



STRONGER, TOGETHER

A practical Victorian fast regional commuter rail network, bringing sustainable growth, liveability and opportunity to Melbourne and the regions

May 2019

Disclaimer

This report has been prepared by Juturna P/L for the City of Greater Geelong. The information in this report has been prepared by Juturna from open-source material, stakeholder consultation and eminent technical input on Victorian fast rail operational matters provided by the authors of the City of Greater Geelong's *Geelong Fast Rail high level technical assessment* (2018).

All reasonable attempts have been made to ensure the accuracy of information contained in this report but Juturna reserves absolute discretion in updating or amending this document.



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About this paper

The culmination of over a year of research, augmented by review and opinion from some of Australia's leading urban planners, infrastructure and manufacturing policy leaders, transport economists and Victorian rail operational experts, *Stronger, Together* offers fresh thinking about Melbourne and regional Victoria's respective growth and opportunity challenges - and how the right scale and design of fast regional commuter rail presents a solution to both.

The document was commissioned by City of Greater Geelong in the context of the State committing to plan for 200km/h fast rail to both Geelong and Ballarat.

It extends this network to include Bendigo, Shepparton and Latrobe as well as interim stations. It does so with a design solution which complements the current (Tullamarine) Airport Rail Link: a fast regional network can be constructed in parallel with this project to deliver major macroeconomic benefits much sooner.

The analysis does not pretend to be the last word, but offers a credible picture of potential. It is not 'rail for rail's sake': fast rail is simply the best solution for bringing larger numbers of regional people to and from a big city at speed, without creating car parking, congestion, road trauma, tolls and car emissions pressures. It is also the only mode capable of making material shifts to relative city-region property values.

The document attempts answers to key questions: *how many commuters could this benefit? By how much might regional commuting times improve? To what extent would it shift population growth patterns out of Melbourne and into the regions? What are the likely effects on the Victorian labour market? Do similar projects and effects exist internationally? Can it be integrated with current major rail projects?*

Key infrastructure design and operational considerations are examined; these should not be read as a perfected network design or train management plan, but are intended to show that there are no 'show-stopping' impediments to the vision.

In recent years many big Australian infrastructure projects have tended to take on their own life almost entirely behind closed doors, away from genuine community debate and scrutiny about what problems they are trying to solve - and how well they may solve them, relative to other solutions.

This document promotes a shared discussion around what regional fast commuter rail can do for Victoria, in the hope that this leads to a vision and a project supported by Melburnians and regional Victorians alike.

Data sources and supporting documents

Unless otherwise indicated, all population and economic statistics employed in this document are 2017 figures from www.economyprofile.com.au or profile.id.com.au

The paper draws on existing publications such as the recent Melbourne-Geelong Fast Rail strategy and high level technical reports¹, as well as the Australian Rail Futures Institute's Intercity: State of Cities fast rail report (2016)² and its subsequent strategies and presentations for fast rail conversion of specific regional corridors.

At a glance

Design

- ***Stronger, Together* is a 200km/h fully-electrified regional commuter rail program between Melbourne and Geelong, Ballarat, Bendigo, Shepparton, Latrobe, interim towns and Tullamarine and Avalon airports, offering world-class economic renewal, labour market expansion and access to opportunity.**
- **Constructed in parallel with Airport Rail Link – it employs shared tunnels and alignments bringing all parts of the network except Latrobe into an efficient common solution.**
- **In fact, constructing Tullamarine Fast Rail without such a parallel project risks ‘locking out’ affordable regional fast rail for Victoria permanently.**

Macroeconomic impact

- **By creating much faster, high-capacity/frequency/amenity/reliability links to nearby regions displaying far lower property prices than Melbourne, fast rail can grow regional Victoria’s population by 1 million people above trend by 2050 – reducing Melbourne growth pressures, especially in the outer suburbs.**
- **By 2050 2.71 million regional Victorians access fast, high-frequency commutes:**
 - **1.27 million within a 35–45-min Melbourne Southern Cross station commute;**
 - **730,000 within a 65-min commute; and**
 - **710,000 within a 100-min commute.**
- **This compares very favourably against a global benchmark for a larger city like London UK CrossRail, which brings 1.5m more people within 45 minutes of the CBD.**
- **It reduces Melbourne congestion costs by perhaps \$800 million per year.**
- **It creates a much larger single labour market to tackle labour force participation risks and offer greater two-way investment, education and job growth.**
- **It drives a shift away from cars – Geelong or Ballarat commuters save 7 weeks of their working lives annually (268hrs p.a.) by switching to fast rail.**
- **A similar Toronto, Canada network displays benefit-costs of 2.6:1: better than any project on Infrastructure Australia’s Priority List. It removes c. 50 million car trips p.a. from Greater Toronto and 13.5 m tonnes of carbon emissions.**
- **Results cannot come at the cost of lost regional character and liveability: funded planning reforms across all three levels of government are vital features to protect liveable and productive growth patterns for ‘fast-rail regions’.**

Financing, funding and delivery

From the outset of its fast rail inquiries in mid-2017, the City of Greater Geelong recognised that proper scale, credible cost estimates and a strategy to pay for the vision were all required.

From that time, the City worked in parallel with a highly-qualified local, national and international consortium which was developing a preliminary financing and funding model and associated project structures for State-wide fast regional commuter rail.

The consortium's guiding business case design objectives included:

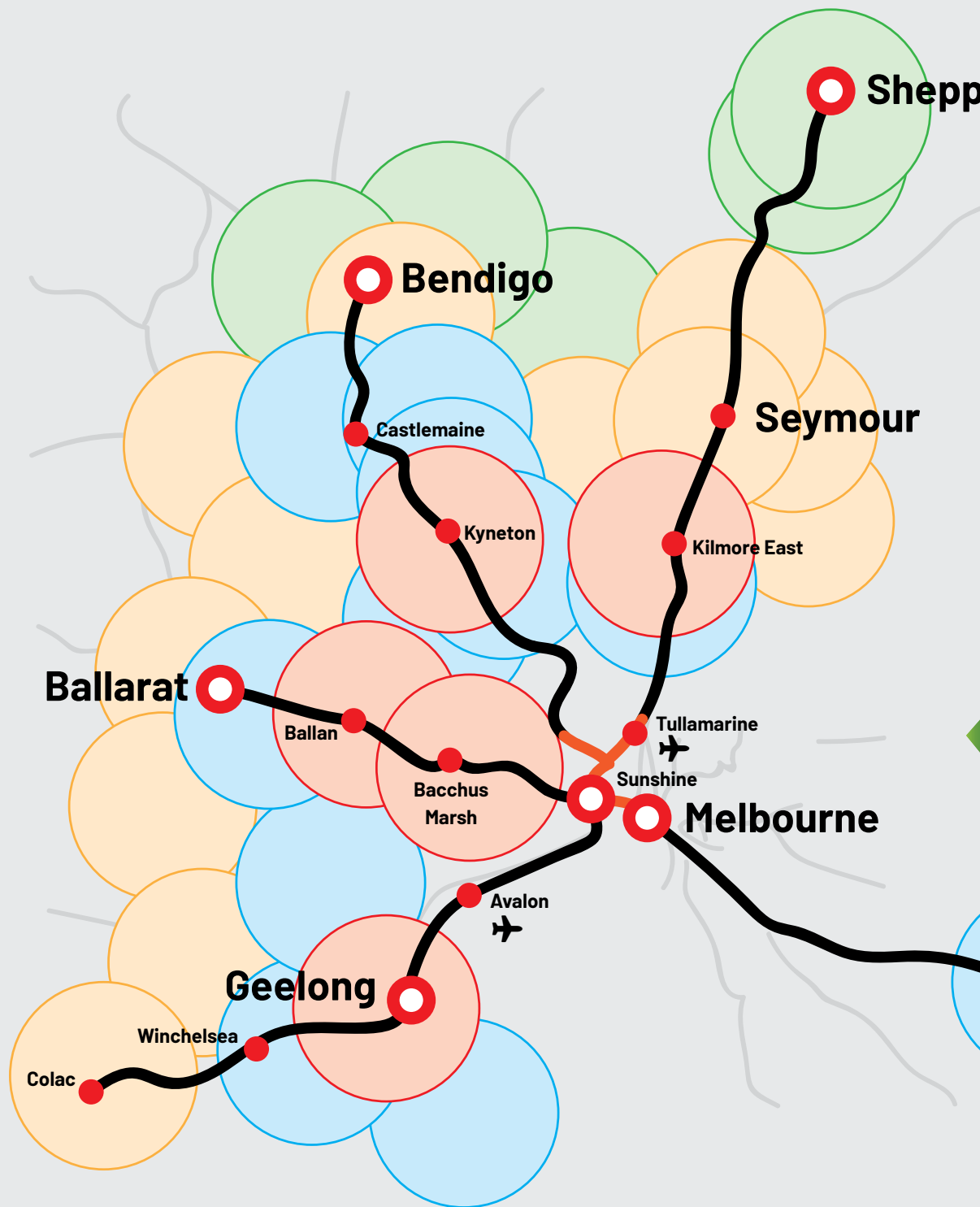
- A project structure embracing all three levels of government and giving genuine agency to regional Victorian communities;
- A revenue model which secures the project but also protects the financial interests of fast rail communities and their local governments;
- A modular design to complement and leverage the Airport Rail Link project, which can be catalytic for Victorian regional fast rail and which can reduce its delivery timeframes; and
- Structures to ensure the project is deliverable for constructors and financiers.

Solutions

The consortium business case offers State and/or Commonwealth governments a reliable and affordable pathway for delivering the project. Key features include:

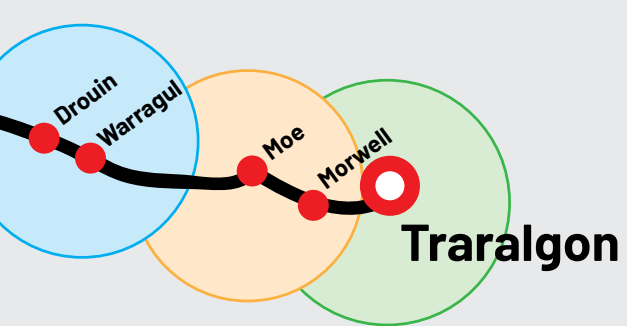
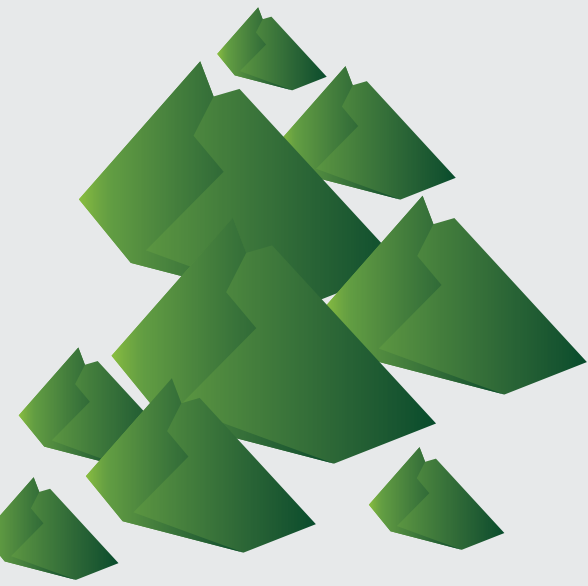
- A superior approach to finance and funding: the Airport Rail Link project, all regional fast lines except Latrobe as well as new fleet can be delivered for the same level of Commonwealth and State grant funding already committed to Airport Rail Link alone - that is, \$5 billion grants from each of the Victorian and Commonwealth governments;
- *A preliminary case was estimated for Latrobe, but this line requires a substantial new alignment which will affect its costs and delivery timeframes.*
- The project offers a commercial rate of return and can be pursued either as a public-private partnership or as a Public Trading Enterprise-funded major project, with market expertise guiding design and delivery;
- The project is planned and constructed in parallel with Airport Rail Link and associated metropolitan suburban track duplications. This allows fast regional services such as Geelong and Ballarat to begin operating within around 6 years in line with likely Airport Rail Link delivery timeframes.
- Comparator projects suggest it can employ c. 8,000 p.a. people for project life;
- It presumes a new 200km/h-capable high-capacity electric train fleet procurement of c. \$1 billion - a major national rail manufacturing opportunity;
- The design, finance and revenue model is of direct relevance to fast rail design objectives of other large Australian cities such as Brisbane and Sydney.

While project adoption is a matter for governments, the strategy document and business case together should give confidence that the *Stronger, Together* network vision is practical, affordable and respects community value-for-money expectations.



Stronger, Together *Victorian fast regional commuter network*

arton



Key



Major station



Interim station



Approximately
35-45 mins
connect - Melbourne
CBD



Approximately
45-65 mins
connect - Melbourne
CBD



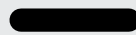
Approximately
65-85 mins
connect - Melbourne
CBD



Approximately
85-100 mins
connect - Melbourne
CBD



New shared Tulla and regional
fast rail lines and tunnels



200kp/h 25kV AC
electric railway

Executive summary

(Designed to be read in conjunction with the At a glance key points and map above)

Context: twin challenges, common solution

- In the decade to 2016, Melbourne took up 86 per cent of all Victorian population growth. Most Melbourne growth moved into new outer suburbs which offer comparatively fewer jobs and less socio-economic infrastructure than other parts of Melbourne.
- This helps explain Melbourne's congestion and opportunity challenges. It also sheds light on why regional Victoria remains Australia's lowest-growth economy.
- Melbourne and regional Victoria face opposite sides of the same problem: Melbourne has benefitted from a recent near-monopoly on State population growth, but the fast pace of this growth is starting to generate costly frictions. Nearby regional cities have mostly missed out on economic growth and are seeking a transition path to future prosperity, while maintaining liveability. A mechanism for achieving solutions for both places has not yet been evident.
- All of Victoria faces looming labour force participation risks, as the ageing population means less people in society will be working. In this context, it is especially important that transport projects unlock maximum labour force participation.
- Victorian country rail policies to date have not resolved these challenges and are not well-equipped for the future: service levels, safety and amenity have all increased dramatically in the past 75 years, but in many cases commuting times to and from regions have changed little, so the *spatial relationship* between very large Melbourne and (by world standards) its relatively small nearby regional cities has not changed much at all.
- More *status quo* will leave Melbourne without meaningful hinterland support and the regions without much better access to capital city growth opportunities. Current regional rail policy does little to slow the forecast fall in labour force participation.

