting Melbourne's Recovery*, found Victoria's roads could become heavily congested as people avoided public transport due to fears of infection.[1] Experience bore out these projections when Melbourne relaxed its 'second wave' lockdowns in the summer of 2020-21.

But further speculation is rife about the COVID-19 pandemic's longer-term effects on Victoria's cities and regions, especially if people work from home more often. Will it prompt a regional revival? Will public transport passenger numbers plummet? Will road congestion disappear? And will Melbourne's central city become a lifeless shell compared to its former glory as the thriving, vibrant heart of the city?

To help answer these questions, we used innovative modelling techniques to generate more rigorous evidence of the possible future impacts of working from home. While the future is inherently uncertain, modelling can help us understand how things might eventuate if particular assumptions hold. The effects of the COVID-19 pandemic and work location preferences of employers and employees are still evolving in the short-term. Our research explores working from home in an analytical framework, to inform decisions today which will have medium to long-term implications.

We developed working from home scenarios and tested them using an integrated land use and transport model: the Victorian Land Use and Transport Integration (VLUTI) model. The model simulates the potential changes to people's living and working locations, and their travel patterns. Our scenarios modelled the effects of a hybrid approach of working from home, with people working some days of the week in the office and some days at home, if they work in jobs where that is possible. We considered the situation 10 to 20 years from now, long after restrictions have lifted and the economy has recovered.

Our scenarios pinpoint the sole effects of working from home, and do not vary other aspects, like changes in Victoria's population growth or immigration rates as a result of COVID-19, so we can make like-for-like comparisons. We expect the broad spatial trends of our modelling of greater working from home to be instructive, even if the overall population size of Victoria differs from that used in our modelling.

People might move a little farther from work

Compared with the case where people resumed their pre-COVID commuting patterns (the 'base case'), our model projects a future with more working from home could mean people disperse a little farther from employment locations. When people can work from home some days each week, our model projects they are willing to tolerate longer commutes on their days in the office. This means outer suburbs, new growth areas, and the peri-urban rural areas of Melbourne could experience faster population growth than they otherwise would.

Larger regional cities like Ballarat and Geelong could experience a similar population dispersion. As our modelled scenarios still require workers to travel to work some days of the week, access to major job precincts remains a factor in people's housing choices. This means these dispersion effects occur in the immediate vicinity of Melbourne and big regional cities, but do not extend to other regional areas farther away.

These population dispersal effects mirror the impacts of other future trends. For example, our previous work found that more widespread use of electric vehicles and autonomous vehicles can also produce slower population growth in inner and middle areas of Melbourne.[2] This means the cumulative impact of working from home and more widespread electric and autonomous vehicle use could produce a more substantial population dispersion than working from home by itself.

[1] Infrastructure Victoria, Transporting Melbourne's Recovery, 2021, Victorian Government, https://www.infrastructurevictoria.com.au/wp-content/uploads/2021/01/Transporting-Melbournes-Recovery-January-2021-FINAL.pdf

[2] Infrastructure Victoria, Major Transport Program Strategic Assessment report, 2021, Victorian Government, https://www.infrastructurevictoria.com.au/wp-content/uploads/2021/08/Major-Transport-Program-Strategic-Assessment-Report.pdf

Jobs may further concentrate in inner Melbourne

In contrast, the effects on job location are the inverse. Our model projects that more working from home tends to somewhat accelerate jobs growth in inner Melbourne, while other areas see marginally slower jobs growth, compared with pre-COVID commuting patterns. With a more dispersed population, certain businesses are locating where they can access the largest workforce catchment, while also accessing agglomeration benefits by being physically close to each other. Inner Melbourne is central and has strong legacy transport infrastructure connections to the broader metropolitan area. Accordingly, our model projects inner Melbourne attracts even more employment than the already large increases projected under pre-COVID commuting patterns.

Even with more people working from home, our 'medium' scenario finds 36% more people travel to the central city each morning in 2036 than in 2018. This is because base case employment growth is already large, and it gets a further boost in our working from home scenarios. By 2036, these growth factors more than offset the reduction in travel produced by some people working from home.

Central Melbourne may continue to experience difficulties recovering during the first few years after the pandemic. But our modelling provides hope that more working from home can actually help boost inner Melbourne's job numbers in the longer-term, helping maintain its primacy as Melbourne's most important employment precinct.

Working from home does not solve road congestion

Transport congestion and crowding rises more slowly in parts of Victoria if people work from home more often than if they resumed their pre-pandemic commuting behaviour. However, the effect is not uniform.

With more working from home, private vehicle use across metropolitan Melbourne does not rise as quickly. But with more people living in outer Melbourne and new growth areas, some drive further when they do commute to the office. This results in longer car trips on average, compared to our base case.

Morning peak congestion in inner and middle Melbourne is slightly lower than it might otherwise be. But morning peak congestion gets worse farther out on most major freeways leading towards inner Melbourne. Overall, the total time drivers spend on congested roads does not substantially change with more working from home. More working from home will not solve road congestion.

Our working from home scenarios also show varying effects on the public transport network. With somewhat faster jobs growth in inner Melbourne, and faster population growth in outer areas, more people make the morning commute into the inner areas of Melbourne, especially by train. At the same time, public transport trips beginning in inner Melbourne rise more slowly, matching slower population growth in these areas in our working from home scenarios. This means overall demand for public transport remains strong in the medium term, even with a shift to working from home.

Responding to more working from home

Our modelling results suggest a lasting shift to working from home could somewhat affect the locational choices of people and businesses, and the performance of Victoria's transport network. These impacts may affect the future decisions of the Victorian Government.

For instance, working from home may reinforce already strong population growth in the outer suburbs, new growth areas, and peri-urban rural areas around Melbourne. This could make achieving the Victorian Government target of most new homes to be in established areas[3] more difficult and may require re-doubling efforts to encourage these developments. It also intensifies the pressure for timely delivery of infrastructure in new growth areas, including for social and environmental infrastructure. Sustainable management of reinforced population pressure in the peri-urban areas around Melbourne may require a more proactive planning response.

Similarly, if more people work from home, people may consume more energy at home, potentially magnifying the benefits of better energy efficiency in new housing. The possible reinforcement of inner Melbourne jobs growth may require Victorian Government action so alternative job precincts are viable.

Potential shifts in demand on Victoria's transport network adds urgency to better manage transport demand, such as with better transport pricing signals and road management technologies, to help respond to shifting transport patterns, rather than relying solely on building new infrastructure.

Potential outward population expansion also reinforces the need for better transport options in Melbourne's outer suburbs and new growth areas. For instance, investing in electrified metropolitan train extensions is likely to continue to provide strong dividends, even if people work from home more often.

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[3] Department of Environment, Land, Water and Planning (DELWP), Plan Melbourne 2017-2050, 2017, Victorian Government, https://www.planmelbourne.vic.gov.au/__data/assets/pdf_file/0007/377206/Plan_Melbourne_2017-2050_Strategy_.pdf

Summary of recommendations

The impacts of working from home have policy implications

Our modelling suggests a lasting shift to working from home could change the structure of Victoria's urban and regional areas and people's travel patterns. Throughout this report we have made policy recommendations for the Victorian Government to consider, in light of our modelling. A summary of these recommendations is provided below.

Responding to changes in population growth trajectories

Given our modelled scenarios show pressure for a more dispersed population, to help meet *Plan Melbourne's* goal to build the majority of new homes in established areas we recommend the Victorian Government:

- Support more homes in priority established places. Identify new priority locations in established suburbs for residential intensification to better use existing infrastructure. Following this, in partnership with local government, review planning settings to allow increased housing density and establish design review advisory panels.

- Use value-capture mechanisms to deliver very low-income housing. Change and actively apply planning regulations to provide affordable rental housing for Victorians on very low incomes in places with good access to public transport and services, when they are re-zoned for more intensive residential use.

For Melbourne's outer and new growth areas to have connected open space and tree canopy cover, we recommend the Victorian Government:

- Target 30% tree canopy coverage in new growth areas. Achieve 30% tree canopy coverage in new growth areas by mandating coverage during precinct development, funding relevant Victorian Government agencies and local government to plant, replace and maintain canopy trees, and work with utility providers to remove barriers to tree planting.

- Develop an interconnected open space network. Help create an interconnected open space network and extend the urban tree canopy, by providing direct funding, and reviewing and reforming the developer open space contribution scheme.

Given the existing expected shortfall of social infrastructure in new growth areas and the possible additional population in growth areas shown in our modelling, we recommend the Victorian Government:

- Fund libraries and aquatic centres in growth areas. Increase funding to support local governments to plan and deliver libraries and aquatic recreation centres in Melbourne's seven growth area municipalities.

- Build new hospital capacity. Reserve land for future hospital sites and build new public hospital capacity to meet Victoria's future needs, especially increases in demand from Melbourne's rapidly growing outer northern and western suburbs.

For infrastructure to keep up with additional population pressure in growth areas, we recommend the Victorian Government:

- Develop and publish long-term statewide infrastructure plans for priority infrastructure sectors for which the Victorian Government maintains substantial responsibilities, including sequencing and timelines for investment. Develop and publish Victoria's integrated transport plan and require the transport and strategic land use plans to align with each other.

- Complete a review of Victoria's many infrastructure contributions schemes to create a consistent and efficient system that contributes to Victorian and local government infrastructure costs.

- Prioritise and oversee infrastructure delivery in growing communities. Empower a government body to monitor infrastructure delivery in Victoria's new growth areas and priority urban renewal precincts, and proactively advise on delivery sequencing and funding. Develop program business cases for growth areas and precincts that consider timing, sequencing and funding of infrastructure.

We recommend the Victorian Government partner with local governments to assess the capacity of peri-urban towns to accommodate accelerated population growth. This should include evaluating existing infrastructure networks' capacity to support growth. The assessment could be through updated regional growth plans and local housing strategies. In places with completed land capacity assessments, the Victorian Government should also support local governments to establish growth boundaries to prevent dispersed settlement.

We recommend that the Victorian Government and local government work to ensure new housing development in peri-urban areas avoids areas of agricultural or natural resource value, natural hazard risk, or environmental sensitivity.

We recommend the Victorian Government act to improve the energy efficiency of homes:

- Require 7-star energy-rated new homes by 2022, and increase afterwards. Require all new homes to achieve a minimum 7.0-star NatHERS rating (or equivalent) by 2022, increasing towards 8.0 stars (or equivalent) by 2025, either through the National Construction Code or Victorian regulations.

- Mandate a home energy disclosure scheme. Develop an energy efficiency disclosure scheme for home sales, to overcome information barriers and encourage energy efficiency improvements to existing homes.

- Strengthen minimum energy efficiency standards for rented homes. Increase minimum energy efficiency standards to reduce energy use and costs in rented homes. Keep updating these standards to reflect new cost effective measures, and improve renters' ability to make home energy efficiency improvements.

Responding to changes in employment patterns

We recommend the Victorian Government identify a limited number of priority suburban centres to concentrate economic activity. These could be places where clustering already occurs and where infrastructure can support growth, such as the national employment and innovation clusters. The Victorian Government should use planning, infrastructure, colocation of services, and public realm improvements to help enable the success of the identified priority suburban centres.

Responding to changes in transport use

Real options is an investment analysis technique that strategically incorporates future uncertainty into infrastructure planning and investment decisions. To help plan for future uncertainty, we recommend the Victorian Government continues to encourage the uptake of real options by further developing its application, promoting its use and building capacity within government to incorporate real options in investment decisions.

To make the most out of existing road capacity to meet changing demand patterns, we recommend the Victorian Government reform road network pricing:

- Incorporate congestion pricing for all new metropolitan freeways. Apply congestion-based peak and off-peak tolling to all new metropolitan freeways to better manage traffic flow and impacts on nearby local roads.

- Once congestion re-emerges in the next five years, trial full-scale congestion pricing in inner Melbourne to reduce congestion on inner city roads.

- Phase out fixed road user charges and introduce user pays charging over the next 10 years. Ensure user pays charging reflects the relative costs of road use, encouraging people to adopt beneficial travel behaviour.

To make the most out of existing rail capacity to meet growing demand we recommend the Victorian Government:

- Permanently adopt discounted off-peak fares for metropolitan public transport.

- Increase off-peak service frequencies and suburban rail corridor capacity.

To expand and improve rail infrastructure to meet growing demand, we recommend the Victorian Government:

- Continue to progress the Western Rail Plan, including electrification of the Wyndham Vale line.

- Develop a business case to extend electrified metropolitan train services from Sunshine to Rockbank, to be delivered by 2031. Consider adding extra stations on the Melton corridor, securing remaining land required for stations and stabling.

- Prepare for Melbourne Metro Two and direct Geelong rail services. Complete a business case for the Melbourne Metro Two Tunnel project, and protect the land required to construct it. Consider using the tunnel to re-route Geelong services direct to Southern Cross, and consider new stations or relocating existing stations.

- Electrify along the existing Seymour line to Beveridge (towards Wallan). Develop a business case to extend electrified metropolitan train services from Craigieburn to Beveridge.

- Develop and progressively deliver a prioritised 15-year network service upgrade program for suburban train corridors, including track and signalling improvements, higher capacity trains, carriage retrofits and an upgraded train control centre.

- Complete a business case to reconfigure the City Loop, including determining its timing.

To increase accessibility to public transport services and limit the increase in park and ride, we recommend the Victorian Government:

- Price parking at major public transport hubs. Once rail and station parking demand has returned to pre-pandemic levels the Victorian Government should charge parking fees at public transport car parks to help encourage people to travel there using public and active transport, and to make parking spaces available for public transport users who need them most.

- Undertake a systematic review of all poor-performing bus networks to identify opportunities to reprioritise services. This could mean route or timetable reform or the introduction of innovative public transport services such as on-demand bus and ride sharing.

- Link outer suburbs to rail with 'next generation' buses. Introduce 'next generation' bus services towards Clyde, Mornington Peninsula, Wollert, and Armstrong Creek. As Victoria recovers from the pandemic, the government should look for other opportunities for these types of services where people are moving to places without existing rail networks.

To improve road network maintenance and adaptability, we recommend the Victorian Government:

- Specify clear levels of service for each type of regional road and bridge. Following this, dedicate a 10-year funding program to sustainably fund Victorian Government regional road and bridge maintenance and upgrades to meet these service levels. Funding should be prioritised based on improving safety, decreasing vehicle emissions, and lifting productivity.

- Introduce new road network demand management technology. Progressively introduce new road network demand management technologies across the state and integrate management systems for different road-based transport modes. Combine them with a road infrastructure upgrade program to optimise the benefits of technologies, such as by providing extra clearways and introducing dedicated lanes for bus routes.

1. Working from home could be here to stay

The COVID-19 pandemic catalysed an immediate and rapid shift to working from home, for those people who could. After the COVID-19 pandemic recedes and restrictions ease, some people may revert to their former working patterns, but many may wish to retain their newfound ways of working.

This chapter explores the data on working from home before the pandemic, the changes the pandemic wrought, and post-pandemic scenarios where some people continuing working from home for part of their work week.

1.1 Working from home better suits certain industries and occupations

In this report, we characterise 'working from home', or teleworking, as employment which can be feasibly done from a worker's place of residence, enabled by digital technologies, in office-based occupations and industries. This excludes, for example, farmers who may be technically working from a property where their residence is also located, but are not teleworking.

Workers' duties better suit working from home in some occupations than others. For instance, an IT professional might easily work from home, as they may only require a desk, chair, computer, and an internet connection, and do not need to work on site. In contrast, a construction worker needs to be physically on site to perform their duties and cannot undertake their work from home.

Occupations suited to working from home include professionals, managers, and administrative workers. These jobs, on average, pay better and require higher skills and qualifications.[4] Businesses relying on these types of workers often cluster together in cities. Melbourne's central city is an example.[5]

Occupations not suited to working from home typically involve physical activities, direct contact with the public, specialised equipment or premises, or hazardous conditions. Examples include trades workers, hospitality workers, carers, and factory workers. We estimate that people can work from home in around a third of Victoria's jobs.[6]

1.2 Working from home was stable before the COVID-19 pandemic

Prior to the COVID-19 pandemic, the proportion of Victorians working from home was relatively stable. Figure 1 shows that over the past two decades, around 25% of Victorian workers did at least some work from home in a typical week.

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[4] *The Productivity Commission, Working from home Research paper, 2021, Commonwealth of Australia, https://www.pc.gov.au/research/completed/working-from-home/working-from-home.pdf*

[5] *SGS Economics and Planning Pty Ltd, Melbourne Functional Economic Region Report, 2019, prepared for Infrastructure Victoria, Victorian*

Government, https://www.infrastructurevictoria.com.au/wp-content/uploads/2019/04/SGS-Melbourne-Functional-Economic-Region-Report-March-2019.pdf

[6] *Infrastructure Victoria adaptation of method in Coates, Brendan, Matt Cowgill, Tony Chen and Will Mackey, Shutdown: estimating the COVID-19 employment shock, 2020, Grattan Institute, method applied to Victorian employment distribution from the 2016 Census.*

Figure 1.   Proportion of workers working from home in Victoria
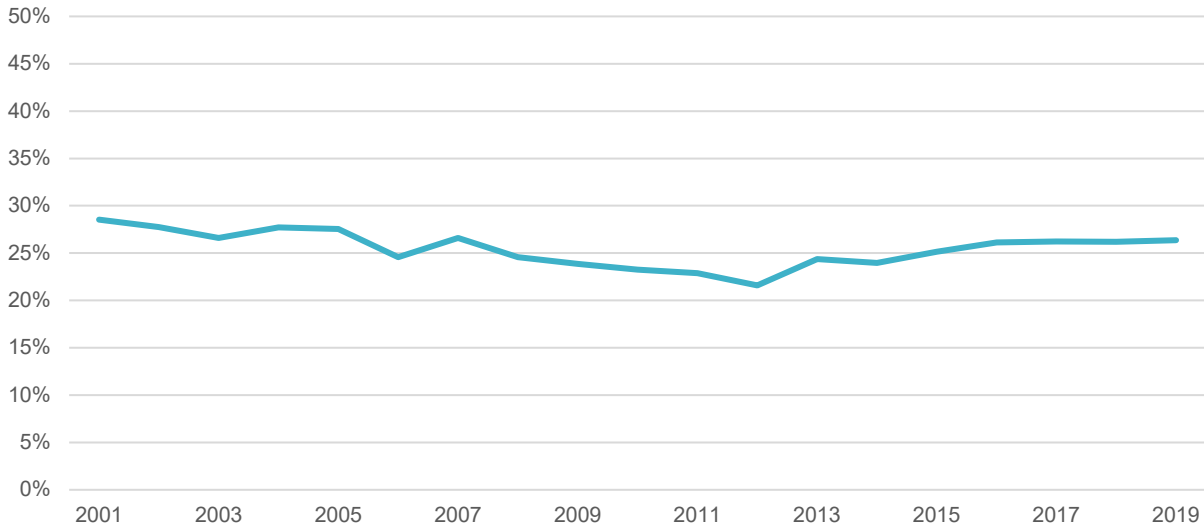
Source: Infrastructure Victoria analysis of Department of Social Services (DSS), Household, Income and Labour Dynamics in Australia (HILDA) Survey, 2021
Note: Working at least one hour from home in a typical work week.

As shown in Figure 2, prior to the COVID-19 pandemic, full-time workers most commonly worked one to five hours a week from home. This suggests that for many people working from home may not have avoided commuting to an office. For example, people may have finished off work at home in the evening, after having worked in the office during the day.

Figure 2.   Distribution of hours worked from home in a typical week for a full-time worker, 2019, Victoria
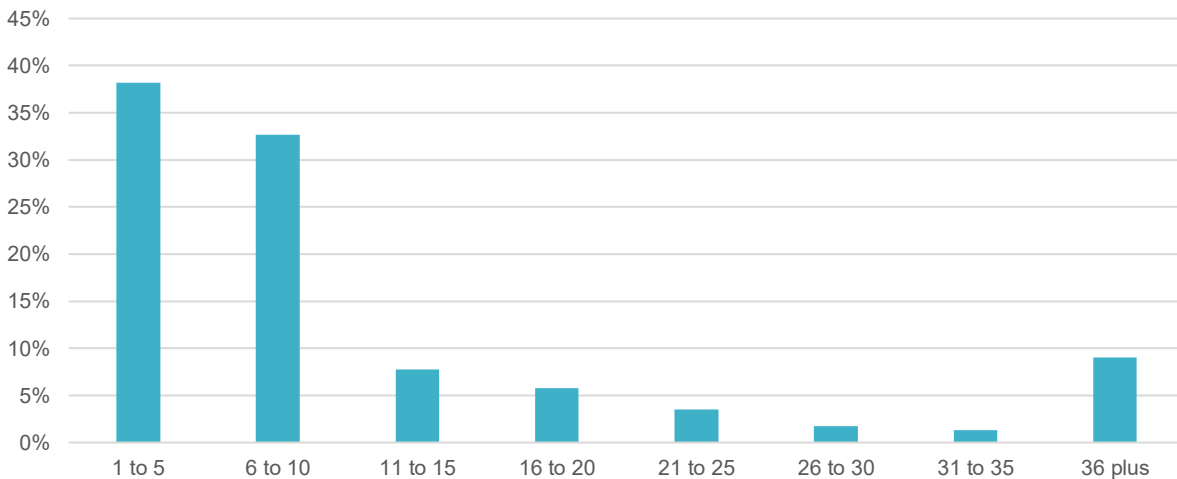
Source: Infrastructure Victoria analysis of Department of Social Services (DSS), Household, Income and Labour Dynamics in Australia (HILDA) Survey, 2021
Note: Limited to occupations that are well suited to working from home as defined in our technical report. Non-zero hours only. Working 38 hours or more a week.

Our analysis of the Household, Income and Labour Dynamics in Australia (HILDA) Survey also suggests that working from home has historically influenced people's housing location decisions. In addition to our land use and transport modelling, we analysed the impact of the ability to work from home on the choice of residential location, prior to the pandemic. We found a small but significant relationship between the ability to work from home and residential location. Our analysis suggests that those who have a formal working from home arrangement with their employer tended to

choose to live in more dispersed locations, farther away from city centres. This broadly supports the results of our land use and transport modelling. More information on this analysis is in the appendix of our accompanying technical report.

1.3   COVID-19 has prompted new ways of working

In March 2020, Victoria introduced stage three restrictions, which required anyone who could work from home, to do so.[7] This, and subsequent restrictions, increased the proportion of employees working from home from around 15% in 2019, to 50% in September 2020.[8]

Many people were forced to adapt to working from home. A survey found Australian families' most common employment change experience in 2020 was working from home.[9] Figure 3 shows that 60% of surveyed families started or increased working from home in 2020.

Figure 3.   Employment changes experienced within families in 2020
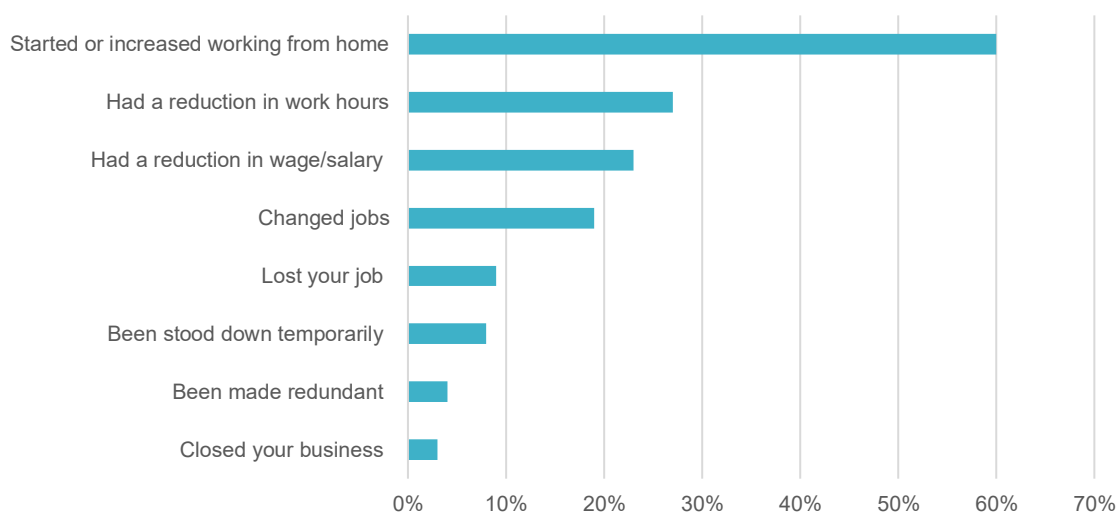
Source: Australian Institute of Family Studies, Families in Australia Survey, Report no. 2 Employment & work–family balance in 2020, 2021

Beyond physically changing their place of work, working from home prompted people to use technology to collaborate and communicate with their colleagues. Technology such as reliable fast internet and tools for online collaboration and communication have been available for years, but working from home rates were stable.[10] Only in a global pandemic with enforced lockdowns did it become widespread.[11]

Globally, the take up of remote work technologies accompanied the rapid adoption of working from home.[12] For example, in December 2019, video conferencing software Zoom had on average 10 million daily meeting participants. This rose to more than 300 million in April 2020, a 30-fold increase.[13] Similarly, users of Microsoft's collaboration software, Teams,

[7] Storen, Rebecca and Nikki Corrigan, COVID-19: a chronology of state and territory government announcements (up until 30 June 2020), 2020 Department of Parliamentary Services, Commonwealth of Australia, https://parlinfo.aph.gov.au/parlInfo/download/library/prspub/7614514/upload_binary/7614514.pdf

[8] Household, Income and Labour Dynamics in Australia Survey and ABS Household Impacts of COVID-19 Survey September 2020

[9] Australian Institute of Family Studies, Families in Australia Survey, Report no. 2 Employment & work–family balance in 2020, 2021, Commonwealth of Australia, https://aifs.gov.au/sites/default/files/publication-documents/2105_2_fias_employment_and_work_family_balance_in_2020.pdf

[10] Davis, Morris A., Andra C. Ghent, and Jesse M. Gregory, The Work-from-Home Technology Boon and its Consequences. No. W28461., 2021, National Bureau of Economic Research, https://www.nber.org/system/files/working_papers/w28461/w28461.pdf

[11] The Productivity Commission, Working from home Research paper, 2021, Commonwealth of Australia, https://www.pc.gov.au/research/completed/working-from-home/working-from-home.pdf

[12] McKinsey & Company, How COVID-19 has pushed companies over the technology tipping point—and transformed business forever, 2020, McKinsey & Company, https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/how-covid-19-has-pushed-companies-over-the-technology-tipping-point-and-transformed-business-forever

[13] Shannon Bond, A Pandemic Winner: How Zoom Beat Tech Giants To Dominate Video Chat, 2020, NPR, https://www.npr.org/2021/03/19/978393310/a-pandemic-winner-how-zoom-beat-tech-giants-to-dominate-video-chat

increased from 20 million in 2019 to 75 million in 2020 and to 145 million by mid-2021.[14] Microsoft reported that two years of digital transformation occurred in the first two months of the pandemic.[15]

1.4   Working from home has benefits and challenges

Some of the direct benefits of working from home for workers and employers include:

- Workers can avoid the time and cost of commuting to an office. Workers typically identify this as the top benefit of working from home.[16]

- Under the right circumstances, working from home can be more productive. This depends on whether people can focus on deep work and be free of distractions. This is influenced by the presence of others at home, people's physical home environment, and their individual preferences.[17]

- Workers report benefiting from greater flexibility in balancing their time.[18] This allows people to combine work and domestic activities and provides more options for the time of day they work.

- Physical distance is a lesser consideration in accepting a job offer. This means both employers and workers have more choices for employment, potentially creating better matches in the labour market. [19]

- Working from home could reduce office lease costs for employers. With fewer staff in the office at any one time, employers may not need to lease as much floorspace. This could result in cost savings, with rent typically one of the top three operating expenses for businesses.[20]

Working from home also has some challenges, including:

- Some workers find working from home reduces their productivity. Again, this can be influenced by a number of factors including the presence of others, the physical home environment, and individual preferences.[21]

- Spending more time at home could mean workers face higher household running costs, such as for electricity, water, and waste.[22]

- Working from home can harm mental health. Removing the physical separation between work and home makes it harder to 'unplug' from work, and this can lead to longer hours and chronic workplace stress or 'burnout'.[23] Australians worked 30 minutes more, on average each day, when working from home became more widespread in 2020.[24]

- Relying on technology also has drawbacks. Communications technology and fast internet has enabled impressive advances in video conferencing, but does not perfectly substitute for interacting in person.[25] 'Zoom

[14]   David Curry, Microsoft Teams Revenue and Usage Statistics, 2021, Business of Apps, https://www.businessofapps.com/data/microsoft-teams-statistics/

[15]   Jared Spataro, 2 years of digital transformation in 2 months, 2020, Microsoft 365, https://www.microsoft.com/en-us/microsoft-365/blog/2020/04/30/2-years-digital-transformation-2-months/

[16]   Beck, Matthew, and David A. Hensher, Insights into working from home in Australia in 2020: Positives, negatives and the potential for future benefits to transport and society, 2021, Institute of Transport and Logistics Studies, The University of Sydney Business School

[17]   The Productivity Commission, Working from home Research paper, 2021, Commonwealth of Australia, https://www.pc.gov.au/research/completed/working-from-home/working-from-home.pdf

[18]   The Productivity Commission, Working from home Research paper, 2021, Commonwealth of Australia, https://www.pc.gov.au/research/completed/working-from-home/working-from-home.pdf

[19]   James, Griffin and Asker, David, The future of office space can create financial opportunities, 2021, Deloitte, https://www2.deloitte.com/us/en/insights/topics/strategy/future-of-office-space-post-covid.html

[20]   James, Griffin and Asker, David, The future of office space can create financial opportunities, 2021, Deloitte, https://www2.deloitte.com/us/en/insights/topics/strategy/future-of-office-space-post-covid.html

[21]   The Productivity Commission, Working from home Research paper, 2021, Commonwealth of Australia, https://www.pc.gov.au/research/completed/working-from-home/working-from-home.pdf

[22]   Kinks, Rebecca, Monitoring and Measuring ESG in an Era of Remote Work, 2021, Cushman & Wakefield, https://www.cushmanwakefield.com/en/australia/insights/monitoring-esg-in-remote-working; Austin, Patrick, Working From Home Is Driving Up Our Energy Costs. Should Employers Foot the Bill?, 2021, TIME, https://time.com/5935050/remote-work-energy-bill/

[23]   Jack Kelly, Wall Street Banks That Demanded Workers To Return To Their Offices May Have To Change Their Plans Due To Delta Variant, 2021, Forbes, https://www.forbes.com/sites/jackkelly/2021/08/04/wall-street-banks-that-demanded-workers-to-return-to-their-offices-mayhave-to-change-their-plans-due-to-delta-variant/?sh=ac27c2c7356c; Australian Unions, Working from home, 2020, ACTU, https://www.actu.org.au/media/1449319/au_workingfromhome_p1.pdf; Krishnamoorthy, Raghu, When Working from Home becomes Living at Work!, 2020, LinkedIn, https://www.linkedin.com/pulse/when-working-from-home-becomes-living-work-raghu-krishnamoorthy/

[24]   Friedman, Arik, Proof our work-life balance is in danger (but there's still hope), 2020, Atlassian, https://www.atlassian.com/blog/teamwork/data-analysis-length-of-workday-covid, figure 2

[25]   Ramachandran, Vignesh, Stanford researchers identify four causes for 'Zoom fatigue' and their simple fixes, 2021, Stanford News, Stanford University Communications, https://news.stanford.edu/2021/02/23/four-causes-zoom-fatigue-solutions/

fatigue' is the term to describe weariness and exhaustion people can feel after prolonged video conferencing. The imperfections of video conferencing mean the brain must work harder to process human interactions.[26]

- Working from home can inhibit building personal relationships and connections with co-workers. A survey of Australian workers found that around 50% of people working from home in 2020 felt disconnected from their co-workers, compared to around 15% of those not working from home.[27]

- Working from home has fewer opportunities for serendipitous connections and knowledge sharing between workers.[28] These interactions can be especially important for early career workers who benefit from being around, and learning from, more experienced staff.[29] Informal interactions enable knowledge spillovers. This helps create agglomeration economies and enhances innovation and economic growth.[30]

Working from home also has broader implications for social equity. Not everyone can benefit from working from home. People who can work from home are typically already well paid and highly educated. People who cannot work from home do not benefit, including service industry workers, like cleaners or sales assistants. The shift to working from home risks further exacerbating pre-existing labour market inequalities.[31]

Working from home could also reduce demand on the transport network and affect road congestion levels. This report explores this in depth and it is a focus of our discussion of policy implications. We have not assessed whether more working from home is a net positive or net negative for society. Instead, our work focuses on the spatial consequences of more working from home, and Victorian Government actions that can harness its benefits while mitigating any negative impacts.

