Urban Development Scenarios
Part A: Land Use Scenarios

Infrastructure Victoria

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SGS Economics & Planning

Certified B Corporation

SGS Economics and Planning Pty Ltd
ACN 007 437 729
www.sgsep.com.au

Offices in Canberra, Hobart, Melbourne, and Sydney, on Ngunnawal, muwinina, Wurundjeri, and Gadigal Country.

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Acronyms and Definitions

Abbreviation/ Term	Description
AAGR	Average Annual Growth Rate
ABS	Australian Bureau of Statistics
Broad hectare / Greenfield	Undeveloped land identified for residential development as defined in the Urban Development Program. Generally located on the urban fringe of metropolitan Melbourne.
CAGR	Compound Annual Growth Rate
CBD	Central Business District
DELWP	Department of Environment, Land, Water and Planning
DoT	Department of Transport
ERP	Estimated Resident Population
FUA	Functional Urban Area
LGA	Local Government Area
MAC	Metropolitan Activity Centres
MM1	Melbourne Metro One (transport project)
MM2	Melbourne Metro Two (transport project)
NIM	Net Internal Migration
NOM	Net Overseas Migration
SA2	Statistical Area Level 2
SRL	Suburban Rail Loop (transport project)
UGB	Urban Growth Boundary

Executive summary

Project context and objectives

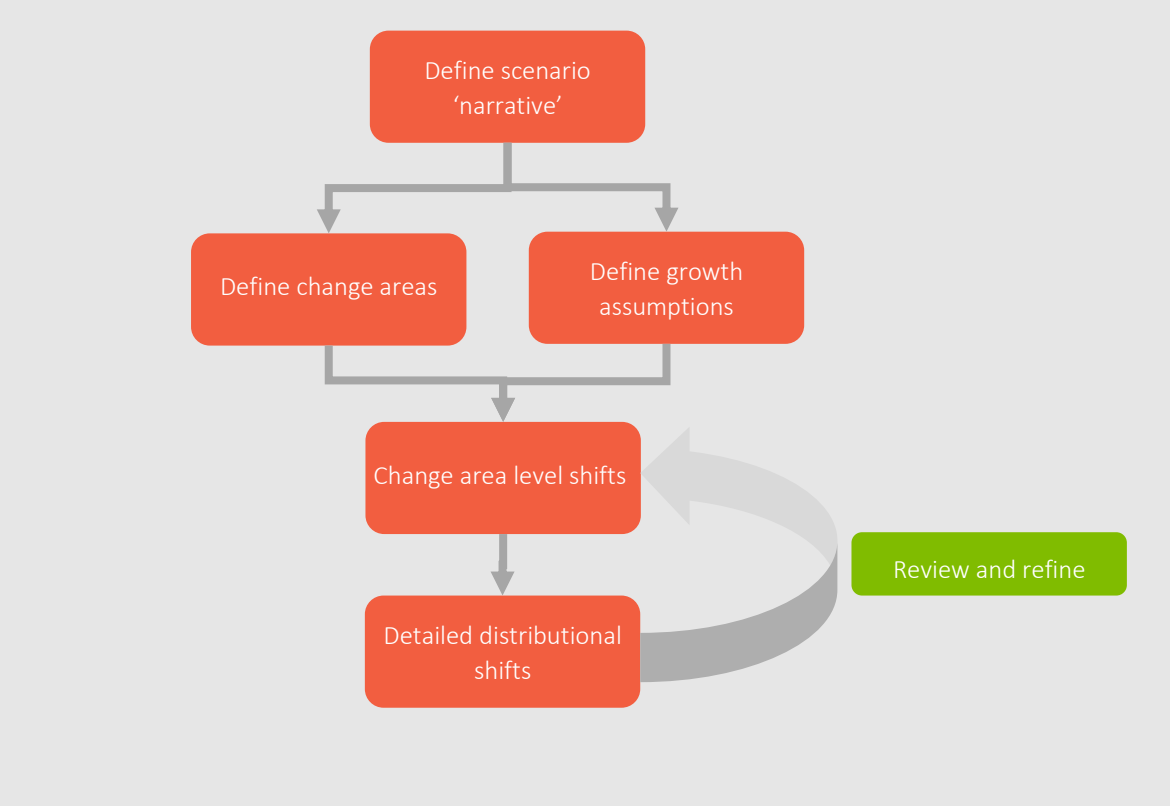
Infrastructure Victoria is leading a research project that investigates future urban development scenarios for the state. The overarching project comprises three phases:

- Phase One: Define a set of plausible scenarios concepts. This has been completed by Infrastructure Victoria.
- Phase Two: Refine and develop these scenarios (**This Part A report**) and prepare a framework to assess the impacts of each (Separate Part B report).
- Phase Three: Undertake detailed modelling of impacts according to the assessment framework.

This (Part A) report presents five plausible urban development scenarios for Victoria, including an overview of the modelling results, the modelling method, assumptions, and a defensible logic and narrative underpinning each scenario. The scenarios have been informed by an analysis of past development trends, research into future drivers of urban development patterns and state policy.

Approach overview

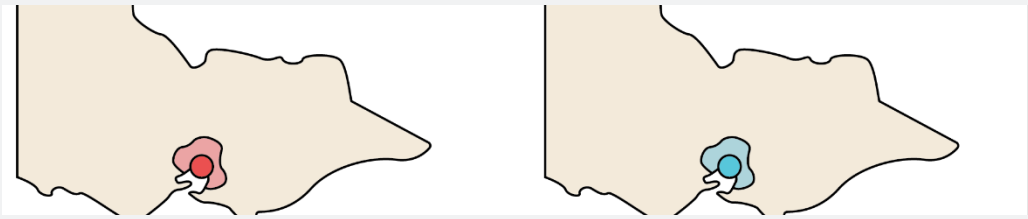
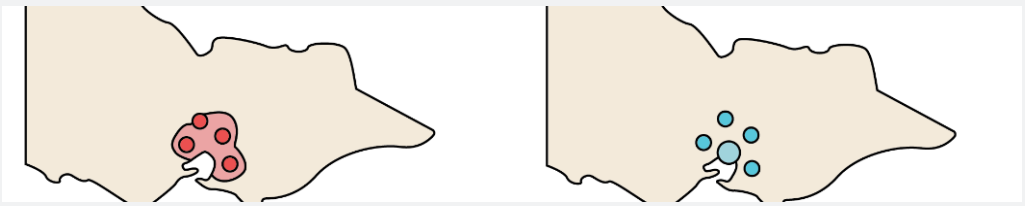
The following provides a high level overview of the approach used to develop plausible scenarios:

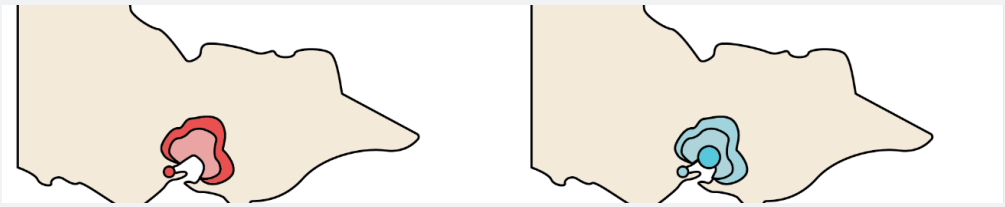
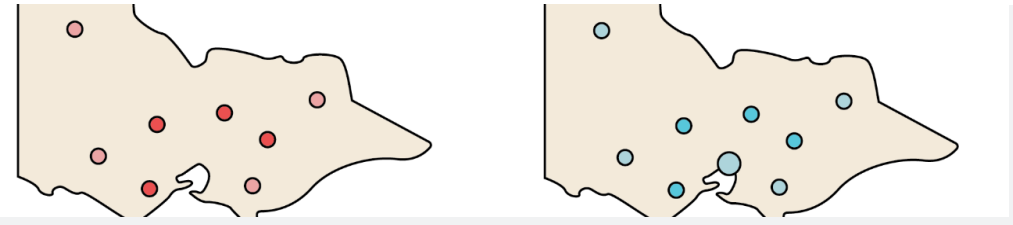