How fast regional commuter rail can transform the relationship

- Genuinely fast, high-capacity and high-frequency rail links between capital cities and nearby regional centres can *change the spatial relationship* of these places: generating a material shift in regional property values and migration patterns, while expanding a more powerful single labour market of two-way opportunities.

A major economy that is underappreciated - and underperforming

- The regional network described in this paper is already home to almost 900,000 and generates almost \$50 bn annually in economic product. This is the same size as Tasmania and the Northern Territory's economies combined; if it were a country, it would rank just inside the top half of national economies worldwide.
- Stubbornly low-productivity growth and difficult transitions from legacy regional industries mean these places need transformative connectivity to Melbourne's \$325 bn economy. Fast-growing Melbourne needs that connection too.

Proposed network

- Fast, high-capacity and high-service-level commuter rail is proposed between **Melbourne** and five nearby regional cities - **Geelong, Ballarat, Bendigo, Shepparton** and **Latrobe (Traralgon)** as well as several interim stops. The network services both of Melbourne's main airports - **Tullamarine** and **Avalon**.

Sympathetic design

- The program is designed to fit sympathetically into existing State rail projects and plans. The catalyst is the State's already-agreed Tullamarine Fast Rail project: *Stronger, Together* would share common new tunnels and the Sunshine rail alignment with this project: it would greatly expand social and economic benefits of Tullamarine airport rail alone; in principle, its construction does not need to wait - it benefits from being designed concurrently with this priority airport project, for almost no lost tempo.
- Conversely, if Tullamarine Fast Rail is designed *without* regional fast rail functionality in mind, this could shut out forever the ability to change the Melbourne-regional spatial relationship for the better.

A conservative approach to technology and network

- The network does not require extremely fast, very expensive (300km/h+) 'bullet trains', built on costly new rail corridors which require land acquisitions. Reasonably fast (i.e. 200km/h), high-capacity, high-frequency regional rail services can be retrofitted within the existing VLine country rail corridors with suitable upgrading of line, train safety management systems and relevant suburban Melbourne metro line duplications.
- The network is mostly limited to a core regional catchment capable of generating a powerful single labour market with Melbourne. This defines itself broadly within a little over a one-hour direct commute to and from the capital.

Transformative fleet

- A new high capacity, 200km/h fully-electric fleet is proposed - it overcomes specific design challenges for the network with a diesel-powered fleet; it also ensures no direct carbon emissions and a quieter, higher-capacity solution which also brings significant new fleet manufacturing investment and jobs to Victoria.

Success templates: international case studies

- The paper considers Toronto's *GO Expansion* regional fast rail business case (2018) - a close comparator for *Stronger, Together* - as well as Oresund sea bridge between Denmark and Sweden - the latter case reveals how powerful the socio-economic effects can be when a disconnected capital city and nearby regions have their spatial relationships changed by smart and fast transport solutions.
- It also measures the project's fast regional access potential against a global benchmark in the form of London's current *UK Crossrail* project.

Design and technical insight

- At a high-level only, the paper outlines likely capital works categories and design considerations.
- This has been guided by eminent operational and engineering design insight gained from high-level technical assessments commissioned as part of City of Greater Geelong's fast rail technical reports (2018) as well as subsequent review and feedback. There do not appear to be any technical or physical 'show-stoppers' to the design

Context: current growth paths and risks

Melbourne's growth frictions

Melbourne's continued strong headline economic performance and its sustained dominance of *World's Most Liveable City* rankings is the envy of many. At well over \$325 billion in economic product per year, Melbourne represents almost 20 per cent of Australia's economy and almost 30 per cent of national economic growth.

But Melbourne's rapid population growth since the turn of the century has not been altogether planned: in 2002 the Victorian government forecast it would take nearly 30 more years for Melbourne to reach 5 million people. This mark was passed in 2018 - 12 years ahead of plan. Melbourne added a further quarter of its population in the decade to 2016.

As this breakneck growth continues, research is emerging to suggest Melbourne's famed liveability is encountering increasing 'growth frictions': worsening traffic congestion, urban sprawl, pollution, and increasing challenges to providing fair access to employment and educational opportunity. These factors in turn manifest themselves as social connectivity and even developmental challenges.

The most challenging impacts are felt in Melbourne's far outer suburbs - where most new Melburnians will live. Over half of Melbourne's population growth in the past decade has been absorbed in greenfield outer suburban sprawl - even though there are fewer jobs and social and economic infrastructure in these places.

Recent State government efforts have redoubled spending in public transport, with rail extensions, higher-capacity rolling stock, network capacity building programs like Melbourne Metro and other investments in the system. The question is how much 'catch-up' is being played to connect the spatial explosion of new outer suburbs with such infrastructure - and how much it will cost to get these services to acceptable levels for a city facing a population of at least 8 million by 2050.

In 2018 Infrastructure Victoria forecast that road congestion in Melbourne's outer suburbs would grow by 36 per cent in under two decades - higher than the forecasts for middle or inner suburbs. Increasing unreliability in transit times - especially for roads - combines with the rise of toll roads to the point where some commuters may begin to face multiple weekly tolls to place pressure on access to opportunity in these outer suburbs; these things combine with losses in Melbourne's traditional manufacturing base to challenge wage growth and wider social outcomes for the residents of outer Melbourne.

Melbourne's record growth - the risks to urban productivity become clearer

The *Making the Most of Our Opportunities* report (2019) is a local government-sponsored economic analysis of Melbourne's population growth and its socioeconomic implications, authored by eminent Australian economists and social resilience experts Dr Peter Brain (NIEIR), Professor John Stanley (University of Sydney) and Associate Professor Janet Stanley (University of Melbourne)³.

The report sheds important light on how Melbourne's rapidly growing outer suburban sprawl has negatively influenced growth in the capacity of residents to capture income, access to opportunity and social opportunity in these places - in short, increasing inequality.

It finds that most of Melbourne's jobs have remained anchored in the city, inner and middle suburbs even as the population base has shifted increasingly to the far outer suburbs, meaning an ever-increasing bulk of the population are becoming stranded from work opportunities by degrees, as congestion, cost of commuting and trip unreliability increases. These factors then interact with legacy underinvestment in major infrastructure in many outer areas of the city to reinforce the challenges. State government expenditures on these matters in recent times have been much stronger, but the inequality effects of relative underinvestment in outer suburban connectivity over decades are becoming evident as the population grows at record pace.

The report finds that 25 years ago, residents in outer Melbourne local government areas like Cardinia, Casey, Melton and Wyndham all showed higher income than the State average. By 2017, all of these outer Melbourne areas were badly trailing State averages: Melton saw a net 28 per cent loss of income growth per working age adult relative to the State average; Casey lost 36 per cent; Wyndham lost 31 per cent.

Above 2 per cent population growth: a recipe for outer suburban failure?

Landmark new modelling of these effects by *Making the Most of Our Opportunities* suggests that there is a clear inverse relationship between Melbourne population growth at LGA level and income growth when an LGA's working age population rises much above 2 per cent: as LGA growth exceeds around 2 per cent on a sustained basis, the capacity of residents to gain income reduces relative to the state as a whole. Melbourne's growth has been well above 2 per cent for over a decade now. This finding contrasts other more optimistic views about Melbourne's growth, such as the Grattan Institute's assertion that Melbourne is 'remarkably adaptive' to historically-high population growth levels, the effects of which are, it argues, largely benign:

*'There is overcrowding on public transport, and commuting times can be unreliable. While most drivers are delayed no more than five minutes getting to work, this number can be much higher on bad routes. But the situation is not spiralling out of control; migration has not brought cities to a standstill. People adapt: some change job or worksite, and working from home is on the rise. Some people move house, or even leave the city; and some change their method of travel, leaving the car at home and catching the train or bus to work. Other people simply accept a longer commute - at least for a time - particularly if they earn a high income'*⁴.

extract from Grattan Institute: *'Remarkably Adaptive: Cities in a time of growth'* 2018

Making the Most of Our Opportunities suggests Melbourne is not working for everybody. Its broad message is that Melbourne risks becoming a powerful agglomeration economy only for some, surrounded by outer suburbs of far less opportunity for too many others.





Nearby Victorian regions: a significant but underperforming asset

Victoria's land mass is almost exactly the same as that of the United Kingdom, but unlike the UK - and thanks to Victoria's particular colonial era (horse-drawn) settlement patterns - most of Victoria's core population centres remain close to Melbourne: Geelong, Ballarat, Bendigo, Shepparton, Latrobe and their surrounding smaller townships are mostly around 150 kilometres or less from the State capital.

In contrast to Melbourne, far less is understood about the potential of these nearby regional centres.

Closer investigation reveals a nationally-significant economy, full of varied and liveable smaller cities with rich ancient and modern histories, strong, connected communities, high levels of liveability and - in comparison to the greenfield new suburbs of outer Melbourne - far deeper and more resilient existing infrastructure and services for growth.

Growth in regional city populations near Melbourne has increased in recent years. This has in part been a function of a deeply unaffordable Melbourne housing market - ranked by *Demographia* in 2018 as the world's fifth most severely unaffordable property market, out of 9 countries and 293 discrete property markets.

It can also in part be explained by the innate rejuvenation of many Victorian regional cities - the result of much community and government hard work - as enjoyable places to live.

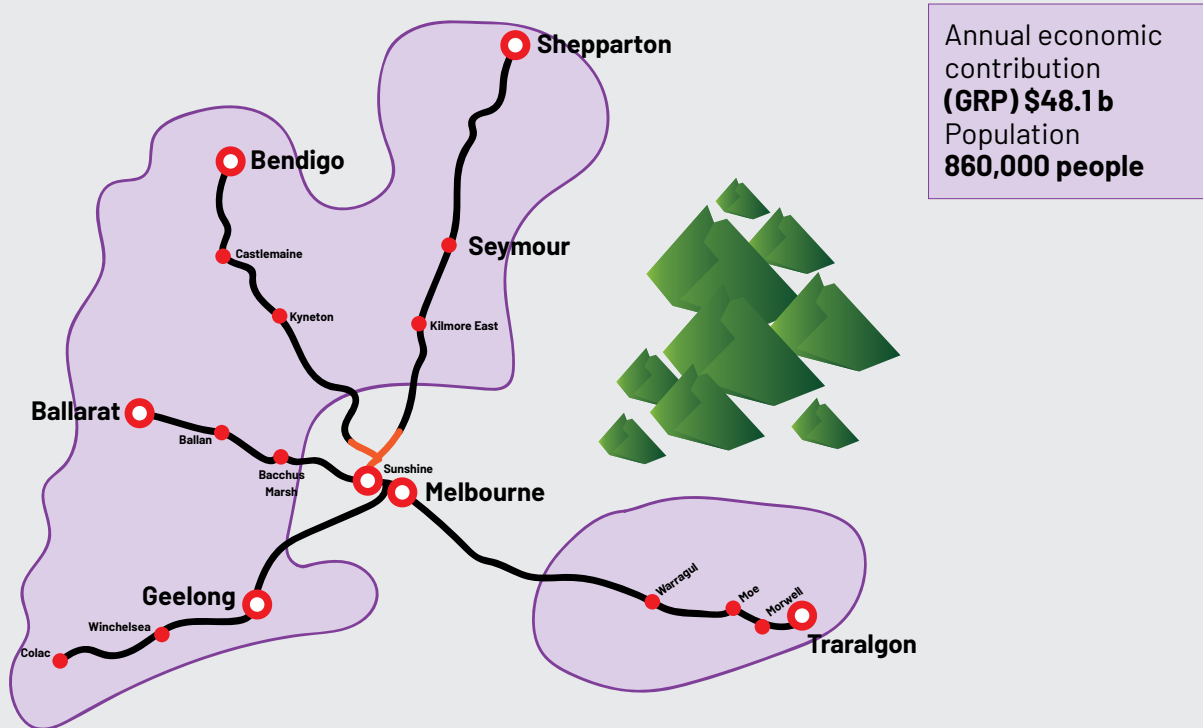
But commuting times between Melbourne and these places have changed little - and in some notable cases, they are worsening: *status quo* transport solutions are not working. This is the key to understanding both the economic growth risk and the potential of Melbourne's nearby regions.

A hidden economy, more significant than some States

For all the challenges, the sheer size of this regional economy suggests its great potential if linked more efficiently with the Greater Melbourne economy with much faster, higher capacity and higher frequency transport.

With a population of almost 900,000 people and a gross regional economic output of almost \$50 bn, the regional fast rail economy surrounding this proposed fast rail network is slightly larger than the Australian Capital Territory's economy and almost as large as those of the Northern Territory and Tasmania combined. It is larger than some smaller Eurozone economies. As a national economy it would rank inside the upper half of the world's almost 200 nation state economies worldwide.