1.5   Working from home could persist

A global study from early 2021 found that 70% of employees wanted flexible remote work options to continue, while 65% also craved more in-person time with their work colleagues.[32] This signals that most people desire a hybrid approach that combines working from home with working in the office. A 2020 survey of Victorian employees working from home found 70% reported that remote working benefitted their lifestyle outside work, and 71% said that it benefitted their work life.[33] Consequently, most workers preferred to work from home more (compared to before the pandemic) following the easing of restrictions.

Businesses also expected more working from home once restrictions ease. Four in five Australian businesses with staff teleworking during the pandemic expected to continue to have staff teleworking long-term.[34] Similarly, around 76% of Australian managers expected their staff would work from home more often after COVID-19, compared to before the pandemic.[35]

These findings indicate many people would like to continue working from home to some degree following the pandemic and the easing of restrictions, and that employers expect more staff to work from home more often.

1.6   Businesses are planning different approaches to working from home

While we expect a general shift to more working from home in the future, the approach to working from home will differ across employers. Already, employers differ in their plans for working from home following the pandemic.

Some employers plan minimal future staff office presence:

[26] Ramachandran, Vignesh, Stanford researchers identify four causes for 'Zoom fatigue' and their simple fixes, 2021, Stanford News, Stanford University Communications, https://news.stanford.edu/2021/02/23/four-causes-zoom-fatigue-solutions/

[27] Australian Unions, Working from home, 2020, ACTU, https://www.actu.org.au/media/1449319/au_workingfromhome_p1.pdf, p.17

[28] Useem, Jerry, When Working From Home Doesn't Work, 2017, The Atlantic, https://www.theatlantic.com/magazine/archive/2017/11/when-working-from-home-doesnt-work/540660/

[29] Jessica Stillman, Why Remote Work Is Bad for Younger Employees, 2020, Inc., https://www.inc.com/jessica-stillman/why-remote-work-sucks-for-younger-employees.html

[30] Florida, Richard, The Death and Life of the Central Business District, 2021, Bloomberg CityLab, https://www.bloomberg.com/news/features/2021-05-14/the-post-pandemic-future-of-central-business-districts

[31] Bonacini, Luca, Giovanni Gallo, and Sergio Scicchitano, Working from home and income inequality: risks of a 'new normal' with COVID-19, 2021, Journal of population economics, 34(1), https://link.springer.com/article/10.1007/s00148-020-00800-7

[32] Microsoft Work Trend Index, The Next Great Disruption Is Hybrid Work—Are We Ready?, 2021, Microsoft 365, https://www.microsoft.com/en-us/worklab/work-trend-index/hybrid-work

[33] Nitish Kumar, and Pugh, Nigel, Victoria work from home survey, 2020, Conducted on behalf of the Department of Jobs, Precincts and Regions by Venture Insights

[34] Australian Bureau of Statistics (ABS), Business Conditions and Sentiments, April 2021, ABS, https://www.abs.gov.au/statistics/economy/business-indicators/business-conditions-and-sentiments/apr-2021#teleworking

[35] John Hopkins and Bardoel, Anne, Key working from home trends emerging from COVID-19, A report to the Fair Work Commission, 2020, Commonwealth of Australia, https://www.fwc.gov.au/documents/sites/clerks-work-from-home/research/am202098-research-reference-list-su-241120.pdf

- Australian software company Atlassian has embraced working from home for its 5,700 global staff. Atlassian already had permissive remote working policies before the COVID-19 pandemic, and its onset spurred their new 'TeamAnywhere' policy. This permits staff to work anywhere in the world, and only requires them to attend an office around four times a year for collaborative workshop events. Acknowledging that some employees nevertheless benefit from working and collaborating in the office, Atlassian will still maintain physical offices.[36]

Many employers are moving to a more hybrid approach:

- Telstra has announced staff will have more flexibility in the future for both their location and hours of work.[37] Prior to the COVID-19 pandemic, Telstra's office-based employees already worked an average of two days a week from home.

- Deloitte Australia will not require staff to be in the office any set number of days a week and has eliminated start and finish times. However, if working with a client team, staff must adhere to the client's working practices.[38]

- Energy company Chevron Australia has signalled that their staff in Perth can work from home on Mondays and Fridays, while they prefer staff are in the office on other weekdays for collaboration.[39]

- Westpac expects to continue with a hybrid model following COVID-19. They would expect staff to work from home some of the week and have two to three days in the office to collaborate. Westpac are also exploring leveraging their operational centres and branches as work hubs.[40]

Some employers have signalled a return to more traditional office-based working:

- The City of Melbourne has committed to requiring 100% of its 1600-strong workforce return to on-site work. This is to support city-based businesses which rely on office staff as customers.[41]

- US banks JPMorgan and Goldman Sachs are also requiring staff to return to offices. The CEO of JPMorgan stated, "most professionals learn their job through an apprenticeship model, which is almost impossible to replicate in the Zoom world" and that working from home lacks "spontaneous learning and creativity because you don't run into people at the coffee machine, talk with clients in unplanned scenarios or travel to meet with customers and employees for feedback on your products and services".[42]

[36] Bianca Healey, Atlassian says staff can limit days in the office to only four a year, 2021, Australian Financial Review, https://www.afr.com/work-and-careers/workplace/atlassian-says-staff-can-come-into-the-office-only-four-times-a-year-20210430-p57npd

[37] Bennett, Tess, Telstra staff to choose where, when they work, 2021, Australian Financial Review, https://www.afr.com/companies/telecommunications/telstra-staff-to-choose-where-when-they-work-20210526-p57vdv

[38] Bennett, Tess, Deloitte to allow all staff to decide where and when they work, 2021, Australian Financial Review, https://www.afr.com/work-and-careers/careers/deloitte-to-allow-all-staff-to-decide-where-and-when-they-work-20210629-p5859t

[39] Kelly, Martin, Workers are still staying at home in virus-free Perth, 2021, Australian Financial Review, https://www.afr.com/property/commercial/workers-are-still-staying-at-home-in-virus-free-perth-20210915-p58rrk

[40] Terzon, Emilia, Australian corporations moving to 'hybrid' models that let workers split time between office and home, 2021, ABC News, https://www.abc.net.au/news/2020-11-25/working-from-home-after-a-coronavirus-vaccine-the-new-norm/12913928

[41] City of Melbourne, City of Melbourne staff to return to CBD workplaces, Media release, Wednesday 24 February 2021, https://www.melbourne.vic.gov.au/news-and-media/Pages/City-of-Melbourne-staff-to-return-to-CBD-workplaces.aspx

[42] Jack Kelly, Wall Street Banks That Demanded Workers To Return To Their Offices May Have To Change Their Plans Due To Delta Variant, 2021, Forbes, https://www.forbes.com/sites/jackkelly/2021/08/04/wall-street-banks-that-demanded-workers-to-return-to-their-offices-may-have-to-change-their-plans-due-to-delta-variant/?sh=ac27c2c7356c

2. Testing the effects of working from home

Infrastructure Victoria is interested in the effects of a shift to working from home over the medium-term because it could affect the structure of Victorian cities and regions, and people's future infrastructure use.

We developed scenarios to model and understand the medium-term impacts of more working from home on the economy, on transport, and on land use outcomes. This provides insights into possible changes in future infrastructure and land use.

2.1 We used an integrated transport and land use model

We used the Victorian Land Use and Transport Integration (VLUTI) model to test the impact of greater working from home. The model simulates interactions between land use and transport systems. This accounts for the interaction between travel behaviour and the location of businesses and households.

The VLUTI model combines two models:

- A spatial computable general equilibrium economic model that incorporates land use, developed by Victoria University in collaboration with Infrastructure Victoria.

- The Victorian Integrated Transport Model developed by the Victorian Department of Transport.

The VLUTI modelling process involves passing information between the two models in an iterative manner to reach an equilibrium between land use and transport demand modelling. You can find more detail on the modelled scenarios in our accompanying technical report and on the model itself in our *Victorian Land Use and Transport Integration model architecture report*.[43]

2.2 We constructed three working from home scenarios

For our modelling, we only applied greater working from home to occupations which have a majority of tasks that can feasibly be performed from home. These occupations include professionals, administrators, and managers. Our working from home scenarios have around 33% of Victorian workers working from home in the future.

Our scenarios are based on a hybrid approach of working from home, with some days of the week worked from the office and some days worked from home.[44]

We tested three scenarios, based on the number of extra days each week these workers spend working from home:

- One extra day a week of working from home: low scenario (WFH low)

- Two extra days a week of working from home: medium scenario (WFH medium)

- Three extra days a week of working from home: high scenario (WFH high)

VLUTI models travel behaviour on an average weekday. This implicitly assumes that people's working from home days, within the model, are spread evenly throughout a work week.

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[43] Infrastructure Victoria, Victorian Land Use and Transport Integration (VLUTI) model architecture report, 2021, Victorian Government, https://www.infrastructurevictoria.com.au/wp-content/uploads/2021/08/Victorian-Land-Use-and-Tran_tion-model-architecture-report.pdf

[44] Informed by surveys of those who worked from home during the pandemic that suggested people want to work from home 2-3 days per week in the future: Institute of Transport and Logistics Studies, Transport Opinion Survey (TOPS) September 2020, 2020, The University of Sydney, https://www.sydney.edu.au/content/dam/corporate/documents/business-school/research/itls/tops-2020-sep.pdf; Kumar, Nitish and Nigel Pugh, Victoria work from home survey, 2020, Conducted on behalf of the Department of Jobs, Precincts and Regions by Venture Insights

We made other related changes in the scenarios. These include decreases to household spending on transport and adjusting work-based trips to be home-based.

We broadly define 'medium-term' as the next 10-20 years. For modelling purposes, we chose the year 2036 to run our simulations and we regard the directions of change shown by the modelling results as generally applicable to the next 10-20 years.

2.3   We compared scenarios to a 'base case'

We compared the modelled impacts of working from home to a 'base case' spatial distribution of population, employment, transport, and economic outcomes. In the base case, people completely return to the working patterns observed before the COVID-19 pandemic, and do not increase their working from home. The base case uses statewide totals of population, employment, households and enrolments from the Small Area Land Use Projections (SALUP) and Victoria in Future (VIF) population projections.[45] These are standard datasets used across the Victorian Government to inform strategic transport modelling assessments in Victoria.

The base case assumes the transport network develops and expands as the population grows to meet day-to-day travel needs. This includes the development of the arterial road network and growth in tram and bus services, including into Melbourne's outer growth areas. The base case includes projects that the Victorian Government has committed to progressively deliver, such as the North East Link, the Metro Tunnel Project, and the Suburban Rail Loop. We provide more information on the base case in our *Major transport program strategic assessment* report.[46]

2.4   We modelled working from home changes, not other COVID-19 impacts

Our modelling focuses on the impacts of greater working from home as a result of COVID-19. We did not consider the direct impacts of COVID-19 on Victoria's overall population and employment in the base case or modelled scenarios, including changes in overseas migration. This is because updated Victorian small area population and employment projections which account for the direct impact of COVID-19 were not available at the time we conducted our analysis.

The extent and timing of a return to international migration is still unclear. The Australian Government Centre for Population has projected population growth rates to return to close to pre-COVID-19 levels in 2023. The pause in migration during the pandemic could mean that in 2031, Australia's population will be 4% smaller than it would have otherwise been.[47]

In any case, we expect the broad spatial trends of our modelling of greater working from home to still be instructive, even if the overall population size of Victoria differs from that used in our modelling.

2.5   Our modelling results split Victoria into six regions

To present our modelling results we have used functional urban areas (FUAs) as our primary geography. FUAs split Victoria into six regions:

- inner Melbourne
- middle Melbourne
- outer Melbourne
- Melbourne new growth areas, which accounts for current and potential areas for greenfield population growth
- regional cities which includes 12 cities: Ballarat, Bendigo, Geelong, Horsham, Mildura, Moe, Morwell, Greater Shepparton, Traralgon, Wangaratta, Warrnambool, and Wodonga
- regional centres and rural areas, which covers all other areas of regional Victoria.

Figure 4 illustrates these FUAs.

We also discuss peri-urban regions in this report. These areas are generally in the regional centres and rural areas FUA and within a 100km radius of central Melbourne. These places are the 'interface' between Melbourne's urban area and Victoria's regions, and can have both rural and urban characteristics.

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[45] *SGS Economics and Planning for Department of Transport, Small Area Land Use Projections (SALUP), 2019; Department of Environment, Land, Water and Planning, Victoria in Future, 2019, Victorian Government*

[46] *Infrastructure Victoria, Major Transport Program Strategic Assessment report, 2021, Victorian Government, https://www.infrastructurevictoria.com.au/wp-content/uploads/2021/08/Major-Transport-Program-Strategic-Assessment-Report.pdf*

[47] *Australian Government Centre for Population, 2020 Population Statement, 2020, Commonwealth of Australia, https://population.gov.au/publications/publications-population-statement.html*

Figure 4.   Functional urban areas
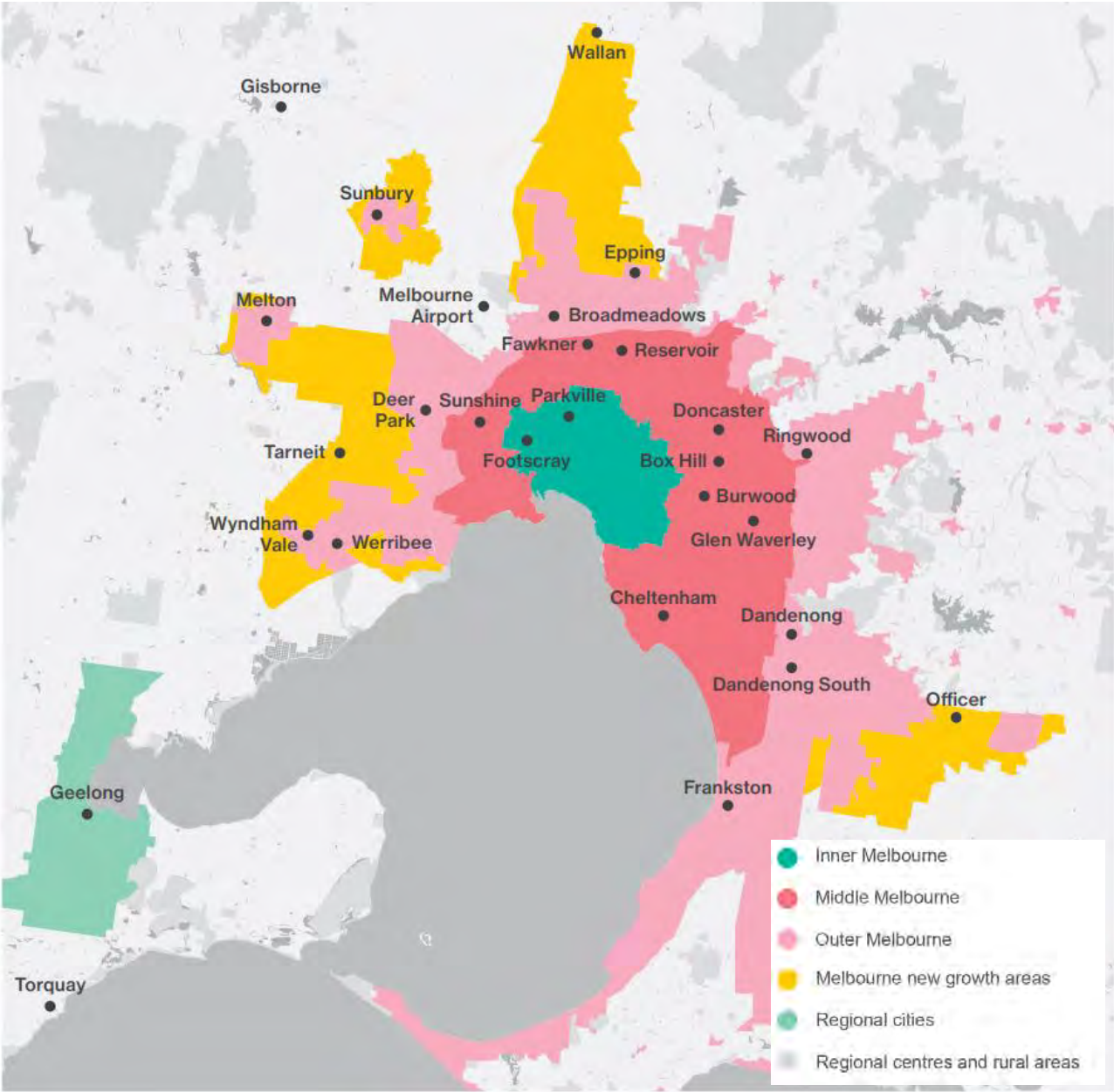
Source: Infrastructure Victoria, Victoria's Infrastructure Strategy 2021–2051, 2021

3. Working from home changes land use and transport patterns

3.1   Population disperses while employment centralises

Our modelling finds that working from home could influence where people choose to live and where businesses locate. When people can work from home some days each week, they can tolerate longer commutes. Consequently, our modelled scenarios find that population disperses away from employment centres.

As shown in Figure 5, this means Melbourne's outer and new growth areas experience faster population growth, relative to the base case. Peri-urban areas on Melbourne's periphery similarly become more attractive places to live if people have less need to commute. However, our modelled scenarios still require people to travel to work some days of the week, meaning regional areas farther from Melbourne do not experience faster population growth, compared with the base case.

Our modelling shows that working from home has the inverse effect on jobs, compared to population. Jobs concentrate within inner Melbourne while other areas see slower jobs growth, compared with the base case (Figure 6). With a more dispersed population, our model projects firms locate where they can access the largest workforce catchment, while also benefiting from agglomeration economies. Inner Melbourne is the focus of the public transport and road networks, and already has the highest density of employment in the base case. Accordingly, our modelled scenarios suggest more working from home means inner Melbourne becomes even more concentrated with jobs.

Figure 5.   Change in population, WFH scenarios vs base case, 2036
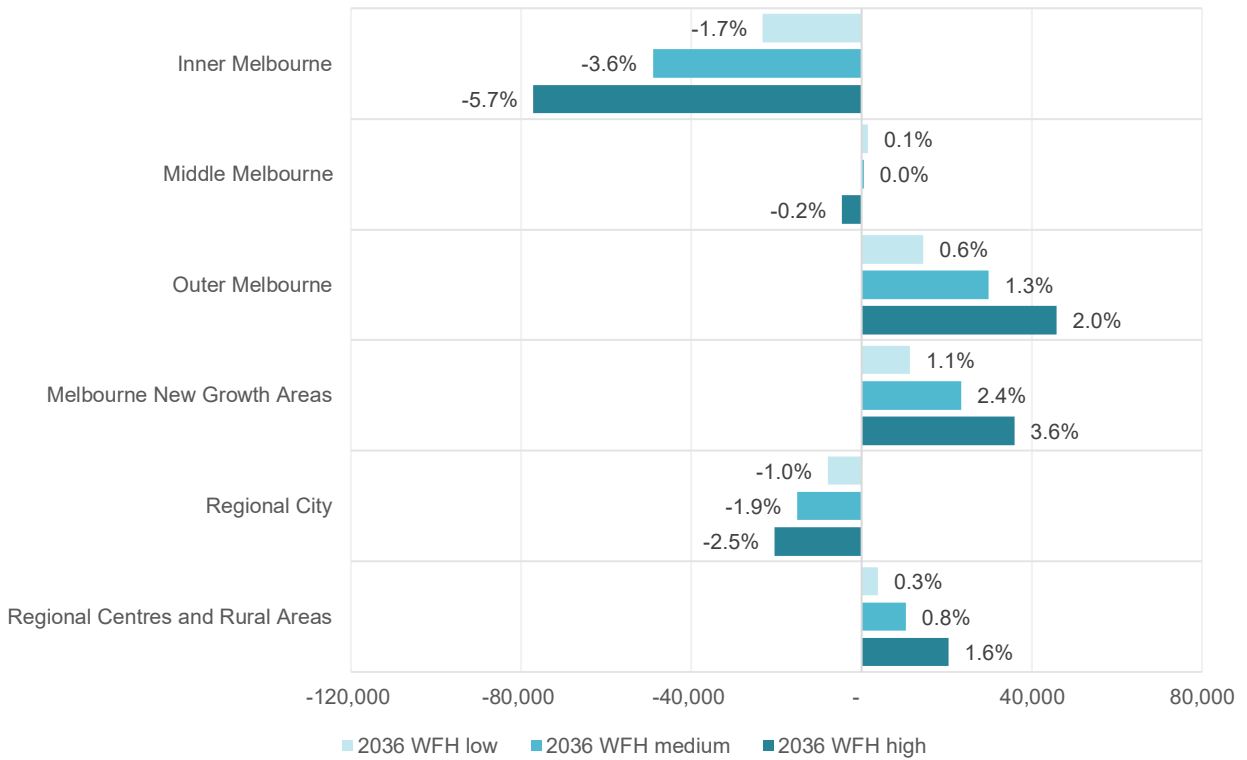
Inner Melbourne
- -1.7%
- -3.6%
- -5.7%

Middle Melbourne
- 0.1%
- 0.0%
- -0.2%

Outer Melbourne
- 0.6%
- 1.3%
- 2.0%

Melbourne New Growth Areas
- 1.1%
- 2.4%
- 3.6%

Regional City
- -1.0%
- -1.9%
- -2.5%

Regional Centres and Rural Areas
- 0.3%
- 0.8%
- 1.6%

Axis: -120,000 | -80,000 | -40,000 | - | 40,000 | 80,000

Legend: ■ 2036 WFH low ■ 2036 WFH medium ■ 2036 WFH high

Source: Infrastructure Victoria analysis of ARUP and Victoria University, Working from home VLUTI modelling, 2021

Figure 6.   Change in employment, WFH scenarios vs base case, 2036
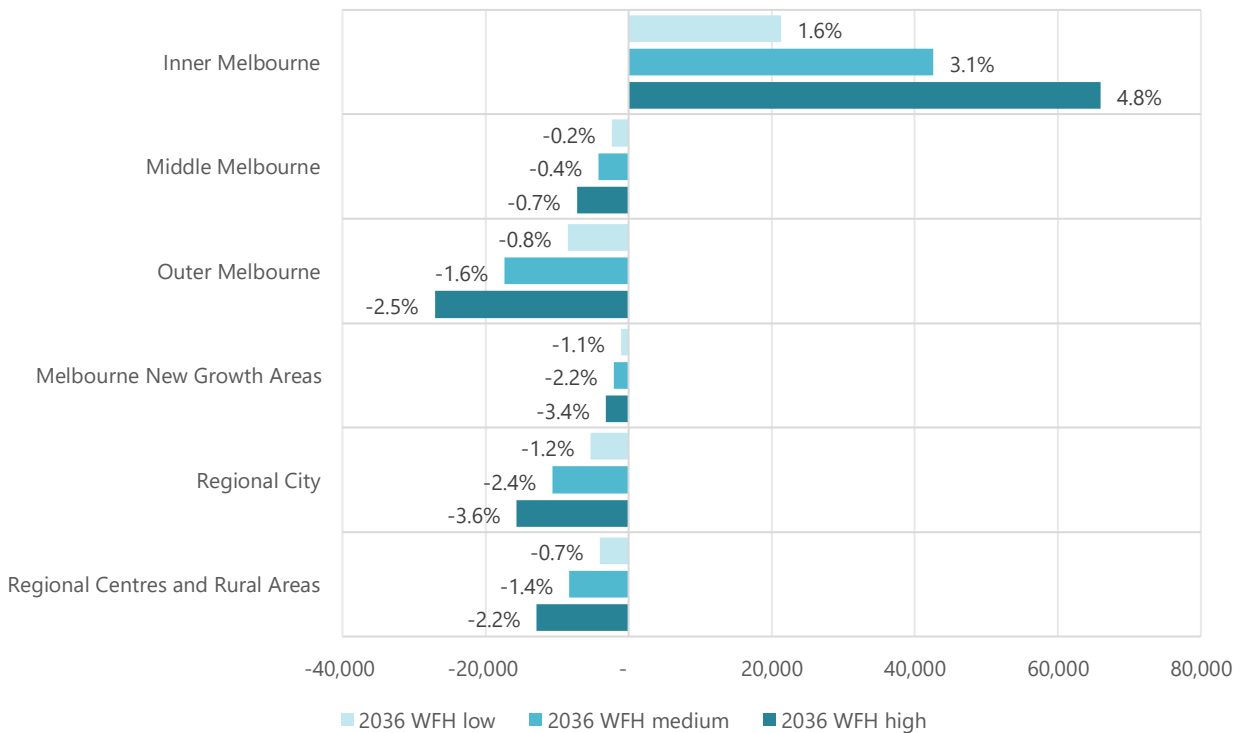
Inner Melbourne
- 1.6%
- 3.1%
- 4.8%

Middle Melbourne
- -0.2%
- -0.4%
- -0.7%

Outer Melbourne
- -0.8%
- -1.6%
- -2.5%

Melbourne New Growth Areas
- -1.1%
- -2.2%
- -3.4%

Regional City
- -1.2%
- -2.4%
- -3.6%

Regional Centres and Rural Areas
- -0.7%
- -1.4%
- -2.2%

Axis: -40,000 | -20,000 | - | 20,000 | 40,000 | 60,000 | 80,000

Legend: ■ 2036 WFH low ■ 2036 WFH medium ■ 2036 WFH high

Source: Infrastructure Victoria analysis of ARUP and Victoria University, Working from home VLUTI modelling, 2021

Figure 7 and Figure 8 illustrate the population and employment modelling results spatially for Melbourne and surrounds.

Figure 7.   Change in population, WFH medium vs base case, 2036

Source: Infrastructure Victoria analysis of ARUP and Victoria University, Working from home VLUTI modelling, 2021

Figure 8.   Change in employment, WFH medium vs base case, 2036

Source: Infrastructure Victoria analysis of ARUP and Victoria University, Working from home VLUTI modelling, 2021

3.1.1   The overall changes are relatively small

While the modelled impact of working from home shows clear spatial trends, the overall trajectory of employment and population growth throughout Victoria does not materially change. Rather, working from home marginally redistributes expected population and employment growth. For context, Figure 9 and Figure 10 present the impacts of working from home against the base case growth in employment and population from 2018 to 2036.

Figure 9.   Change in population 2018 to 2036, WFH scenarios and base case

Source: Infrastructure Victoria analysis of ARUP and Victoria University, Working from home VLUTI modelling, 2021