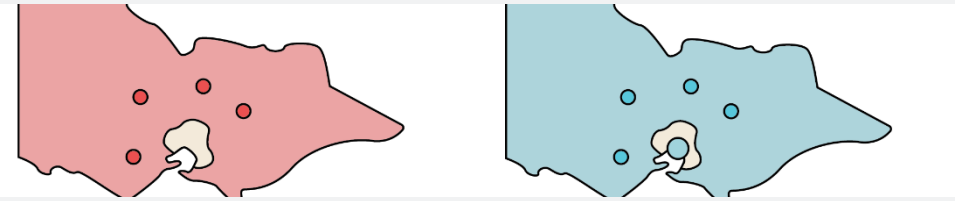
1. First, a clear conceptual narrative is established for each land use scenario – this is qualitatively defined and considers a wide range of aspects including broad macro-economic context, local development capacity and potential choices/trade-offs that could play out
2. Scenario narratives are translated into land use implications associated with:
    - Change areas – custom defined areas (grouped from SA2s) which might be impacted by the scenario in a broadly similar way (i.e., growth areas, inner Melbourne, regional centres, etc)
    - Change assumptions – broad land use development assumptions, linked to change areas, scenario narratives, enabling infrastructure and market preferences/trends.
3. Population by age and employment by industry is then redistributed (within a fixed Victorian total) using an iterative and two stage process: First by 'change areas' and then by SA2s. Employment is also distributed in a two-stage process: population serving shifts (i.e. retail following population) and direct employment shifts (i.e. employment moving directly due to scenario assumptions) this analysis is undertaken for 2036 and 2056 as future projection years with 2021 as a base year.
4. Scenario results are then progressively reviewed and refined using a range of land use metrics to ensure they align with scenario narratives, and present sufficiently different, yet plausible outcomes.

Land use scenarios

The following five plausible alternative land use scenarios have been developed for Victoria.

	Scenario	Description
1	Compact City	 The Compact City scenario reflects more concentrated urban development in the inner city of Melbourne and housing development in places of high transport accessibility. This structure supports sustainable city outcomes adapting to climate change impacts through policy and behavioural change. This leads to reduced car dependency and a focus on government investment in accessible affordable housing. Consolidation of both residential and employment growth, primarily in inner Melbourne and middle Melbourne along train corridors. This trend will accelerate from 2031 and result in lower growth across outer Melbourne and regional Victoria, particularly areas at risk of adverse climate change impacts. The central city and inner urban renewal precincts experience the largest population and employment growth, reaching their aspirational residential densities while also continuing to attract a large net inflow of workers. **Key Focus Areas:** ▪ Focuses most heavily on inner Melbourne, with much higher employment and population growth levels than other scenarios. Outer Melbourne, Melbourne new growth areas and regional Victoria receive the lowest shares of growth under this scenario.
2	Consolidated City	 The Consolidated City scenario reflects a response to climate change through the development of key centres across Melbourne providing local living and working through changing preferences to create a polycentric city that balances the distribution of people and jobs across a number of high density precincts. Population and jobs growth focuses on a select number of suburban centres outside the central city within metropolitan Melbourne. Both households and firms/workers maintain a preference for accessible and agglomerated locations, but find these needs met within key suburban precincts – Monash, Heidelberg, and Sunshine - which have benefitted from successful government investment. Much of the growth in population and population-serving jobs is drawn from growth that would have otherwise located in outer Melbourne. However, these precincts also compete