Fig. 1: Stronger, Together fast regional commuter rail economy



Analytical base

For analytical purposes, the *Stronger, Together* region has been defined as the following 15 regional Victorian local government areas which fall into a core fast commuting catchment:

Ballarat	Greater Geelong	Macedon Ranges
Baw Baw	Greater Shepparton	Moorabool
Colac-Otway	Hepburn	Mount Alexander
Golden Plains	Latrobe	Queenscliffe
Greater Bendigo	Mitchell	Surf Coast

Regional growth - past challenges and future opportunities

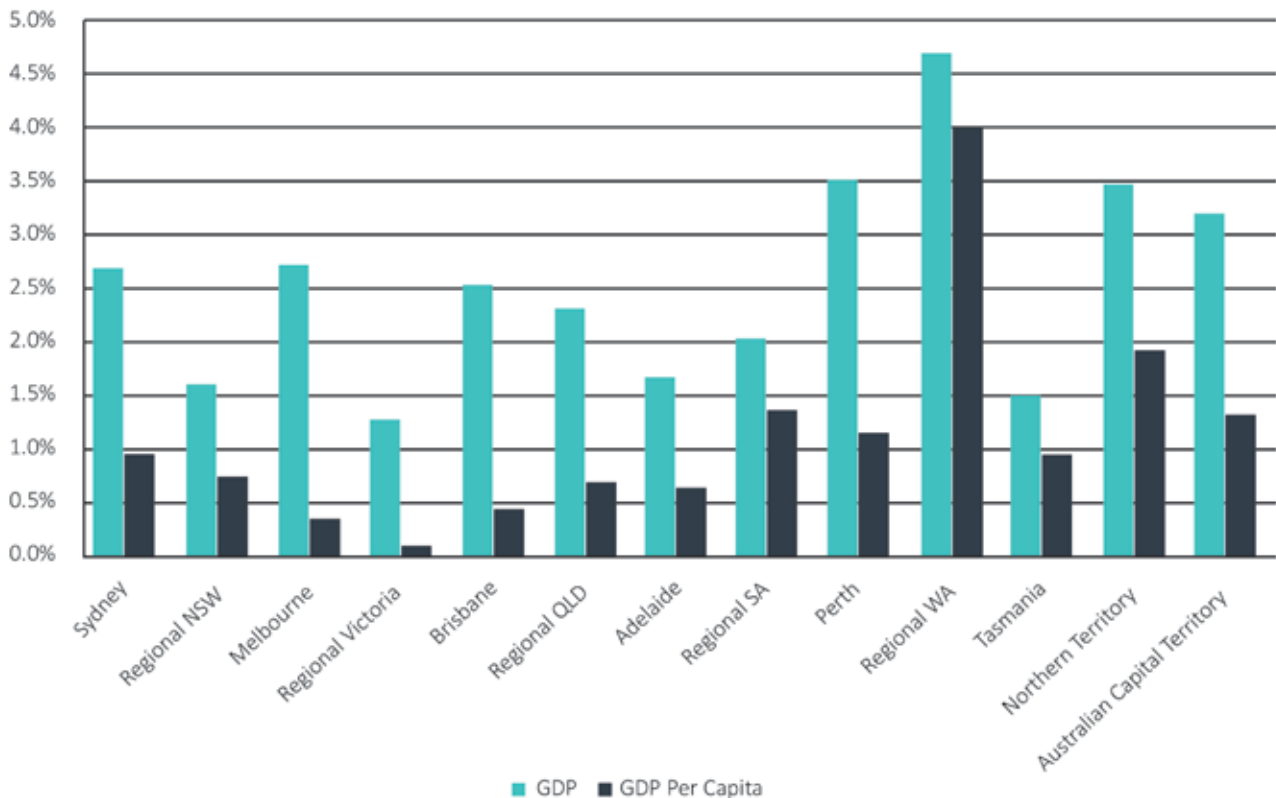
In general, Victorian regional cities and townships suffer from economic underperformance, characterised by an overreliance on mostly low-return regional agriculture (which itself will face far more challenges in a drying climate) and forced transitions away from important legacy industries: car manufacturing and aluminium smelting in Geelong, traditional fruit processing around Shepparton and legacy coal-fired power generation in the Latrobe Valley, to name just three examples.

Hard work by these communities, their businesses and governments has stabilised and even grown some of these regions, but overall productivity growth remains low, especially compared to Melbourne.

This to some degree reflects the story of regional Victoria as a whole: it has been the least productive economy of any major city or region in Australia over the past decade. The challenge for these regional centres lies in finding new sources of economic growth and high-paying, high-productivity jobs. Yet regional Victoria still lacks a credible, genuinely transformative government plan for growth and renewal.

The continued headline economic growth of the Australian economy may have helped to mask this regional problem, but by the same token any future global economic downturn will make these shortcomings all too apparent:

Fig 2. Decade to 2016 avg. GDP & GDP % per capita growth all Aust cities/regions



Source SGS Economics: *Productivity or perish - the Australian challenge for the 21st century* August 2018. Data displays results from FY06-07 to FY16-17

Important gains but transport connections to Melbourne a barrier

This Statewide picture does not tell the whole story - some nearby regional centres to Melbourne are indeed experiencing economic as well as population growth. Over the past decade, for example, Moorabool (Bacchus Marsh) Mitchell (Seymour; Kilmore) and Surf Coast (Torquay) have been growing their populations at rates similar or higher to that of Melbourne.

Meanwhile, a combination of increasing road traffic congestion for regional car commuters to and from Melbourne, combined with little in the way of transformative change in transit times for country rail services both threaten to move regions further away in terms of their spatial relationship to Melbourne, not closer; this has negative implications for future regional economic opportunity.

Overcoming Victoria's 'big-capital, small regions' structural weakness

Few places in the world show such a disparity between a very large capital city size and relatively small populations of nearby regional cities as Victoria.

This suggests a structural weakness: Melbourne lacks the depth and expansive legacy public transport footprints of - for example - a Greater London, or Greater Paris - public transport footprints on this scale would allow Melbourne to grow its population to much higher levels more readily, without risking growth or fair access to opportunity for all residents.

Even assuming further commitments to Melbourne public transit and car connectivity, Melbourne probably needs supportive and well-connected regions to do more, if it is to keep itself growing while remaining liveable and free from excessive sprawl.

Fast, high-reliability and high-capacity commuting rail services between Melbourne and nearby regions offer this outcome. The potential is further underlined by an existing knowledge economy presence in each of the five regional cities proposed in this network, which all already host major Victorian university campuses (see *Wider benefits, following*).

In this context, smart planning may then stand a fair chance of building enduring 'green buffers' between these nearby regions and Melbourne's outer suburbs.

Melbourne's nearby regional cities are a remarkable resource. They await a frictionless mobility solution, backed by proper planning, to be truly transformed into vibrant 'connected places' contributing more to broader-based sustainable economic and population growth.

Network

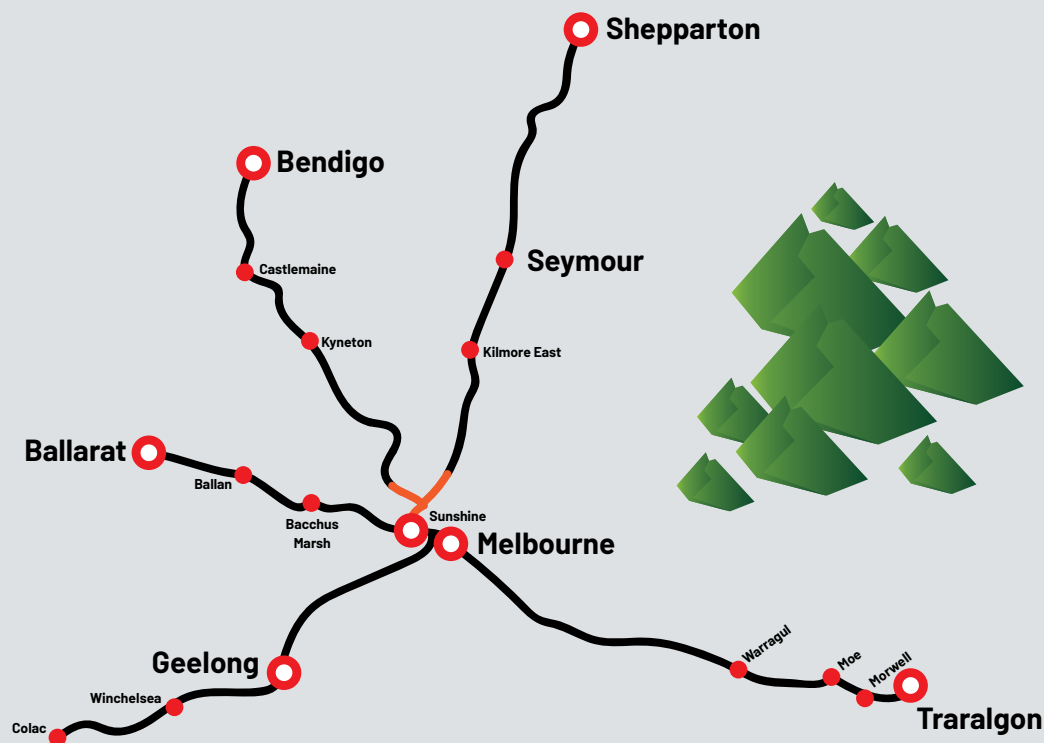
A limited but powerful fast regional commuter network between Melbourne and nearby regions would span a \$50 billion *per annum* regional economy mostly within around 150 kilometres or less of Melbourne and would incorporate five major regional city destinations:

- Geelong,
- Ballarat,
- Bendigo,
- Shepparton; and
- Traralgon (Latrobe)

Designed to maximise uplift

The regions include line extension beyond Geelong to Colac-Winchelsea, which has been included due to the specific prospects of this region for catering for substantial population uplift in the Greater Geelong area: much of this area would remain within effective fast rail daily commuting range of Melbourne.

Fig. 3 Stronger, Together Regional Fast Rail Commuter Network



Station service coverage within regional centres

The more frequent service levels and higher seating capacity *per train* - in part a function of a new fast, higher-capacity regional electric fleet (see *New Fleet, following*) will ensure that all key stations or planned new growth stations within these major regional city areas (such as Warrenheip in Ballarat, for example) could each be well-serviced with high-capacity fast trains.

Service increases and station coverage - ensuring access for entire regional cities

It is important that fast rail does not just service regional city centre stations; where relevant, it should also reach entire regional communities *via* secondary stations.

Technical advice suggests an 8 train per hour (train every 7.5 minutes) peak service for Greater Geelong is operationally manageable under the sort of retrofitted fast regional program outlined. This would provide enough capacity to ensure that all of Geelong's current stations - Lara, Corio, North Shore, North Geelong, Geelong, South Geelong, Marshall and Waurin Ponds - each receive some hourly coverage. A handful of express services could also be provided.

Interim regional stops

Several interim stops would be included in the fast regional commuter network. This is vital for the ability of the services to create a much larger 35-45 minute regional commuter base (see *Mechanism: transformative commuting, following*).

This is also an important point of difference with status quo efforts to improve parts of the regional lines and services over time. The network has been designed explicitly to maximise uplift of commuters into a reasonable daily commute to and from the city (*this matter is returned to in the Impact discussion, below*).

The precise number and location of interim stops would be a matter for discussion; ultimately this is a matter of trading service amenity and catchment in the interim communities while maintaining competitive overall commuting times for the regional cities at the end of the fast rail services.

For analytical purposes, the following interims have been assumed:

- **Geelong fast line - Winchelsea and Colac**
- **Ballarat fast line - Ballan and Bacchus Marsh**
- **Bendigo fast line - Kyneton and Castlemaine**
- **Shepparton fast line - Kilmore East and Seymour**
- **Latrobe fast line - Warragul and Drouin**

Continued movement of passengers at regional stations beyond the fast rail network and on any interim stations not serviced by fast rail is considered in the *Broad design and construction assumptions following*).



Mechanism: transformative commuting

Three basic factors combine to *shift the spatial relationship between the regions and Melbourne*, in turn driving a reliable economic shift in regional land values, perceived amenity, modal shift and ultimately population redistribution out of Melbourne to the regions.

- **Much lower total commuting times**
- **Higher commuter service frequency, amenity, seating availability**
- **Higher reliability commuting**

Without any one of these three conditions in place, it is highly unlikely that the spatial relationship between Melbourne and these regions would change significantly from *status quo* - meaning that in a strategic sense, any incremental investment will be of limited value.

Much lower total commuting times

To date, Victorian regional rail policy has for the most part focussed on everything but travel times. Although service frequency, network capacity, amenity and safety have all risen dramatically, the speed of rail commuting between Melbourne and most Victorian regional cities has changed little in over 75 years. Trains themselves are capable of higher top speeds, but many other factors - not the least of which is the vast land area expansion of suburban Melbourne - all conspire to limit overall travel time for regional commuters.

Line infrastructure upgrades, fast inner-Melbourne regional service running *via* a dedicated express tunnel, a fast new high-capacity regional electric fleet and appropriate train management systems can all increase running speed and reduce overall journey times dramatically.

If proper onwards connectivity at regional cities and interim stations is provided - such as sufficient park-and-ride capacity and bus connectivity - many more people from a wider regional catchment are brought into attractive total commuting times than is possible today.

This shifts property values in these regions, relative to Melbourne. The infrastructure upgrades proposed in this program do not only reduce commuting time dramatically - they also increase the reliability of these travel times. Reliability (i.e. journey time predictability) is a central yet often-overlooked aspect of commuting. Higher reliability commuting acts to strengthen regional property value uplift and inward migration levels to the regions.

Recently, some of these steps have started to be taken by Victoria, such as the segregation of the Wyndham metro and Geelong country rail lines in Melbourne's west. But if the aim is to lift a material amount of population into the regions while keeping these people properly connected into a two-way common labour market, isolated line segregations and iterative works are unlikely to produce the desired uplift.

Higher commuter service frequency, amenity, seat availability

If dramatically quicker and much more reliable total regional commuting times are made available, it is essential that service frequency and seating capacity is increased to match reliably-increased demand. This is the third condition for unlocking a significant migration pattern change away from Melbourne and into fast rail-enabled regional cities and surrounding townships.