Figure 10.   Change in employment 2018 to 2036, WFH scenarios and base case

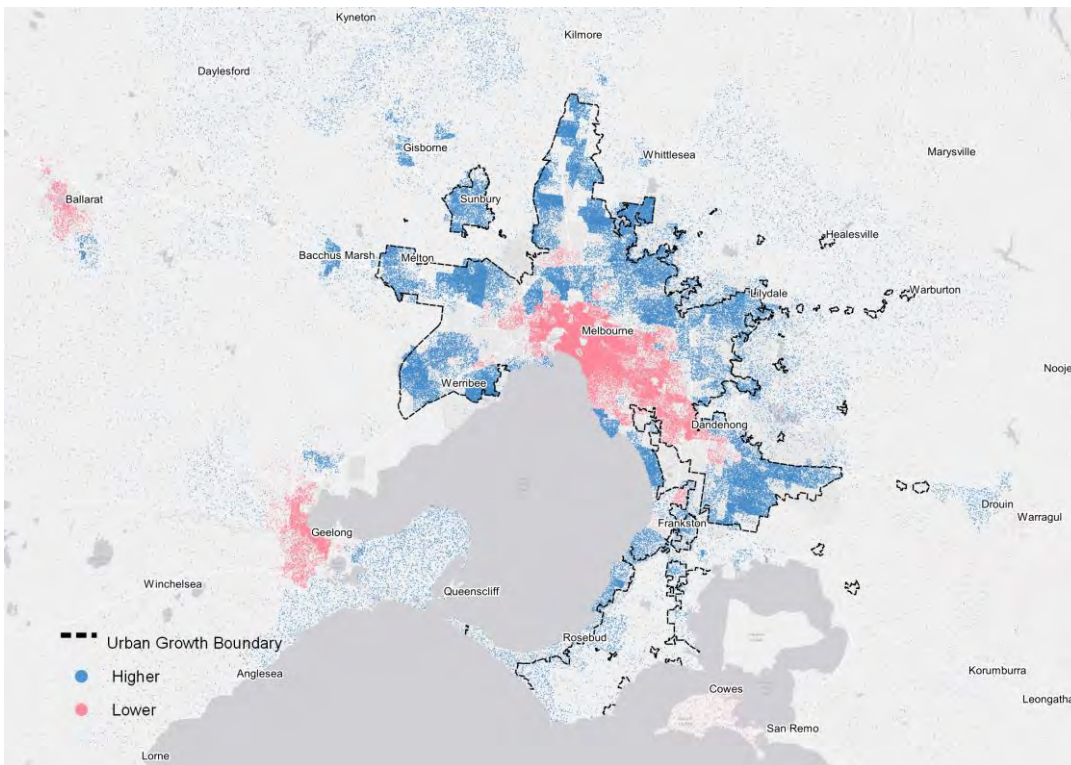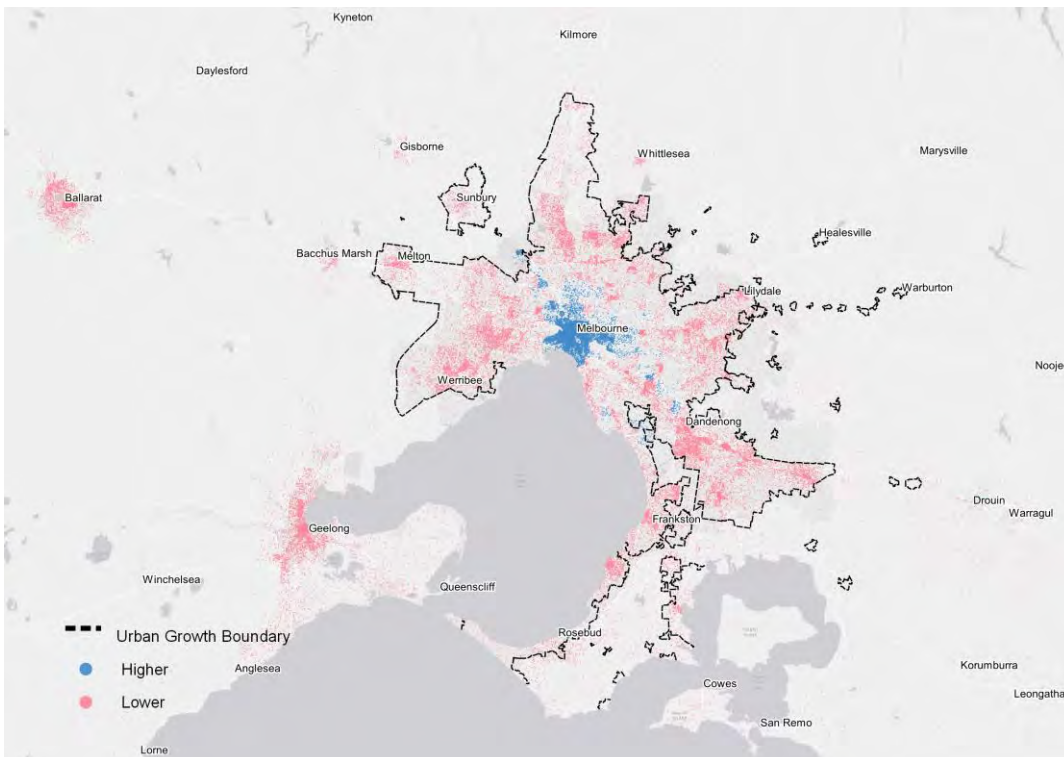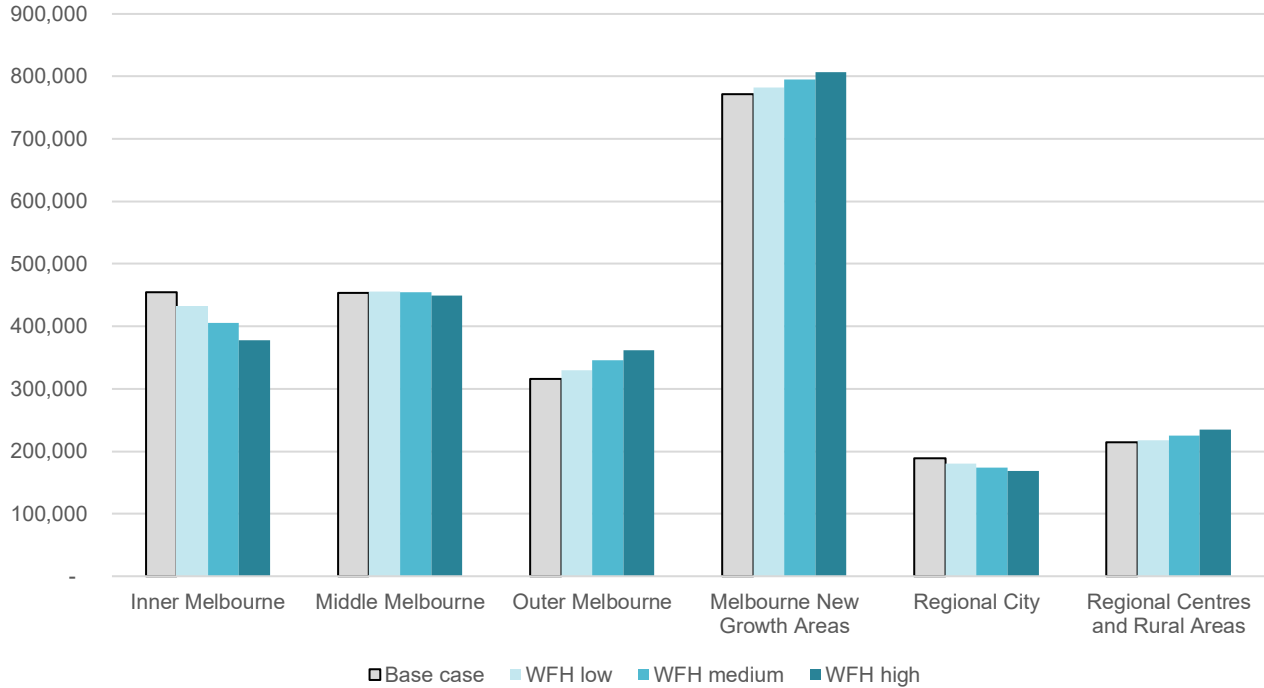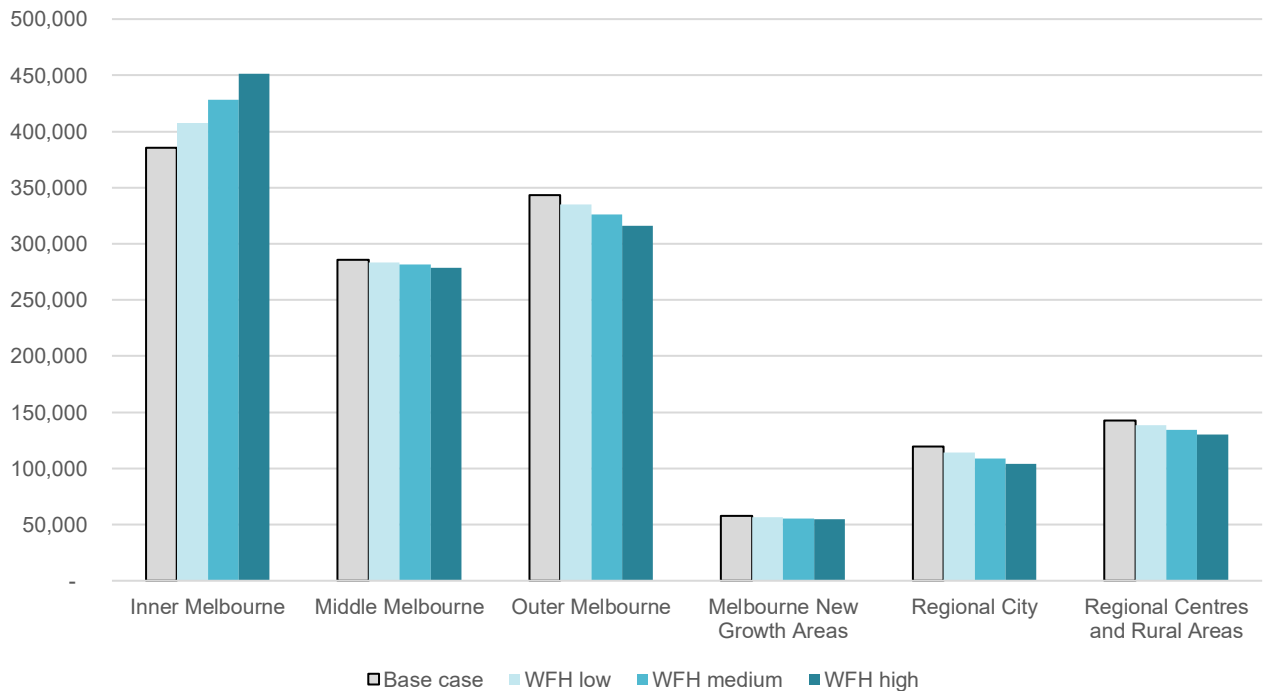*Source: Infrastructure Victoria analysis of ARUP and Victoria University, Working from home VLUTI modelling, 2021*

Even though working from home only results in marginal changes, the broad trends are still instructive, and, as we discuss later, there are consequential effects on the transport system.

Other long-term trends may cause a similar dispersion effect on population. For example, our *Major transport program strategic assessment* report tested a scenario with more widespread use of electric vehicles, and further in the future, more autonomous vehicles.[48] This suggested these technologies could offer transport cost reductions, resulting in slower population growth in inner and middle areas of Melbourne. This means the cumulative impact of working from home and more widespread electric and autonomous vehicles use could produce a more substantial population dispersion than working from home by itself.

3.1.2 Inner Melbourne experiences slower population growth but faster jobs growth

Working from home affects demand on employment and residential land use in inner Melbourne. Our modelling projects it induces a trend towards increased urban expansion, with relatively slower population growth in inner and middle Melbourne and faster growth in outer and new growth areas. Compared to the base case, inner Melbourne's population in 2036 is 3.6% smaller in our medium working from home scenario, around 50,000 people.

Areas of inner Melbourne where employment land uses predominate over residential uses become even less residential. This results in some local variations in population change within inner Melbourne. For example, working from home has a larger impact on the population of the central city than surrounding suburbs. This effect decreases with proximity from the central city. Northern and north-eastern inner suburbs, including parts of the Moreland and Darebin Local Government Areas (LGAs), attract more residents compared to the base case.

Today, inner Melbourne has the greatest share of jobs of any area, including the greatest share of 'knowledge intensive' jobs.[49] Our analysis indicates that more working from home causes even more firms to locate to inner Melbourne, with economic activity continuing to focus in and around the central city, including in the Docklands, Southbank and St Kilda Road precincts. This amounts to an increase of 3.1%, or around 40,000 jobs, in inner Melbourne, in the medium scenario compared to the base case. This is likely related to the benefits of agglomeration as well as the dispersal of population. A more dispersed population reinforces the advantages of the central city, which is the focus of the public transport and road networks, in providing the best location to access more dispersed labour markets. This modelling outcome challenges recent media and public policy commentary which speculates that working from home could result in the central city's demise.[50]

Even with the reduced need to travel to work every day, our modelling finds the number of people who travel to the central city each morning still increases by around 36% between 2018 and 2036 in the medium scenario. This is a result of projected employment growth between 2018 and 2036, and the relocation of jobs to the central city due to working from home. This suggests that even in a future where more people work from home, more often, the central city will continue to be the centre of Victoria's economic activity and attract many visitors each day.

3.1.3 Outer Melbourne and growth areas experience faster population growth, but jobs growth slows

Working from home results in physical proximity to employment becoming less important for workers in occupations suitable for working from home. Our modelling finds that this could cause more people to live in Melbourne's outer and new growth areas.

Our working from home modelling shows outer Melbourne attracting around 30,000 extra people in 2036, a 1.3% increase in the medium scenario compared to the base case. New growth areas attract around 25,000 more residents, which is a 2.4% increase. These are locations already experiencing rapid growth from 2018 to 2036 under base case conditions and working from home causes them to grow even faster.

At the same time, these places attract fewer jobs than the base case. Outer Melbourne has around 15,000, or 1.6%, fewer jobs relative to the base case in 2036 in the medium scenario. Melbourne's new growth areas see around 2,000 or 2.2% fewer jobs in the medium scenario, compared to the base case in 2036. This means most major and metropolitan activity centres in Melbourne's outer and new growth areas contain less employment, compared to the base case as a result of working from home.

[48] Infrastructure Victoria, Major Transport Program Strategic Assessment report, 2021, Victorian Government, https://www.infrastructurevictoria.com.au/wp-content/uploads/2021/08/Major-Transport-Program-Strategic-Assessment-Report.pdf

[49] SGS Economics and Planning Pty Ltd, Melbourne Functional Economic Region Report, 2019, prepared for Infrastructure Victoria, Victorian Government, https://www.infrastructurevictoria.com.au/wp-content/uploads/2019/04/SGS-Melbourne-Functional-Economic-Region-Report-March-2019.pdf, p.10

[50] Eddie, Rachel and Bianca Hall, Office workers return, but will the CBD ever be the same?, 2021, The Age, https://www.theage.com.au/national/victoria/office-workers-return-but-will-the-cbd-ever-be-the-same-20210117-p56unw.html; Millar, Royce, To CBD or not to CBD? COVID's question for the future of Melbourne, 2021, The Age, https://www.theage.com.au/national/victoria/to-cbd-or-not-to-cbd-covid-s-question-for-the-future-of-melbourne-20210603-p57xqj.html

This modelled employment location describes the physical office location rather than where work is performed, as some of the work associated with these jobs would be performed elsewhere, at workers' homes or even local cafes. We have not explicitly modelled greater use of coworking spaces, located in suburban areas, close to where people live. However, we expect this situation could show similar trends to the scenarios we have modelled.

3.1.4   Peri-urban areas experience faster population growth

Our analysis finds the implications of working from home differ within regional centres and rural areas. Working from home results in faster population growth occurring in peri-urban regions which are relatively close to major cities, while impacts are muted in other, more remote regional areas. With less need to commute every day of the week, workers may tolerate a longer commute, and living in peri-urban areas becomes more attractive. However, the same does not apply to regional places farther from cities because people still commute to work some days of the week within the modelled scenario.

Peri-urban regions are places outside Melbourne's urban growth boundary within a 100km radius of central Melbourne. These places, shown in Figure 11, are the 'interface' between Melbourne's urban area and Victoria's regions, and support a diverse mixture of land uses characteristic of both rural and urban settings. Because of their proximity to Melbourne, working from home results in more residents moving to peri-urban locations if they are commuting to work less frequently.

Figure 11.   Change in population, WFH medium vs base case, peri-urban Melbourne (100 km radius), 2036
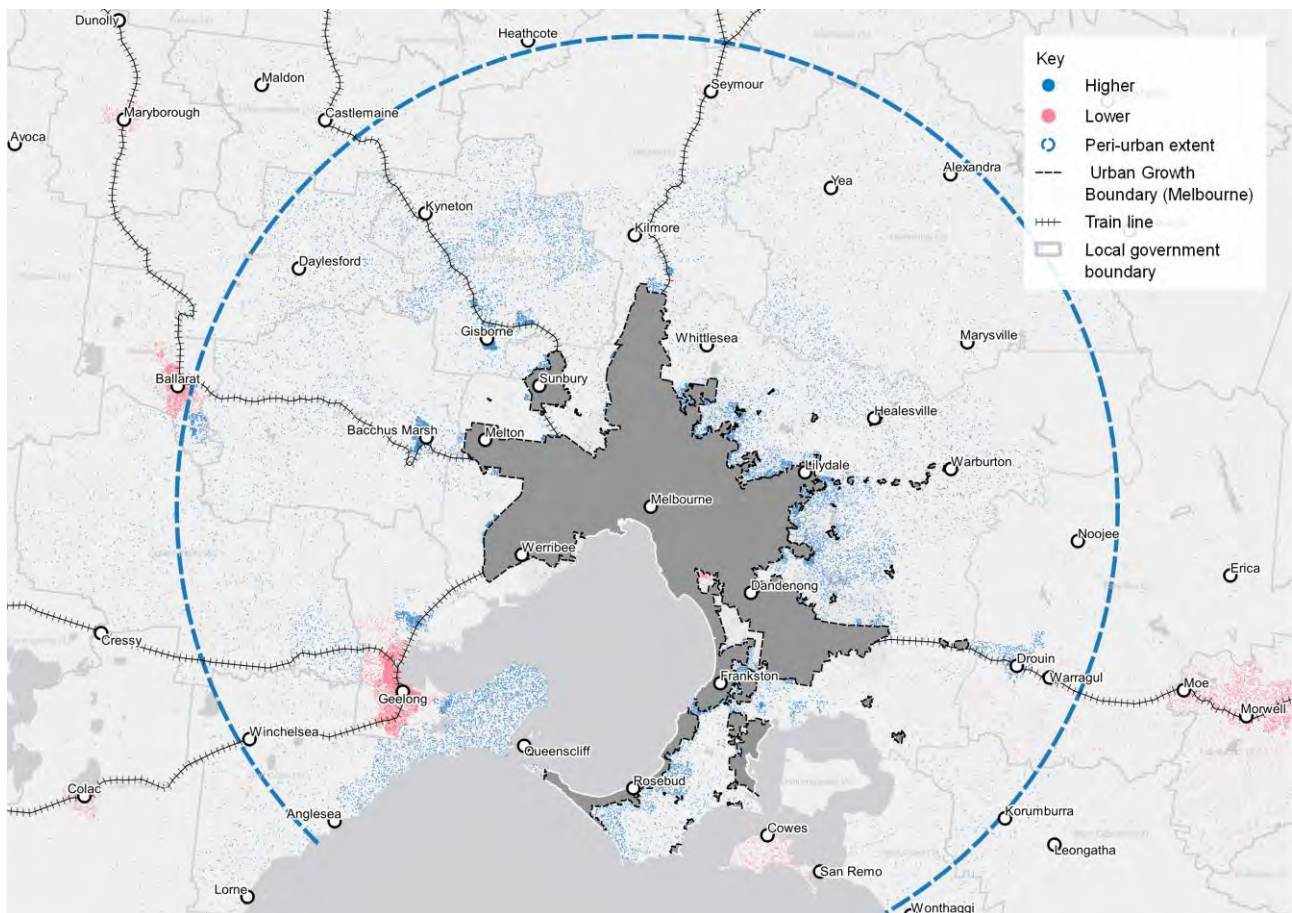
Source: Infrastructure Victoria analysis of ARUP and Victoria University, Working from home VLUTI modelling, 2021

The base case projects population growth in some peri-urban areas. For example, Bacchus Marsh[51] is projected to grow by 62% from 22,000 to 36,000 people between 2018 and 2036 in the base case. This growth accelerates in the medium working from home scenario, reaching 37,000 people instead—around 3% larger.

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[51] *Bacchus Marsh SA2*

Faster population growth in peri-urban areas outside existing towns is also projected in our scenarios. For example, the area outside of the Bacchus Marsh town[52] has a population 6% larger, around 450 people, under the medium scenario compared to the base case in 2036.

Faster population growth occurs in municipalities with large amounts of non-urban, green wedge land outside Melbourne's urban growth boundary, such as Mornington Peninsula, Yarra Ranges, and Nillumbik. The working from home scenario also results in additional population growth in environmentally sensitive coastal locations and bushfire prone areas. For example, Kinglake[53] is 9% larger (400 people), under our medium scenario, compared to the base case in 2036.

Consistent with broader employment trends, additional population is not accompanied by employment growth in these areas under any of the work from home scenarios. Instead, our model suggests more people in occupations suitable for working from home live farther from their workplace, travelling for work outside of their local areas to employment centres, such as Melbourne's central city.

3.1.5   Population growth slows in regional cities

While regional city populations continue to grow in our scenarios, working from home encourages some workers to live farther from regional cities where they can take advantage of lower housing costs as they can commute less frequently. This results in all regional cities experiencing slower population growth compared to the base case.

Some regional cities follow a similar pattern to Melbourne. In our working from home scenarios, populations become more dispersed as living close to work becomes less important for people who can work from home. For example, working from home results in Geelong's growth areas, such as Armstrong Creek, Lara and Northern Geelong, attracting extra residents while more central, established parts of Geelong grow more slowly, compared to the base case. Ballarat also experiences faster population growth in some of its peripheral areas, while growth slows in Ballarat's city centre. This results in Ballarat's outer suburbs attracting more new residents, and some additional population growth occurring in rural areas outside the established settlement boundary.

Recent media reporting has highlighted an increasing demand for housing in regional cities following the COVID-19 pandemic, which is contributing to short-term housing shortages and rising house prices.[54] Our modelling provides a longer-term view, which suggests the legacy of working from home could be increasing population dispersion in large Victorian cities, but not necessarily more population in all regional areas. If employers widely adopt a hybrid model of working from home, workers still need some physical connection to their workplace. This could result in stronger population growth in regional areas with transport access to Melbourne, and around larger regional cities which support knowledge economy jobs. Regional cities which have relatively few of these jobs are less likely to attract additional residents working from home.

Alternatively, if workers choose to work from home every weekday, and their employer allows it, the location of work could be irrelevant to residential location. This could open up regional areas and cities farther afield from Melbourne to live in and work from, but we have not modelled this situation. Our modelling of working from home of an additional one to three days a week is based on recent surveys on worker preferences. Workers, on average, state they prefer a hybrid model of working from home once the pandemic subsides.[55] This implies physical connection to employment could remain important in the future.

3.2   Working from home reduces travel

Our working from home scenarios suggest people take fewer trips overall on Victoria's transport network, compared with the base case, because some people substitute their commute with a day at home. However, the effect is not uniform. While parts of Victoria experience less transport crowding and congestion, other areas experience higher demand on the transport network, compared with the base case.

The modelling presented in this report looks to the medium-term effects, rather than the immediate impacts of the COVID-19 pandemic. Infrastructure Victoria has previously released a report on the short-term transport impacts of COVID-19 during the recovery period, titled *Transporting Melbourne's Recovery*. That short-term impact analysis examined the still-present initial challenges and risks of COVID-19, where commuters had a higher preference for private

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[52] *Bacchus Marsh Region SA2*

[53] *Kinglake SA2*

[54] Wright, Patrick, *How the housing boom is impacting families in regional Victoria, 2021, ABC Everyday,*
      https://www.abc.net.au/everyday/housing-boom-impacting-families-regional-australia/100279372

[55] *Institute of Transport and Logistics Studies, Transport Opinion Survey (TOPS) September 2020, 2020, The University of Sydney,*
      https://www.sydney.edu.au/content/dam/corporate/documents/business-school/research/itls/tops-2020-sep.pdf;
      Kumar, Nitish and Nigel Pugh, Victoria work from home survey, 2020, Conducted on behalf of the Department of Jobs, Precincts and Regions by Venture Insights

vehicles and avoided a return to public transport. Domestic and international travel remained limited and working from home was prevalent but not necessarily required by government restrictions.

This report looks further into the future, seeking to illustrate what a post-COVID-19 horizon could bring—a period where many aspects of our daily lives have returned to normal with one exception: our choices in where we live and work have been influenced by an increase in working from home practices, creating a new equilibrium in how often workers, who can work from home, commute.

Our modelling of the impact of working from home on the transport network finds, compared with the base case:

- overall, less private vehicle (car) trips and less local congestion outside of main arterial roads and freeways
- higher vehicle volumes and congestion on outer metropolitan and regional freeways into Melbourne during the morning peak (7am to 9am on a typical weekday)
- higher public transport mode share, particularly in outer areas of Melbourne on metropolitan and regional train services suited to long distance travel to central locations
- higher passenger volumes and crowding on inbound rail services during the morning peak.

3.2.1   Car use slows but public transport changes vary by area

In our working from home scenarios, people take 150,000 fewer private vehicle trips across metropolitan Melbourne during the morning peak compared to the base case in 2036, see Figure 12. People use cars less statewide compared to the base case, despite more residents living in outer Melbourne and new growth areas, which are places generally associated with higher car use.

But the modelled changes in public transport use varies in different places (see Figure 13). In the working from home scenarios the central city has fewer residents but more jobs. This leads to more radial commuting, especially by train, into the inner areas of Melbourne during the morning peak. The medium working from home scenario has 18,000 or 10% fewer public transport journeys beginning in inner Melbourne during the morning peak compared to the base case, while public transport journeys starting in outer Melbourne and new growth areas increase, driven by faster population growth there.

Shifting commuter travel patterns also changes the mode shares of cars and public transport. While public transport mode share in inner Melbourne is 1% lower compared to the base case in the medium scenario, brought about by slower population growth in the area, public transport mode share is higher in all other FUAs, compared with the base case. Public transport's share of trips is especially higher in outer Melbourne and new growth areas (0.8% and 0.9% higher, respectively). This is caused by both the dispersion of population and centralisation of employment as many people find public transport convenient for accessing the central city from outer areas, although some will still drive.

Overall, public transport services experience strong growth in demand for radial metropolitan services, while orbital routes around Melbourne experience a reduction in boardings. The Suburban Rail Loop business case notes the impacts of COVID-19, including increasing working from home, could result in fewer daily boardings on the Cheltenham to Airport section of the Suburban Rail Loop (an orbital route) in 2036.[56]

[56] KPMG, Business and Investment Case, Appendix C1: Suburban Rail Loop Demand Modelling Report, 2021, Prepared for Suburban Rail Loop Authority, Victorian Government, https://suburbanrailloop.vic.gov.au/Library/BusinessandInvestmentCase

Figure 12.   Change in private vehicle trips, WFH scenarios vs base case, morning peak, 2036

Source: Infrastructure Victoria analysis of ARUP and Victoria University, Working from home VLUTI modelling, 2021

Figure 13.   Change in public transport trips, WFH scenarios vs base case, morning peak, 2036
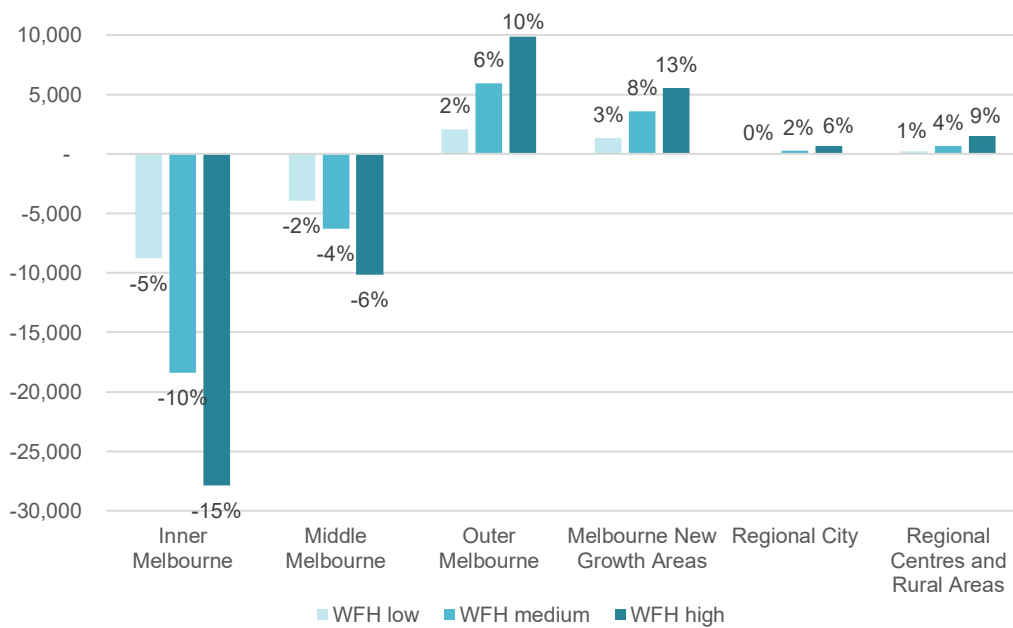
Source: Infrastructure Victoria analysis of ARUP and Victoria University, Working from home VLUTI modelling, 2021

3.2.2   Freeways become congested more quickly

Working from home also changes the pattern of private vehicle usage. More people live in outer Melbourne and new growth areas, and some will drive farther when they do travel to the office. Consequently, on average, car trips are longer in distance in the working from home scenarios, compared to the base case.

Under the working from home scenarios, the central city becomes an even more attractive location for businesses. This reaffirms the role of the central city as a major workplace destination for more residents living farther away. Inbound traffic volumes on some major freeways are higher by up to 2100 extra vehicles during the morning peak, including on the Princes, Western and Calder Freeways, compared with the base case. The opposite trend occurs in the outbound direction during the same period. With slower population growth in the inner and middle rings of the city, growth in

vehicle trips from these destinations during the morning peak also slows, leading to lower outbound traffic volumes of around 850 to 1000 vehicles along some corridors, compared with the base case.

When comparing to the base case, congestion worsens more slowly in inner and middle Melbourne. With fewer vehicles on inner city arterials, congestion is lower in the morning peak compared to the base case. However, with greater demand for travel originating in outer Melbourne and new growth areas, congestion begins farther out along most major freeways leading towards Melbourne in the morning peak, compared to the base case. Using the Princes Freeway as an example (Figure 14), under the working from home high scenario, traffic volumes near Point Cook (Sneydes Rd) in the base case are projected as far out as Lara (Avalon Rd), putting extra pressure on the Princes Freeway inbound much earlier on in the journey to Melbourne.

Figure 14.   Princes Freeway road volume, morning peak, 2036
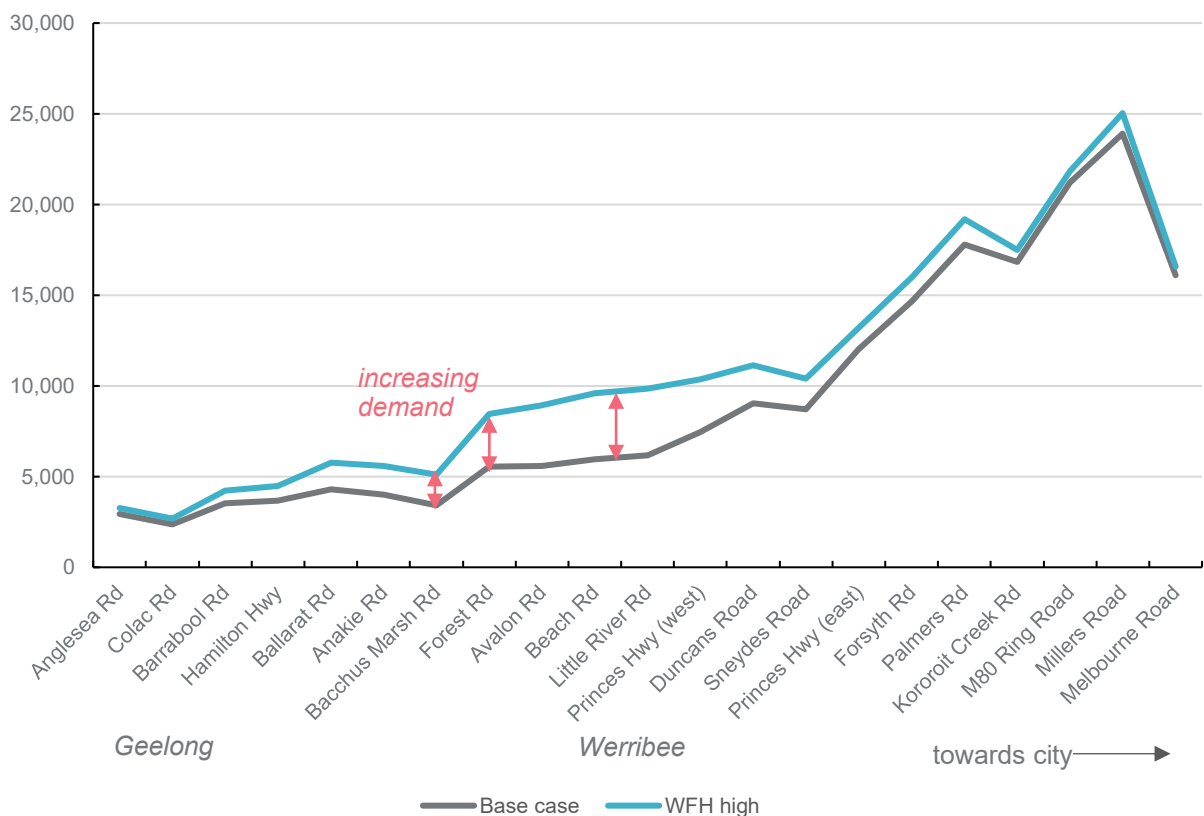
Source: Infrastructure Victoria analysis of ARUP and Victoria University, Working from home VLUTI modelling, 2021

Longer journeys produce longer trip times, especially for journeys originating in outer Melbourne and beyond. Many of these trips are not only longer in length, but also face higher levels of congestion on regional freeways, compared with the base case. Average trip times for journeys beginning in outer Melbourne are 4% longer in the medium working from home scenario than in the base case, and journeys beginning from regional cities are around 6% longer. While car trips are on average longer in distance and duration, compared to the base case, they are also at higher speeds as freeways are used more frequently.

3.2.3   Longer distance rail travel grows faster

Public transport patronage follows a similar pattern to car travel in the working from home scenarios. As inner Melbourne has a relatively smaller population, demand from inner Melbourne for trains, trams and buses grows more slowly with working from home. Conversely, V/Line and metropolitan train routes servicing new growth areas experience a large increase in patronage as population in these areas is higher, compared to the base case. During the morning peak, services along long-distance corridors such as the Pakenham/Cranbourne metro line and Sunshine V/Line services experience higher demand than in the base case.

Just like regional freeways, rail services along these lines experience higher levels of demand beginning farther out, leading to increased crowding as they approach the city in the morning peak. While train capacities can handle this slight increase in commuters close to the start of their inbound journey, many train lines face larger crowding issues by the time services reach middle and inner Melbourne, further exacerbated by other commuters boarding in the middle and

inner suburbs. Crowded train passenger hours travelled on metropolitan services are up to 13% higher when travelling through middle Melbourne, compared with the base case.

Using the Pakenham corridor as an example of this (Figure 15), typical train loads at the middle ring suburb of Hughesdale in the base case are already recorded almost as far out as Dandenong in the working from home high scenario, some 16km earlier along in the morning peak journey.