Scenario		Description
		with central Melbourne for employment in knowledge intensive services and the health and education sectors. **Key Focus Areas:** ▪ Has a growth focus on middle Melbourne. Population growth for outer Melbourne, the new growth areas and regional Victoria would relatively low, but higher than Scenario 1, with the result that Scenario 1 still forecasts slightly higher population growth overall for middle Melbourne. However, the distribution of population growth within middle Melbourne differs between the scenarios, as discussed in more detail in the following chapters. Scenario 2 also features the highest employment growth rates for middle Melbourne of any scenario.
3	Dispersed City	 The Dispersed City forecasts a more dispersed urban structure with increased population in outer Melbourne. Melbourne's urban footprint expands as population growth spreads across outer Melbourne, peri-urban areas, and the new greenfield development areas at Melbourne's fringe Residential development slows across inner and middle Melbourne, with households choosing to live in outer Melbourne (including new growth areas, with the UGB needing to expand along growth corridors) and in peri-urban towns stretching along transport corridors from Melbourne to Torquay, Seymour, and Traralgon. While population serving employment moves proximate to residents, there will be less movement of knowledge sectors, which continue to be attracted to central Melbourne. More people work from home part-time, but many still need to live within a reasonable distance of Melbourne, limiting migration into further away regional areas. **Key Focus Areas:** ▪ Places substantial levels of growth in outer Melbourne and the new growth areas, drawing growth from inner Melbourne and middle Melbourne. There is also a shift towards regional centres and rural areas focused around peri-urban Melbourne compared to Scenario 1 and 2.
4	Network of Cities	 The Network of Cities scenario projects a future where housing affordability in metropolitan Melbourne combined with continuing remote working leads to the development of regional cities as people choose to live regionally. Policy leads the development of these cities as higher density areas and they become consolidated centres for living regionally with mass transit

Scenario		Description
		connections between these regional cities and Melbourne maintaining the physical connections. These regional cities grow and densify attracting both population serving and higher order employment. Increased agricultural employment across the regions is also served by workers from regional cities. At the expense of metropolitan Melbourne, a large portion of Victoria's growth is accommodated in Geelong, Ballarat, and Bendigo. Traralgon also experiences additional population growth to a moderate extent and smaller regional cities attract additional residents and associated population serving employment. **Key Focus Areas:** ▪ Allocates more growth to regional cities, which under this scenario would receive several times more growth than under some other scenarios. Regional centres and rural areas also receive moderately high growth rates, but less than under Scenario 3 or Scenario 4.
5	Distributed State	 In the Distributed State scenario population growth decentralises from existing settlements with housing affordability in established areas leading people to settle regionally. This growth in regional areas is unmanaged and results in sprawling low density development across the state. Residential growth slows within metropolitan Melbourne as development becomes more dispersed from existing metropolitan and regional centres across the state, initially in major regional cities and then in low density corridors which stretch from Melbourne to regional centres, and between regional centres. Agricultural production falls as export demand is lower and farmland is used for urban sprawl. At the same time, companies return manufacturing and fabrication to Australia with industrial employment slowing the decline of manufacturing at the expense of business and government services. **Key Focus Areas:** ▪ Places very high levels of growth in the rural centres and regional areas FUA, reflecting employment and population growth spread broadly across regional Victoria. Regional cities also have very high growth rates, although lower than under Scenario 4.