Capacity is of direct relevance to the technical choices around rolling stock and train safety management systems; this paper proposes a shift to a new regional fleet of fully-electric, 200km/h-capable high-capacity (possibly double-deck) trains (see *New fleet, following*).

Amenity matters too: compared to car commuting and even to the existing fleet, the certainty of being seated and productive on the commute to and from work or education matters greatly - in this sense, 'productivity' could mean working, or just catching up on sleep. The scale of population uplift involved in *Stronger, Together* (See *Impact analysis following*) creates economically-significant extra productive working hours for the Victorian economy. Newer fleet design for regional services could go beyond being wi-fi enabled and might include a business section with tables and space for laptop work to be conducted. Modern European designs for regional fast services already cater to this market.

Higher-reliability commuting

Why worsening commuter reliability matters

The *reliability* of commuting to and from Melbourne has worsened. This matters, because it shapes how much time each commuter needs to 'budget' for their total commute from home to work and back each day. Once or twice per month, a car commuter might expect to face a large and unforeseeable Melbourne traffic jam that slows their journey dramatically. This leads the motorist to budget slightly more travel time every trip in order to hedge against the potential for being late due to such delays on any future trip. In this way, total travel time commitment blows out - and eats up more of the commuter's days. This is not picked up entirely by average travel time analysis.

Trains face reliability challenges too. Outages and delays caused by regional services being delayed by suburban trains using the same lines reduce country service reliability. This problem is acute for Latrobe commuters: country trains find themselves on the suburban metro network stopping at most if not all stations from over an hour out of Melbourne, because of the lack of dedicated fast regional lines alongside suburban tracks. As fast increasing suburban metro services eat up more capacity on shared lines (as is already occurring) the problem worsens.

A *Stronger, Together* program involves the duplication of outer suburban Melbourne railway lines - separating fast regional services from suburban trains completely. This helps regional commuting reliability and total budgeted travel time. So does upgrading for regional station park-and-ride capability. These work in concert with improved commute times to turn regional centres into more attractive and valuable living locations for commuters.

Transformative commuting and arresting dwindling labour force participation

Like the rest of Australia, Victoria's population is ageing; this means the job and tax burden gradually falls on the shoulders of proportionally less and less Victorians. This is something of a hidden problem but once represented graphically, the challenge it poses for the economy and for standard of living is stark:

Fig. 4 Victoria's labour force participation rate, historical and forecast to 2046



Source: Deloitte Access Economics Current and Future State of Victoria (2016)

In this setting, it is of vital importance to design transport infrastructure which retains as many ageing Victorians as possible within the workforce for as long as possible and encourages wide, easy access to the core Melbourne labour market. This is what fast regional rail can do.

The *Stronger, Together* network is designed to saturate the potential regional population catchment within daily commuting of Melbourne. This helps arrest Victoria's decline in labour force productivity.



Case study: *GO Expansion fast regional rail (2018)*

A similar and highly-productive Canadian business case.

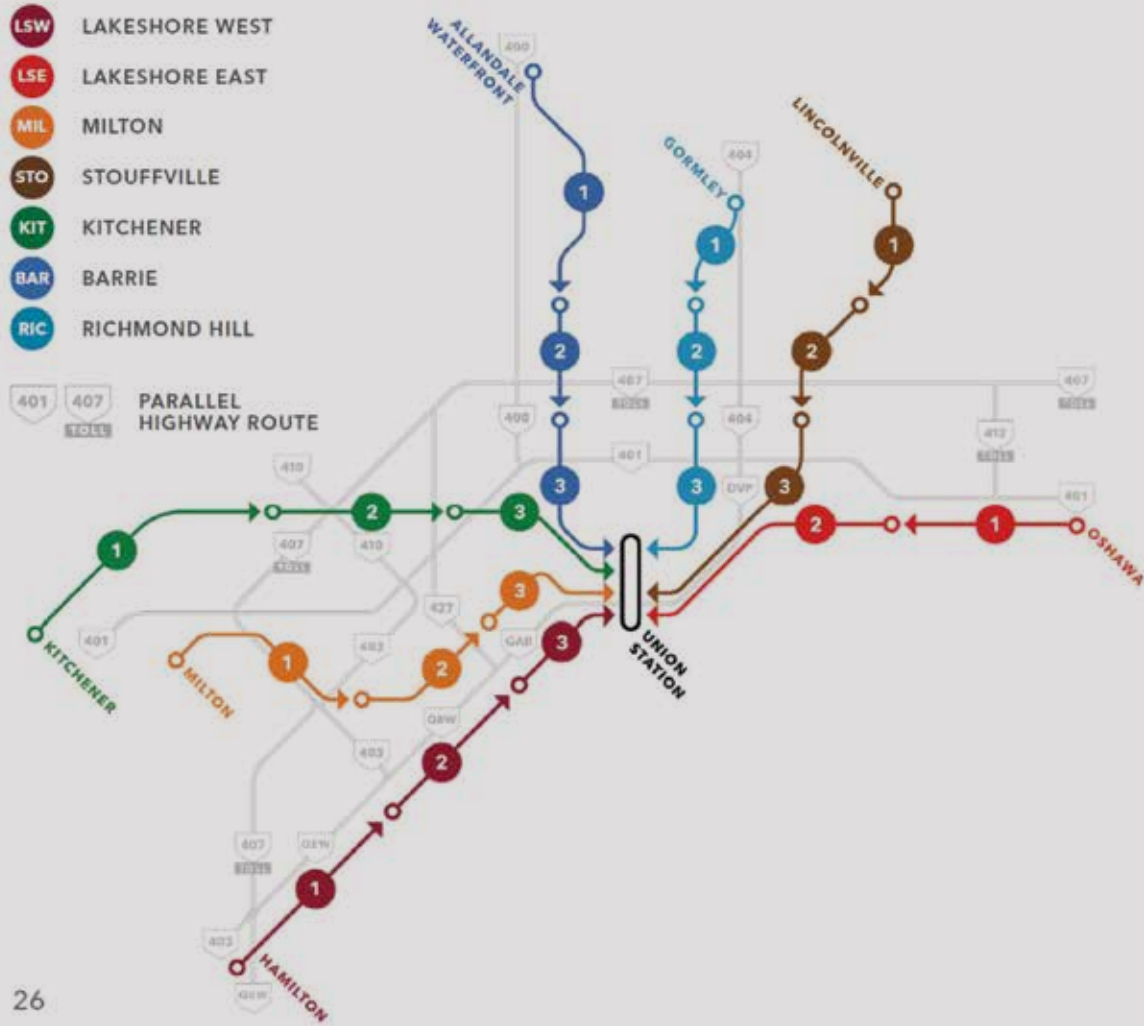
Like Melbourne, the city of Toronto in Ontario province, Canada, is regularly near the top of *World's Most Liveable City* rankings. Like Melbourne, it is large by western standards, with a greater central area population of over 6 million people. Also like Melbourne, it is surrounded by nearby regional cities such as Hamilton. Such cities are among the fastest growing in North America.

For several years Ontario's public transit system (GO) and government have identified that along with its metropolitan services, Toronto needed to link its regional commuter cities *via* fast, electrified, higher-capacity and more frequent service. This was to be pursued in the interests of four main considerations:

- **Providing safe, reliable, convenient connections** between Toronto and nearby regional cities;
- **Improving the quality of life** by reducing the time, cost and stress of commuting;
- **Investing for a prosperous economy** by growing the regional labour market with fast city-region connections and creating new construction and manufacturing opportunities along the way; and
- **Protecting the environment** by moving to zero-emission electric fast trains and by taking cars and their emissions off the roads.

Travel distances for the fast regional GO network are slightly shorter than for Melbourne and nearby regions, but in other respects, the system offers similar commuter time savings to Toronto's regional cities to those on offer between Melbourne and its regional cities

Fig. 5 GO Expansion Toronto regional electric fast commuter rail network (2018)



Source: GO Expansion Full Business Case November 2018

A strong economic case

In 2018, a formal business case was published for *GO Expansion*⁵. This business case mirrors in many respects the design and operational impacts for the Victorian fast regional rail program outlined in this paper. More importantly, *GO Expansion* business case shows that the project stacks up - it offers a benefit-cost ratio of 2.6:1 - meaning the project returns \$2.60 for every dollar invested.

This outcome is stronger than any current high-profile national priority project identified by Infrastructure Australia.

Key estimated benefits of GO Expansion:

- Major service level increases and travel time reductions to all regions
- Capacity building - over 1,000 new services per day
- A modal shift effect wherein over 50 million car trips *per year* avoided
- An estimated 7,000 less car accidents per year resulting in death or injury
- Combined electric fast rail fleet and reductions in car travel create estimated total project carbon emission savings of 13.5 million tonnes of carbon dioxide equivalents from the Greater Toronto atmosphere.
- Net investment of \$21 billion, incremental economic costs of \$16.2 billion over investment lifecycle
- Economic benefits estimated at \$42 billion, comprising:
 - \$35.4 billion in transport user benefits;
 - \$3.3 billion in road user benefits;
 - \$1.9 billion in car operating cost savings;
 - \$1.1 billion in accident reduction and health benefits;
 - \$330 million in emissions reduction benefits
- A project net present value of \$25.9 billion, which the business case suggests will generating a benefit of c. \$9,000 per household
- Average 8,300 full time jobs for each year during construction and major new fleet manufacturing and maintenance employment



Case study: Oresund sea bridge (2000)

Oresund bridge, linking Denmark and Sweden: how a growing global city and a disconnected regional centre achieved stronger futures together

The Danish capital of Copenhagen and Malmo - Sweden's third largest city - are the closest of neighbours: only 40 kilometres separates each city centre. But they have been separated throughout history by 14 kilometres of sea channel - the Oresund.

Until 2000, large-scale commuting between the cities was not practical - it required a time-consuming sea ferry trip and car or bus transfers, making a return trip take several hours daily. The economies and communities of Greater Copenhagen and Greater Malmo (the Zealand and Scania regions) were separated, not integrated.

By 2000 Copenhagen was a leading northern European capital. Like Melbourne, it regularly ranked highly in *World's Most Liveable City* competitions. Also like Melbourne, Copenhagen was experiencing growing pains in housing supply, house price affordability, access to opportunity and traffic congestion.

By the same year, Malmo displayed very close parallels with Geelong: like Geelong, Malmo was an industrial port city of around a quarter-million people, suffering from a loss of legacy shipbuilding and car manufacturing; like Geelong, Malmo had come through a very serious economic collapse and loss of population in the 1980s and early 1990s. Like Geelong, by the mid-1990s Malmo had decided to restructure itself as a knowledge economy, founding a new regional university (Malmo University, est. 1998) and redeveloping its industrial foreshore and city centre.

By the mid-1990s - following many years of lobbying and policy development led largely by these regional communities themselves - the Danish and Swedish governments began work on an 8 kilometre road and rail sea bridge from Sweden, linking to a 4km undersea tunnel (*via* an artificial island in the strait) to complete the connection to Denmark

Oresund bridge opened in 2000 - immediately transforming forever the relationship between capital city and region: Malmo and Copenhagen and their airports now required only around 30 minutes car or bus commutes or fast metro between the cities.

Because the project is now almost 20 years old, it has attracted extensive academic attention, including both ex-ante and ex-post analysis, so that the effects of this infrastructure and lessons learned can be considered reliable.

Daily transit increases have been strong: in 1999 less than 400,000 people per year took the ferry. In 2017, almost 8 million cars and 11.4 million rail passengers used Oresund bridge - over 20,000 people per day commuted to work in either Copenhagen or Malmo⁶.

The main beneficiary of the bridge has been the regional labour market - by 2010, academic analysis confirmed that as much as 73% of the total benefits of the bridge could be attributed to labour market benefits⁷.

This is precisely the effect sought in the *Stronger, Together* programme: more job opportunities and better jobs for more people, across a newly-efficient catchment

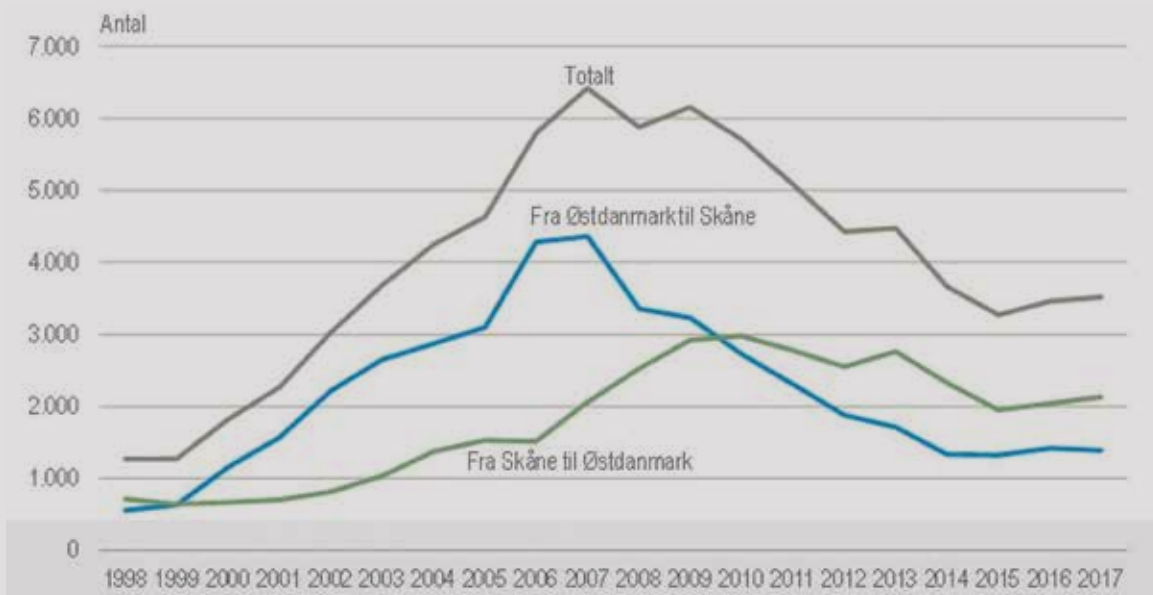
Changing speed and reliability of regional commuting changes everything

The key lesson of Oresund for Victoria is that if the speed and reliability of transport between two places is genuinely transformed, the spatial economic relationship of these places is also changed very reliably: previous assumptions about how and why people commute and where they are prepared to live change forever.