Figure 15.   Pakenham corridor train load, morning peak, 2036
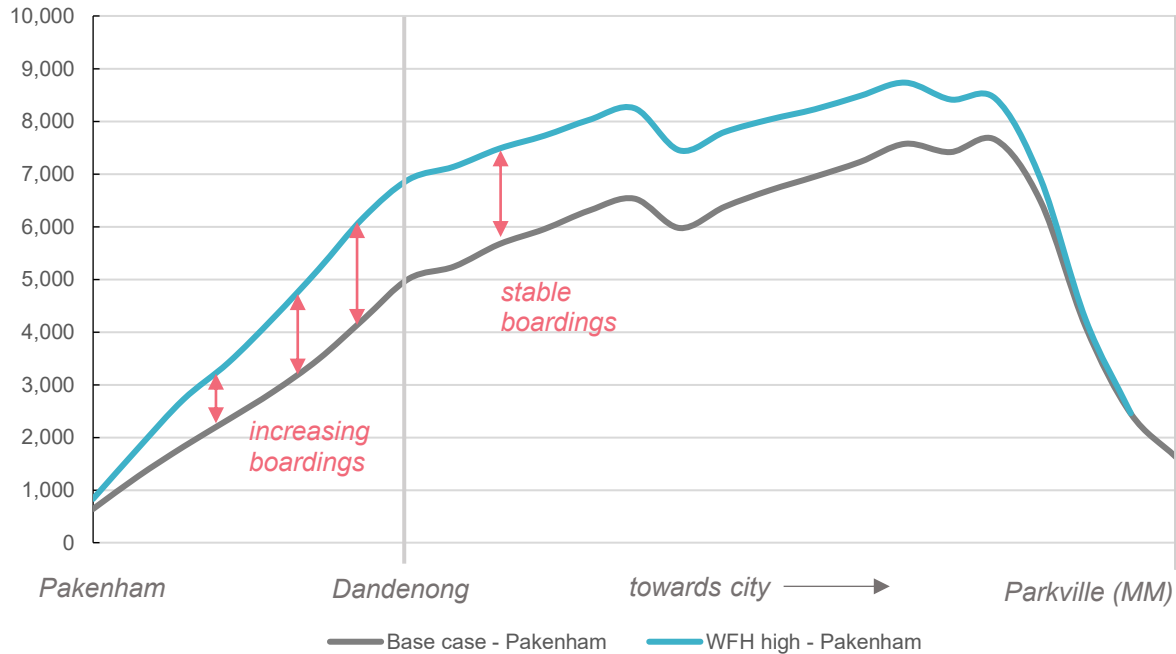
Source: Infrastructure Victoria analysis of ARUP and Victoria University, Working from home VLUTI modelling, 2021

Due to the higher public transport mode share, both total distance and hours travelled on public transport are higher in the working from home scenarios. While trips are longer, people also travel at faster speeds. Similar to the road network, these higher speeds are likely driven by more common longer-distance train commutes towards the central city on the metropolitan and regional rail lines. This reflects the dispersion of people from inner areas (which typically have relatively shorter public transport commutes) to outer areas which have longer public transport commutes, as well as the concentration of employment within central Melbourne.

3.2.4   Local travel grows more slowly

Figure 16 and Figure Figure 17 show origin-destination data. Our working from home scenarios project slower growth in local trips occurring within individual FUAs, and slower growth in trips heading outbound from inner Melbourne in the morning peak, compared to the base case. The only acceleration in trip growth is from travellers originating in outer areas travelling inbound during the morning peak, towards the central city. These are net effects, reflecting the combination of multiple changes. For example, our model projects an increase in people taking home-based trips when working from home, such as for running errands from home rather than their office. But this increase is offset by slower growth in work trips overall, and more frequent longer trips outside people's local areas.

Figure 16. Change in private vehicle origin-destination pairs, WFH medium vs base case, morning peak, 2036

				Destination			
		Inner Melbourne	Middle Melbourne	Outer Melbourne	Melbourne New Growth Areas	Regional City	Regional Centres and Rural Areas
Origin	Inner Melbourne	- 12,095	- 5,324	- 504	- 28	- 0	- 20
	Middle Melbourne	- 94	- 26,940	- 7,721	- 297	2	- 380
	Outer Melbourne	1,999	2,570	- 29,860	- 4,399	- 193	- 1,868
	Melbourne New Growth Areas	902	1,556	- 2,910	- 4,816	- 264	- 1,324
	Regional City	58	118	1,137	1,134	- 18,643	- 866
	Regional Centres and Rural Areas	335	544	2,223	2,061	- 1,571	- 13,765

Source: Infrastructure Victoria analysis of ARUP and Victoria University, Working from home VLUTI modelling, 2021
Note: Blue indicates more trips, compared to the base case, for the origin and destination pair. Red indicates less trips.

Figure 17. Change in public transport origin-destination pairs, WFH medium vs base case, morning peak, 2036

				Destination			
		Inner Melbourne	Middle Melbourne	Outer Melbourne	Melbourne New Growth Areas	Regional City	Regional Centres and Rural Areas
Origin	Inner Melbourne	- 16,019	- 2,931	228	377	- 2	- 50
	Middle Melbourne	1,010	- 5,560	- 1,656	- 37	10	- 77
	Outer Melbourne	6,792	2,214	- 2,559	- 378	- 37	- 85
	Melbourne New Growth Areas	2,900	1,566	- 176	- 592	- 49	- 67
	Regional City	85	- 20	114	194	- 196	79
	Regional Centres and Rural Areas	328	72	172	99	9	- 42

Source: Infrastructure Victoria analysis of ARUP and Victoria University, Working from home VLUTI modelling, 2021
Note: Blue indicates more trips, compared to the base case, for the origin and destination pair. Red indicates less trips.

We defined a measure of transport accessibility to employment as the proportion of jobs accessible from home locations using private vehicle or public transport within 45 minutes. By this measure, inner and middle Melbourne residents have higher job accessibility levels in the working from home scenarios, compared to the base case. This is because more jobs locate in the central city in the working from home scenarios, expanding the pool of available jobs within reach of inner and middle Melbourne residents.

Outer Melbourne and new growth area residents also experience a small increase in transport accessibility to jobs in the working from home scenarios. Melbourne has strong radial public transport connections like metro train and V/Line services, and the working from home scenarios have more jobs in the central city. This actually produces improved accessibility for workers in outer Melbourne and new growth areas, because these jobs are slightly more accessible to residents living farther away from the city, compared to if those jobs were dispersed throughout the suburbs, as in the base case. This measure of accessibility does not account for the 'virtual' (as opposed to transport or physical) increase in accessibility working from home enables with a reduced need to commute every day of the week.

Figure 18.   Change in transport accessibility to jobs (within 45 minutes), WFH medium vs base case, morning peak, 2036

Source: Infrastructure Victoria analysis of ARUP and Victoria University, Working from home VLUTI modelling, 2021

3.2.5   Working from home modestly reduces carbon emissions

Changes in land use and transport patterns as a result of working from home has implications for road vehicle carbon emissions (CO_2 metric tonnes). Emissions are calculated as a function of distance travelled and network speeds, meaning that disruptions like traffic congestion or land use changes leading to long-distance commuting can impact daily emissions.[57] The working from home scenarios all succeed in modestly reducing vehicle emissions, the largest reduction being in the medium scenario.

The medium scenario records 1392 fewer metric tonnes of CO_2 compared with the base case over a 24 hour period. This represents 0.6% lower total emissions from road vehicles. This overall reduction is likely due to the emissions increase, as a result of longer distance travel, being more than offset by the emissions reduction due to reduced congestion in the city and less travel in general.

[57]This measure does not account for changes in emissions from other modes of transport such as public transport.

4. Responding to changes in population growth trajectories

4.1 Supporting more homes in established areas

4.1.1 Slower population growth in established areas

Our modelling shows that working from home could slow population growth in Melbourne's established inner and middle suburbs and accelerate population growth in outer Melbourne and new growth areas. Our base case projects around 50% of Melbourne's new dwellings to 2036 will be in inner and middle established areas, or around 395,000 dwellings. The medium working from home scenario marginally reduces this to 48%. This means inner and middle Melbourne would have around 20,000 fewer dwellings in 2036, compared to the base case.

Slower population growth in Melbourne's established areas means fewer households can benefit from their typically high levels of existing infrastructure. *Plan Melbourne* includes a policy for the majority of new housing to be in established areas of Melbourne.[58] Our modelling shows that working from home could make this policy harder to achieve.

4.1.2 Governments can provide infrastructure more efficiently in established areas
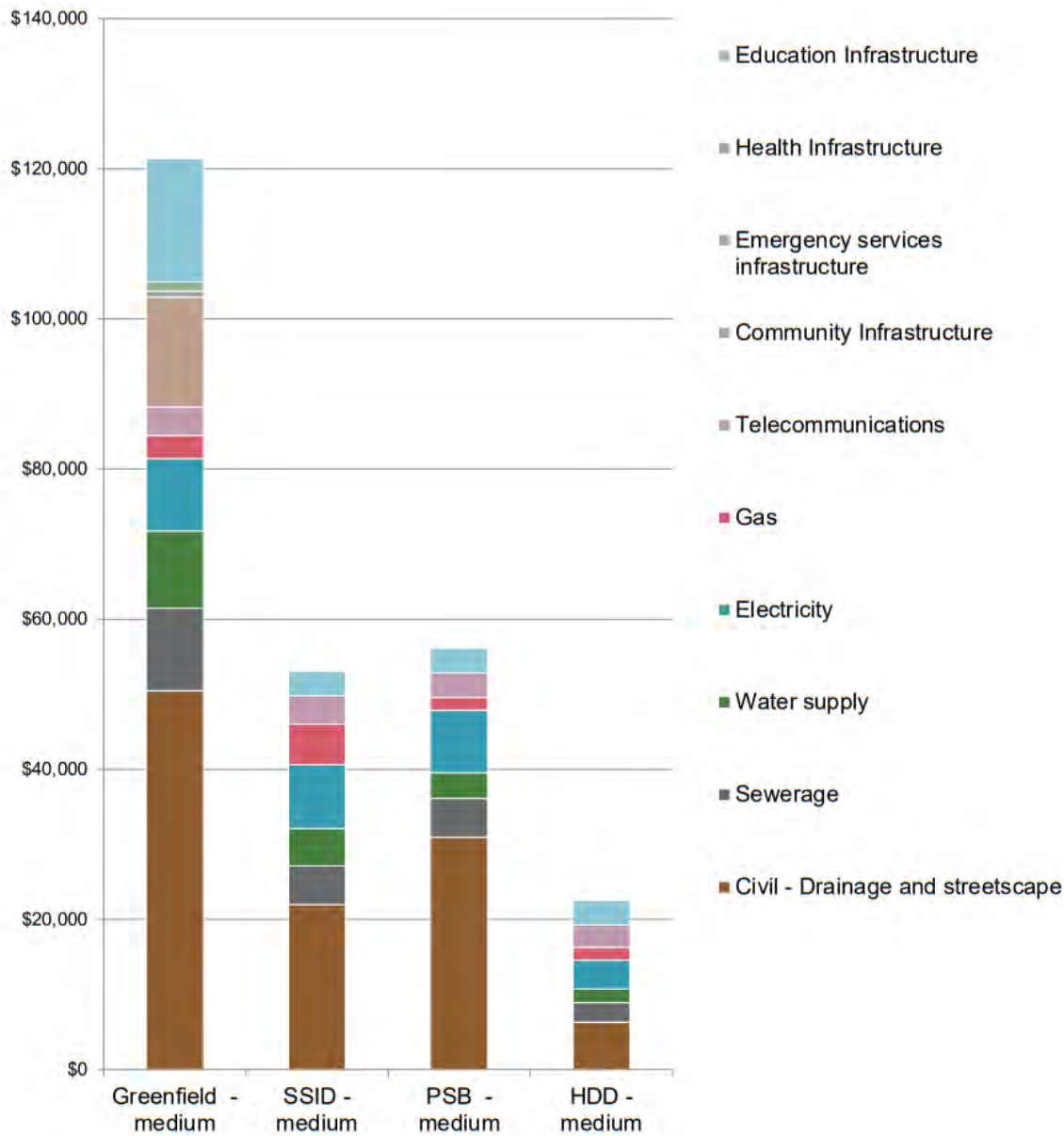
Our *Infrastructure provision in different development settings* report found that it can be two to four times less expensive to provide infrastructure for new homes in established areas rather than new suburbs, excluding transport costs.[59] Figure 19 shows that infrastructure capital costs per dwelling in a greenfield area can total around $120,000, compared to around $55,000 in an established area, such as middle Melbourne. While infrastructure costs can significantly vary between different settings, established areas will be less expensive to service where there is the capacity to support more dwellings without a major infrastructure upgrade, augmentation or land acquisition for expansion.

[58] *Department of Environment, Land, Water and Planning (DELWP), Plan Melbourne 2017-2050, 2017, Victorian Government, https://www.planmelbourne.vic.gov.au/__data/assets/pdf_file/0007/377206/Plan_Melbourne_2017-2050_Strategy_.pdf*

[59] *Infrastructure Victoria, Infrastructure Provision in Different Development Settings: Metropolitan Melbourne Technical Paper Volume 1, 2019, Victorian Government, https://www.infrastructurevictoria.com.au/wp-content/uploads/2019/08/IPIDDS-Metro-Melbourne-Vol-1-Technical-Paper-Aug2019.pdf.pdf*

Established areas typically have better transport access to jobs, education, and services.[60] For some jobs, working from home means people do not need to travel to a workplace as often. But physical job access still matters if workers commute to work on some days. People will also still need physical access to education institutions, health services, and recreation, among others. Building homes in established areas allows new residents to take advantage of existing, well developed transport networks. This helps achieve *Plan Melbourne*'s goal of 20-minute neighbourhoods, where daily needs can be met within a 20-minute walk from home, with access to safe cycling and local transport options.[61]

[60] Infrastructure Victoria, Major Transport Program Strategic Assessment report, 2021, Victorian Government,
https://www.infrastructurevictoria.com.au/wp-content/uploads/2021/08/Major-Transport-Program-Strategic-Assessment-Report.pdf
[61] Department of Environment, Land, Water and Planning (DELWP), 20-minute neighbourhoods, 2021, Victorian Government,
https://www.planning.vic.gov.au/policy-and-strategy/planning-for-melbourne/plan-melbourne/20-minute-neighbourhoods

The Victorian Government's metropolitan planning strategy, *Plan Melbourne*, broadly encourages more dwellings in established areas. It notes the profound benefits of a compact city:[62]

- **Social**: Encourages positive social interaction and diversity, improves the viability of (and access to) community services and enables more (and better integrated) housing.

- **Economic:** Enhances the economic viability of development, improves the economic viability of infrastructure delivery and utilises existing infrastructure.

- **Transport**: Creates sustainable demand for more transport options—including public transport, walking and cycling—and can reduce overall travel time.

- **Environmental:** Creates opportunities for efficient use of resources and materials, creates less pollution through the promotion of sustainable transport, preserves and helps fund the maintenance of public open space, creates new public open space, reduces overall demand for development land, and avoids expanding suburbs without supporting services.

4.1.3   Continue to support new homes in established areas

Our modelling finds working from home could add population pressure in new growth areas, making *Plan Melbourne's* goal of the majority of new dwellings in established areas harder to achieve.

Many established suburbs of Melbourne can accommodate more homes, with plentiful access to employment, education, services, and good transport connections, as well as better integration of land use and infrastructure. By understanding community needs, and carefully investing in supporting infrastructure and upgrades, these established places can add more homes, and become sustainable and inclusive communities.

The Victorian Government should develop clear criteria to identify priority places, and better integrate land use and infrastructure planning for these to efficiently and effectively deliver a denser urban form. It should include these places in the final Metropolitan Regional Land Use Framework Plans and next periodic review of *Plan Melbourne*, partner with local governments to develop or update associated structure plans, and support planning scheme amendments. Precinct plans should detail the local community's aspirations, any barriers to achieving them, and the infrastructure, cost and funding mechanisms required. This could include reviewing current land use zones to support more housing. Land use re-zoning can potentially remove restrictions and improve certainty for residential development.

In supporting new homes in established areas, provision should be made for low-income households to ensure equitable access to housing in established areas. Inner and middle Melbourne is particularly well served with good transport and high residential amenity. This makes them well suited to accommodate more housing for very low-income households. The Victorian Government should introduce mandatory requirements when re-zoning residential land to include a value capture mechanism to facilitate delivery of more affordable rental housing. Pursuing greater housing density and diversity in established areas is a counter-balancing measure to offset extra pressure toward population dispersion, helping achieve an urban form that reduces infrastructure costs and supports broader community wellbeing and service delivery efficiency.

To help meet** Plan Melbourne's **goal of the majority of new homes in established areas, we recommend the Victorian Government:

- ***Support more homes in priority established places. Identify new priority locations in established suburbs for residential intensification to better use existing infrastructure. Following this, in partnership with local government, review planning settings to allow increased housing density and establish design review advisory panels.**[63]*

- ***Use value-capture mechanisms to deliver very low-income housing. Change and actively apply planning regulations to provide affordable rental housing for Victorians on very low incomes in places with good access to public transport and services, when they are re-zoned for more intensive residential use.**[64]*

4.2   Outer and growth areas will need their infrastructure needs met

4.2.1   Connected open space is good for people and the environment

Base case population estimates project Melbourne's new growth areas to rapidly grow in coming decades with around 770,000 more residents between 2018 and 2036. Our modelling shows that working from home could accelerate

[62] *Department of Environment, Land, Water and Planning (DELWP), Plan Melbourne 2017-2050, 2017, Victorian Government, https://www.planmelbourne.vic.gov.au/__data/assets/pdf_file/0007/377206/Plan_Melbourne_2017-2050_Strategy_.pdf*

[63] *Infrastructure Victoria, Victoria's infrastructure strategy 2021-2051, 2021, Victorian Government, recommendation 35*

[64] *Infrastructure Victoria, Victoria's infrastructure strategy 2021-2051, 2021, Victorian Government, recommendation 36*

population growth even further in these areas, meaning new residents may need earlier access to adequate infrastructure.

Without the need to travel to a workplace every day, people may recreate closer to home in their local neighbourhoods. This means high quality open space, and tree canopy coverage, may be increasingly needed in Melbourne's new growth areas. Tree canopies and vegetation help dissipate heat trapped in urban environments, provide shade, support evaporative cooling, and reduce water run-off, air pollution and ultraviolet radiation. Mature trees encourage walking and cycling, enhance safety perceptions, and support biodiversity.[65]

Outer and new growth areas in the north and west of Melbourne have lower tree canopy cover than other urban regions. As illustrated in Figure 20, tree canopy cover in the western region was 5.8%, while in the northern region it was 11.7%.[66] By comparison, the eastern region had a canopy cover of 22.6%. Expanding canopy cover in new suburbs in Melbourne's north and west can reduce urban heat, provide habitat, and improve urban amenity in an increasingly hot, dry climate.

Figure 20.   Tree canopy cover is lower in Melbourne's northern and western suburbs.
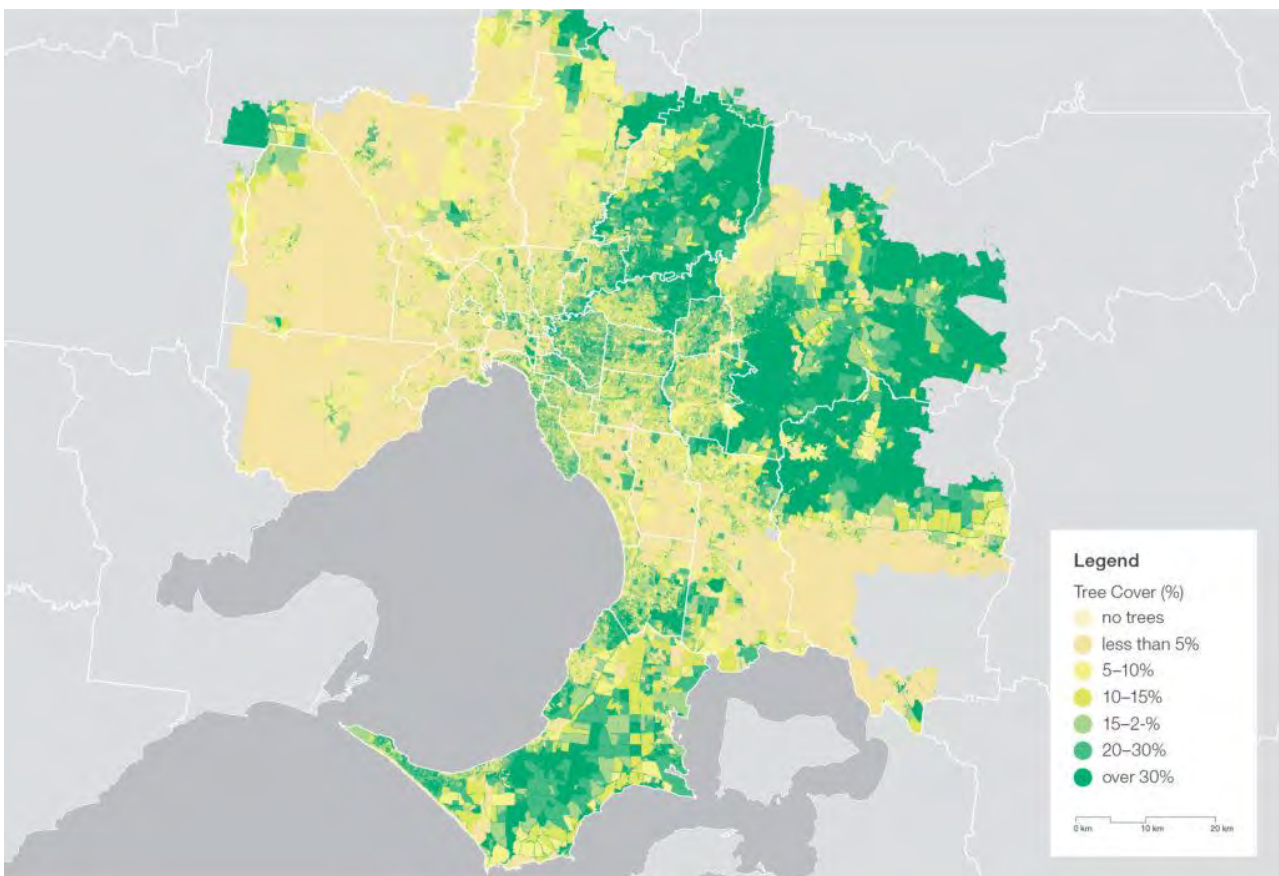
Source: Joe Hurley et al., Urban vegetation cover analysis Melbourne Metropolitan Region, 2018

Public open space includes parks, local streets, waterways, Crown land, and trails. The COVID-19 pandemic demonstrated the value of public open space. People heavily used these spaces for health and recreation. They also support more tree cover, helping reduce urban temperatures and local flooding. In previous community research, we found safe, adaptable multi-functional spaces help manage the impacts of increased housing development.[67] Connected patches and corridors of open space provide opportunities for recreation, active transport, and habitat connectivity.

[65] *Infrastructure Victoria, Victoria's Infrastructure Strategy 2021-2051, 2021, Victorian Government, https://www.infrastructurevictoria.com.au/wp-content/uploads/2021/08/1.-Victorias-infrastructure-strategy-2021-2051-Vol-1.pdf, p. 211*

[66] *Clean Air and Urban Landscapes Hub, Urban Vegetation Cover Analysis, Melbourne Metropolitan Region, 2018, Clean Air and Urban Landscapes Hub*

[67]   *RPS, Infrastructure Victoria 30-year infrastructure strategy engagement report (stage one and two), 2020, prepared for Infrastructure Victoria, www.infrastructurevictoria.com.au/wp-content/ uploads/2020/05/Density-done-well-engagement-report-FINAL.pdf, p. 4*

Street trees increase canopy cover and provide cooler shaded corridors for walking and cycling. Connected open space will help achieve *Plan Melbourne's* goal of 20-minute neighbourhoods in growth areas.[68]

For Melbourne's outer and new growth areas to have connected open space and tree canopy cover, we recommend the Victorian Government:

- **Target 30% tree canopy coverage in new growth areas. Achieve 30% tree canopy coverage in new growth areas by mandating coverage during precinct development, funding relevant Victorian Government agencies and local government to plant, replace and maintain canopy trees, and work with utility providers to remove barriers to tree planting.[69]**

- **Develop an interconnected open space network. Help create an interconnected open space network and extend the urban tree canopy by providing direct funding, and reviewing and reforming the developer open space contribution scheme.[70]**

4.2.2 Growing communities need access to social infrastructure

Many rapidly growing areas lack sufficient social infrastructure to meet their residents' current and future health, education, sport and recreation needs. Our modelling shows that increasing working from home could lead to faster population growth in new growth areas, which would make addressing the lack of social infrastructure more pressing.

Growth areas have fewer libraries and aquatic centres for each person than the rest of Melbourne.[71] Figure 21 shows the locations of existing libraries, and identifies planned new growth areas. With our modelling finding even faster population growth in these areas, this deficit in facilities could worsen more quickly.

This could also mean more families with young children in these areas. Growth area councils contain 35% of all of Melbourne's children aged four years and under, and by 2036 this will increase to 40%, under the base case.[72] Existing libraries and aquatic centres cannot give these children the same access as their peers have elsewhere. Libraries and aquatic centres have large upfront capital costs and current funding does not adequately account for this new regional-scale infrastructure in growth areas.[73]

[68] *Department of Environment, Land, Water and Planning (DELWP), 20-minute neighbourhoods, 2021, Victorian Government, https://www.planning.vic.gov.au/policy-and-strategy/planning-for-melbourne/plan-melbourne/20-minute-neighbourhoods*

[69] *Infrastructure Victoria, Victoria's infrastructure strategy 2021-2051, 2021, Victorian Government, recommendation 77*

[70] *Infrastructure Victoria, Victoria's infrastructure strategy 2021-2051, 2021, Victorian Government, recommendation 37*

[71] *Infrastructure Victoria, Victoria's Infrastructure Strategy 2021-2051, 2021, Victorian Government, https://www.infrastructurevictoria.com.au/wp-content/uploads/2021/08/1.-Victorias-infrastructure-strategy-2021-2051-Vol-1.pdf, p.204*

[72] *Infrastructure Victoria, Victoria's Infrastructure Strategy 2021-2051, 2021, Victorian Government, https://www.infrastructurevictoria.com.au/wp-content/uploads/2021/08/1.-Victorias-infrastructure-strategy-2021-2051-Vol-1.pdf, p.204*
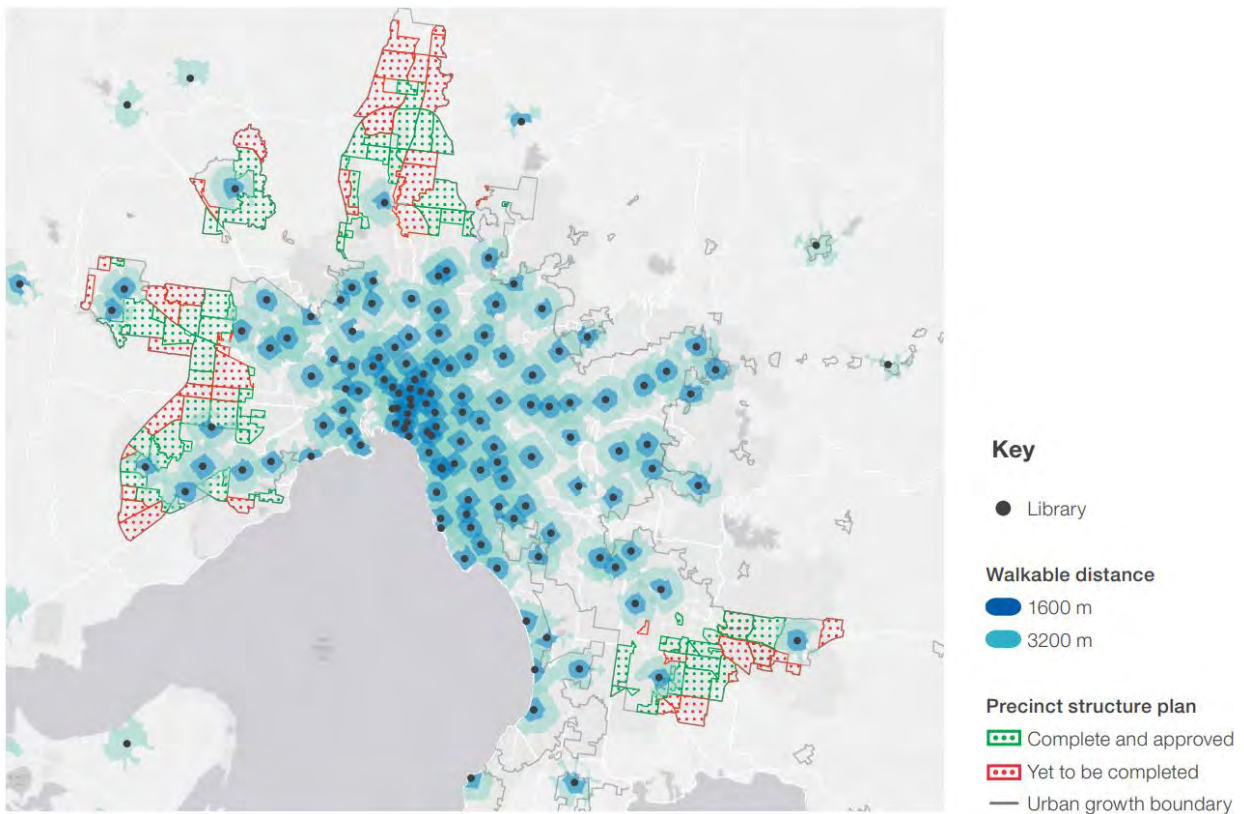
[73] *Infrastructure Victoria, Victoria's Infrastructure Strategy 2021-2051, 2021, Victorian Government, https://www.infrastructurevictoria.com.au/wp-content/uploads/2021/08/1.-Victorias-infrastructure-strategy-2021-2051-Vol-1.pdf, p.204*
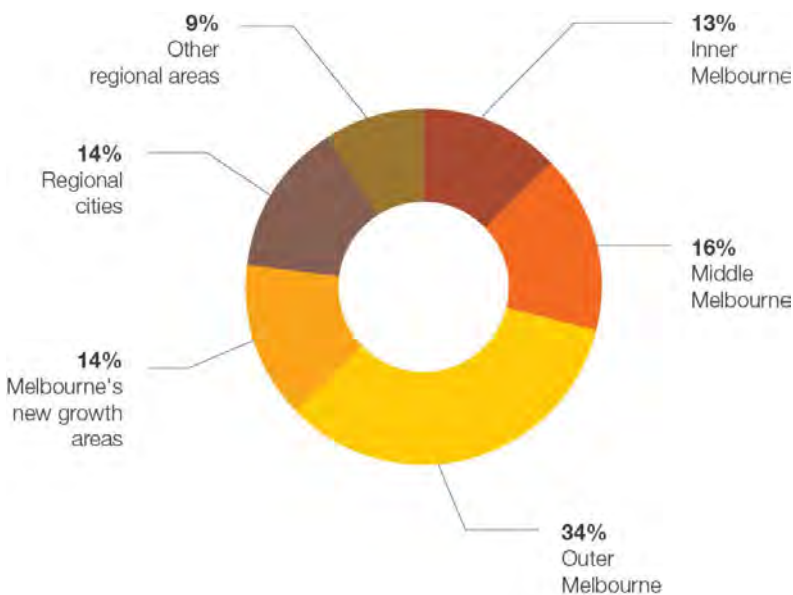
Key

● Library

Walkable distance
● 1600 m
● 3200 m

Precinct structure plan
Complete and approved
Yet to be completed
— Urban growth boundary

Source: Infrastructure Victoria, Social infrastructure in Melbourne's growth areas, 2021

Faster population growth in new growth areas will also put health infrastructure under pressure. Even without working from home, rapidly growing outer suburbs and new growth areas will generate the greatest share of extra demand for hospital services. Figure 22 shows the share of projected new hospital inpatient service demand growth by FUA from 2018-19 to 2041-42 (this does not take into account the faster growth as a result of working from home).

Figure 22.   Demand for hospital services will grow fastest in Melbourne's outer suburbs and growth areas

9%
Other
regional areas

13%
Inner
Melbourne

14%
Regional
cities

16%
Middle
Melbourne

14%
Melbourne's
new growth
areas

34%
Outer
Melbourne

Source: Infrastructure Victoria analysis of Department of Health and Human Services, Inpatient Projection Model, 2018

Given the existing expected shortfall of social infrastructure in new growth areas and the possible faster population growth in growth areas shown in our modelling, we recommend the Victorian Government:

- ***Fund libraries and aquatic centres in growth areas. Increase funding to support local governments to plan and deliver libraries and aquatic recreation centres in Melbourne's seven growth area municipalities.[74]***

- ***Build new hospital capacity. Reserve land for future hospital sites and build new public hospital capacity to meet Victoria's future needs, especially increases in demand from Melbourne's rapidly growing outer northern and western suburbs.[75]***

4.2.3 New growth areas need infrastructure at the right time

Unlike established areas, new dwellings in growth areas have less existing infrastructure to draw on. People moving into new growth areas will rely more heavily on new infrastructure. A shift to more working from home could mean faster population growth in these areas than previously expected. Reforming planning, funding, and delivery of integrated infrastructure servicing these areas can help ensure people have the infrastructure they need, when they need it.