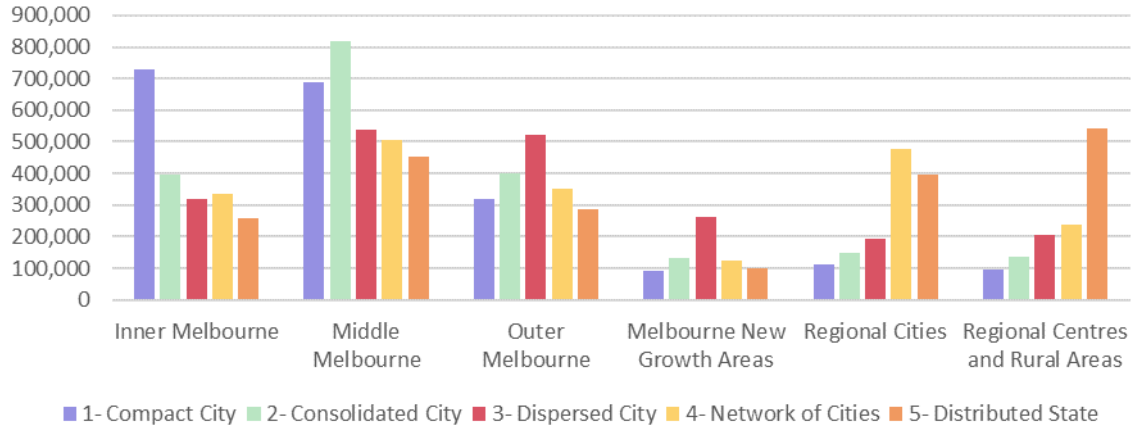
POPULATION GROWTH 2021-2056 BY FUA

POPULATION BY FUA, 2056

	Inner Melbourne	Middle Melbourne	Outer Melbourne	Melbourne New Growth Areas	Regional Cities	Regional Centres and Rural Areas
1- Compact City	1,974,000	2,752,000	2,333,000	1,340,000	1,010,000	1,260,000
2- Consolidated City	1,435,000	2,738,000	2,462,000	1,597,000	1,079,000	1,359,000
3- Dispersed City	1,140,000	2,149,000	2,619,000	2,079,000	1,168,000	1,514,000
4- Network of Cities	1,297,000	2,229,000	2,428,000	1,562,000	1,677,000	1,476,000
5- Distributed State	1,144,000	2,132,000	2,328,000	1,410,000	1,404,000	2,250,000

Source: SGS Economics and Planning, 2022

EMPLOYMENT GROWTH 2021-2056 BY FUA



EMPLOYMENT BY FUA, 2056

	Inner Melbourne	Middle Melbourne	Outer Melbourne	Melbourne New Growth Areas	Regional Cities	Regional Centres and Rural Areas
1- Compact City	1,695,000	1,476,000	1,158,000	200,000	477,000	494,000
2- Consolidated City	1,359,000	1,608,000	1,240,000	244,000	513,000	536,000
3- Dispersed City	1,282,000	1,326,000	1,361,000	371,000	558,000	603,000
4- Network of Cities	1,300,000	1,296,000	1,192,000	234,000	843,000	636,000
5- Distributed State	1,221,000	1,240,000	1,125,000	211,000	763,000	940,000

Source: SGS Economics and Planning, 2022

1. Introduction

This section introduces the project, outlines the purpose and structure of this report, and provides an overview of the method.

1.1 Project context

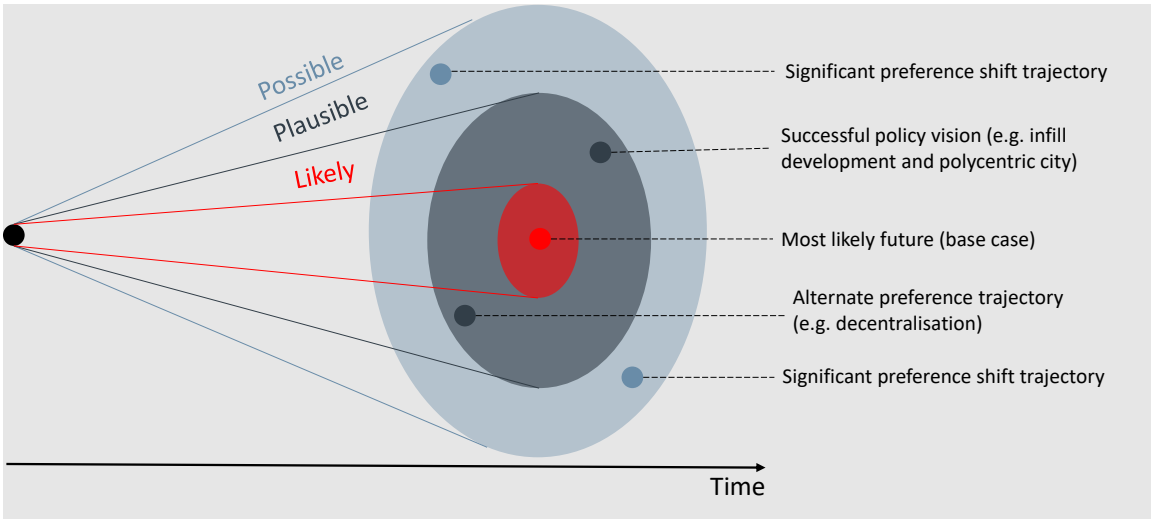
Infrastructure Victoria is leading a research project that investigates future urban development scenarios for the state. The project comprises three phases:

- Phase One: Define a set of plausible scenarios concepts. This has been completed by Infrastructure Victoria.
- Phase Two: Refine and develop these scenarios (Part A) and prepare a framework to assess the impacts of each (Part B).
- Phase Three: Undertake detailed modelling of impacts according to the assessment framework.