Oresund bridge offered new, reliable, sub-one hour commuting between established cities with very different housing market values - Copenhagen at the time was substantially more expensive than Malmo. The advent of bridge commuting drove a major redistribution of the population out from Greater Copenhagen and into Malmo and the surrounding region, where Danes could take advantage of far cheaper house prices and high liveability, yet retain sub one-hour commuting times to Copenhagen.

Relocations from the Danish side to the Swedish began growing rapidly. This drove a local 'agglomeration effect' between Malmo and Copenhagen not previously obtainable.

Fig. 6 Relocations between East Denmark and South-west Sweden 1998-2017



Key:

Blue line = relocations from East Denmark to SW Sweden

Green line = relocations from SW Sweden to East Denmark

Grey line = total relocations

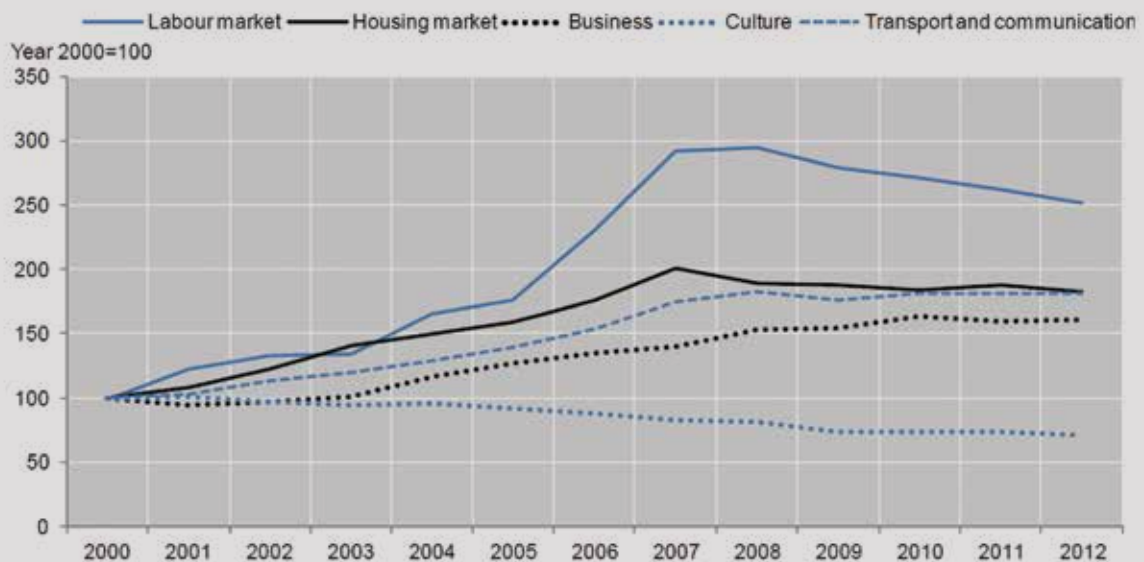
Source: Denmark Statistics

NB: This curve of growth - showing an initial property price arbitrage followed by a return to a trend closer to the capital city levels - has informed this document's analysis of the uplift available to Victoria from a regional fast commuter rail network - (See *Impact below*).

Stronger, together: an integrated cross-border economy and society

As the graph above reveals, within a decade, property price differentials and migration patterns had settled: in effect, Greater Malmo was a functional, integrated part of the Greater Copenhagen economy. The two regions are now effectively a single housing and labour market - parts of a larger, more powerful and diversified single economy than could ever have been anticipated in the 1990s. Malmo has emerged as a healthy and attractive knowledge economy, retaining its own identity and forging much deeper connectivity to nearby trading economies.

Fig. 7 OECD East Denmark - South-west Sweden integration index post-Oresund
Link: 2000-2012



Source: Oresund Committee (2013), *Oresund Integration Index 2012*.

Oresund bridge holds important lessons for Victoria:

- Nearby regional Victorian cities offer a reliable resettlement option for Melburnians if fast, reliable and high capacity commuter transit is in place
- As capital and regional city property values equalise over time, they settle into stable longer term population growth patterns (i.e. a new equilibrium)
- In time, population resettlement works both ways, as a larger single labour market starts to emerge.
- Consistent with some wider research⁸, the regional centre is more likely to take economic advantage of fast rail if it has underlying infrastructure assets in place like a regional university and a highway to the capital as well as rail.

Impact: fast regional commuting times

Table 1. Current and projected regional travel times from key cities to suburban metro hubs and airports

Route	Current travel	New travel
Geelong to Avalon Airport	N/A	8 mins
Geelong to Sunshine	46 mins	27 mins
Geelong to Melbourne	62 mins	35 mins
Ballarat to Sunshine	60 mins	48 mins
Ballarat to Melbourne	75 mins	56 mins
Bendigo to Tullamarine Airport	N/A	58 mins
Bendigo to Sunshine	N/A	66 mins
Bendigo to Melbourne	118 mins	74 mins
Shepparton to Tullamarine Airport	N/A	82 mins
Shepparton to Sunshine	N/A	90 mins
Shepparton to Melbourne	162 mins	98 mins
Latrobe (Traralgon) to Melbourne	140 mins	95 mins
Latrobe (Traralgon) to Tullamarine Airport	N/A	120 mins
Melbourne Southern Cross to Tullamarine	N/A	16 mins
Melbourne Southern Cross to Avalon	N/A	27 mins

Notes:

- All new service times assume 200km/h electric, high-capacity trains on retrofitted network with facilitating new works as outlined in the document.
- Current times as per VLine regional service timetables; average times have been attempted where minor service discrepancies exist across the day.
- All regional fast rail services except for Latrobe employ the Western Fast Rail tunnel as planned for the Tullamarine Fast Rail project.
- Geelong fast rail service times are based on professional dynamic modelling – an express Melbourne-Geelong time of 32 minutes is not included in the table but is achievable. All other times reflect informed assumptions by technical expertise in this field including the work and advice of senior members of the Rail Futures Institute. Transit times above Rail Futures Institute estimates as provided in its 2016 *Intercity* report are explained by Intercity assuming 130-160km/h speeds, not 200km/h.

Travel saving	Notes
N/A	No service exists. New station on Geelong fast line
19 mins	Dedicated regional fast line, existing alignment, 3 stops
27 mins	Via Sunshine and then West Melbourne fast rail tunnel
12 mins	Dedicated regional fast line, existing alignment
19 mins	Using West Melbourne fast rail tunnel
N/A	No service exists. New service via Tulla airport and Sunshine
N/A	No service exists. New service via Tulla airport and Sunshine
44 mins	Dedicated regional fast line via Tulla airport and Sunshine
N/A	No service exists. New service via Tulla airport and Sunshine
N/A	No service exists. New service via Tulla airport and Sunshine
64 mins	Dedicated regional fast line via Tulla airport and Sunshine
45 mins	Dedicated regional fast line, upgraded alignment
N/A	No service exists. New service via Sunshine to Tulla airport
N/A	No service exists. New service via Sunshine to Tulla airport
N/A	No service exists. New station on Geelong fast line

- Time estimates Sunshine to Tullamarine airport reflect an assumed 8 minute transit. Sunshine to Southern Cross *via* the Western fast rail tunnel is an assumed further 8 minutes inclusive of a 1-minute stop at Sunshine station.
- Latrobe (Traralgon) estimates are offered as indicative only and should be treated with caution, as significant further work on a dedicated new regional fast rail alignment is required for this destination, especially relative to the quite well understood performance parameters of other centres employing the Sunshine/Western fast rail tunnel alignment.



Impact: regional population growth

Extent of regional network commuting benefits

The envisaged fast rail network in terms of total estimated commuting time is divided into four basic improved commuting brackets:

 **35-45 minutes to/from Melbourne CBD**

 **45-65 minutes to/from Melbourne CBD**

 **65-85 minutes to/from Melbourne CBD**

 **85-100 minutes to/from Melbourne CBD**

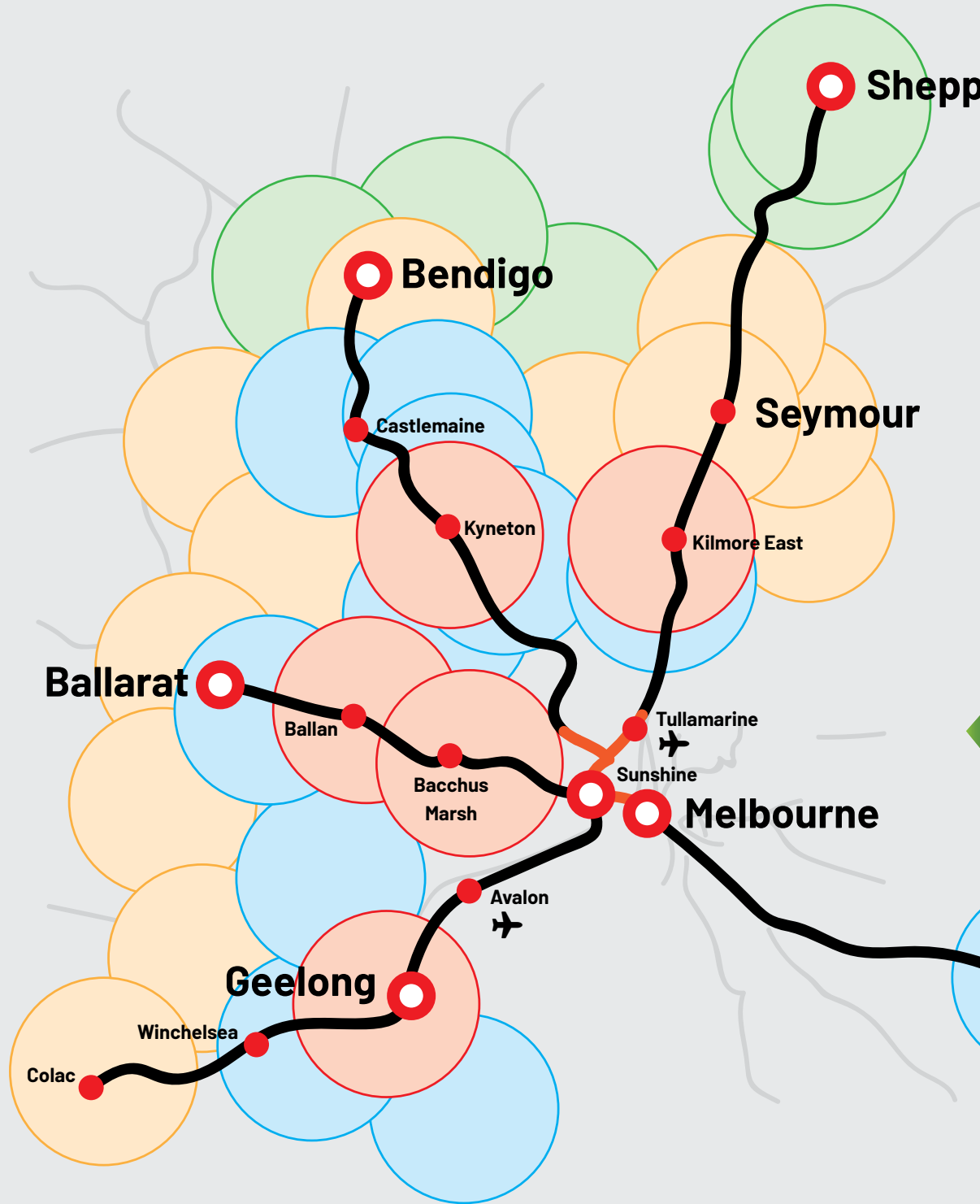
Commuting bracket estimates have been made at the local government level for those government areas within the network. Commuting impacts on adjoining local government areas have not been included - they would be additional users - so that this impact can be considered reasonably conservative in terms of identified catchment.

Onwards connectivity

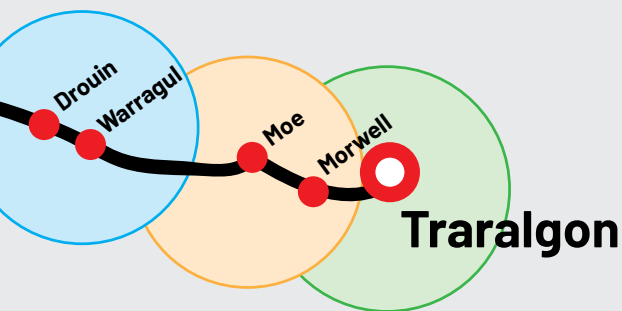
As the following schematic (overleaf) suggests, some regional communities may not receive a fast rail station themselves, but will nevertheless be within a reliable car or bus commute of one: this can form the basis of integrated bus service planning to hub fast rail stations.

In some notable cases such as the Bellarine peninsula and the Surf Coast near Geelong, the size of the 1-hour commuter catchment could be expanded considerably at relatively low cost with bus rapid transit networks synchronised to service the fast rail in Geelong - BRT networks could be extended to these regions within existing regional highway corridors - this tends to be far lower in cost than light rail, but delivers a similar high-capacity and amenity service when designed properly.