Existing infrastructure planning can be compartmentalised and does not always support or encourage agencies and departments to find synergies, combine funding and synchronise infrastructure delivery.[76] To better integrate land use and infrastructure planning, the Victorian Government should prepare and publish long-term statewide plans for priority infrastructure, including transport. These plans should include sequencing and timelines for infrastructure decision-making and investment. This will help plan for the range of infrastructure needs in rapidly growing areas.

Currently, infrastructure contributions schemes to fund new infrastructure can be complex, time consuming, inflexible and inconsistent.[77] The Victorian Auditor-General's Office noted that contributions are not delivering the infrastructure needed for communities in growing areas to support their quality of life.[78] A patchwork of inconsistent infrastructure contributions schemes can disincentivise development, with developers avoiding areas with contributions schemes in place.[79] The Victorian Government should complete a review of Victoria's infrastructure contributions schemes. Informed by this review, they should implement a consistent, efficient and transparent contributions system, with a clear scheme for developers to contribute to infrastructure costs. The system should apply to areas with significant housing growth. This will help fund the infrastructure people living in new growth areas will need.

The Victorian Government can improve their precinct structure planning to guide growth area infrastructure planning, to better meet the needs of growing communities. While the Victorian Planning Authority can encourage cooperation amongst governments, developers, and utility and service providers, no one entity provides leadership or is accountable for the delivery of timely infrastructure. Individual government agencies can choose the extent to which they include their own infrastructure and service planning in Precinct Structure Plans. Utility providers undertake their infrastructure planning on fixed, three to five-year time horizons, and do not coordinate their budgets with the Precinct Structure Plan process. This means the Victorian Government can find it difficult to deliver infrastructure and services in a timely, coordinated sequence.[80] These existing issues could be exacerbated if Melbourne's growth areas experience even faster growth rates in the medium-term.

Future governance arrangements could provide greater clarity on stakeholder responsibilities and monitor gaps and systemic issues. Clearer policy direction would also support government agencies, councils, the private sector and local communities to make complementary investments. A more collaborative approach would better support people, businesses, utility companies and service providers in growth areas, helping to drive productivity, enhance social benefits and improve environmental outcomes. This would better place infrastructure planning and delivery to deal with faster than previously expected population growth in these areas, which our modelling shows could be a consequence of a shift to working from home.

To ensure infrastructure keeps up with additional pressure for population in growth areas, we recommend the Victorian Government:

- ***Develop and publish long-term statewide infrastructure plans for priority infrastructure sectors for which the Victorian Government maintains substantial responsibilities, including sequencing and***

[74] *Infrastructure Victoria, Victoria's infrastructure strategy 2021-2051, 2021, Victorian Government, recommendation 73*

[75] *Infrastructure Victoria, Victoria's infrastructure strategy 2021-2051, 2021, Victorian Government, recommendation 69*

[76] *Infrastructure Victoria, Victoria's Infrastructure Strategy 2021-2051, 2021, Victorian Government, https://www.infrastructurevictoria.com.au/wp-content/uploads/2021/08/1.-Victorias-infrastructure-strategy-2021-2051-Vol-1.pdf, p.103*

[77] *Infrastructure Victoria, Victoria's Infrastructure Strategy 2021-2051, 2021, Victorian Government, https://www.infrastructurevictoria.com.au/wp-content/uploads/2021/08/1.-Victorias-infrastructure-strategy-2021-2051-Vol-1.pdf, p.103*

[78] *Victorian Auditor-General's Office, Managing Development Contributions, 2020, Victorian Government, https://www.audit.vic.gov.au/report/managing-development-contributions?section=*

[79] *Infrastructure Victoria, Victoria's Infrastructure Strategy 2021-2051, 2021, Victorian Government, https://www.infrastructurevictoria.com.au/wp-content/uploads/2021/08/1.-Victorias-infrastructure-strategy-2021-2051-Vol-1.pdf, p.103*

[80] *Infrastructure Victoria, Victoria's Infrastructure Strategy 2021-2051, 2021, Victorian Government, https://www.infrastructurevictoria.com.au/wp-content/uploads/2021/08/1.-Victorias-infrastructure-strategy-2021-2051-Vol-1.pdf, p.103*

timelines for investment.[81] Develop and publish Victoria's integrated transport plan and require the transport and strategic land use plans to align with each other.[82]

- *Complete a review of Victoria's many infrastructure contributions schemes to create a consistent and efficient system that contributes to Victorian and local government infrastructure costs.[83]*

- *Prioritise and oversee infrastructure delivery in growing communities. Empower a government body to monitor infrastructure delivery in Victoria's new growth areas and priority urban renewal precincts, and proactively advise on delivery sequencing and funding. Develop program business cases for growth areas and precincts that consider timing, sequencing and funding of infrastructure.[84]*

4.3   Consider whether peri-urban areas benefit from faster population growth

Working from home could increase demand for housing in peri-urban areas. Victorian and local governments need to carefully consider the suitability of these regions for accommodating additional housing, as they may have limited infrastructure capacity, and can contain sensitive natural environments and non-urban land uses.

4.3.1   More people in peri-urban areas around Melbourne

Our modelled working from home scenarios simulate faster population growth in peri-urban areas outside Melbourne and regional cities. Faster growing peri-urban places include the Murrindindi, Macedon Ranges and Moorabool Local Government Areas. Peripheral areas of some regional cities, particularly Geelong and Ballarat, also have more residents in 2036 compared to the base case.

The media have reported short-term population trends and rising housing costs in Victorian regional towns.[85] Our modelled working from home scenarios examine a hybrid model of working from home, which still requires travelling to work some days. Under these circumstances, our modelling finds that regional areas relatively close to Melbourne experience faster population growth, while other regional areas do not.

Therefore, the shift to working from home could increase demand for land, homes and infrastructure in regional areas near Melbourne. Tensions already exist in regional Victoria between aspirations for more infill development which better use existing infrastructure and pressure to re-zone land on the edges of towns for low density residential development.[86] The latter could compromise agricultural and sensitive environmental land uses, and have higher bushfire and flood risks in some locations.

4.3.2   Plan for growth within peri-urban towns with good access to infrastructure

People can be attracted to the proximity to nature, amenity, and accessibility of peri-urban towns. Some towns have residents who commute to larger urban centres, while others are retirement or 'tree change' destinations.[87] Towns which are well connected to Melbourne experienced relatively high population growth before the pandemic.

Peri-urban places do not always receive equivalent policy or infrastructure attention compared to areas within Melbourne's urban growth boundary or large regional cities such as Geelong, Ballarat and Bendigo. Peri-urban areas also differ in their strengths and challenges, and may require different policy responses to other regional areas.

Plan Melbourne identifies urban development pressures in Melbourne's peri-urban areas,[88] and our modelling suggests that these could increase with more working from home. The *Plan Melbourne Implementation Plan* focuses primarily on agricultural, green wedge and distinctive landscape peri-urban areas.[89] It includes a Victorian Government action to support local governments to prepare peri-urban township strategies for places which regional growth plans identify as

[81] Infrastructure Victoria, Victoria's infrastructure strategy 2021-2051, 2021, Victorian Government, recommendation 32

[82] Infrastructure Victoria, Victoria's infrastructure strategy 2021-2051, 2021, Victorian Government, recommendation 33

[83] Infrastructure Victoria, Victoria's infrastructure strategy 2021-2051, 2021, Victorian Government, recommendation 34

[84] Infrastructure Victoria, Victoria's infrastructure strategy 2021-2051, 2021, Victorian Government, recommendation 72

[85] Terzon, Emilia, COVID-19 has made a tree change more alluring – but that may not last, 2021, ABC News, https://www.abc.net.au/news/2021-06-25/covid-regional-australia-population-housing-services/100235562

[86] Jolyon Attwooll, Record new homes built, Ballarat Courier, 11 February 2021, p.3; Alex Ford, The growth question, Ballarat Courier, 21 November 2020, p.17; Jolyon Attwooll, Building Boom, Ballarat Courier, 30 November 2020, p.1; City of Ballarat, Today Tomorrow Together: The Ballarat Strategy Our Vision for 2040, 2015, City of Ballarat, https://www.ballarat.vic.gov.au/sites/default/files/2019-04/Ballarat%20Strategy%202040.pdf

[87] Aither, An analysis of regional Victoria's strengths and challenges. Inter-regional assessment, 2019, Prepared for Infrastructure Victoria, Victorian Government, https://www.infrastructurevictoria.com.au/wp-content/uploads/2019/04/Aither-Inter-regional-assessment-March-2019.pdf, p.34

[88] Department of Environment, Land, Water and Planning (DELWP), Plan Melbourne 2017-2050, 2017, Victorian Government, https://www.planmelbourne.vic.gov.au/__data/assets/pdf_file/0007/377206/Plan_Melbourne_2017-2050_Strategy_.pdf, p.89

[89] Department of Environment, Land, Water and Planning (DELWP), Plan Melbourne Implementation Actions: Plan Melbourne 2017-2050, 2019, Victorian Government, https://www.planmelbourne.vic.gov.au/__data/assets/pdf_file/0007/377125/3.-Plan_Melbourne_2019_Implementation_Actions.pdf, Action 17 and Action 74

appropriate for more growth.[90] The Victorian Government and local governments might also consider setting strategic directions for peri-urban places, including considering their infrastructure needs and capacity, by refreshing regional growth plans and as part of the next periodic review of *Plan Melbourne*.

In Melbourne's peri-urban areas, local government housing strategy and township planning vary in quality. Future infrastructure needs may not be clear in all peri-urban areas. Local governments may be incrementally re-zoning land on the fringes of peri-urban towns, without undertaking strategic land assessment as part of a housing strategy. But without these assessments and forward planning, new residents may find they lack the basic utilities, infrastructure and services they need. Problems with insufficient water and sewerage infrastructure may be more intense for peri-urban areas than in Melbourne's growth suburbs, as these areas cannot readily leverage Melbourne's existing utility infrastructure. A full assessment of towns' current urban areas and residential land supplies should include evaluation of existing infrastructure networks' capacity to support growth.

This strategic planning can also support local governments in defining settlement boundaries for peri-urban towns. These boundaries prohibit or limit urban development outside them. The Victoria Planning Provisions include this mechanism, which is already used, for example, in these locations:

- The Shire of Macedon Ranges has protected settlement boundaries for a number of towns within its boundaries, defined in 2018 changes to the *Planning and Environment Act 1987*.[91] This includes Kyneton, which our modelling shows could experience increased population growth with more working from home. The Shire is currently working on developing boundaries for Gisborne.[92] Both towns are already well connected to Melbourne with a regular V-Line service.

- To the east of Melbourne, Shire of Yarra Ranges' townships such as Seville and Yarra Junction have clearly defined urban areas as part of Melbourne's urban growth boundary.

- The City of Greater Geelong's Settlement Strategy 2036 Housing Framework Plan introduced indicative settlement boundaries for towns on the Bellarine Peninsula.[93]

- In Melbourne's north, the City of Whittlesea has proposed an urban growth boundary around the peri-urban Whittlesea township. The council is under pressure from landowners to shift green wedge areas to residential zones. It is also aware of land banking outside of the township in anticipation of a zoning change. It is advocating for a boundary as it would prefer development to occur within the existing town.[94]

If working from home continues, peri-urban regions may become more attractive places to live. Some peri-urban towns are well serviced by V/Line and have the infrastructure capacity to accommodate more housing in their established areas. State planning policy currently identifies towns which may be able to accommodate more growth. However, in other locations, carefully managed population growth can help maintain their amenity, preserve their heritage and protect significant landscapes.[95] Victoria's regional growth plans further identify peri-urban towns where major population growth may be supported, requiring further assessment.[96] Good quality evidence of the impact and consequences of more peri-urban housing development means the Victorian Government and local governments can make better decisions about whether and how to respond to trends contributing to more dispersed settlement, such as working from home.

We recommend the Victorian Government partner with local governments to assess the capacity of peri-urban towns to accommodate accelerated population growth. This should include evaluation of existing infrastructure networks' capacity to support growth. The assessment could be through updated regional growth plans and local housing strategies. In places with completed land capacity assessments, the Victorian Government should also support local governments to establish growth boundaries to prevent dispersed settlement.

[90] Department of Environment, Land, Water and Planning (DELWP), Plan Melbourne Implementation Actions: Plan Melbourne 2017-2050, 2019, Victorian Government, https://www.planmelbourne.vic.gov.au/__data/assets/pdf_file/0007/377125/3.-Plan_Melbourne_2019_Implementation_Actions.pdf, Action 103

[91] Department of Environment, Land, Water and Planning (DELWP), Macedon Ranges Statement of Planning Policy, 2019, Victorian Government, https://www.mrsc.vic.gov.au/files/assets/public/policies/macedon-ranges-statement-planning-policy.pdf

[92] Macedon Ranges Shire Council, Town-specific planning projects, Gisborne and New Gisborne, 2021, Macedon Ranges Shire Council, https://www.mrsc.vic.gov.au/Build-Plan/Planning-For-Our-Future/Town-based-Projects/Gisborne-and-New-Gisborne?BestBetMatch=gisborne%20boundary|d13b95b2-5146-4b00-9e3e-a80c73739a64|4f05f368-ecaa-4a93-b749-7ad6c4867c1f|en-AU

[93] City of Greater Geelong, Settlement Strategy, 2020, City of Greater Geelong, https://www.geelongaustralia.com.au/common/Public/Documents/8d848164a97b196-settlementstrategyfinalupdatedfeb2021.pdf, p.89

[94] City of Whittlesea, Draft Whittlesea Township Strategy 2020, 2020, City of Whittlesea, https://www.whittlesea.vic.gov.au/media/5106/whittlesea-township-strategy-2020-singles.pdf, p.29

[95] Department of Environment, Land, Water and Planning (DELWP), Victoria Planning Provisions: 11.03-3S Peri-urban areas, 2021, Victorian Government, https://planning-schemes.api.delwp.vic.gov.au/schemes/vpps/11_03-3S.pdf?_ga=2.209290261.62057989.1633515094-530846483.1601899109

[96] For example, Department of Transport, Planning and Local Infrastructure (DTPLI), Central Highlands Regional Growth Plan, 2014, Victorian Government, https://www.planning.vic.gov.au/__data/assets/pdf_file/0026/94445/Central-Highlands-Regional-Growth-Plan-May-2014.pdf

4.3.3 Protect sensitive peri-urban areas

Peri-urban places are often non-urban landscapes without extensive and well-developed infrastructure networks. They can be vulnerable to physical risks such as bushfire, waterway flooding and coastal inundation. Expanding peri-urban towns can also have a physical impact on agriculture, biodiversity, and water quality. People moving to peri-urban towns may not anticipate the range of existing land uses in surrounding areas which generate local and regional economic activity and jobs.

Figure 23 shows the bushfire risk in Melbourne's peri-urban areas. A changing climate means Victoria will be at risk from more frequent and intense bushfires.[97] More people living in bushfire hazard areas increases risks to life and property. This can result in higher costs in the construction of houses and infrastructure in these areas to meet higher resilience and safety standards, as well as higher costs in rebuilding after catastrophic events.[98] The Department of Environment, Land, Water and Planning (DELWP) review of green wedges and agricultural land notes that applications for new subdivisions and dwellings in green wedge areas with Bushfire Management Overlays may not be approved.[99]

Figure 23.   Areas of bushfire risk
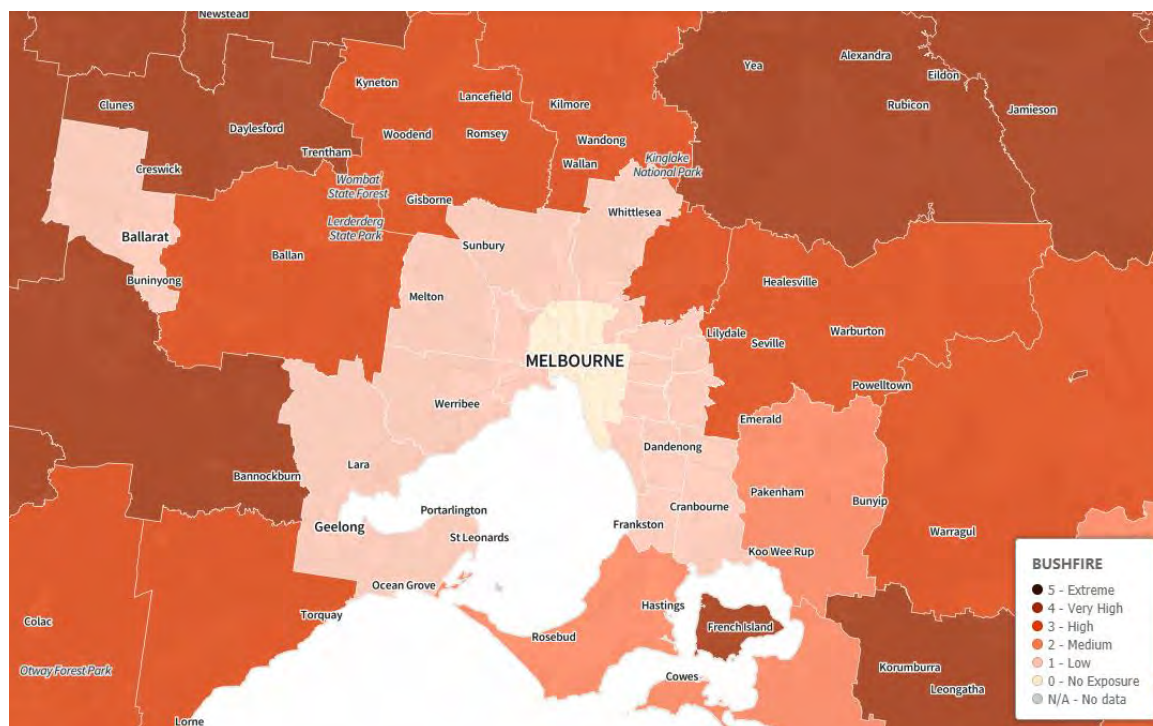
Source: SGS Economics and Planning, Mapping natural perils across Australia, 2016

Our modelling also shows pressure on coastal areas of environmental significance, including parts of the Bellarine Peninsula and the Surf Coast Local Government Area. Rising sea levels and increasingly heavy rainfall are projected to exacerbate coastal erosion and flooding, damaging many low-lying ecosystems, infrastructure, and homes. More frequent storm surges can make this worse.[100]

Peri-urban areas can have productive uses, such as agriculture and mining, which may conflict with more housing development. DELWP's ongoing review of Melbourne's green wedges and agricultural land noted that some of Victoria's most productive agricultural land is within Melbourne's green wedge and peri-urban areas.[101] Figure 24 illustrates the

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[97] *Infrastructure Victoria, Victoria's Infrastructure Strategy 2021-2051, 2021, Victorian Government, https://www.infrastructurevictoria.com.au/wp-content/uploads/2021/08/1.-Victorias-infrastructure-strategy-2021-2051-Vol-1.pdf, p.54*

[98] *Department of Environment, Land, Water and Planning (DELWP), Frequently Asked Questions For lot owners in a Bushfire Prone Area, 2020, Victorian Government, https://www.planning.vic.gov.au/__data/assets/pdf_file/0032/481928/FAQs-Bushfire-Prone-Areas.pdf*

[99] *Department of Environment, Land, Water and Planning (DELWP), Planning for Melbourne's Green Wedges and Agricultural Land Consultation Paper, 2020, Victorian Government, https://www.planning.vic.gov.au/__data/assets/pdf_file/0014/501026/Consultation-Paper-Planning-for-Melbournes-Green-Wedges-and-Agricultural-Land-FINAL.pdf, p.36*

[100] *Infrastructure Victoria, Victoria's Infrastructure Strategy 2021-2051, 2021, Victorian Government, https://www.infrastructurevictoria.com.au/wp-content/uploads/2021/08/1.-Victorias-infrastructure-strategy-2021-2051-Vol-1.pdf, p. 67*

[101] *Department of Environment, Land, Water and Planning (DELWP), Planning for Melbourne's Green Wedges and Agricultural Land Consultation Paper, 2020, Victorian Government, https://www.planning.vic.gov.au/__data/assets/pdf_file/0014/501026/Consultation-Paper-Planning-for-Melbournes-Green-Wedges-and-Agricultural-Land-FINAL.pdf, p. iv*

green wedge and farming lands in Melbourne's peri-urban area. These areas provide food to a growing Melbourne, support local economies, and contribute to Victoria's exports.[102]

The DELWP review has proposed protecting farmland with stronger requirements for minimum lot sizes for owners to build new homes. This should help prevent converting agricultural land to urban uses, and counterbalance increasing demand for residential uses, which could be exacerbated by more working from home. Individual local governments should also consider the findings from DELWP's review and associated planning scheme changes.

Figure 24. Peri-urban planning zones
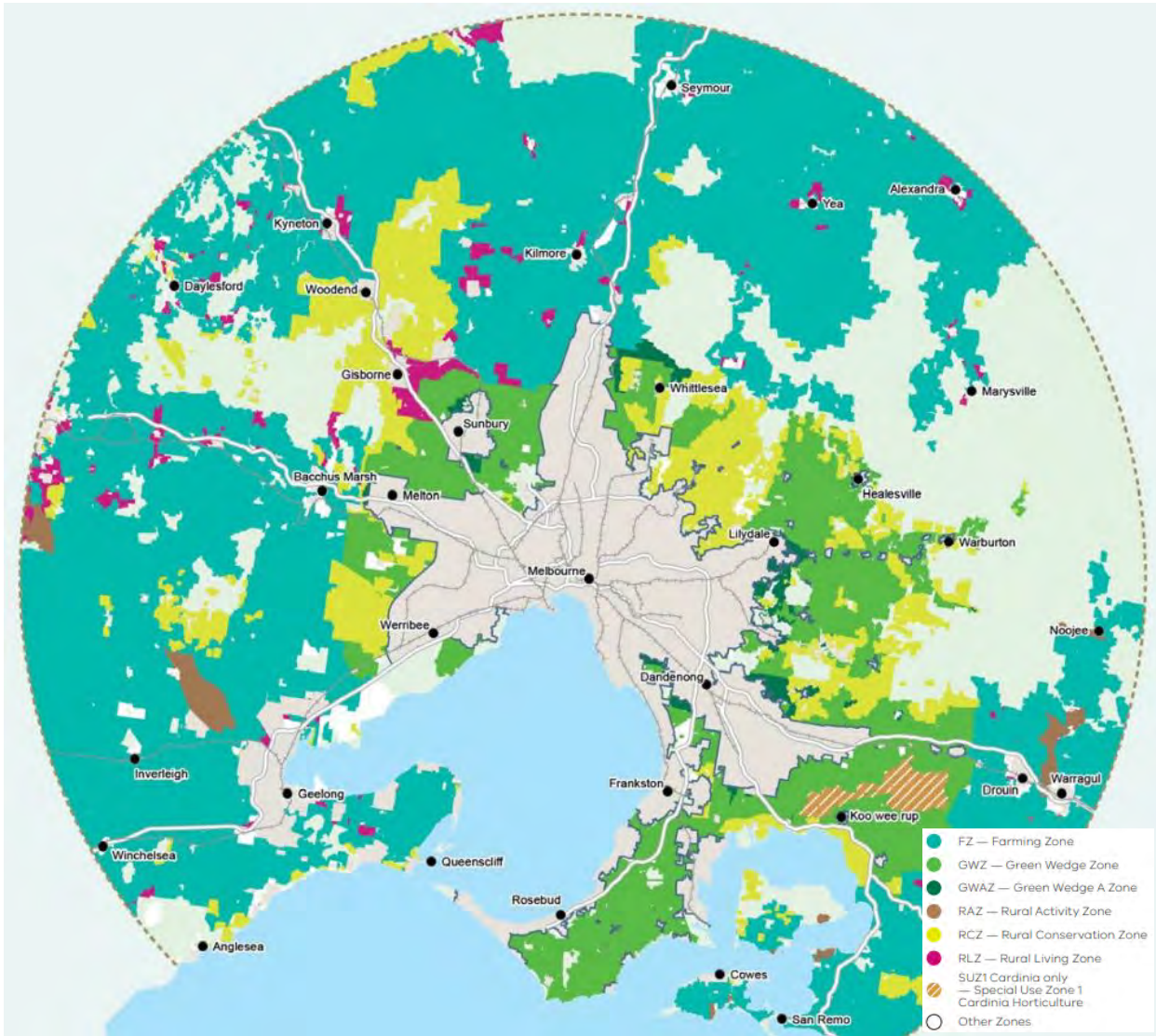
Source: Department of Environment, Land, Water and Planning (DELWP), Planning for Melbourne's Green Wedges and Agricultural Land Consultation Paper, 2020

More people living in Melbourne's peri-urban areas may accelerate conflict with other productive uses such as mining. Quarries supply rock to help support new home construction all over Victoria, but development pressure near existing or proposed quarry sites can place their operations at risk. For example, the Beveridge North West Precinct Structure Plan illustrates the potential conflict between a proposed quarry and future nearby residents.[103]

[102] *Department of Environment, Land, Water and Planning (DELWP), Planning for Melbourne's Green Wedges and Agricultural Land Consultation Paper, 2020, Victorian Government, https://s3.ap-southeast-2.amazonaws.com/hdp.au.prod.app.vic-engage.files/3716/0627/6497/Consultation_Paper_-_Planning_for_Melbournes_Green_Wedges_and_Agricultural_Land_FINAL.pdf*

[103] *North Central Review, Wallan quarry meeting now online, 7 September 2021, https://ncreview.com.au/2021/09/07/wallan-quarry-information-session-to-be-held-online/; North Central Review, Quarry decision in minister's hands, 9 March 2021, https://ncreview.com.au/2021/03/09/quarry-decision-in-ministers-hands/*

Peri-urban areas with defined distinctive landscapes may have stronger protections. The Shire of Macedon Ranges has defined boundaries for some towns. The Bellarine Peninsula and Surf Coast draft planning statements also propose this approach. These areas experience faster population growth in our working from home scenarios. Containing growth within settlement boundaries, and prioritising areas within those boundaries as high change, incremental, and minimal change along with specified greenfield areas, should concentrate residential development. This approach aims to reduce development impact on biodiversity, water and coastal areas, while minimising new development's vulnerability to bushfire and flooding. The strength of these approaches will depend on local governments' interpretation of policies which suggest discouraging, avoiding and directing rather than prohibiting or preventing.

We recommend that the Victorian Government and local government work to ensure new housing development in peri-urban areas avoids areas of agricultural or natural resource value, natural hazard risk, or environmental sensitivity.

4.4   Working from home means more time at home

The pandemic demonstrated to workers and employers that working from home can be viable. Surveys of workers have found that people want to spend more time working from home, once restrictions have eased.[104] Our medium scenario is based on two additional days worked from home each week in the medium-term.

More working from home means people spend more time at home. People will consume energy at home for heating, cooling and lighting, rather than in an office. They also use more water and create more waste at home. If the shift to working at home persists, then this transfer of consumption from the office to home affects the efficiency of energy and other utility use.

4.4.1   Energy efficient homes for more time at home

Using energy more efficiently is essential to meeting Victoria's net-zero greenhouse gas emissions target by 2050. Energy use in buildings accounts for around one-third of Victoria's total greenhouse gas emissions, with heating and cooling making up over 40% of home energy costs.[105] Using electricity more efficiently also helps reduce demand overall, ultimately saving on infrastructure costs, as well as cost savings to individual households.[106]

The energy efficiency of homes and buildings can lock in future energy demand, as they are long-lasting and can be difficult to change. More than half of Australia's building stock in 2050 will be constructed during the next 30 years, at prevailing energy efficiency standards. The rest may need retrofitting to help prevent escalating energy costs and demand. Many well-established international energy management policies, practices, and technologies have significant potential.[107]

Energy efficiency becomes even more important in a warmer climate, avoiding extra cooling costs and heat-related health consequences. One study found residents of 0.9 energy star rated homes in Melbourne were about 50% more vulnerable to experiencing heat stress during a heatwave compared with residents of 5.4 energy star rated homes.[108]

Efforts to improve energy efficiency of existing housing and non-residential buildings in Victoria are underway. This includes incentives through the Victorian Energy Upgrades program to assist businesses and households to improve buildings, appliances and equipment as well as housing retrofit programs for low-income households that provide subsidised upgrades.[109]

With working from home shifting energy use from office buildings to homes, the Victorian Government should do more to improve the energy efficiency of homes. ***We recommend the Victorian Government act to improve the energy efficiency of homes:***

- ***Require 7-star energy-rated new homes by 2022, and increase afterwards. Require all new homes to achieve a minimum 7.0-star NatHERS rating (or equivalent) by 2022, increasing towards 8.0 stars (or equivalent) by 2025, either through the National Construction Code or Victorian regulations.[110]***

- ***Mandate a home energy disclosure scheme. Develop an energy efficiency disclosure scheme for home sales, to overcome information barriers and encourage energy efficiency improvements to existing homes.[111]***

- ***Strengthen minimum energy efficiency standards for rented homes. Increase minimum energy efficiency standards to reduce energy use and costs in rented homes. Keep updating these standards to reflect new cost effective measures, and improve renters' ability to make home energy efficiency improvements.[112]***

[104] *Institute of Transport and Logistics Studies, Transport Opinion Survey (TOPS) September 2020, 2020, The University of Sydney, https://www.sydney.edu.au/content/dam/corporate/documents/business-school/research/itls/tops-2020-sep.pdf*
Kumar, Nitish and Nigel Pugh, Victoria work from home survey, 2020, Conducted on behalf of the Department of Jobs, Precincts and Regions by Venture Insights

[105] *Infrastructure Victoria, Victoria's Infrastructure Strategy 2021-2051, 2021, Victorian Government, https://www.infrastructurevictoria.com.au/wp-content/uploads/2021/08/1.-Victorias-infrastructure-strategy-2021-2051-Vol-1.pdf, p. 40*

[106] *Infrastructure Victoria, Victoria's Infrastructure Strategy 2021-2051, 2021, Victorian Government, https://www.infrastructurevictoria.com.au/wp-content/uploads/2021/08/1.-Victorias-infrastructure-strategy-2021-2051-Vol-1.pdf, p. 40*

[107] *Infrastructure Victoria, Victoria's Infrastructure Strategy 2021-2051, 2021, Victorian Government, https://www.infrastructurevictoria.com.au/wp-content/uploads/2021/08/1.-Victorias-infrastructure-strategy-2021-2051-Vol-1.pdf, p. 40*

[108] *Infrastructure Victoria, Victoria's Infrastructure Strategy 2021-2051, 2021, Victorian Government, https://www.infrastructurevictoria.com.au/wp-content/uploads/2021/08/1.-Victorias-infrastructure-strategy-2021-2051-Vol-1.pdf, p. 40*

[109] *Department of Environment, Land, Water and Planning (DELWP), 2020 Report on Progress: Plan Melbourne 2017-2050, 2020, https://planmelbourne.vic.gov.au/__data/assets/pdf_file/0005/544253/Plan-Melbourne-Report-on-Progress-2020.pdf, p.55, Action 82*

[110] *Infrastructure Victoria, Victoria's infrastructure strategy 2021-2051, 2021, Victorian Government, recommendation 05*

[111] *Infrastructure Victoria, Victoria's infrastructure strategy 2021-2051, 2021, Victorian Government, recommendation 06*

[112] *Infrastructure Victoria, Victoria's infrastructure strategy 2021-2051, 2021, Victorian Government, recommendation 07*

5. Responding to changes in employment patterns

5.1   Inner Melbourne remains an important area for employment

Our modelling suggests that more working from home could further concentrate employment in inner Melbourne. This is likely due to inner Melbourne offering employers better transport access to a more dispersed population and the benefits of agglomeration. This effect is concentrated within the central city, Docklands, Southbank and St Kilda Road precincts. These places already have a large share of knowledge-intensive jobs in industries such as professional, scientific and technical services, financial and insurance services, information media and telecommunications occupations.[113]

The gravity of the pull of employment towards inner Melbourne reduces with distance from the central city. Our modelling of working from home finds all other areas of Victoria see a reduction in employment in 2036, compared to the base case.

5.1.1   Office use may be different in the future

Our modelling suggests that working from home is unlikely to be the demise of the central city over the medium-term. The central city remains a prominent centre for employment and economic activity in our working from home scenarios.