Population and employment growth patterns across Victoria are influenced by a wide range of interacting factors. Some of these change drivers are within the control of government (e.g., policy or infrastructure investment), while others are externally driven (e.g., structural economic changes, people's travel behaviour, working/living preferences, and climate change impacts). Many of these factors have been evolving significantly in recent decades. Technological advancements and changes to social structures have greatly influenced urban structures over time, with other factors having experienced disruption or being intensified during the COVID pandemic. All the drivers of urban development and society are dynamic and inter-related and lead to a continual transformation of the way people live, work and play.

This has created much uncertainty around the future urban development patterns of Victoria. While there may be a most likely future scenario, there are a wide range of plausible alternatives that should be considered and planned for - far beyond a simple 'high' and 'low' scenarios.

FIGURE 1: CONCEPTUALISING LAND USE FUTURES



Source: SGS Economics and Planning

In addition, these various urban development scenarios may have significantly different social, economic, and environmental outcomes for the state as a whole and across segments of the population. One possible scenario may maximise economic growth while imposing large social and environmental costs. Another policy-led scenario may only realise benefits if resident behaviours do or don't shift from current trends.

Following Phase One of the project, SGS Economics and Planning (SGS) has been commissioned to undertake Phase Two. That is, refining and further developing the scenario narratives established by Infrastructure Victoria in Phase One (Part A) and preparing a framework and measurement approach to assess the outcomes of scenarios in terms of broad economic, social, and environmental impacts (Part B).

In Phase Three, the impacts of each scenario will be measured using guidance from the framework, which will ultimately help establish a robust evidence base to support recommendations in the next infrastructure strategy update.

1.2 Purpose of this report

Against this background, this report (Part A) presents five plausible urban development scenarios, including an overview of the modelling results, the modelling method, assumptions, and a defensible logic and narrative underpinning each scenario.

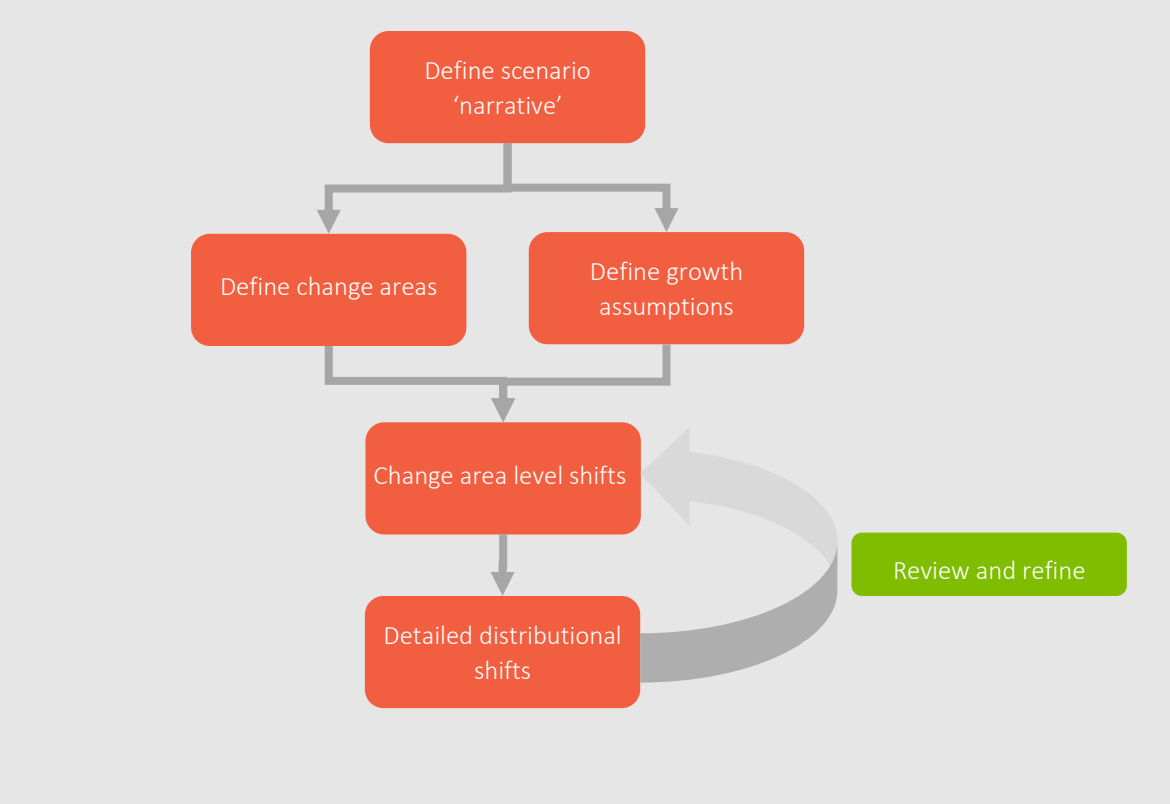
The remainder of this report will be structured as follows:

- Section 1 describes the background and objectives of the project.
- Section 2 provides an overview of the **historical urban development of Victoria** and the **factors driving development pathways**, addressing key issues that this project will need to consider, such as structural economic change, the changing nature of work, and the effects of climate change.
- Section 3 **summarises the urban development scenarios** to provide a comparative snapshot of the scenario narratives and results.
- Sections 4 to 8 provide a **detailed scenario review**, breaking down each of the five urban development scenarios, the narrative context, and detailed results. This section will describe the modelling assumptions to the extent that they aid the narrative, with more detailed and technical assumptions reserved for Appendix D. The following five urban development scenarios are presented:
  - Scenario 1: Compact City
  - Scenario 2: Consolidated City
  - Scenario 3: Dispersed City
  - Scenario 4: Network of Cities
  - Scenario 5: Distributed State
- Section 9 provides a summary and outlines next steps.

1.3 Method overview

The following outlines approach used to create each scenario, with a more detailed description provided in Appendix D.

FIGURE 2: SCENARIO DEVELOPMENT METHOD



Source: SGS Economics and Planning, 2022

Model dimensions

The urban development scenarios are comprised of several variables, which describe the scale and distribution of residential and employment land uses. Residential variables include:

- **Estimated Resident Population (ERP)** segmented by the following age groups:
  - 0 – 14 years old
  - 15 – 24 years old
  - 25 – 44 years old
  - 45 – 64 years old
  - 65 – 84 years old
  - 85+ years old
- **Employment** at place of work, segmented by 10 categories (see Appendix C).
- **Time periods** of 2011, 2016, 2021, 2036, 2056.
- **Spatial units** defined by 2021 SA2s

Define scenario narrative

First, a clear conceptual narrative is established for each scenario. This forms the basis for any population and employment redistribution relative to 2021. For consistency with comparing scenarios and future scenario assessment work, the following variables are held constant across scenarios at a state-wide level:

- Total population and age distribution, implying no differences in fertility/mortality/migration rates
- Total households and dwellings, implying no differences in household formation preferences by age group at the state level.
- Total employment, implying no differences in participation or unemployment rates. However, the distribution of employment across sectors may vary.

Define 'change areas' and associated growth narrative assumptions

Spatial deviations from 2021 are referred to as 'change areas' and they are defined based on the narrative of each scenario (e.g., a change area may be a bushfire risk area in which development will be restricted under one scenario).

For each scenario, broad growth assumptions are defined, along with the enabling infrastructure and aligned market preferences that these imply (e.g., a compact city is only possible if market preferences shift towards higher density living). These change areas as shown spatially in Appendix A.

Change area level shifts to population and employment

The Base Case is aligned to the SALUP22 (Small Area Land Use Projections 2022), developed by SGS for the Department of Transport (DoT). SALUP22 is based internal state government forecasts.

This is used to assist in defining scenario assumptions, with development patterns pivoting away from this forecast.