Fig. 8 *Stronger, Together* fast regional commuter network - indicative regional fast rail commuting times by broad location



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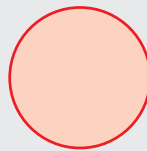
Key



Major station



Interim station



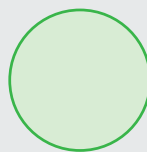
Approximately
35-45 mins
connect - Melbourne
CBD



Approximately
45-65 mins
connect - Melbourne
CBD



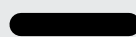
Approximately
65-85 mins
connect - Melbourne
CBD



Approximately
85-100 mins
connect - Melbourne
CBD



New shared Tulla and regional
fast rail lines and tunnels



200kp/h 25kV AC
electric railway

Designed to be transformative: maximising regional commuter uplift

Regional populations benefitting from this fast rail network have been examined to determine what scale of growth and therefore population shift might be plausible to expect. This involves understanding what a plausible growth trajectory for these regions might look like with transformative fast rail in place.

This is an important point of difference of *Stronger, Together* when compared with *status quo* efforts to improve parts of the regional lines and services over time, such as the current Regional Rail Revival program.

It is only through engineering widespread transformative travel times and schedule intensity that a material scale of population is likely to be redistributed to the regions while remaining fully connected to the Greater Melbourne labour market - this is what creates the economic conditions for two-way growth, as opposed to a system which merely sets regional centres up to be dormitory suburbs for Melbourne.

A regional population growth trajectory

The Oresund sea bridge case study (above) shows that once region and capital city receive transformative new transit speeds, migration patterns change in a material way - they are driven by simple property arbitrage opportunities: homes and businesses in the regions are cheaper than Melbourne but the transit times to and from these regions start to compare very favourably with many suburbs of Melbourne. What Oresund also shows is that over time these growth patterns begin to equalise as region-city land values resettle into new long-run balances (equilibria).

Setting credible regional growth rates

The regional population uplift model therefore takes the past decade of historic population growth for the regional LGAs in question and assumes a peak 10-year fast rail growth period from the first day of operations, followed by two step-downs in growth towards 2050 - broadly in line with the population shift curves in the Oresund experience (see preceding case study). The modelling also assumes an initial announcement and construction ramp of c. 50% above the 10-year historical regional growth rates. This is intended to reflect the fact that interest in regions will increase reliably as soon as a fast rail service is announced: past project experience such as Gold Coast Light Rail⁹ suggests that upon project announcement, some investors and prospective commuters will seek to pre-position in anticipation of such services.

Key regional growth rate assumptions for *Stronger, Together* are as follows:

Table 2. % population growth rates employed for fast rail population shift analysis

New rail commuting catchments to/ from Melbourne	Average annual growth rate last decade	New annual growth rate from announcement to opening	New annual growth rate first decade from opening	New annual growth rate after first decade operations	New annual growth rate to 2050
35-45 minutes	2.06	3.43	4.8	3.85	2.9
45-65 minutes	2.14	3.07	4.0	3.2	2.4
70-85 minutes	2.05	2.62	3.2	2.7	2.2
85-100 minutes	0.77	1.58	2.4	2.2	2

Note: Assumes a 2019 project inception.

Can regional growth be better planned than outer Melbourne has been?

The regional growth rates are noticeably lower than historical annual growth in many outer suburbs of Melbourne over the past decade, which has been generally between 5 and 7 per cent at local government area level - and well over 50% per year in the case of some outer suburban 'growth hotspots':

- **Tarneit**, in Melbourne's outer-west, grew by 28,800 people in the decade to 2016, this represents - 37.2 per cent annual growth.
- **Truganina** also in the outer-west, grew by 21,850 people - a 69 per cent annual increase over this decade.
- **Cranbourne East** in the south-east grew by 22,600 people- over 53 per cent annual growth over this decade.

As well as lower growth requirements overall, regional fast rail city and town growth may prove more sustainable: smarter planning approaches, properly funded by all levels of government from the outset, could mean that established regional fast rail cities and towns might avoid the sprawl effects of fast growth seen in some outer Melbourne greenfield suburbs.

A funded and agreed 'fast regional rail growth plan' is an essential 'guard rail'

Attentive regional city planning, backed by a suitably-reformed regional planning and investment system, (*see Planning to keep fast rail regions liveable below*) offers planners a better opportunity to develop considerably higher-density regional city centre and inner and middle ring densities in these regional cities and towns, in a way Melbourne has struggled to do in aggregate over the past decade (noting that the majority of Melbourne's previous decade's population growth settled in under-equipped outer Melbourne suburbs).

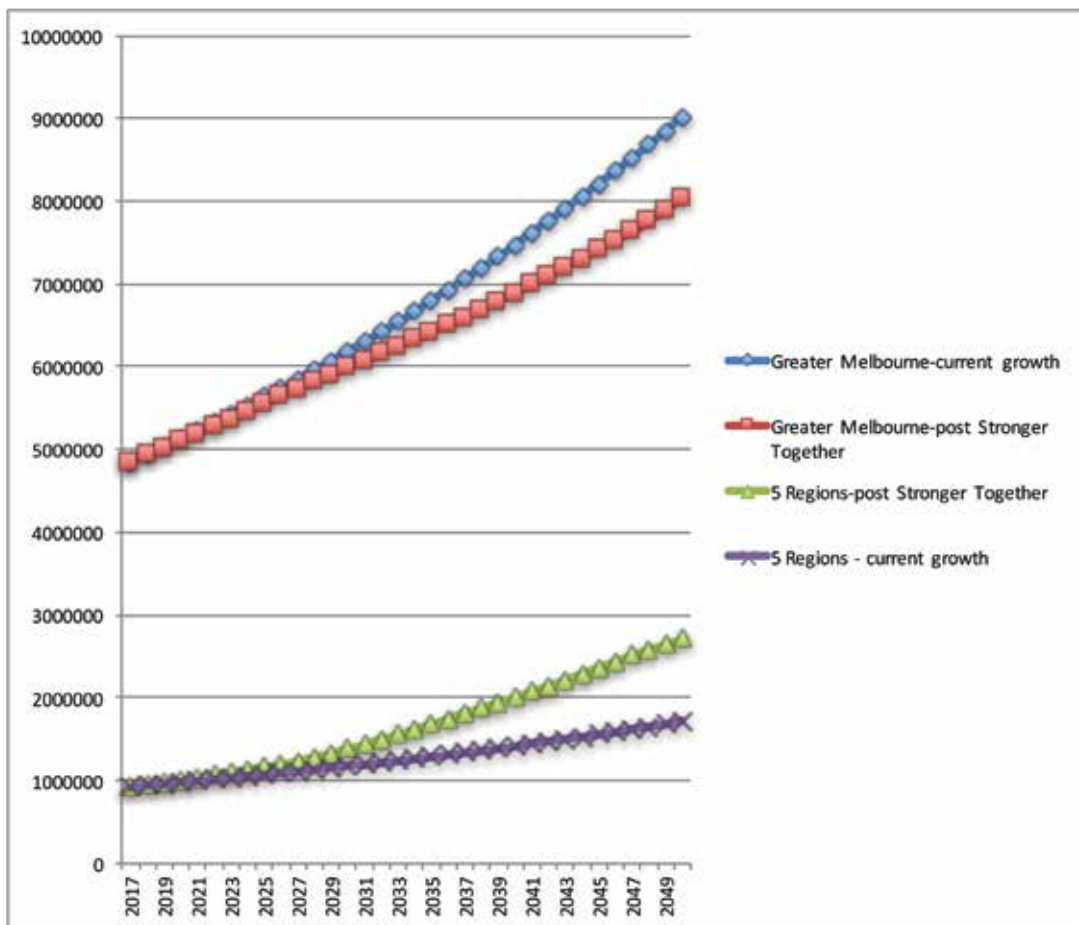
The greatest planning and growth infrastructure funding attention is likely to be required for the closest commuting townships within the 35-45 minute category.

Results

Modelling of the aforementioned population growth rates across the existing LGA populations in their respective commuting time categories suggest that **Stronger Together would see a net increase in regional Victoria's population (above trend) of 1 million people by 2050**. This effect is achieved over just 21 years, given an assumed full operational start year of 2029.

Earlier construction and operation of some lines which do not require a 10-year construction timeframe, such as Geelong and Ballarat, would increase this regional population shift effect even further by 2050.

Fig. 9 Regional population increases from fast rail to 2050



The bulk of population redistribution from the program will clearly be driven by a reduction in Melbourne population growth as Melburnians or new entrants to the Victoria make a choice to be within a reliable and pleasant commute to the capital of around one hour or less while gaining access to a cheaper property market and a desirable lifestyle - a very large cohort of people stand to be connected closer to a 45-minute total commute (see below).

This ultimately should be the core objective of any regional fast rail program: it aligns with accepted behavioural and transport economic theory about commuting preferences, known as the Marchetti Constant¹⁰.

Impact: transforming regional commuting

Results

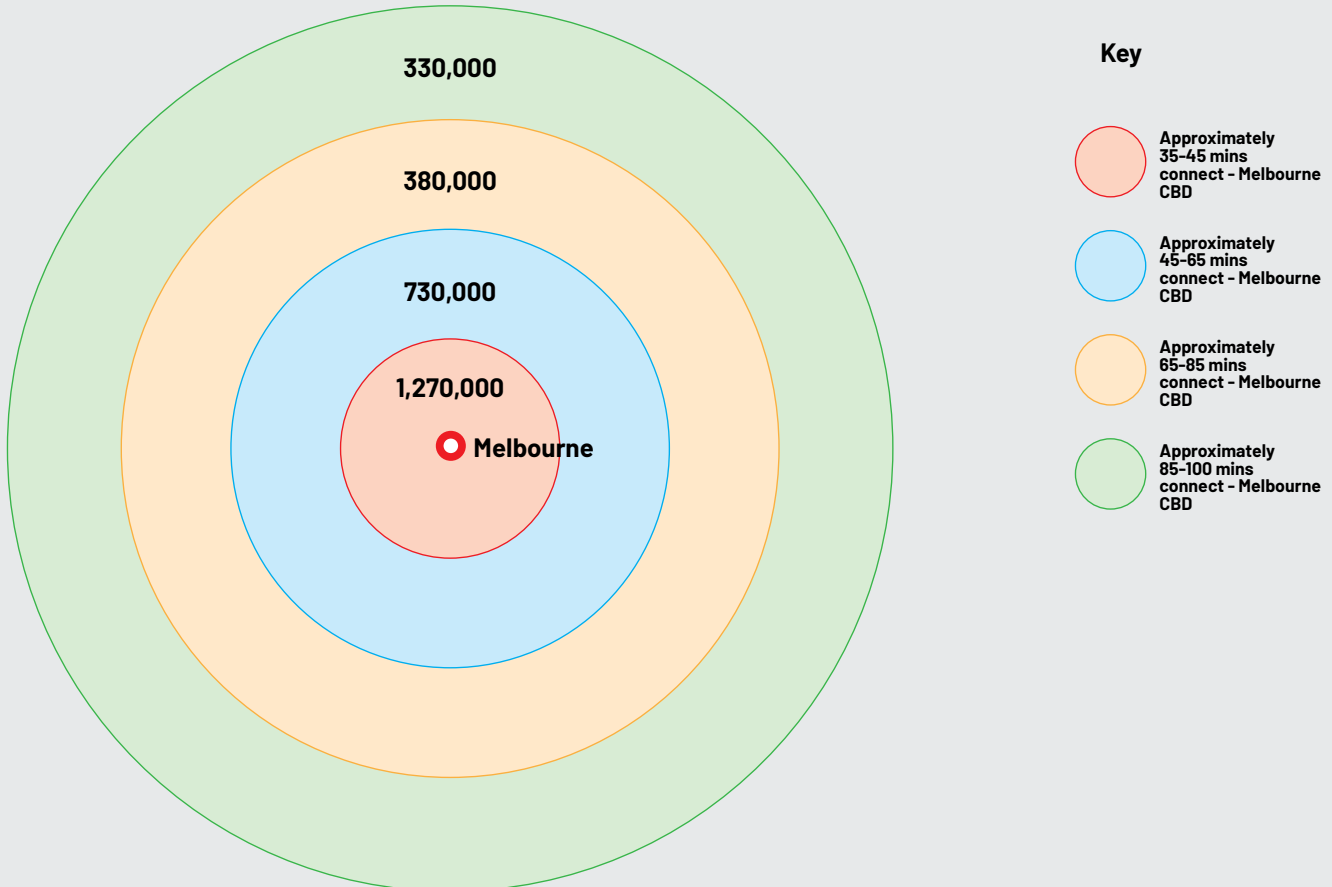
The following table suggests how many people would be positioned with access to the *Stronger, Together* fast regional rail network commuting time categories by 2050, based on the aforementioned growth and network design assumptions.

Table 3. Fast regional rail nominal commuting population at 2050 by commuter time catchments

New regional commuting bracket	Population 2050
35-45 minutes to CBD	1,270,000 people
45-65 minutes to CBD	730,000 people
65-85 minutes from CBD	380,000 people
85-100 minutes to CBD	330,000 people
Total regional uplift	2,710,000 people

This can be represented visually as follows:

Fig. 10 Regional population fast rail commuter catchments by category at 2050





UNDERGROUND

Comparable transformative uplift to London's UK Crossrail - in a much smaller city.

This report considered the very large London *UK CrossRail* project and its outer suburban fast commuter uplift as a global benchmark worth measuring *Stronger, Together* against for its ability to uplift distant commuters at transformative speeds in large numbers.

CrossRail is a London underground and regional railway extension - the largest since World War Two. It involves a new underground line attached to extensions to the east and west of London, including to Heathrow airport. In that sense the *Stronger, Together* regional network and *UK Crossrail* are very different projects.

However, there are important similarities: ***UK CrossRail* aims to bring 1.5 million extra Londoners into a 45-minute or less commute to and from the city centre at project opening in 2020.**

This document's impact analysis suggests that **by 2050, *Stronger Together* would bring 1.27 regional Victorians within a c. 45 minute or less commute of the Melbourne city centre.** This bears favourable comparison to *UK CrossRail* noting that Greater London is already almost 4 million people larger than Melbourne - helping to underscore the global credentials of the Victorian program.