However, the precise impact of working from home on the net demand for central city commercial office space in the medium-term is not clear and is not something we explicitly modelled. Changes in workplace practices as a result of working from home will influence overall demand for space and market supply responses. Within an individual workplace, working from home could mean fewer total people attending the office on any particular day. People may only travel in for more collaborative activities, rather than to undertake work that could otherwise be done at home. Existing central city businesses may repurpose or consolidate their office spaces to save money. Other employers may move into the central city.

In the short-term, the Victorian Government and the City of Melbourne have focused on the impact of fewer central city workers coming into work as a direct result of enforced restrictions.[114] In the medium-term, the market will adjust to changes in office space demand, both in quantity and how it is used. Office space demand modelling for US cities finds slight short-term decreases in office space absorption. In the longer-term, it predicted markets would recover from this initial shock and find a new equilibrium for price, supply, vacancy and demand.[115] These broad trends are likely to apply to Melbourne.

5.1.2   The central city can readily adjust to change

For several decades Melbourne's central city has had a relatively deregulated land use zone. This allows a wide range of uses, few height controls and limited options to object to proposed development.[116] These conditions allow the market to respond to changes to demand for central city buildings over the medium-term. In the short-term, there are signs that landlords are already taking flexible approaches with tenants and tenancies.

In the short-term, owners and tenants can reconfigure existing office spaces. Over a longer period, architects can design flexibility into new buildings to easily adapt to multiple future uses. Buildings with flexible design also have environmental

[113] SGS Economics and Planning Pty Ltd, Economic, Social & Environmental Profile: Inner Melbourne Region, 2019, prepared for Infrastructure Victoria, Victorian Government, https://www.infrastructurevictoria.com.au/wp-content/uploads/2019/04/SGS-Economic-social-and-environmental-profile-Inner-Metro-Region-April-2019.pdf

[114] Lenaghan, Nick, Empty desks a rising problem for landlords, 2020, Australian Financial Review; https://www.afr.com/property/commercial/empty-desks-weigh-on-melbourne-s-landlords-20200907-p55t4f

[115] Katsikakis, Despina, Davic C Smith, Rebecca Rockey, Michael Rodriguez, Christopher Leinberger, David Bitner, Workplace Ecosystems of the Future, 2020, Cushman & Wakefield and The Center for Real Estate and Urban Analysis, George Washington University

[116] Buxton, Michael, When system becomes strategy: next steps in Victorian neoliberal planning, 2017, State of Australian Cities Conference 2017, https://apo.org.au/node/178311

sustainability benefits and can reduce the cost and extent of alterations.[117] Working from home could mean that offices have fewer people sitting at workstations, but more people collaborating on tasks and using the office outside traditional 9am to 5pm work hours.[118] Some office building owners are already responding to tenants expressing interest in more flexible office workspaces, including more space for meetings and collaboration.[119] For example, Australia's largest commercial office space owner is expanding its existing flexible space options and offering rentals from one hour to ten years.[120]

Working from home may mean an individual employer chooses to reconfigure, move, or reduce their office space in the short-term. However, the agglomeration benefits to businesses of locating in dense urban environments remain. This means, the central city as a whole will continue to attract employers in the medium-term.[121] With many employers moving to a hybrid working from home model, some office space will still be required and, as our modelling shows, the central city is an ideal location to access a dispersed workforce with a radial public transport network. Furthermore, if existing businesses reduce their overall floorspace demand, other employers who could not previously afford space in the central city could viably locate there in the future, including technology start-ups or new creative businesses.[122]

5.2 Focus employment outside of the central city on a limited number of suburban hubs

The COVID-19 pandemic experience of working from home has spurred speculation that businesses could relocate to suburban locations, closer to where workers live. This is based on assumptions that work from home could catalyse the development of virtual business models, changing commercial space requirements and encouraging firms to consider lower rents in suburban locations or smaller satellite offices.[123]

Supporting multiple employment centres outside the central city is a goal of *Plan Melbourne*. Direction 1.2 of *Plan Melbourne* seeks to "improve access to jobs across Melbourne and closer to where people live." It identifies national employment and innovation clusters, metropolitan activity centres and major activity centres as priority places for jobs growth. However, as our modelling shows, increasing working from home results in slower jobs growth in these places, strengthening the attractiveness of the central city for office-based work.

Multiple forces are working against increased polycentricity in the medium-term. Under our working from home scenarios, the central city still provides access to the biggest potential labour pool as well as agglomeration benefits. While jobs centralise, the shift to working from home results in people accepting longer commuting distances on the days they attend their workplace. This results in Melbourne's urban population structure becoming more dispersed.

These two trends—population dispersal and employment centralisation—create challenges to achieving a more polycentric city. For example, if working from home further centralises employment in inner Melbourne, there are implications for the Suburban Rail Loop project and its ability to generate an uplift in suburban jobs around station precincts. The Suburban Rail Loop business case details findings from its integrated land use and transport modelling of a scenario which accounts for the impacts of COVID-19, including more working from home in the future.[124] In line with our modelling, it modelled population dispersion as a result of working from home, making density more difficult to achieve around station precincts. Therefore, to achieve the planned density and maximise the benefits of the Suburban Rail Loop precincts, there needs to be a continued focus on prioritising precincts and making them attractive for employment and population growth.

[117] Macmillan, Sebastian, The value handbook, Getting the most from your buildings and spaces, 2006, Commission for Architecture and the Built Environment, https://www.designcouncil.org.uk/sites/default/files/asset/document/the-value-handbook.pdf

[118] Bleby, Michael, Office landlords and their 'exploding' platform, 2021, Australian Financial Review, https://www.afr.com/property/commercial/office-landlords-and-their-exploding-platform-20201211-p56mrb

[119] Johanson, Simon and Carolyn Cummins, Hybrid work creates risks for office demand, 2021, Sydney Morning Herald, https://www.smh.com.au/business/companies/hybrid-work-creates-risks-for-office-demand-20210628-p584vj.html

[120] Lenaghan, Nick, Biggest office landlord to offer more flexible space, Biggest office landlord to offer more flexible space, 2021, Australian Financial Review, https://www.afr.com/property/commercial/empty-offices-didn-t-hurt-australia-s-biggest-landlord-20210209-p570r6#:~:text=The%20country's%20largest%20office%20landlord,during%20the%20COVID%2D19%20period.

[121] Florida, Richard, The Death and Life of the Central Business District, 2021, Bloomberg CityLab, https://www.bloomberg.com/news/features/2021-05-14/the-post-pandemic-future-of-central-business-districts

[122] Le Grand, Chip, Government weighs plan for Melbourne revival, 2020, The Age, https://www.theage.com.au/national/victoria/government-weighs-plan-for-melbourne-revival-20201017-p565z4.html; PwC Australia, Changing Places: how hybrid working is reinventing the Australian CBD, 2021, PwC, https://www.pwc.com.au/important-problems/future-of-work-design-for-the-future/changing-places-australian-cbd.htmll

[123] Victoria Planning Authority, Shaping Urban Victoria: VPA's response to Covid-19, 2021, Victorian Government, https://vpa.vic.gov.au/wp-content/uploads/2021/07/Shaping-Urban-Victoria-VPAs-Response-To-COVID-19-July-2021.pdf

[124] KPMG, Business and Investment Case, Appendix C1: Suburban Rail Loop Demand Modelling Report, 2021, Prepared for Suburban Rail Loop Authority, Victorian Government, https://suburbanrailloop.vic.gov.au/Library/BusinessandInvestmentCase

As discussed earlier, hybrid working from home may also lead to rent adjustments in the central city. This could expand the office market to new firms, attracted by these rental adjustments and agglomeration benefits.[125] If more firms do locate to inner Melbourne, this could further strengthen the agglomeration benefits of the central city, opening opportunities for skills sharing, matching and learning which occur when firms cluster together.

Without intervention, our modelling suggests working from home could reinforce the current economic geography of Melbourne. The Victorian Government can take different initiatives to support more jobs in suburban centres, such as:[126]

- reviewing planning settings so suburban centres can support productive uses, including ensuring adequate supply of commercial and industrial land and managing conflict with residential land use
- investing in infrastructure which better connects businesses to markets, other businesses and workforces
- locating government services in or next to suburban job clusters
- supporting investments for high quality public realm.

Focusing these efforts on a limited number of suburban hubs will increase the chances of their success in light of the challenges working from home may pose to achieving *Plan Melbourne's* goal of developing employment centres outside the central city. Identifying priority suburban employment centres could form part of the next periodic review of *Plan Melbourne*.

We recommend the Victorian Government identify a limited number of priority suburban centres to concentrate economic activity. These could be places where clustering already occurs and where infrastructure can support growth, such as the national employment and innovation clusters. The Victorian Government should use planning, infrastructure, colocation of services, and public realm improvements to help enable the success of the identified priority suburban centres.

[125] *The Productivity Commission, Working from home Research paper, 2021, Commonwealth of Australia, https://www.pc.gov.au/research/completed/working-from-home/working-from-home.pdf*

[126] *SGS Economics and Planning Pty Ltd, Analysing Melbourne's Enterprise Precincts, 2018, prepared for Department of Environment, Land, Water and Planning, Victorian Government, https://www.planning.vic.gov.au/__data/assets/pdf_file/0020/326711/Analysing-Melbournes-Enterprise-Precincts-SGS-Economics-and-Planning.pdf*

6. Responding to changes in transport use

6.1 Incorporate uncertainty in infrastructure planning

The COVID-19 pandemic highlights the uncertainty of the future. Our modelling shows that a shift to working from home will affect land use and transport demand, and could further concentrate jobs in inner Melbourne while dispersing population away from employment areas. However, working from home may not be the only lasting impact of the COVID-19 pandemic. People changed their purchasing behaviour for goods and services during the pandemic,[127] and business changed their mechanisms for trading with one another.[128] These changes are also likely to have long-term impacts, which will become more apparent as Victoria recovers from the pandemic. Other disruptive events are also on the horizon, such as climate change and the rise of automation and other emerging technologies.[129,130]

Governments can account for future uncertainty in making infrastructure investment decisions to be prepared for change. In this chapter we identify transport recommendations which are necessary under different pre and post-COVID-19 growth assumptions, and become more salient if the shifts to working from home we modelled occur.

To help account for future uncertainty, we also recommend that government further embrace the use of 'real options'. Real options is an investment analysis technique that strategically incorporates future uncertainty into infrastructure planning and investment decisions.

6.1.1 Traditional investment analysis does not adequately value flexibility

Traditional investment frameworks, such as cost benefit analysis, consistently assess and compare the performance of different projects. However, they do not typically strategically assess the uncertainty accompanying them.[131] This means that traditional cost benefit analysis may undervalue projects that offer greater flexibility at higher cost. Investment flexibility often allows projects to perform better in uncertain future scenarios. Incorporating real options into cost benefit analysis and infrastructure planning can capture and evaluate the benefits of this flexibility, so investment decisions can account for the uncertainties of the future.

6.1.2 Real options can value flexibility as part of investment analysis

A real options framework allows decision-makers to value projects which perform well in multiple future scenarios and under a range of assumptions, such as variations in demand, demographics and technology. Real options analysis captures the benefits of investment flexibility, rather than only its costs.

A real options framework first requires the identification of possible future scenarios and their likelihood. This reflects current beliefs about future risks and events which may affect the project.

Decision-makers can then design a range of investment options that suit the different scenarios, as well as investment options that are more flexible and can be adapted to suit multiple scenarios. Such flexibility gives decision-makers

[127] Brown, Brandon, Lindsay Hirsch, Rene Schmutzler, Jasper van Wamelen and Matteo Zanin, *What consumer-goods sales leaders must do to merge stronger from the pandemic*, 2020, McKinsey & Company, https://www.mckinsey.com/industries/consumer-packaged-goods/our-insights/what-consumer-goods-sales-leaders-must-do-to-emerge-stronger-from-the-pandemic

[128] Wunderman Thompson Commerce, *The B2B future shopper report*, 2020, Wunderman Thompson Commerce, https://insights.wundermanthompsoncommerce.com/en-au/the-b2b-future-shopper-report-2020

[129] Infrastructure Victoria, *Advice on Automated and Zero Emissions Vehicles Infrastructure*, 2018, Victorian Government, . https://www.infrastructurevictoria.com.au/wp-content/uploads/2019/04/Advice-on-automated-and-zero-emissions-vehicles-October-2018.pdf

[130] The Office of the Victorian Information Commissioner, *Closer to the Machine, Technical, Social and legal aspects of AI*, 2019, Victorian Government, https://ovic.vic.gov.au/wp-content/uploads/2019/08/closer-to-the-machine-web.pdf

[131] Department of Treasury and Finance, *Investing under uncertainty, Real options analysis technical supplement – Investment Lifecycle and High Value High Risk Guidelines*, 2018, Victorian Government

options for an alternative future.[132] The following table summarises various project design options to manage risk and uncertainty.

This allows decision-makers to compare investment options to each other under the various future scenarios. They can select the investment option with the greatest benefit across future scenarios, accounting for its cost, and adjusting for their probability. This better describes an investment option's performance across multiple scenarios, rather than a single scenario. More costly but more flexible design options may perform better in this analysis.

Figure 25.   Types of real options

Type of option	Description	Examples
Staging	Building discrete parts of the project over time, in line with an overarching plan.	**Transport:** The 1969 Melbourne Transportation Plan highlighted planning reservations for several freeways, including the now M80 Ring Road. The M80 Ring Road was then developed in stages between 1989 and 1997.
Scale change	Ability to scale the project up or down.	**Education**: Relocatable buildings are used to provide flexibility to accommodate enrolment fluctuations.
Scope change	Ability to add or remove elements from the project.	**Transport**: Melbourne Metro business case refers to the project incorporating features for further improvements to the network in the future, such as longer platforms to enable 10 car trains.[133]
Defer	Defer or delay a decision on a project until further information becomes available.	**Transport:** A decision on when to construct a heavy rail link from Avalon airport to the existing track between Melbourne and Geelong was deferred as the number of flights was too low to be able to justify building now. However, a preferred rail route has been identified and protected, meaning the option to invest is available to government and demand can be monitored.[134]
Research or learning	Investing in finding more information.	**Energy**: Providing funding for feasibility studies into alternative technologies that reduce carbon emissions.
Abandon	Discontinuing investment.	**Transport**: After taking into consideration an independent review, ceasing the Registration and Licensing project as the project was identified as no longer suiting the community's need.[135]

Sources: Adapted from the Victorian Department of Treasury and Finance, Investment Lifecycle and High Value/High Risk Guidelines Prove, 2019, p. 10. Examples identified by Infrastructure Victoria.

Governments can take three steps to apply real options in project selection to incorporate the added flexibility benefits.

1.   Continue developing guidance and encourage discussions about uncertainty

As a first step, the Victorian Government should build on real options guidance, beyond the Department of Treasury and Finance's existing technical guidance. This can open discussion about uncertainty and government investment planning. While we modelled future uncertainties and their impact in the medium-term, investment managers need more guidance to embrace uncertainty and flexibility in extracting the maximum value from investments.

2.   Promote real options as an approach and develop capability

Decision-makers should consider real options throughout the entire investment lifecycle. Including real options at the strategic planning stage generates the greatest value. The Victorian Government should promote use of real options analysis across all government agencies, and especially during business case development. This may include training for project designers to learn about real options and apply them appropriately.

[132] *Department of Treasury and Finance, Investing under uncertainty, Real options analysis technical supplement – Investment Lifecycle and High Value High Risk Guidelines, 2018, Victorian Government*

[133] *Rail Projects Victoria, Melbourne Metro Business Case, 2016, Victorian Government, http://metrotunnel.vic.gov.au/__data/assets/pdf_file/0006/40677/MM-Business-Case-Feb-2016-WEB.pdf, p.7.*

[134] *Willingham, Richard, Preferred route revealed for Avalon Airport rail link, but no start date is sight, 2014, The Age, http://www.theage.com.au/victoria/preferred-route-revealed-for-avalon-airport-rail-link-but-no-start-date-in-sight-20140919-10j748.html*

[135] *Cowan, Paris, Victoria dumps RandL project, writes off $97 million, 2015, IT News, https://www.itnews.com.au/news/victoria-dumps-randl-project-writes-off-97m-403600*

3. Enhance transparency of decision-making

By enhancing transparency of decision-making processes, governments can better justify investments to the public and explain the reasoning behind any real options considered in developing a project. Aligning projects with an evidence-based long-term strategic plan can provide transparency, and may assist in public communication of the reasons for taking a real options approach.

We recommend the Victorian Government continues to encourage the uptake of real options, further developing its application by promoting its use and building capacity within government to incorporate real options in investment decisions.

6.1.3   Real options in action

In the early 2000's the Victorian Government evaluated a proposal to expand the Royal Women's Hospital. To decide whether to proceed with this investment, decision-makers needed to estimate the future demand for maternity services. The hospital's recent (at the time) 20% increase in maternity services demand had coincided with the Federal Government's baby bonus.[136] Before the baby bonus, Victoria's birth rate was in long-term decline, thus decreasing the demand for maternity services. Without the baby bonus, the birth rate may have resumed the long-term trend, or alternatively, demand may have continued to increase in line with the short-term trend.

Decision-makers could have invested in a large expansion under the assumption that demand for maternity services would remain high. Alternatively, they could have implemented a real option allowing later addition of new, easily expandable capacity if future demand was higher.

The final Royal Women's Hospital building design incorporated an adjustable roof and other design features which allowed for easier construction of an extra two floors if needed.[137] This allowed the government to save costs if the demand for maternity service did not eventuate, whilst also having the option to increase capacity if demand was higher.

6.2   Transport network pricing can harness the power of flexible work

Before the COVID-19 pandemic, people had limited ability to shift their time of travel for work, or to skip the trip altogether, because working from home and flexible working was not widely accepted. Post-COVID-19, many people intend to work from home more often, on average two to three days each week in feasible occupations. This shift to working from home and more flexible working increases the acceptability of changing commuting behaviour. It can better align transport network users' incentives with their impact on the network.

The disruption of COVID-19 will also challenge the 9am to 5pm workday. Many see the office as becoming primarily a place of collaboration, rather than simply a place to attend every day for set hours.[138] People may prioritise office work for meeting face to face to share ideas and collaborate. Staggered starts can limit crowding in office common areas in the short-term. A June 2020 survey found that 46% of staff would be more likely to return to the office if employers allowed staggered start times.[139] These potential changes would also mean that office start and finish times could become more flexible. Future work behavioural changes could allow more people greater choice in their commuting options. This strengthens the impact of transport pricing reforms, making an already promising change even more beneficial.

6.2.1   Working from home alone will not resolve congestion

Flexible work can affect transport system use. Figure 26 shows that working from home an extra two days each week in feasible jobs could mean around half a million fewer daily car trips, compared to the base case in 2036: a 2.4% reduction. Road vehicles would emit 1,400 fewer tonnes of greenhouse gases (a 0.6% reduction).

[136] *The Victorian Auditor General's Office, The New Royal Women's Hospital – a public private partnership, 2008, https://www.audit.vic.gov.au/sites/default/files/20080625-Royal-Women%27s-Hospital-Public-and-Private-Partnership.pdf, p.24*

[137] *The Victorian Auditor General's Office, The New Royal Women's Hospital – a public private partnership, 2008, https://www.audit.vic.gov.au/sites/default/files/20080625-Royal-Women%27s-Hospital-Public-and-Private-Partnership.pdf, p.25*

[138] *Six Ideas by Dexus, A Research Study on the Outcomes of the COVID-19 Working From Home Experience, 2020, Dexus Funds Management Ltd, https://www.dexus.com/-/media/project/dexus/dexuscom/3-discover-dexus/prism/articles/new-era-of-the-blended-workspace/sixideasbydexus_wfh_researchstudy.pdf*

[139] *Grundy, Emily and SCRUB media, SCRUB survey, wave 4, 2020, Behaviour Works, https://www.behaviourworksaustralia.org/scrub-project-wave-4-australians-views-on-private-gatherings-remote-working-and-getting-tested/*
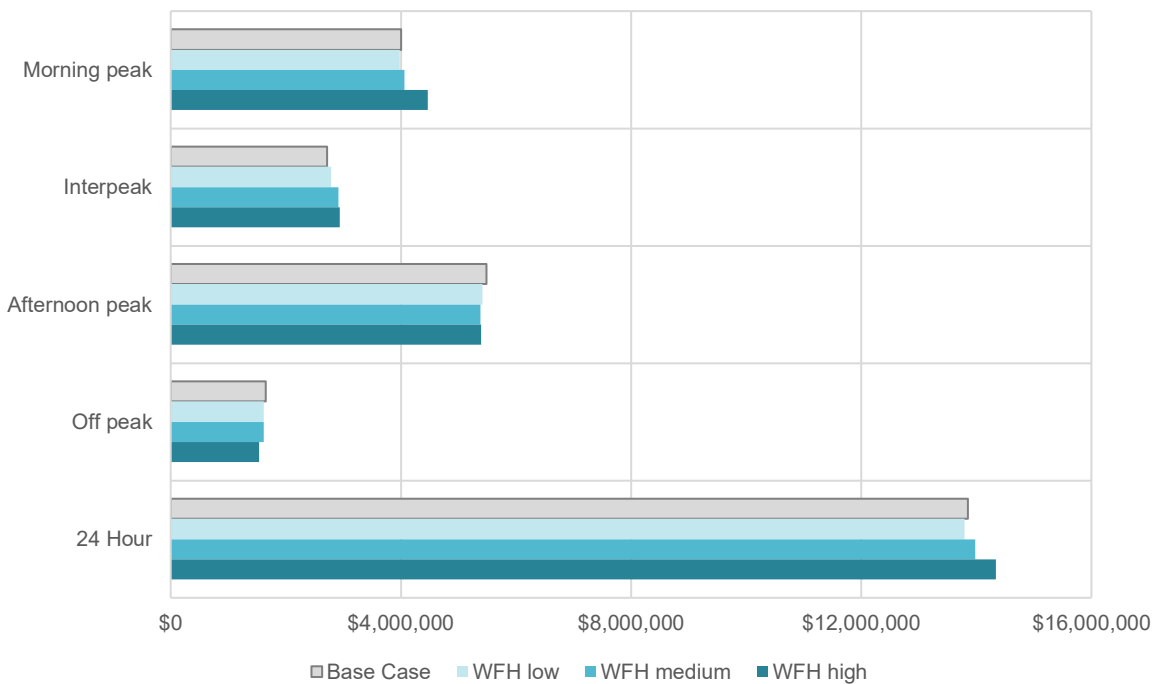
	Tonnes of CO2		Trips
WFH low	-1,053		-267,485
WFH medium	-1,392		-558,403
WFH high	-1,312		-879,045

Source: Infrastructure Victoria analysis of ARUP and Victoria University, Working from home VLUTI modelling, 2021

Perhaps surprisingly, our modelling shows road congestion remaining stubbornly high despite the shift to working from home. The costs of congestion in the working from home scenarios remain at similar levels to the base case, as shown in the figure below.

Figure 27.   Private vehicle cost of road congestion, WFH scenarios vs base case, 2036

Source: Infrastructure Victoria analysis of ARUP and Victoria University, Working from home VLUTI modelling, 2021
Note: Cost of congestion is a measure which provides a monetary estimate on the impact of congestion on private vehicle road users, primarily from the additional time of travel caused by congestion. Time periods are for an average non-school holiday weekday.

|	
Morning peak:	*7am to 9am*
Inter-peak:	*9am to 3pm*
Evening peak:	*3pm to 6pm*
Off-peak:	*6pm to 7am*

While working from home reduces the number of overall trips, the remaining trips become longer. This shifts more traffic from local and arterial roads and onto freeways (Figure 29). Consequently, there is more congestion farther out on the freeway system for inbound journeys in the morning peak. The net effect means that the average car driver spends nearly the same proportion of their travel time in congested conditions.

We see some reductions in congestion in inner Melbourne during the morning peak, but the overall network sees little change. The high working from home scenario shows the most significant increases in congestion. This scenario finds large numbers of residents dispersed to the outer areas of the metropolitan road network who still travel to inner Melbourne for work some days of the week (Figure 28). This means working from home may not reduce congestion on the road network.
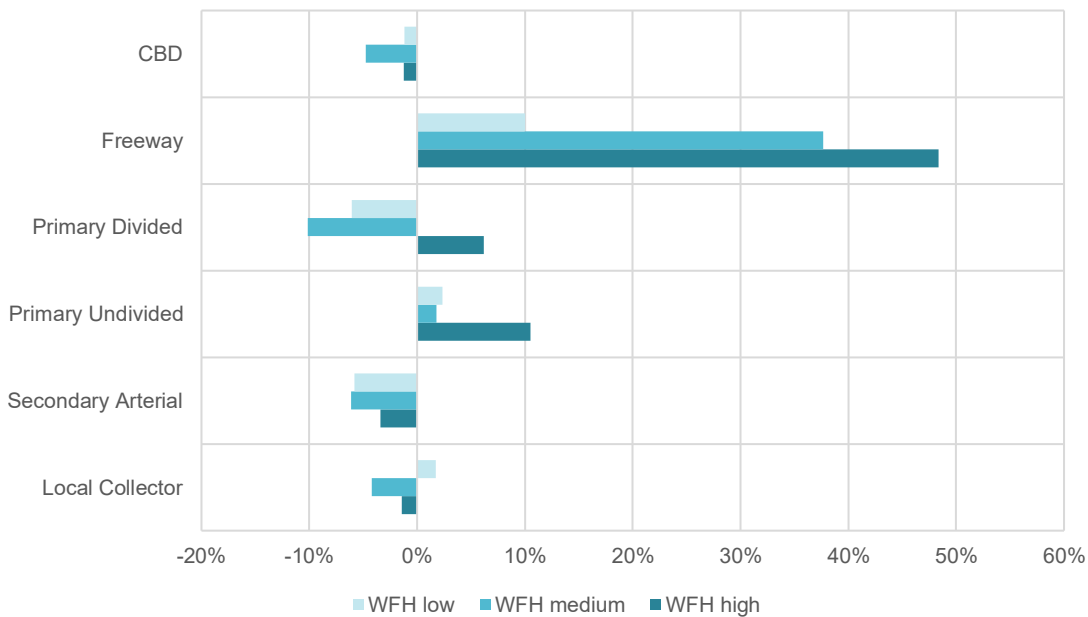
Figure 28. Private vehicle congestion changes, WFH scenarios vs base case, 2036
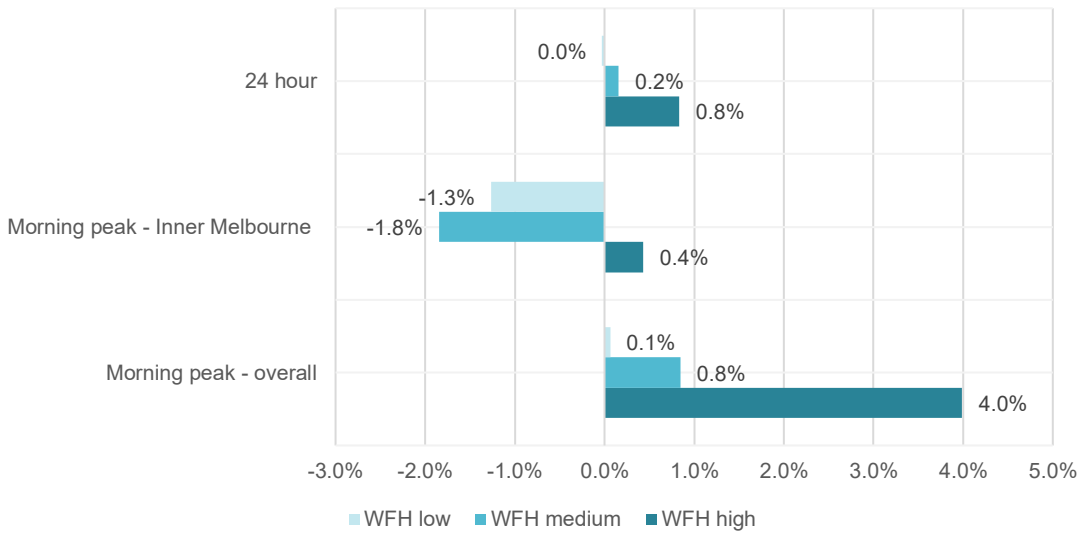
Source: Infrastructure Victoria analysis of ARUP and Victoria University, Working from home VLUTI modelling, 2021
Note: Change in congestion here is measured using the difference in the delay hours ratio between scenarios. Delay hours ratio is simply the ratio of time trips would take with no congestion (free flow) and the modelled time the trip will take.

Figure 29. Change in congested vehicle kilometres by road type, WFH scenarios vs base case, morning peak, 2036

Source: Infrastructure Victoria analysis of ARUP and Victoria University, Working from home VLUTI modelling, 2021

Our modelling also assumes that people are working from home evenly throughout the week. In practice, there may be a tendency for people to work from home more at the start or end of a work week. A recent survey for the Committee for Sydney found that business leaders expected Tuesday to Thursday to be popular days for their employees to attend the office.[140] Should people favour working from offices in the middle of the week, there could be worse congestion during the morning peak than what we have modelled.

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[140] Committee for Sydney, Sydney Leadership Survey 2021, August 2021, https://sydney.org.au/wp-content/uploads/2021/08/CFS-Sydney-Leadership-Survey-August-2021.pdf

6.2.2 Pricing reform will incentivise an effective and efficient transport network

As noted in section 1.1, only around a third of Victorian workers can feasibly work from home.[141] Even for people who can, working from home may not suit everybody. Working from home has different benefits and drawbacks for workers (section 1.4). Many factors influence the potential benefits to individual workers, including their personal preferences, type of work, home situation, and career stage.[142] Many people who can technically work from home may still prefer to travel to an office to work.

Employers and workers will individually choose the extent they pursue working from home to get the most out of their work and personal lives. Those choices will affect other transport system users. Putting the right incentives in place will help the transport system work effectively and efficiently for everyone.

Our modelling shows more working from home has limited impact on overall congestion, and the suitability of working from home will differ from person to person. Designing incentives to influence transport choices can help tackle future congestion. Left unchecked, congestion will continue to cause delays and frustration, even under increasing levels of working from home.

Since our first 30-year infrastructure strategy in 2016, Infrastructure Victoria has advocated for a better way to price transport. Our two detailed papers on transport pricing (G*ood Move: fixing transport congestion* and *Fair Move: better public transport fares for Melbourne)* explored transport system improvements by examining different pricing scenarios across roads, public transport and parking.

Reforming transport pricing can help achieve a transport network which efficiently gets people to their desired destination at the right time. To do this, pricing systems need to reflect not only the costs to the private user—time, energy and maintenance costs—but also the costs to other users and society, such as additional congestion and crowding, air and noise pollution, and accidents. Transport prices will have increasing benefits as more people have the flexibility needed to respond to them (Figure 31, section 6.3.1). More flexible work practices associated with working from home could open up more opportunities for flexible travel.

Victoria's current transport prices provide little incentive for travel choices to help improve network efficiency. Most motorists pay a set of fixed charges (including registration, accident insurance, and stamp duty) regardless of how much they travel. Fixed charges mean drivers pay the same amount no matter how often they drive on roads, and do not reflect all road costs. Our modelling only allowed limited changes in people's time of travel, producing a stubborn level of congestion in the morning peak, despite many people working from home.

Prices that vary by time and location can encourage people to take advantage of more flexible work hours and travel outside traditional peak times. New flexible transport prices that vary by time of day, place and mode can replace fixed upfront road charges and uniform public transport fares. In general, off-peak travel should cost less than peak travel, and underused services or areas should be cheaper than crowded or congested ones. Lower priced off-peak travel would help alleviate the congestion on Victoria's roads and ease peak period crowding on public transport, which persist even with more working from home. In the case where people cluster their commuting days in the middle of the week, transport pricing can also offer lower charges on days when capacity is underused to help encourage people to spread travel throughout the week.

These reforms can improve the way people use Victoria's roads and public transport, and take advantage of greater work flexibility. Our pre-COVID-19 analysis found that public transport fare reform alone increased public transport users by 56,000 while car use was reduced by 96,000 trips per day. Despite the increase in public transport use there were also 30,000 fewer daily peak hour train boardings, while off-peak public transport services saw an increase of over 100,000 trips.[143] When road user charging reforms were combined with fare reforms, car usage was reduced by 168,000 trips per day, people spent 8% less time in congestion, and most people paid less for transport.[144]

These transport pricing system reforms encourage people to make travel decisions that account for the broader costs and benefits of travel. This helps the transport network operate efficiently for the benefit of everyone. Greater flexible working can supercharge the impact of these reforms.