Wider benefits

Apart from rebalancing capital city and region population growth by 1 million people by 2050, *Stronger, Together* would usher in several other significant operational benefits for Melbourne and regional Victoria:

Modal shift away from cars and Melbourne congestion cost reductions

One of the most obvious benefits from the program is a material modal shift away from regional car commuting. A quantum for this shift has not been estimated in this paper. Not all car drivers from regions will find the fast rail service meets their precise needs, but the network has been designed to maximise the choice and flexibility of commuting locations **and thereby increase Victorian labour force participation:**

- Fast rail commuters can travel to the city via Southern Cross Station; or
- They can connect seamlessly onto Melbourne Metro at Sunshine station for access to Parkville, the greater CBD and south east Melbourne; or
- They can transfer at Sunshine to other suburban rail and bus services, or at an equivalent future transfer location on the Latrobe fast line.

This illustrates the way in which fast regional rail complements the existing Melbourne network - it guides commuters to key transfer points to maximise onward connectivity and use of important new network developments, like Melbourne Metro. Choice of destination combines with major reductions in total transit time to induce maximum modal shift.

Greater regional choice and mobility caters to major emerging trends

The network also assists other emerging challenges, such as increasing regional aged community isolation as older drivers relinquish driving licences and - at the other end of the spectrum - the growing global phenomenon of a reduction in the number of young people taking up driver licences and car ownership¹¹. To date, these groups would be best placed to move to Melbourne to maximise their access choices, but this is simply impractical for many people in these categories. At the margins, this creates challenges for regions trying to retain people in these age groups; these growing trends reinforce regional isolation.

The *Stronger, Together* network would cater better to these emerging trends in regional Victoria.

Shifting from the car: weeks of work annually saved from regional commuters' lives

Leaving aside lower travel costs compared to car running and parking costs, fast regional rail travel would deliver vast productivity and amenity benefits compared to increasingly congested freeway and tollway commuting.

The estimated new rail travel times (*see above*) can be compared with approximate peak daily car commuting times and then annualised over a 46-week, 38hr per week working year. This reveals just how much more productive regional city commuters can become by switching to fast rail:

Both **Geelong and Ballarat** secure c. 70-minute (two-way) daily fast rail savings over road commuters to and from Melbourne's CBD - fast rail would **reduce commuting by 268 hours annually - equal to 7 extra working weeks per year spent driving.**

Bendigo secures c. 125-minute (two-way) daily fast rail savings over road - this would **reduce commuting by 479 hours annually - saving rail commuters just under 13 extra working weeks which would otherwise be spent driving to and from work.**

\$800m p.a reduction in Melbourne traffic congestion costs?

This paper has not undertaken a detailed analysis of the impacts of a *Stronger, Together* program on Melbourne's worsening road congestion, but on its face the program does appear to offer a significant foil for offsetting congestion.

The recent *Making the Most of Our Opportunities* report suggested that:

'For 1 million population growth diverted from Melbourne to regional Victoria, about half of whom would otherwise each be making 2 car trips/day in Melbourne of c. 10kms trip length, this congestion cost saving could be worth around \$800 million a year to Victorians over the 15 year period to 2030 (congestion costs created in regional Victoria would be an offset but should be minimal).'

Making the Most of Our Opportunities report (2018) p. 86

Fast rail links Victoria to two international airports, not one

At present, the Tullamarine Fast Rail project intends to provide fast and frequent rail rather than conventional bus transport to Tullamarine airport. Converting the Geelong line alone to regional fast rail allows Melbourne to secure fast, high-capacity transit to and from a new station on the mainline adjacent Avalon International Airport - access will be from either Geelong itself, or from Southern Cross station in Melbourne, or from Greater Melbourne via Sunshine station.

The trip from Southern Cross to Avalon will take around 27 minutes. A mainline Avalon station/terminal design concept on the Geelong line has already been developed with operational rail expertise, which includes customs clearance and check-in gates at this station to allow onwards seamless transit to airside boarding lounges. Having two airports served by fast, high-capacity trains will ensure that airport competition is maximised to benefit air travellers and the Victorian economy.

Major event uplift - regions to Melbourne, Melbourne to regions

The fast regional rail network offers much faster high-capacity uplift to and from Melbourne, not just for commuters but also (with proper scheduling) for major events. This is a boon for those visiting Melbourne from the regions, but also increases the capacity of regions to host sporting, cultural and other important major events. It capitalises on existing regional success stories such as the Bendigo Art Gallery, which is already well-known for hosting major international exhibitions. Fast rail can multiply the benefits of these wider cultural and economic renewal programs.

Kardinia Park game-day station potential for Geelong

Refitting works for the Geelong fast rail aspects of the program will require a well-understood widening and redevelopment of the short South Geelong tunnel between Geelong and South Geelong stations. The southern end of this 400 metre tunnel is adjacent to the northern end of the 35,000 seat Kardinia Park stadium of Geelong Football Club.

The new tunnelling and approach design for this tunnel may be capable of incorporating a game-day station at the northern end of Geelong's stadium. If so, it would allow fast rail travellers from Melbourne to reach football, soccer, cricket and other stadium events in Geelong in under 40 minutes from the Melbourne CBD; this could also remove the need to close a major road artery next to Kardinia Park to allow rail commuters to stadium events to walk safely across this road after games to access the more distant South Geelong train station.

Dramatically faster region-to-region connectivity

The proposed network design also delivers fast region-to-region networked travel across Victoria - something not available under current systems or current government regional rail plans.

For all lines, the Sunshine station interchange offers a rapid transfer from one regional fast rail city to another. While not likely to be high volume, the functionality gains for tourism and regional mobility are impressive: Geelong to Bendigo by rail would be reduced from 3 train travel hours plus long transfer delays to around 1.5 train travel hours and far less delay due to higher service levels.

Regional urban economic renewal led by regional university campus growth?

All of the five regional fast rail cities are home to university campuses, including the headquarters of Australia's largest regional university, Deakin, in Geelong.

Economic analysis of fast regional rail centres worldwide reveals that those centres with access to universities tend to retain more of the investment and economic activity gains of fast capital city commuting connections. Fast rail offers these universities a step change in the pace of regional transition to high-wage 'knowledge economies'.



Deakin University relocated its main campus into repurposed heritage-listed wool stores on Corio Bay's waterfront in the 1990s - the campus is already close to the Geelong train station. Fast rail will ensure that Melbourne students and academic visitors can access the Deakin Geelong campus with a short walk from the train, adding to the attraction of the university as a place for study and collaboration.

Other regional fast rail cities like the **Federation University** city campus in Ballarat would also appear to be prime candidates for repurposing more of their city's historic urban centre for high-value tertiary education, research and linked commercial start-ups.

Broad design and construction assumptions

The vision for this network needs a practical infrastructure solution. While much detail would remain to resolve, recent developments such as the Tullamarine Fast Rail, Sunshine Station redevelopment and outer suburban metro line duplications combined with conventional approaches to fast rail refits overseas give Victoria a historically-unmatched starting point to design and deliver the network.

Technical or physical 'show-stoppers'

The discussion that follows does not represent itself as exhaustive or final. However, it can be asserted with some confidence, based on eminent advice sought in this regard, that there do not appear to be any substantial technical or physical 'show-stoppers' which outright preclude the *Stronger, Together* network from being designed successfully: the network employs well-understood, non-controversial technology and operational approaches seen across much of western Europe in particular over the last two decades.

Major works - line refits, level crossings

To operate at the higher 200km/h speeds on some sections, the new network will require some significant upgrades and refits to existing regional tracks.

It will also require the removal or grade separation of most if not all level crossings on these fast routes, as per the European experience for these sorts of speeds. In the case of more distant centres such as Shepparton, this requires a sizeable amount of crossing treatments, although it should be noted that these equate not to the Melbourne major metro level crossing removal treatments in cost or design, but rather closer to the treatments seen in many European country level crossings on regional fast commuter routes.

Management systems

Expert advice sought during City of Greater Geelong's *Melbourne Geelong Fast Rail* reports (2018) suggests that the current VLine centralised traffic control system and its train protection and warning system would appear capable of accommodating 200km/h train operations at its upper limit - noting that above these speeds and for networks with mixed traffic, upgrades to more elaborate electronic train management systems are certainly required - and available.

Suburban Melbourne train line duplications

As is already recognised in current government rail policies, a key source of delay and congestion for regional services lies in the fact that Melbourne has never segregated its regional rail lines from its suburban metropolitan service network.

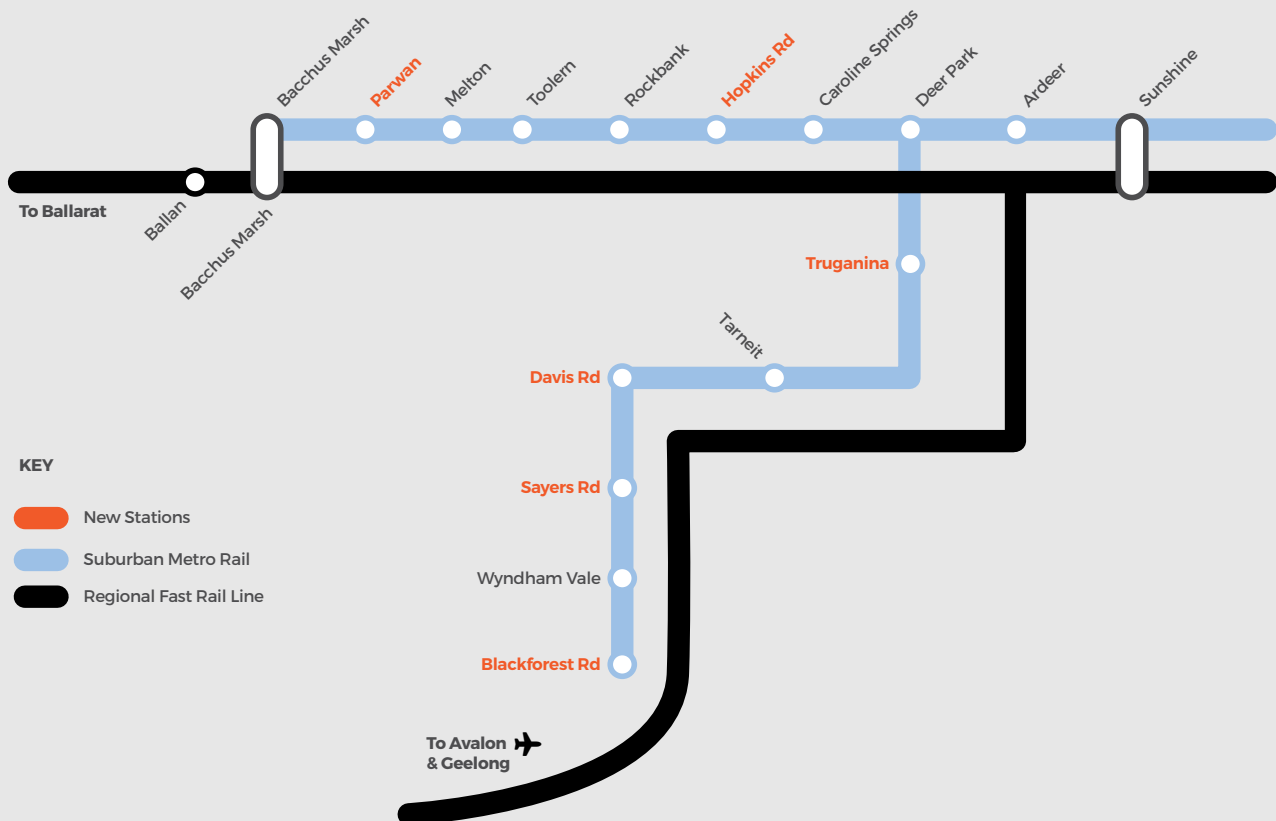
This legacy challenge creates the greatest challenges on the Geelong line. Tarneit in Melbourne's outer west is serviced by Geelong and Warrnambool trains, yet it has been the highest growing region in Australia over the past decade. This has led to consistent 50 per cent or more peak train overloading on all Geelong and Warrnambool trains over the past few years - a matter which has drawn significant criticism from the Victorian Auditor-General¹². As outer suburban Melbourne and regional populations continue to grow, the Geelong overcrowding phenomenon faces most if not all regional rail lines.

Current Victorian government plans and works are already committed to resolving this problem on some regional lines. The Victorian government's *Western Rail Plan* forms a perfect complementary basis for *Stronger, Together* by committing to segregating the Melton and Wyndham lines from the Geelong and Ballarat services.

Geelong and Ballarat metro quad-tracking

Geelong and Ballarat fast high capacity regional commuter rail will see the Wyndham Vale and Melton extensions of the Sunbury metro line duplicated, for the addition of 6 new suburban metro stations, including Tarneit. This duplication allows Geelong trains to bypass Tarneit altogether, with a first outer Melbourne stop likely being the Sunshine interchange, from which regional commuters can alight to access either the Melbourne metro and the wider Melbourne suburban rail system, or for transfers to either Tullamarine or Avalon international airports, or onwards to other regional centres or the Melbourne central business district at Southern Cross station.

Fig. 11 New duplicated tracks showing new stations - Wyndham and Melton lines



Western Melbourne shared fast rail tunnel

Consistent with Tullamarine fast rail design thinking, the final c. 8 kilometres of inner Melbourne traverse for all regional fast rail services except Latrobe would occur *via* fast rail tunnel.

The official selection of the Sunshine station alignment for Tullamarine fast rail services finalises the location of the inner Melbourne tunnel. This same tunnel was examined for the Melbourne-Geelong fast rail technical report. It saves regional services significant transit time.

Smart shared tunnel design accommodates airport and regional operations

The *Melbourne-Geelong Fast Rail* technical reports of 2018 designed and costed this tunnel alignment via Sunshine with a nominal capacity of 20 trains *per* hour (one-way); technical advice suggests that this could be expanded up to a maximum of 24 paths with the adoption of a contemporary high-capacity signalling system for tunnels. Assuming that Tullamarine Fast rail services are integrated with regional fast rail, this offers the following outcomes for peak regional service levels. They afford significant uplift from current service levels, while also offering a 6 service *per* hour (one-way) dedicated fast service from Melbourne to Tullamarine airport.

Table 4. Indicative mature peak service levels and path requirements for regional fast rail using the new Western Melbourne fast rail tunnel

Destination	Trains per hour peak (one way)
Geelong	8
Ballarat	4
Bendigo (<i>via</i> Tullamarine)	4
Shepparton (<i>via</i> Tullamarine)	2
Tullamarine Airport (terminating)	6
TOTAL	24

Critical tunnel design decisions could 'make or break' regional fast commuter rail

The centrality of the inner west fast rail tunnel for delivering an overall Victorian regional fast rail vision cannot be overstated. The design of this tunnel is on foot now, as part of Tullamarine Fast Rail project. Due attention to ensuring that this tunnel has sufficient future-proofed capacity and access points for regional city fast rail services is the single most important near-term requirement for regional fast rail.

Latrobe alignment - a separate challenge

Of all the five regional fast rail candidates, Latrobe City's regional rail alignment has to date suffered the most from sharing the suburban metropolitan tracks, largely due to the unprecedented expansion for residential suburbs in the south-east of Melbourne in the past two decades. As result of this expansion, Gippsland regional services are slowed to suburban all station stopping speeds as far out as around hour from Melbourne.

Technical advice received during the Melbourne-Geelong fast rail report development was that, due primarily to incursions into the existing regional rail quad-tracking reserves around Dandenong, it is likely that simple duplication of the suburban metro lines to segregate regional expresses are not a viable complete solution for Latrobe fast rail.

Instead, a major access tunnel or sky rail solution may be required to liberate the Latrobe regional alignment to run at effective fast regional commuter speeds. A significant body of work is inevitable to resolve this particular access challenge for Latrobe. The Australian Rail Futures Institute will soon publish a detailed design paper in this regard.

Southern Cross station platform capacity

Technical advice undertaken for the initial Melbourne-Geelong high-level technical report also suggests that Southern Cross station itself presents no capacity obstacle to fast rail operations as envisaged. This assumes that in parallel with the project the State will continue towards eventual removal of the obsolete N-Class loco-hauled carriage services. N-Class platform shunting turnarounds take significantly longer per loco than diesel multiple units such as the VLocity; this reduces platform productivity. It was estimated (although not published) for the Geelong technical report that resolving this as well as some sympathetic platform redesign work will improve productive daily operational capacity of Southern Cross station.

Wider operations: other network commuters from non-fast rail locations

Not all regional centres in Victoria would receive the new fast commuter rail service as envisaged in this document. In this context, obvious questions arise as to how to interface the service with other more distant country rail stations and how to retain intermediate stations nominally inside the new fast rail network but not necessarily serviced by fast rail. There are options in these respects to be explored; this document offers some insights rather than the last word.

Treatment of country services beyond the fast rail network

In the case of more remote country rail services hauled by N Class locomotives, a transfer supported by synchronised timetabling to and from fast commuter services at the fast rail regional terminals (Geelong, Ballarat, etc) may make sense for reducing overall trip times to end-destinations in wider regional and rural Victoria, subject to transfer amenity and superior overall transit times being achieved.

For example, the current rail service from Swan Hill to Melbourne Southern Cross via Bendigo would gain an almost 40 minute travel time saving even allowing time for a transfer to and from the fast trains at Bendigo. Moreover, as these more distant regional lines are retrofitted to accept VLocity running speeds in the order of 130-160km/h, these regional cities are in turn brought much closer still to Melbourne.

This underlines the increased role that major fast rail regional centres can begin to play as bigger and more important regional hubs for more distant Victorian communities, offering more health education, retail, financial and other services to improve the quality of life for regional Victoria.

Treatment of non-fast rail intermediate stops within a fast regional network

Subject to further technical effort, this could present two broad potential courses of action: either

- existing non-fast rail stations remain serviced with conventional fleet accessing Melbourne on existing above-ground alignments, but requiring additional passing loops and some modification to timetable;

or

- the fast rail network as envisaged is expanded to all intervening regional stops at some level of service, trading time savings at the margins for more coverage - but also at the cost of a possibly more modest property value and population uplift effect.

Construction and manufacturing opportunities

This report relies only on close comparator projects in Melbourne and regional Victoria as well as similar projects overseas, such as the *GO Expansion* program in Toronto.

On this basis, noting the scale of construction jobs forecast for Melbourne Metro and the regional rail upgrade programs as well as the stated Toronto full business case figure of 8,300 full-time jobs for the duration of the project, a figure of around 8,000 jobs for each of the years of construction appears reasonable.

Likewise, the fleet manufacturing, fit out and maintenance opportunities for a new fleet (see *New Fleet, below*) are significant. The scale of fleet required to service the capacity and frequency envisaged for *Stronger, Together* is significant and would also require a dedicated new maintenance facility. Victoria is well positioned to secure much of this work given the presence of multiple rolling stock manufacturers in the State.

Construction timeframes

The *Stronger, Together* network would be developed in parallel with the Airport Rail Link, with delivery of fast lines such as Geelong and Ballarat achievable, given due government priority, within the 5-7 years which appears required for Airport Rail Link - in this sense, the airport project and not the regional line refits shapes the critical time path for delivery. Other destinations such as Bendigo and Shepparton need not be drawn-out - design, planning and construction also begins immediately, parallel to Airport Rail Link. In this way, Victoria captures major macroeconomic effects sooner.

A longer design and delivery timeframe will be required for Latrobe.

In recent years the Victorian government has shown how drastically timeframes can be collapsed through a combination of high government priority, fast-tracked approvals, smart, market-led technical solutions, proper project structuring and scaled-up project rollouts. **The Melbourne Level Crossing Removals Authority** is an example - less than a decade ago, the idea of more than 50 Melbourne level crossings removed would have assumed construction timeline stretching to decades.

New fleet

A faster, more efficient, greener fleet for the future task

The program proposes a shift in fleet to a more contemporary, higher-capacity 200km/h-capable, electric-powered, energy-efficient fleet. Such fleets are increasingly found across modern high-capacity regional commuter rail networks in Europe. The shift in fleet is driven by environmental, future network expansion and local manufacturing motivations, but *prima facie*, technical engineering constraints on the network as envisaged suggest an electric fleet offers the most practical and efficient strategic solution.

The shift to a fast electric fleet represents a significant step in terms of cost, construction, maintenance infrastructure, systems and training. But this strategic fleet upgrade underpins the operational outcomes which maximise the socio-economic benefits for the Victorian economy and community.

Engineering arguments for an electric fleet

The shared western Melbourne fast rail tunnel is the single most important facilitator for both Tullamarine fast rail and for four major fast regional networks - it allows fast services from Geelong, Ballarat, Bendigo and Shepparton to take vital minutes off their journey through inner Melbourne at much higher service levels. In turn this greatly improves the operational and economic impact of the Tullamarine Fast Rail program.

Technical advice to the high-level Melbourne-Geelong fast rail design project suggests the long tunnel precludes the current diesel-powered VLocity fleet from service- diesel trains require cleaner, cooler air intakes in order to operate underground for this distance.

- This would force the project - and Tullamarine Fast Rail, for that matter - to be designed with several large diesel fume exhaust stacks above ground in the inner-west communities of Melbourne, or for service frequency to be reduced quite significantly, so that due time could elapse between each train for exhaust fumes to dissipate.
- The Melbourne-Geelong high-level expert technical report also considered an alignment for a skyrail alternative in western Melbourne, but this was not deemed practical.
- Another potential alternative explored was retrofitting of hybrid diesel and electric power plants - bimodal power - into the existing VLocity regional fleet - the electric motors would switch on during long tunnel running to avoid diesel emissions in the tunnel. The retrofitting process would be very costly and complex for a large fleet which is already part way through its useful life. Retrofitting could also lessen seating capacity at the margins.

None of these options were considered desirable or practical for the long term.



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Speed and an electric fleet

There is an operational performance benefit from moving from the current 160km/h capable VLocity fleet to a 200km/h higher-capacity fleet, especially on more distant routes where higher speeds can be sustained for longer periods.

It may be that in future it becomes more feasible to expand the network and increase speeds on some sections above the 200km/h mark. This would be the case, for example, for any expansion into the Wodonga-Sydney line, where very fast train aspirations may or may not create a different operational requirement. Likewise, more distant Victorian regional fast rail candidates such as Mildura could in time benefit greatly from higher sustained running speeds on appropriate sections.

Under these conditions, cost-effective diesels are generally considered to have reached their operational speed limit at 200km/h: diesel power plants are heavy and take up considerable space relative to the usually roof-mounted electric power arrangements of electric trains. Electric trains thus tend to have more space for passengers available, which is a key ingredient in regional population uplift.

Emissions and amenity

The overwhelming carbon and sound emissions advantage of electric trains are another strong factor in their favour relative to diesels. Electric trains produce no direct emissions and in contrast to diesel trains are extremely quiet. For now, electric power plants running in Victorian may draw their power from an energy grid which includes much fossil fuel power, but the choice to make the fleet electric ensures that the future net energy footprint of fast regional rail will augment green credentials in line with any shift towards a more renewable Victorian energy mix.

Toronto's new regional electric fleet - major environmental benefits

The Toronto *GO Expansion* business case (2018) offers a pertinent example of why an entire major city and regions would make the capital expenditure decision to shift their fleet to a logical and sustainable electric end-state - *GO Expansion* fleet choice together with modal shift carbon emission savings promises to take around 13.5 million tonnes of CO₂-equivalent emissions out of the Greater Toronto atmosphere.

Higher capacity, double-deck carriages

As already outlined, the project makes its population uplift gains based on a function of transformative travel time reductions, travel time reliability gains and major capacity, amenity and schedule frequency improvements.

In the case of capacity, as is the case on a high-capacity fast regional commuter network like the French RER, regional stations and Southern Cross station alike will need to consider train length solutions which deliver high passenger numbers per train yet can also meet existing platform lengths, or at least reduce major station redesigns wherever possible.

This consideration suggests modern double-deck or double and single-deck mixed units, such as those in use today on most French fast regional commuter networks, are the most sensible choice, noting that some significant refits would be required in any event to conform to the Victorian operating requirements.

With this said, it is important to recognise that when considering a hierarchy of project design, tunnels and other fixed infrastructure must be built with the operational capacity and uplift objectives of regional fast rail and its fleet in mind - not the other way around.

Regional electrification infrastructure

Moving to electric for the fast regional network will require electrification with pylons as per the current Melbourne regional network. This is distinct infrastructure: most modern fast rail technology operates on 25kvAC power, rather than the 1500v DC power which is used by Melbourne's suburban rail system.

Managing the current VLocity fleet in transition

As a fast regional rail program was rolled out, there would no longer be a requirement for the legacy VLocity fleet on these services. Proper phasing strategy will need to be developed to maximise the utility of existing fleet during and after transition to a faster, electrified, higher capacity and higher service frequency regional rail network.

This would include VLocity track upgrades to more distant destinations such as Warrnambool, most likely in larger consists. This program in and of itself would offer significant travel time gains to these more distant regional centres.

Funded plans to keep 'fast rail cities' liveable

State planners have long understood that Melbourne's nearby regional centres, townships and surrounding rural areas have more than enough developable land available to take a very large population uplift from Melbourne - what is more they hold more established economic and social infrastructure fit for this purpose than new outer Melbourne greenfield suburbs.

In the past, regional land availability has been a moot point, because there has been no practical mechanism for inducing the step-change in population uplift from Melbourne that would drive reliable demand for more developable regional lots.

But the commuting times, reliability and capacity of the proposed regional fast commuter network makes this possible. This prompts the central question of how these regions are to manage a significant increase in population growth while retaining liveability, specific independence and character.

At present, outside Melbourne, local governments are solely responsible for the development plans for their cities and townships. Notwithstanding 2014's *Plan Melbourne* document considering policies for a number of peri-urban areas, there remains no formal State plans for Victorian regional centres and towns, nor any Commonwealth plans for these places.

This arrangement arguably functions well enough in the historically-low regional population growth context - for example, regional Victoria's overall population grew by less than 13 per cent across the decade to 2016.

But these same local plans would be placed under great pressure in higher population growth scenarios, absent explicit planning and infrastructure investment support from State and Commonwealth governments.

Without a universally-agreed plan across all three levels of government for how a fast rail enabled region is to grow while remaining liveable and develop supporting social and economic infrastructure, the actual development of these regions would probably fall substantially to a game of political chance, where only superior lobbying and marginal seat status is any guarantee of success.

A smarter system may involve fast rail cities and towns entering into growth plans ratified by all three levels of government.

This would assist fast rail communities in taking a measured, empirical approach to capacity challenges and stepped infrastructure needs in a higher growth future. As outlined in the *Impact* discussions above, regions have the opportunity to plan better for growth, learning the lessons of Melbourne's outer suburban sprawl - more attention to inner suburb densification may be a key success factor for fast rail regional cities.

Whatever the solution, the significant regional population distribution outlined in this paper cannot be considered realistic without some form of agreed and funded *Fast Rail Growth and Liveability Strategy* for these places.

Any solution which leaves regional cities and towns to manage fast rail population growth solely through local government ratings and increases in grants, fees and fines would be to export the worst aspects of outer Melbourne's greenfield suburban sprawl to the regions - this would be no solution at all.



Endnotes

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