We recommend the Victorian Government reform road network pricing:

[141] *Infrastructure Victoria adaptation of method in Coates, Brendan, Matt Cowgill, Tony Chen and Will Mackey, Shutdown: estimating the COVID-19 employment shock, 2020, Grattan Institute, https://grattan.edu.au/wp-content/uploads/2020/04/Shutdown-estimating-the-COVID-19-employment-shock-Grattan-Institute.pdf*

[142] *The Productivity Commission, Working from home Research paper, 2021, Commonwealth of Australia, https://www.pc.gov.au/research/completed/working-from-home/working-from-home.pdf*

[143] *Infrastructure Victoria, Fair Move: better public transport fare for Melbourne, 2020, Victorian Government, https://www.infrastructurevictoria.com.au/wp-content/uploads/2020/09/Fair-Move-Better-Public-Transport-Fares-for-Melbourne-Final-2.pdf, p. 8-9*

[144] *Infrastructure Victoria, Good move: fixing transport congestion, 2020, Victorian Government, p. 7*

- *Incorporate congestion pricing for all new metropolitan freeways. Apply congestion-based peak and off-peak tolling to all new metropolitan freeways to better manage traffic flow and impacts on nearby local roads.[145]*

- *Once congestion re-emerges in the next five years, trial full-scale congestion pricing in inner Melbourne to reduce congestion on inner city roads.[146]*

- *Phase out fixed road user charges and introduce user pays charging over the next 10 years. Ensure user pays charging reflects the relative costs of road use, encouraging people to adopt beneficial travel behaviour.[147]*

Transport network pricing recommendations relevant to public transport are contained in section 6.3.

6.3   Make the most out of existing rail capacity to meet growing demand

Melbourne's rail network was under pressure before the COVID-19 pandemic, experiencing overcrowding and increasing unreliability.[148] Our modelling shows the shift to working from home could increase public transport demand in outer and new growth areas of Melbourne in the medium-term, putting additional strain on many peak hour rail lines (Figure 30).

To help meet the growing demand for rail services the Victorian Government should get the most value from its existing public transport capacity by using a two-pronged approach: discount off-peak fares and additional services in off-peak times.
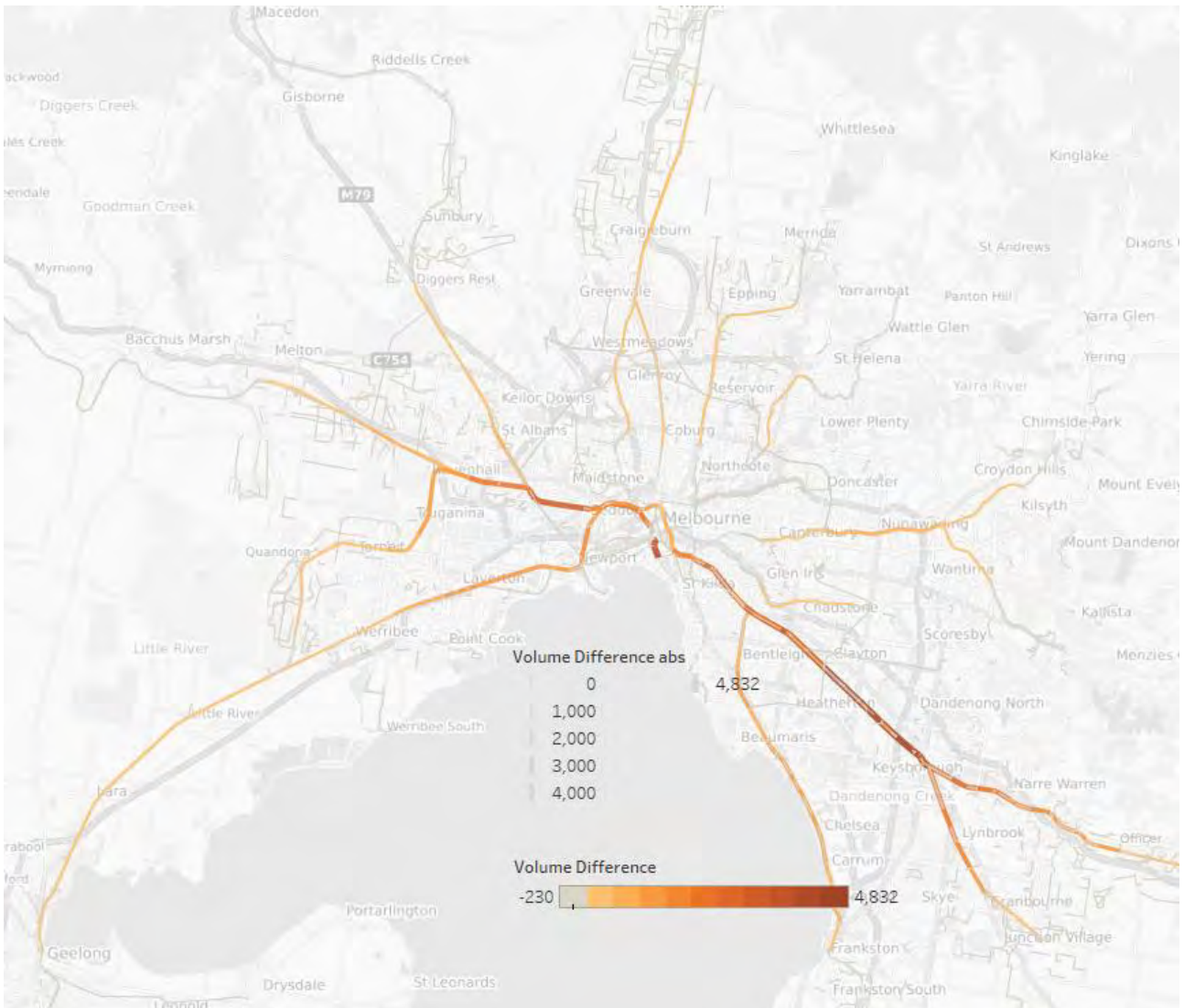
[145] Infrastructure Victoria, Victoria's infrastructure strategy 2021-2051, 2021, Victorian Government, recommendation 51

[146] Infrastructure Victoria, Victoria's infrastructure strategy 2021-2051, 2021, Victorian Government, recommendation 52

[147] Infrastructure Victoria, Victoria's infrastructure strategy 2021-2051, 2021, Victorian Government, recommendation 53

[148] Infrastructure Victoria, Fair Move: better public transport fare for Melbourne, 2020, Victorian Government, https://www.infrastructurevictoria.com.au/wp-content/uploads/2020/09/Fair-Move-Better-Public-Transport-Fares-for-Melbourne-Final-2.pdf

Public Transport (pax) Difference in AM Peak (07:00 - 09:00)

Source: Infrastructure Victoria analysis of ARUP and Victoria University, Working from home VLUTI modelling, 2021

6.3.1   Discount off-peak fares

Even before the disruption from COVID-19, public transport users were willing to shift their time of travel. Our analysis using Department of Transport survey data found that for work trips, over half the respondents said they can shift their time of travel. Of those able to shift their travel time, 54% could alter their trip by up to 15 minutes, 38% by up to half an hour, 24% by up to an hour and 13% by more than one hour.[149]

Following the initial outbreak of COVID-19, a survey found that by May 2020 60% of people said that they were more likely to shift their time of public transport travel if it was discounted in off-peak periods (Figure 31). Interestingly, the stated size of the impact of an off-peak discount was comparable with the impacts of more structural changes in people's ability to manage their own time, such as changes to school drop-off or work times.

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[149] *Infrastructure Victoria analysis of Department of Transport survey data, 2020*

Figure 31. Ratings of public transport time-shifting measures
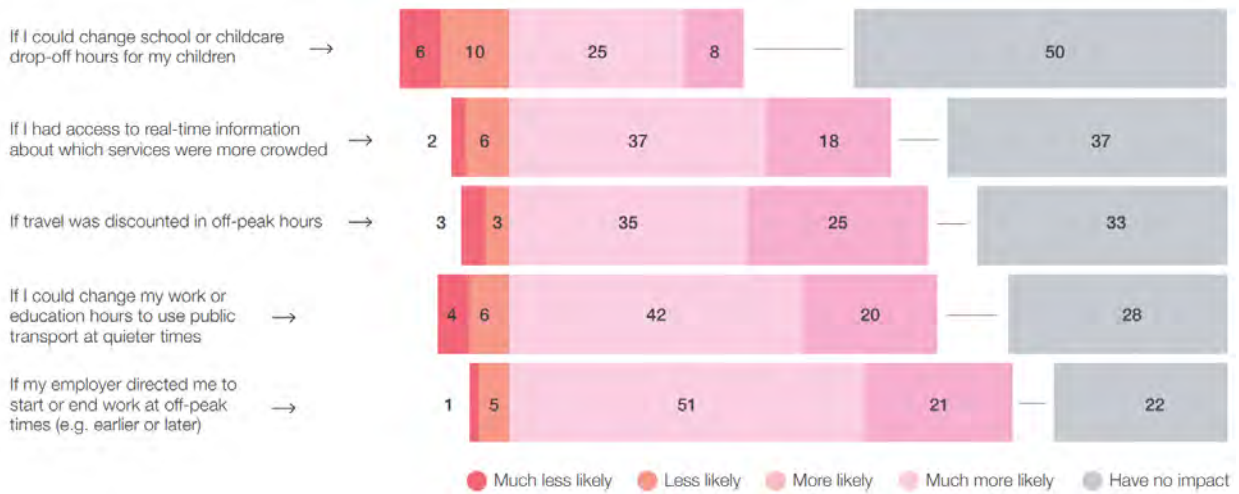
Source: Survey by BehaviourWorks for Infrastructure Victoria. Survey date: 19 May 2020

If flexible work continues to become more embedded in Victoria's workplaces after the COVID-19 pandemic, people's openness to shifting their time of travel will likely increase. This makes the impact of off-peak fares even greater. Encouraging people to travel at times with spare capacity will help reduce pressure on peak rail services.

People may be more flexible in how and when they make their journeys to work after the COVID-19 pandemic. To harness the power of this potential flexibility to reduce crowding at peak times on the rail network, the Victorian Government should make permanent the now discontinued temporary off-peak fare discount.

The Victorian Government should also monitor commuting behaviour for clustering of commuting days in the middle of the week, and consider using fares and other transport charges to encourage spreading travel throughout the work week.

We recommend the Victorian Government permanently adopt discounted off-peak fares for metropolitan public transport. [150]

6.3.2 Increase off-peak services

More frequent services and passenger capacity can also attract users to use public transport in off-peak times. More off-peak services can help alleviate the increasing transport stress people experience in outer and new growth areas.

People will use public transport for a particular journey if it is the easiest to use. Services which are reliable, frequent, direct and safe will attract more people to use public transport.[151]

Increasing off-peak service frequencies reduces waiting times, and typically does not require building any extra infrastructure. If trains run closer together, people can spend less effort on journey planning, as they can merely 'turn-up-and-go'. More frequent services can improve reliability, because another train can soon accommodate passengers affected by failures, rather than people needing to wait another 20-30 minutes.

Increasing frequencies towards 'turn up-and-go' train services in the off-peak, counter-peak and on the weekend gives people more travel choices in more locations. This helps make the most of existing public transport infrastructure, which could come under increasing pressure if the shift to working from home changes where people live and how they travel.

We recommend the Victorian Government increase off-peak service frequencies and suburban rail corridor capacity.[152]

6.4 Expand and improve rail infrastructure to meet growing demand

Our working from home modelling finds more people could live in new growth areas. Many of them will rely on rail services to travel to work when not working from home.

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[150] Infrastructure Victoria, Victoria's infrastructure strategy 2021-2051, 2021, Victorian Government, recommendation 45

[151] Infrastructure Victoria analysis of Department of Transport survey data, May 2018

[152] Infrastructure Victoria, Victoria's infrastructure strategy 2021-2051, 2021, Victorian Government, recommendation 59

V/Line regional train services are the closest available rail service for many people living in Melbourne's new growth areas. This adds more suburban passengers to regional trains, resulting in increased overcrowding and reduced reliability, especially on the Geelong, Ballarat, and northern regional line toward Seymour. Even before accounting for the impacts of working from home, this pressure is projected to increase in the future. Our base case projects Ballarat and Seymour V/Line services to be over capacity by the end of this decade.

Our working from home scenarios show even greater increases in public transport usage on Melbourne's outer and new growth area rail networks than previously projected. Figure 32 shows particular capacity impacts on sections of track in Melbourne's west, running from Melton and Wyndham Vale to Sunshine. The south-east rail lines show similar impacts, with the Frankston and Pakenham/Cranbourne lines becoming more crowded in our working from home scenarios. These work from home impacts are on top of already very significant increases in rail demand due to the projected growth in population in the 2036 base case.

The Victorian Government should consider building new infrastructure over the next decade to accommodate growing rail patronage, particularly long-distance trips from these new growth areas.

Figure 32.   Large volume increases on public transport links, WFH medium vs base case, morning peak, 2036
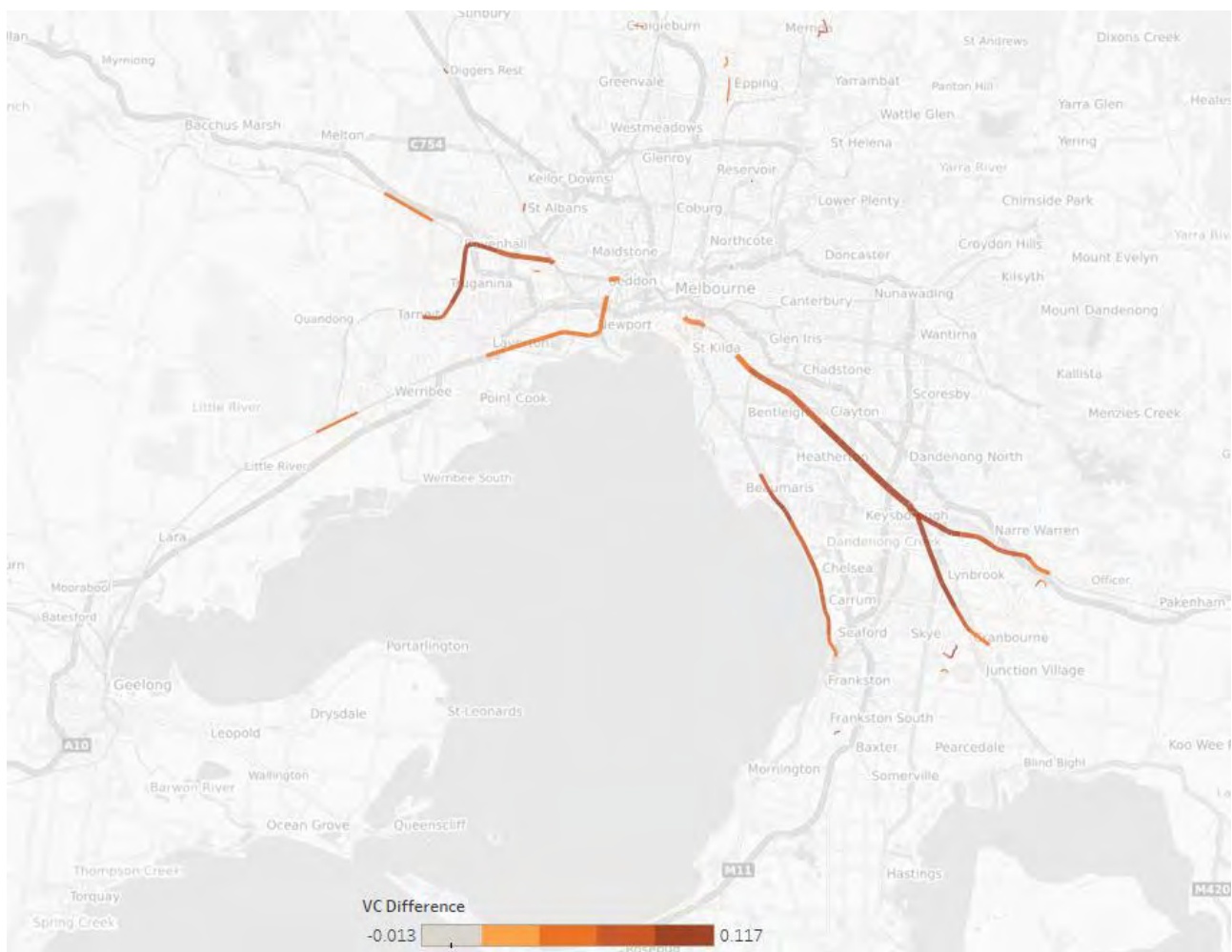
PT Passenger / PT Capacity Difference in AM Peak (07:00 - 09:00)

Source: Infrastructure Victoria analysis of ARUP and Victoria University, Working from home VLUTI modelling, 2021
*Note: Limited to public transport links where the volume to capacity ratio is at least 5% higher in the WFH medium scenario compared to the base case.*

6.4.1   Continue to progress the Western Rail Plan

Our medium working from home scenario projects even stronger population growth than previously expected in Melbourne's western new growth areas. The Victorian Government should continue to progress transport upgrades for Melbourne's western growth areas.

Data from 2017 (Figure 33) shows that crowding on the Geelong line was already a problem before the COVID-19 pandemic. One this line, which also services some of Melbourne's outer western suburbs, trains exceed seated capacity when they reach Melbourne's outer suburbs.

Figure 33. Geelong line average passenger loads between stations, inbound morning peak to Southern Cross Station, March 2017
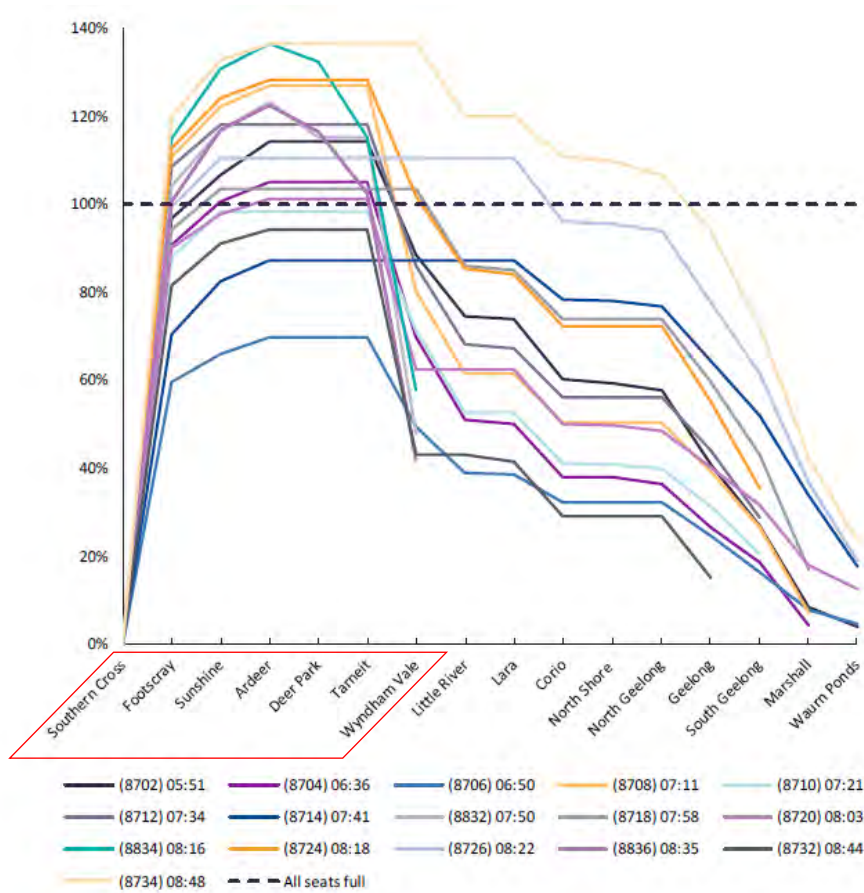
Note: 2016–17 data is from July 2016 to March 2017.

Note: Services have different stopping patterns. Services that run express between stations show the train load of the most recent stop for each of the stations bypassed. Morning peak services include all trains arriving at Southern Cross before 9 am. The train load is shown as the number of seats filled as the train departs from the station. Each line represents a train service, with the train number shown in brackets and the arrival time at Southern Cross.

Source: Victorian Auditor-General's Office, V/Line Passenger Services, 2017

The Victorian Government is developing a Western Rail Plan and has committed to upgrading the Geelong line. This will provide more capacity on the Ballarat line and Wyndham Vale corridor with new dedicated track for Geelong between Werribee and Laverton (Figure 34), taking pressure off one of the key corridors impacts by increased working from home (Figure 32).

Figure 34.   Western Rail Plan

Source: Major Transport Infrastructure Authority (MTIA), Geelong Fast Rail, 2021

The Western Rail Plan also includes options for the Melton and Wyndham Vale lines. The Victorian Government has indicated that the Suburban Rail Loop will also include a future western section. Our working from home scenarios suggest faster population growth in western Melbourne and increasing demand for rail services. Higher capacity trains between Wyndham Vale and Southern Cross can help manage this growing rail demand. The Victorian Government should move swiftly to undertake detailed planning for these improvements, including electrification of the Wyndham Vale rail line.

We recommend the Victorian Government extend rail services in Melbourne's western and northern growth areas. It should continue to progress the Western Rail Plan, including electrification of the Wyndham Vale line.[153]

6.4.2   Upgrade rail services for growing communities along the Melton corridor

In coming decades, the existing Bacchus Marsh and Melton V/Line services will not be able to accommodate growing rail demand from Melbourne's western new growth areas. Our modelling suggests working from home can cause faster population growth in these areas, making this problem more urgent. The Western Rail Upgrade would help alleviate this pressure.

The Western Rail Upgrade project incorporates upgrades to support more train services on the Melton corridor. These upgrades are a result of electrifying the rail line from Sunshine to the vicinity of Rockbank by 2036, which would serve the proposed Mt Atkinson Major Activity Centre at Hopkins Road. The new services operating from the new Mt Atkinson station would use high capacity metropolitan trains and travel through the Metro Tunnel.

[153] Infrastructure Victoria, Victoria's infrastructure strategy 2021-2051, 2021, Victorian Government, recommendation 74

Figure 35.   Proposed Western Rail Upgrade and associated benefits
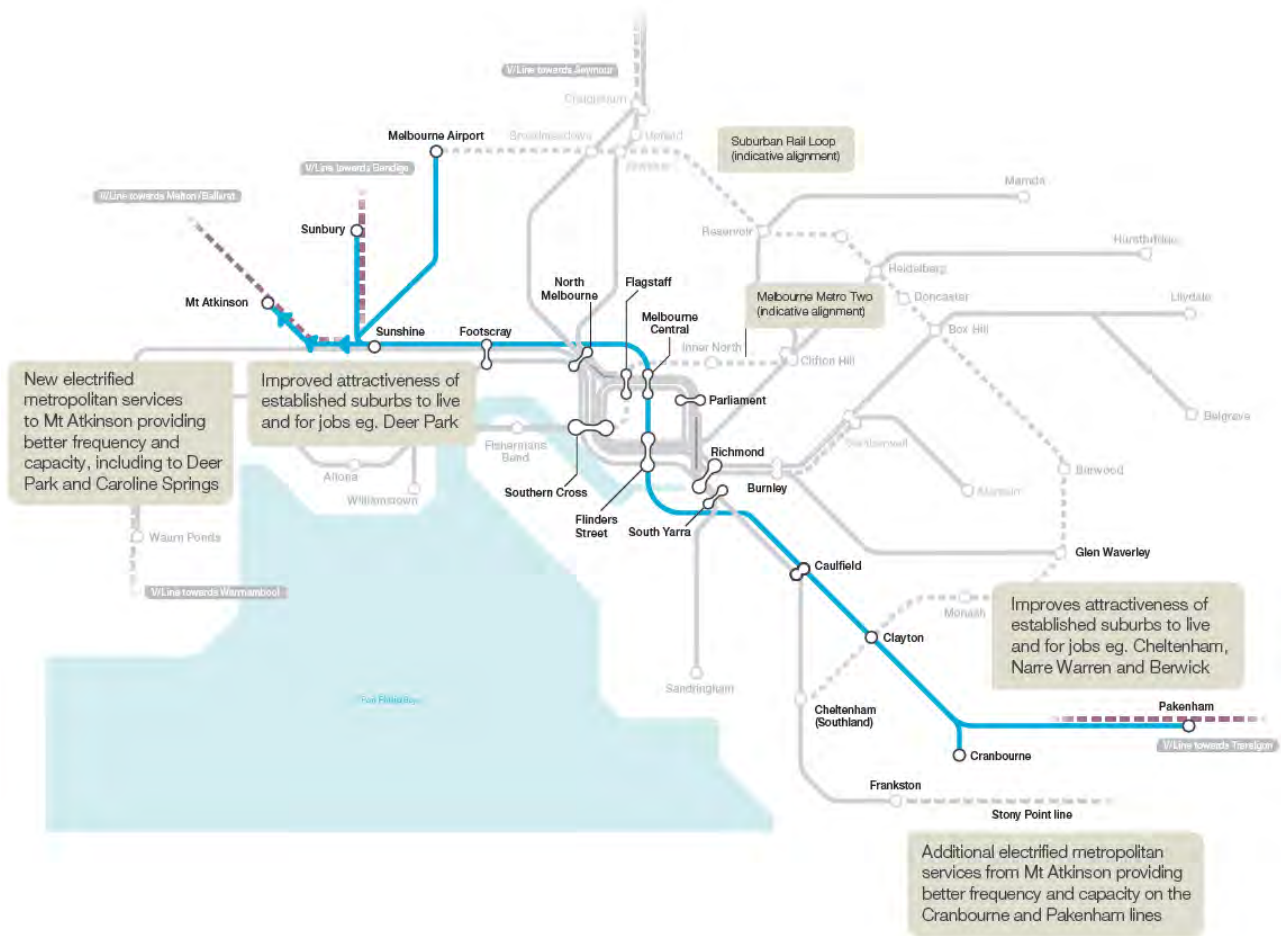
Source: Infrastructure Victoria, Major Transport Program Strategic Assessment, 2021

The Western Rail Upgrade would increase rail capacity for communities in the Melton, Casey, and Cardinia LGAs. Our working from home scenarios suggest these LGAs experience higher population growth, compared to the base case. Consequently, our medium working from home scenario shows boardings 6% higher in 2036 compared to the base case on the Mt Atkinson-Pakenham line before Sunshine station in the morning peak. The working from home scenario further reinforces the baseline population growth in Melbourne's outer west and the need for the Western Rail Upgrade to support the travel demands of new residents.

We recommend the Victorian Government extends rail services in Melbourne's western and northern growth areas. Develop a business case to extend electrified metropolitan train services from Sunshine to Rockbank, to be delivered by 2031. Consider adding extra stations on the Melton corridor, securing remaining land required for stations and stabling.[154]

6.4.3   Boost rail capacity between Melbourne and Geelong

Our modelled working from home scenarios find the Princes Highway could experience higher inbound volumes farther out in the commute from Geelong towards Melbourne. This is because our working from home scenarios project faster population growth in Melbourne's outer and new growth areas, including towards Geelong. Figure 36 shows that the Princes Freeway experiences some of the largest increases in vehicle volumes travelling inbound during the morning peak.

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[154] *Strategy recommendation 74*

Figure 36.   Increase in morning peak vehicle volumes, WFH medium vs base case, 2036
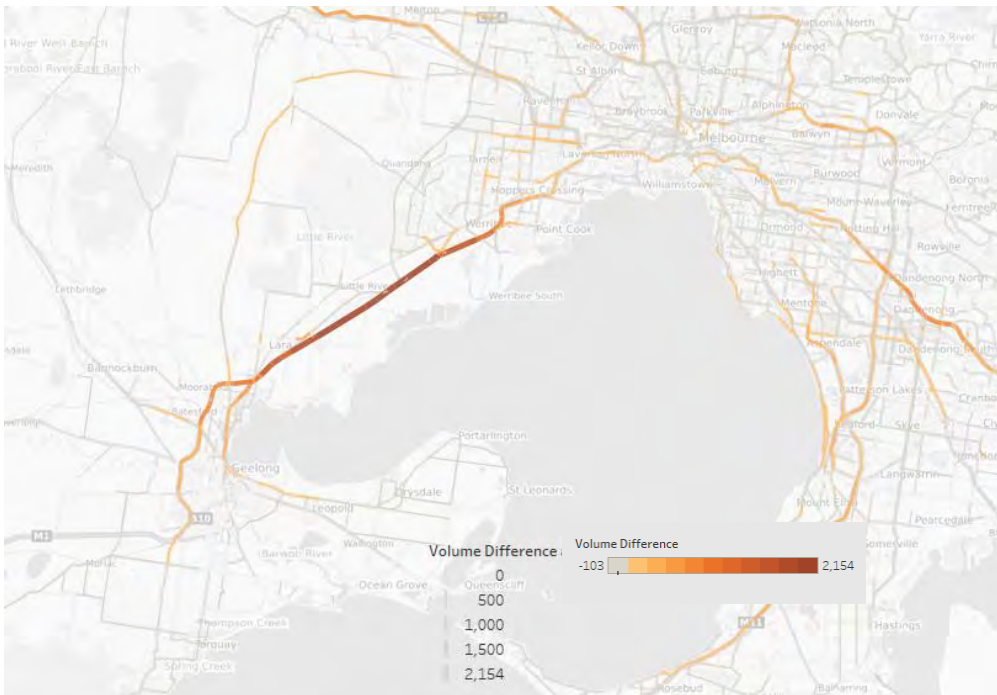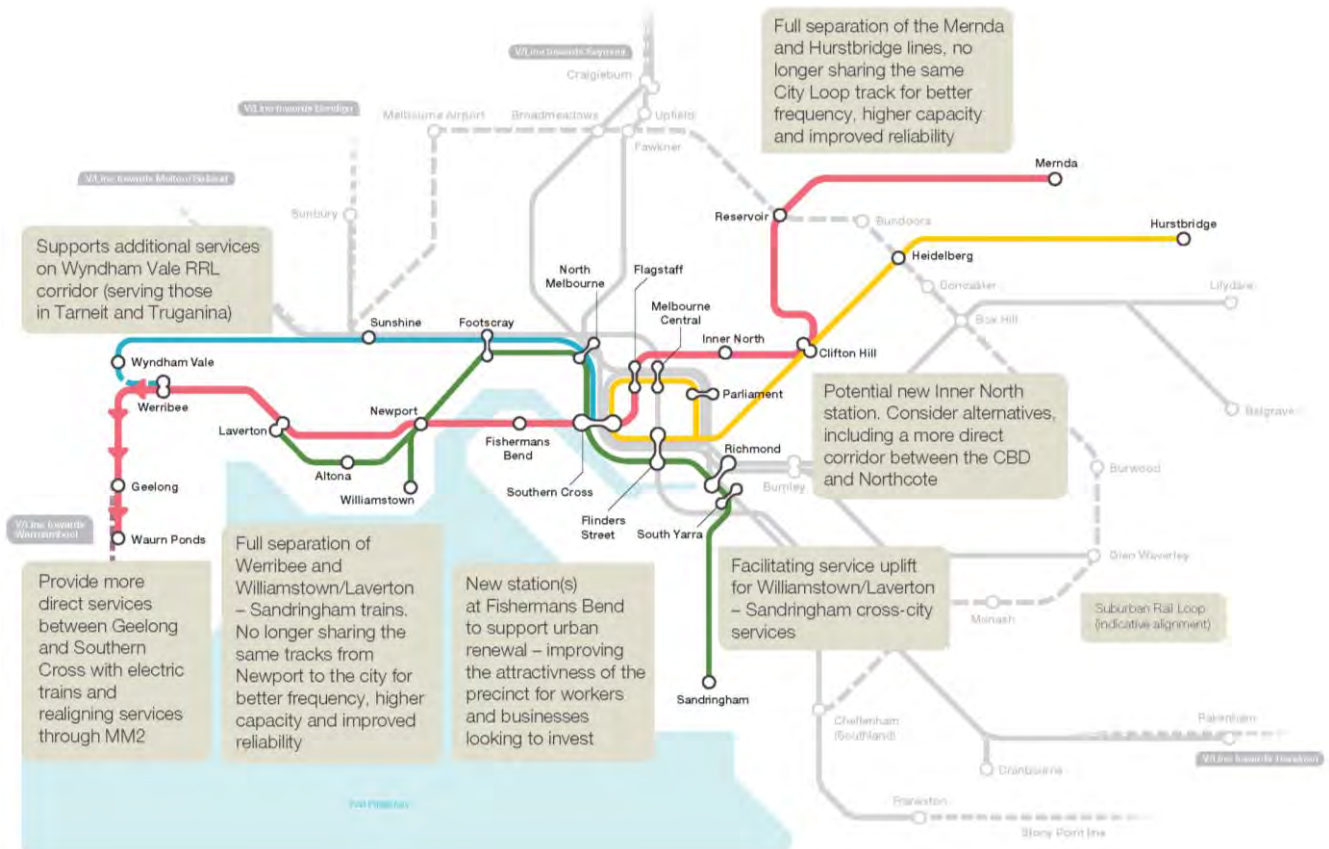

Source: Infrastructure Victoria analysis of ARUP and Victoria University, Working from home VLUTI modelling, 2021

The Melbourne Metro Two and direct Geelong rail services project will support travel heading towards Melbourne's central city along this corridor, helping reduce road congestion and providing commuters with high quality, frequent and direct rail services to Melbourne's central city.

The Melbourne Metro Two and direct Geelong rail services project includes construction of a new rail tunnel connecting Newport to Clifton Hill (Mernda line) and electrification of the rail network to Geelong. The project's two new underground rail lines also enable a reconfiguration of the network's service patterns, expanding the network to create more independently operating lines through central Melbourne. The Melbourne Metro Two tunnel also provides a more direct route for electrified rail services from Geelong to Southern Cross station, which can align and build upon the Victorian Government's existing commitment to the Geelong Faster Rail project.

Figure 37.   Melbourne Metro Two project benefits

Source: Infrastructure Victoria, Major Transport Program Strategic Assessment, 2021

Our base case modelling also projects rapid population growth in Melbourne's outer north east, including in Mernda and Hurstbridge. Our working from home scenarios show these populations growing even faster. The Melbourne Metro Two project allows the Mernda line to use the new tunnels to operate independently of the Hurstbridge line. The lines no longer share the same City Loop tunnel, allowing both to have higher frequencies, higher capacity, and improved reliability. This supports populations in Melbourne's northern outer and new growth areas.

Our modelling also suggests faster jobs growth in inner Melbourne, on top of increases already projected in the base case. Providing heavy rail at Fishermans Bend, complementing proposed tram links, supports increasingly concentrated jobs in inner Melbourne. With full completion of the proposed Melbourne Metro Two project, not only will commuters from the outer west have direct access to the Fishermans Bend employment precinct, but also commuters along the Mernda corridor, without having to interchange.

***We recommend the Victorian Government prepares for Melbourne Metro Two and direct Geelong rail services. Complete a business case for the Melbourne Metro Two Tunnel project, and protect the land required to construct it. Consider using the tunnel to re-route Geelong services direct to Southern Cross, and consider new stations or relocating existing stations.*[155]**

6.4.4   Electrification of the northern rail corridor to Beveridge

If the shift to working from home persists, our modelling projects even more people living in Melbourne's northern new growth areas than previously expected. Many of these people will rely on rail to take them to work on the days they are not working from home. This could heighten the pressure on rail services to Melbourne's outer north.

To improve capacity on the Seymour line, the Victorian Government should consider extending the electric network towards Wallan, as far as Beveridge in the first instance. Under the base case, Seymour line regional services and Craigieburn metropolitan services will become overcrowded towards the end of this decade, driven by population growth in Melbourne's northern growth corridor. Our medium working from home scenario shows that the outer sections of these lines come under even greater pressure, with 10% more boardings on the Wallan-Glen Waverley line before Craigieburn station in the morning peak.

[155] *Infrastructure Victoria, Victoria's infrastructure strategy 2021-2051, 2021, Victorian Government, recommendation 61*

Similar to future growth in Melbourne's west, the working from home scenario will further reinforce baseline growth expected in Melbourne's outer north, further reinforcing the need for electrification of the northern rail corridor to Beveridge. The Victorian Government should extend electrified metropolitan train services to Beveridge and determine whether there is a further need to extend to Wallan in the future. This project would also be contingent on the reconfiguration of the City Loop, discussed in section 6.4.6.

We recommend the Victorian Government extend rail services in Melbourne's western and northern growth areas. Electrify along the existing Seymour line to Beveridge (towards Wallan). Develop a business case to extend electrified metropolitan train services from Craigieburn to Beveridge.[156]

6.4.5   Increase suburban rail corridor capacity

Despite fewer work trips due to increasing working from home, our modelling finds the entire metropolitan train network could be under more pressure as population continues to grow in Melbourne's outer and new growth areas. Demand for rail increases from more people making long distance journeys by rail to central Melbourne, even though they travel less frequently.

A train network with separate, segregated rail lines can carry more passengers and is more resilient to disruptions. The Melbourne Metro Tunnel project is a step toward untangling the rail network and enabling more capacity on some rail lines.[157] More, currently unfunded complementary corridor upgrades can help realise these potential capacity benefits.

The Victorian Government should develop, progressively deliver and regularly update a 15-year network service upgrade program to cater for growing demand along each suburban rail corridor. This program should prioritise infrastructure upgrades to rail lines with high population and passenger growth, and those that are nearing their maximum capacity. Our working from home modelling results suggest that outer and new growth areas of Melbourne, which have high levels of population growth in the base case, may grow even faster with a shift to working from home.

For each train corridor, the program should identify infrastructure upgrades and priority timetable improvements to allow more trains to run more frequently, and more reliably. The corridor upgrades program should consider all methods of delivering extra capacity, such as track and signalling improvements, new higher capacity trains and train carriage retrofits. The program should clarify rail service improvements that better respond to demand changes, and coordinate with tram and bus service improvements.[158] These improvements will help respond to increasing demand for rail services in outer and new growth areas, which could be a result of the shift to working from home.

We recommend the Victorian Government increase suburban rail corridor capacity. Develop and progressively deliver a prioritised 15-year network service upgrade program for suburban train corridors, including track and signalling improvements, higher capacity trains, carriage retrofits and an upgraded train control centre.[159]

6.4.6   Reconfigure the City Loop

We have recommended increasing the rail capacity on both metro and regional train services to Melbourne, which our modelling shows could come under more pressure in the medium-term with a shift to working from home.

This extra capacity cannot be fully realised without reconfiguring the existing City Loop. For example, extending electrified metropolitan train services to Beveridge takes pressure off the regional services from Seymour and shifts them to an extended Upfield line. Only six train services can currently use the Upfield line each hour due to congestion in the City Loop. Reconfiguring the City Loop can increase the number of services from six to 22.

Reconfiguring the City Loop will add more train capacity on the Upfield, Craigieburn, Frankston and Glen Waverley train lines. These four transport corridors serve growing outer areas of Melbourne which could grow even faster in the future based on our working from home scenarios.

Currently, four City Loop tunnels carry trains around the CBD and then back out to suburban stations. Constructing two short tunnel links between Flagstaff and North Melbourne stations, and Parliament and Richmond stations, can create two independent train lines from two of the City Loop tunnels. This also allows Craigieburn train services to link directly with the Frankston corridor, and Glen Waverley services to Upfield services, with trains running across the city on independent lines.
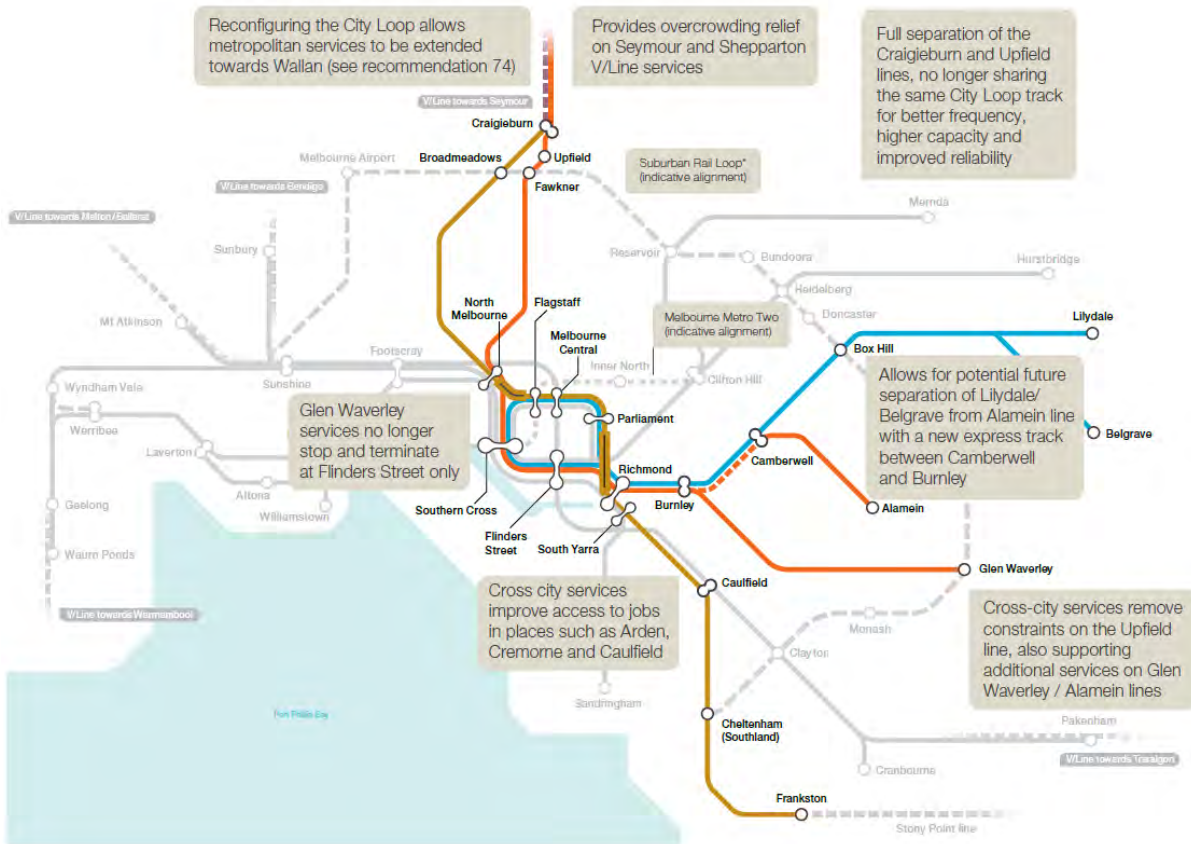
[156] Infrastructure Victoria, *Victoria's infrastructure strategy 2021-2051*, 2021, Victorian Government, recommendation 74

[157] Rail Projects Victoria, *Metro Tunnel Project, Benefits of the project (website)*, 2021, Victorian Government, metrotunnel.vic.gov.au/about-the-project/benefits-for-your-train-line

[158] Mornington Peninsula Shire, *Submission to Victoria's draft 30-year infrastructure strategy*, 2021, www.infrastructurevictoria.com.au/wp-content/uploads/2021/05/S148-Mornington-Peninsula-Shire_Redacted.pdf, p. 13

[159] Infrastructure Victoria, *Victoria's infrastructure strategy 2021-2051*, 2021, Victorian Government, recommendation 59

Figure 38.   Reconfiguring the City Loop allows more trains to run through the city

Source: Infrastructure Victoria, Major Transport Program Strategic Assessment, 2021

Under the working from home scenarios, the new outer northern electrified corridor experiences greater demand. Inbound station boardings just before Craigieburn experience an increase of around 10%, equivalent to an extra 340 passengers in the morning peak. Our working from home scenarios also find that more jobs could concentrate in the central city. This means reconfiguring the City Loop becomes even more important in supporting workers making their commute on the days they do travel to work, because it boosts the capacity of the network to funnel people in and out of the central city.

The City Loop reconfiguration project complements both the major trends our working from home scenarios project. It supports new residential development in growth areas while also catering for more employment locating in the central city.

We recommend the Victorian Government reconfigure the City Loop. Complete a business case to reconfigure the City Loop, including determining its timing.[160]

6.5   Increase accessibility to public transport services and limit the increase in park and ride

The increasing use of public transport in Melbourne's outer and new growth areas, as modelled in our working from home scenarios, may worsen issues around station parking and local congestion if more people drive to train station car parks. To encourage people to use alternative ways to access train services, we recommend actions that improve people's mobility options in growing areas of Melbourne.

People's distance from the centre of Melbourne influences the way they access train services. Figure 39 shows that people living in Zone 1 mostly walk to train stations, while in Zone 2 a majority drive. An even higher proportion use private vehicles in peri-urban locations.

This means the farther people live from the centre of Melbourne, the more likely they are to use private vehicles to reach train stations. Bus use is also higher in Zone 2 locations, suggesting people are willing to use buses under the right conditions.

Figure 39.   Modes used in journeys from home to a train service, 2018
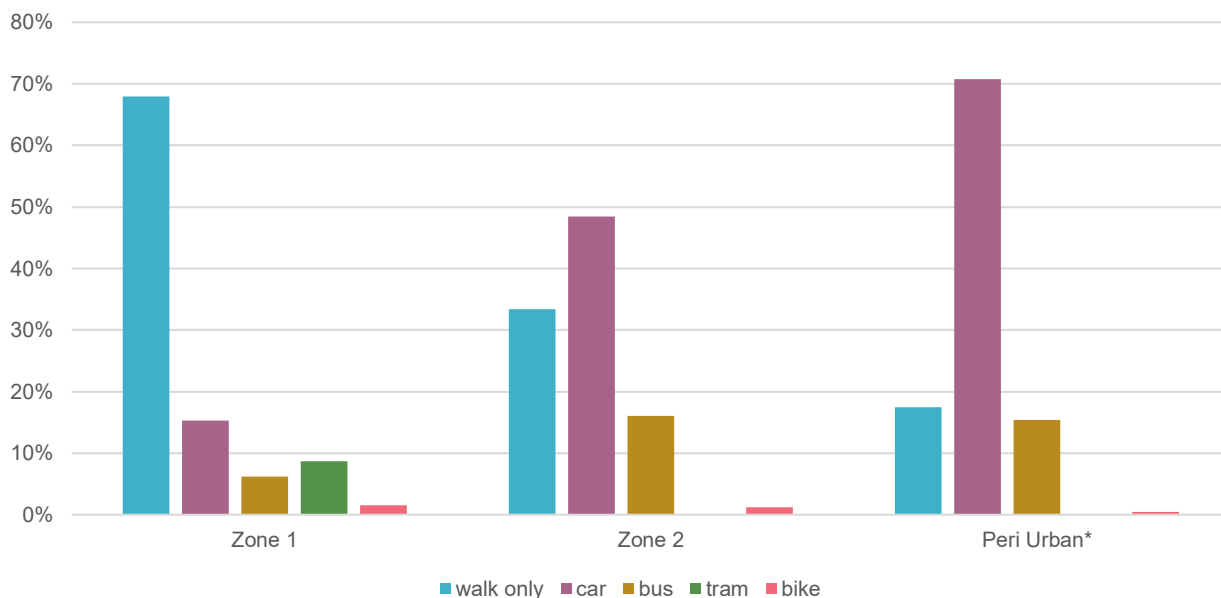
Source: Infrastructure Victoria analysis of Department of Transport, Victorian Integrated Survey of Travel and Activity (VISTA) data, 2018
Note: Sums to over 100 percent in some instances due to people who drove using private vehicle and subsequently used a bus (mostly peri-urban).
*Peri-urban only includes those surveyed in Yarra Ranges, Cardinia, Nillumbik, Macedon Ranges, Mornington Peninsula, Melton, Moorabool, Surf Coast and Mitchell LGAs.

High levels of driving to train stations in outer areas is due to less frequent and less direct bus services, greater parking availability, and lower housing densities. With our modelling finding more people living in Melbourne's outer and new growth areas, train station parking in these areas could become even busier. Giving people time and cost-efficient travel options can help them move away from private vehicles for trips to railway stations in outer areas. The Victorian Government can also price train station parking to more effectively allocate space.

6.5.1   Allocate car parking more effectively with pricing

Currently many train stations have free parking, which is available on a first come, first served basis. This means most car parks fill up very early on weekday mornings.[161] Free parking encourages people to drive to stations, even if they have other viable transport options. Overflowing carparks makes it harder for people without other options to get a car park.

The Victorian Government has invested in expanding car parks at train stations in Tarneit, Wyndham Vale and Cranbourne.[162] Continually expanding car parking is unsustainable, as the population keeps growing and land becomes both more scarce and more expensive. While the short-term impact of COVID-19 has seen demand for rail services fall, our modelling suggests that in the medium-term, as the health crisis passes, Melbourne's outer and new growth areas could see more population and rail service demand.

[161] *Premier of Victoria, More Station Car Parking And Safer Train Stations (media release), 2018, Victorian Government and https://www.danandrews.com.au/policies/more-train-station-car-parking-for-commuters-out-west and https://www.jamesmerlino.com.au/media-releases/more-train-station-car-parking-for-mooroolbark-commuters/ https://www.premier.vic.gov.au/more-station-car-parking-and-safer-train-stations/; ALP Victoria, More Train Station Car Parking For Commuters Out West (media release), 2018, ALP Victoria, https://www.danandrews.com.au/policies/more-train-station-car-parking-for-commuters-out-west; ALP Victoria, More Train Station Car Parking For Mooroolbark Commuters (media release), 2018, ALP Victoria, https://www.jamesmerlino.com.au/media-releases/more-train-station-car-parking-for-mooroolbark-commuters/.*

[162] *Department of Transport, Car Parks for Commuters, 2021, Victorian Government, https://carparks.vic.gov.au/*

Our modelling also shows working from home does not solve Melbourne's road congestion. Road congestion is exacerbated by free or cheap on-street parking.[163] This encourages drivers to cruise for parking, contributing to congestion, and preventing other, potentially better uses of valuable land. For instance, car parks could be better used for bus, tram and bicycle lanes, wider footpaths or even green space.[164] Free parking at train stations also discourages people from using active or public transport to access these services.

Charging for parking can help solve these parking problems.[165] Charging even a low rate for parking can encourage some people to walk, cycle or catch a bus to their train station or transport hub, freeing up space for others who do not have viable alternatives. The Victorian Government should set parking fees so some parking spots remain vacant for much of the morning peak, meaning people arriving later can still get a park if they need one. This also assists people choosing to work more flexibly and taking advantage of off-peak fares.

We recommend the Victorian Government price parking at major public transport hubs. Once rail and station parking demand has returned to pre-pandemic levels the Victorian Government should charge parking fees at public transport car parks to help encourage people to travel there using public and active transport, and to make parking spaces available for public transport users who need them most.[166]

6.5.2   Better buses in outer and new growth areas

Carparking reforms are only effective if people have credible alternatives to driving, such as taking the bus. Our previous research found over 20% of Melbourne's bus routes carried very few passengers. Many of these routes are in outer and new growth areas and typically provide infrequent services along meandering routes with a limited span of hours.[167] Our modelling finds that a shift to working from home could lead to more people in outer and new growth areas of Melbourne and Geelong. This heightens the need for effective bus services in these areas.

More attractive bus services can help encourage people to use them to reach train stations and other destinations. Faster, more direct services can help tip the balance towards people choosing buses more frequently. Past bus service reforms unwound complex and confusing routes, integrated routes with train stations, and improved frequencies.[168] For example, the Victorian Government reformed the Wyndham bus network to coincide with the opening of the Regional Rail Link.

The Victorian Government can also use high quality 'next generation' bus services to connect people living farther way to train services. These buses could provide service and features similar to a rail service. For instance, they could have fewer but better quality stops, and facilities to interchange with other modes, including cycling.

These kinds of reforms can help ensure that appropriate bus services serve growing communities, including routes that provide direct connections to train stations and activity centres.

To enhance bus services in Melbourne's outer and new growth areas we recommend the Victorian Government:

- *Undertake a systematic review of all poor-performing networks to identify opportunities to reprioritise services. This could mean route or timetable reform or the introduction of innovative public transport services such as on-demand bus and ride sharing.[169]*

- *Link outer suburbs to rail with 'next generation' buses. Introduce 'next generation' bus services towards Clyde, Mornington Peninsula, Wollert, and Armstrong Creek. As Victoria recovers from the pandemic, the government should look for other opportunities for these types of services where people are moving to places without existing rail networks.[170]*

[163] Terrill, Marion, Greg Moran and James Ha, *Why it's time for congestion charging*, 2019, Grattan Institute, grattan.edu.au/wp-content/uploads/2019/10/923-Why-its-time-for-congestion-charging.pdf; City of Melbourne, *Transport strategy 2030*, 2019, City of Melbourne, www.melbourne.vic.gov.au/SiteCollectionDocuments/transport-strategy-2030-city-of-melbourne.pdf

[164] Infrastructure Victoria, *Good move: fixing transport congestion*, 2020, Victorian Government, www.infrastructurevictoria.com.au/ wp-content/uploads/2020/03/Good-Move-fixing-transport-congestion-Infrastructure-Victoria.pdf, p. 12

[165] Infrastructure Victoria, *Good move: fixing transport congestion*, 2020, Victorian Government, www.infrastructurevictoria.com.au/wp-content/uploads/2020/03/Good-Move-fixing-transport-congestion-Infrastructure-Victoria.pdf. p. 24–27

[166] Infrastructure Victoria, *Victoria's infrastructure strategy 2021-2051*, 2021, Victorian Government, recommendation 50

[167] Infrastructure Victoria, *Five Year Focus Immediate actions to tackle congestion*, 2018, Victorian Government, https://www.infrastructurevictoria.com.au/wp-content/uploads/2019/04/Five-year-focus-Immediate-actions-to-tackle-congestion-April-2018.pdf, p. 37

[168] Department of Transport, *Victorian Bus Plan*, 2021, Victorian Government, https://transport.vic.gov.au/-/media/tfv-documents/dot_victorias_bus_plan_june_21.pdf

[169] Infrastructure Victoria, *Five Year Focus Immediate actions to tackle congestion*, 2018, Victorian Government, https://www.infrastructurevictoria.com.au/wp-content/uploads/2019/04/Five-year-focus-Immediate-actions-to-tackle-congestion-April-2018.pdf

[170] Infrastructure Victoria, *Victoria's infrastructure strategy 2021-2051*, 2021, Victorian Government, recommendation 75

6.6 Improve road network maintenance and adaptability

In the medium-term, our modelling suggests that road congestion persists in a future with more working from home. This means both regional and metropolitan roads still need good maintenance, and to adapt to changing needs and conditions.

6.6.1 Reform regional road funding and maintenance

Our modelling shows travel pattern changes and population dispersion in Melbourne and regional cities, meaning regional roads must remain safe and well-maintained. Our modelling shows significant traffic increases along freeways linking regional areas to Melbourne, particularly roads from Geelong, Ballarat, Kyneton and Broadford. While on average the number of regional trips decreases in our working from home scenarios, the remaining journeys cover longer distances.

Figure 40.   Freeway volume increases, WFH medium vs base case, 2036
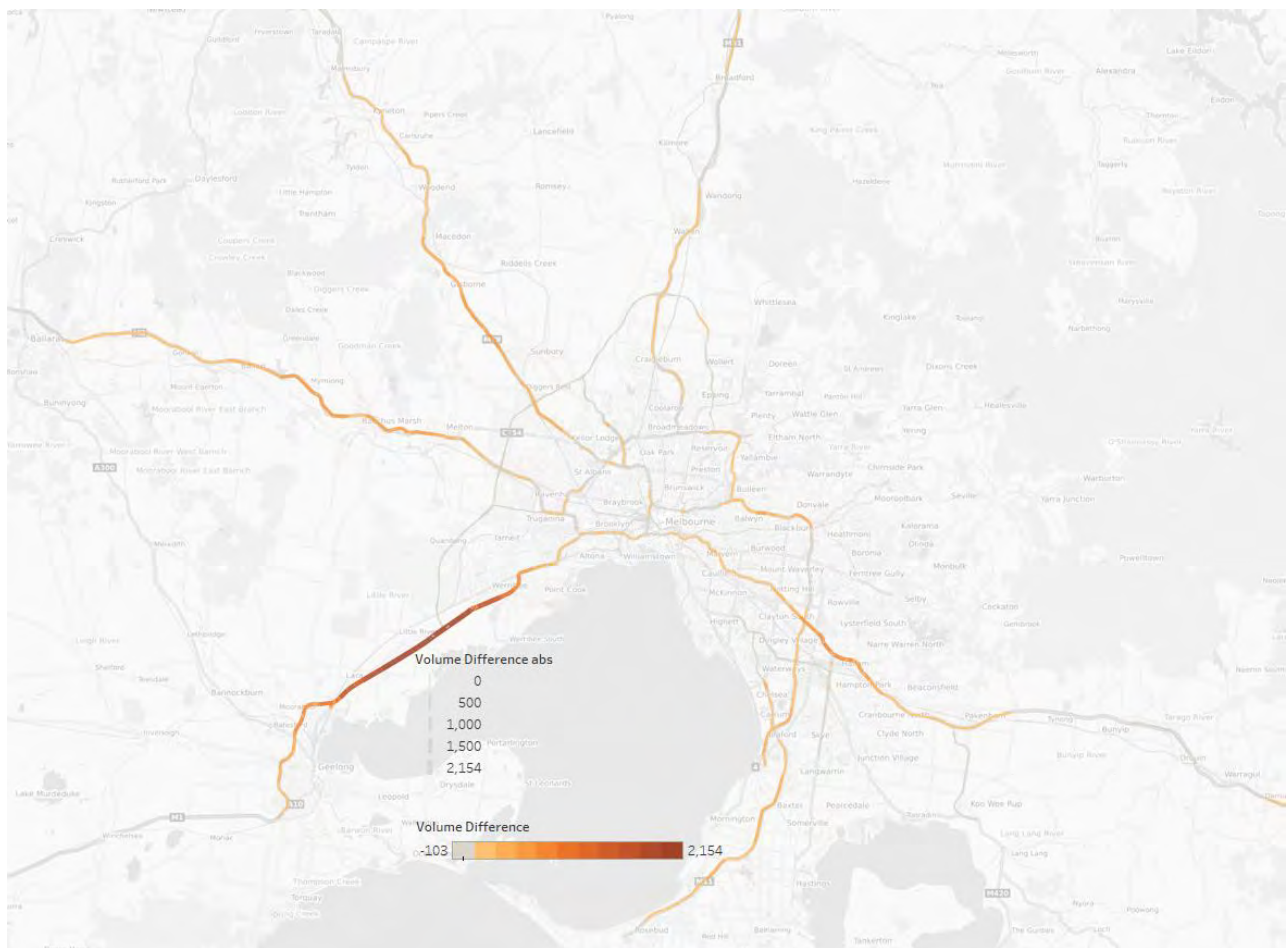
Car & Truck (veh) Difference in AM Peak (07:00 - 09:00)

Source: Infrastructure Victoria analysis of ARUP and Victoria University, Working from home VLUTI modelling, 2021

This reinforces the need for the Victorian Government to define the level of service, or desired condition, of each type of regional road and bridge in a hierarchy based on defined criteria, in a transparent framework. The Victorian Government does not need to maintain every road to the same standard, but they should be maintained to meet their intended purpose. For example, a regional freeway needs to be maintained at a much higher standard than a narrow backroad serving a few rural properties. The level of service could define the desired speed, volume, safety and types of vehicles the road is intended to carry.

Assigning roads to these levels of service needs to match local and regional requirements, catering for a region's growth, local travel, freight, through traffic, industry, and emergency access needs. As they change, the quality and condition of roads may need to change too. After specifying road service levels, the Victorian Government should allocate funding to priority maintenance and upgrades, determined by desired safety, vehicle emissions, productivity outcomes, and existing road condition.

We recommend the Victorian Government specify clear levels of service for each type of regional road and bridge. Following this, dedicate a 10-year funding program to sustainably fund Victorian Government regional road and bridge maintenance and upgrades to meet these service levels. Funding should be prioritised based on improving safety, decreasing vehicle emissions, and lifting productivity.[171]

6.6.2 Increase flexibility and responsiveness of the road network

Our working from home scenarios find mixed impacts on the road network. Roads do not become as congested in inner areas, but freeways become congested faster, and overall the cost of congestion is slightly higher, compared to the base case.

Social changes, such as working from home, affect the spatial layout of Victoria's cities and people's travel patterns. A better road management system can better adapt to these changing social needs and conditions. Investing in a new road management system project would transform the road network's operational performance by using contemporary technology to improve traffic flow and manage disruptions, including for buses and trams.[172] For example, the project includes upgraded traffic signals, live incident detection and variable lane uses for clearways, bus lanes or multi-directional operation.

Road management systems, like the use of dynamic lanes during peak periods, could help to more smoothly manage increasing traffic volumes as more outer suburban residents travel towards the central city, as we modelled in the working from home scenarios. These scenarios also show heavier use towards and along regional and metropolitan freeways. Road management system upgrades improve the capacity of these freeways, along with the whole road network.

We recommend the Victorian Government introduce new road network demand management technology. Progressively introduce new road network demand management technologies across the state and integrate management systems for different road-based transport modes. Combine them with a road infrastructure upgrade program to optimise the benefits of technologies, such as by providing extra clearways and introducing dedicated lanes for bus routes.[173]

[171] *Infrastructure Victoria, Victoria's infrastructure strategy 2021-2051, 2021, Victorian Government, recommendation 78*

[172] *Infrastructure Victoria, Major Transport Program Strategic Assessment report, 2021, Victorian Government, https://www.infrastructurevictoria.com.au/wp-content/uploads/2021/08/Major-Transport-Program-Strategic-Assessment-Report.pdf; Infrastructure Victoria, Victoria's Infrastructure Strategy 2021-2051, 2021, Victorian Government, https://www.infrastructurevictoria.com.au/wp-content/uploads/2021/08/1.-Victorias-infrastructure-strategy-2021-2051-Vol-1.pdf*

[173] *Infrastructure Victoria, Victoria's infrastructure strategy 2021-2051, 2021, Victorian Government, recommendation 24*

About us

Infrastructure Victoria is an independent advisory body, which began operating on 1 October 2015 under the *Infrastructure Victoria Act 2015*.
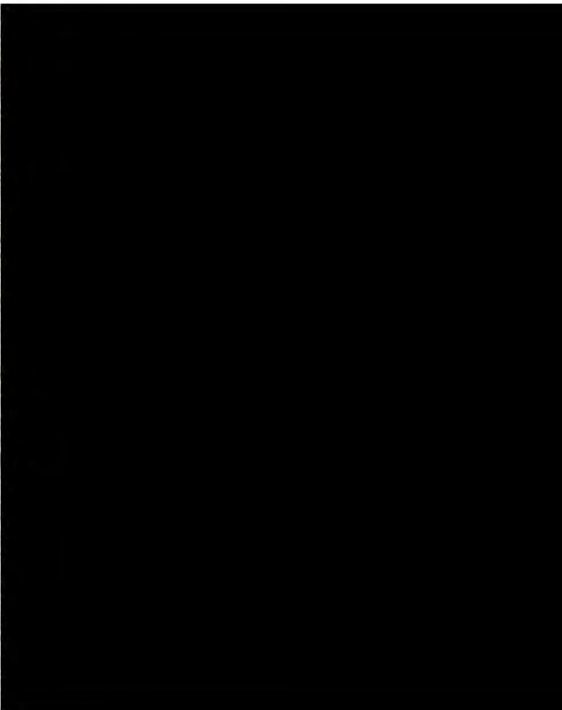
Infrastructure Victoria has three main functions:

• preparing a 30-year infrastructure strategy for Victoria, which is refreshed every three to five years

• providing written advice to government on specific infrastructure matters

• publishing original research on infrastructure-related issues.

Infrastructure Victoria also supports the development of sectoral infrastructure plans by government departments and agencies.

The aim of Infrastructure Victoria is to take a long-term, evidence-based view of infrastructure planning and raise the level of community debate about infrastructure provision.

Infrastructure Victoria does not directly oversee or fund infrastructure projects.