- Population change is the lever used to redistribute residential growth. This may include age-specific shifts for selected change areas, which are offset in others to retain the Victorian totals.
- Employment redistribution is implemented in two stages.
  - For population serving sectors, the employment shift in each change area will reflect the residential growth of the scenario.
  - For all sectors (including population serving) where relevant, narrative-defined employment outcomes will be imposed for selected change areas and offset in the remainder.

Review and refine

Population and employment levels, growth rates, and densities were reviewed to further refine scenarios and ensure they do not exceed plausible outcomes (despite the scenarios being designed to represent divergent urban forms such as compact cities versus dispersed development).

2. Factors driving development pathways

Urban development patterns are driven by a wide range of complex and interrelated factors. These dynamics impact Melbourne and regional Victoria from policy, planning, economic, housing, transport, precinct, site, and market perspectives. Appendix E provides analysis of the historical urban development of Melbourne and Victoria.

2.1 Key Insights

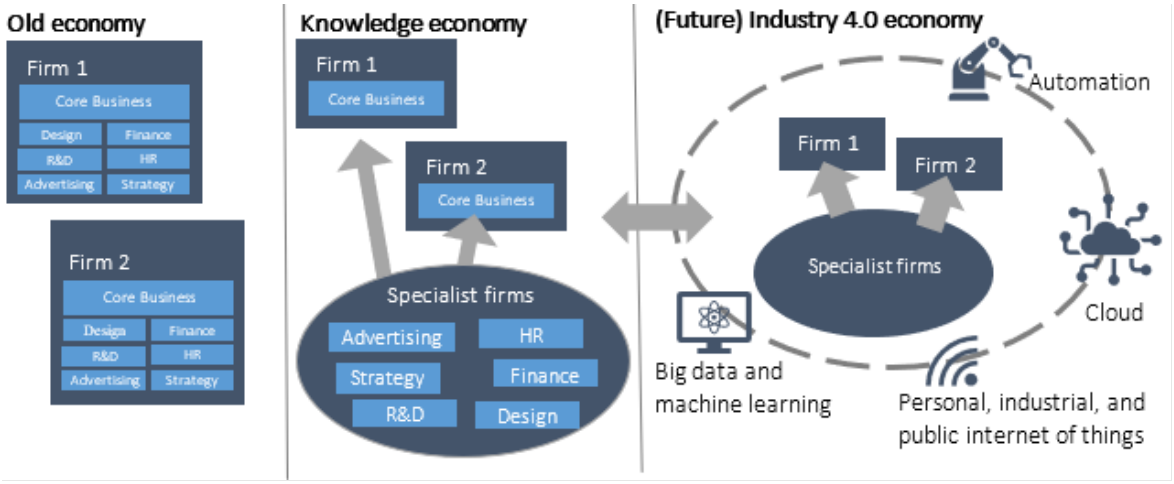
- The distributions of population and employment across Victoria and Melbourne are strongly linked to transport infrastructure provision and land availability.
- Overseas migration is a major driver of population growth, particularly in Melbourne. The population is forecast to continue to age, which has implications for labour force availability and the distribution of services, particularly healthcare.
- Population and jobs have been growing rapidly in Victoria over the past 25 years. Over the last 15 years, the spatial distribution of population growth has been more dispersed relative to employment growth, which concentrated within inner Melbourne and key suburban activity centres.
- Policies and plans can help drive the development of urban development pathways. Setting clear directions and objectives for the future of regions provides the overarching framework for delivering infrastructure to support urban development.
- The nature of work and the composition of Victoria's economy continue to evolve with the shift to a service-orientated economy and potential evolutions from automation in the dawn of Industry 4.0.
- Climate change and extreme weather have the potential to significantly alter urban development pathways and influence the residential and employment opportunities of Victorians.

2.2 Changing nature of work

Figure 3 illustrates how the Australian economy has evolved and the current, and future, transition to Industry 4.0. The old, manufacturing-based economy relied on traditional hierarchical, self-contained businesses structures. The transition to a knowledge economy introduced a more dynamic structure that takes a flexible, innovative, and collaborative approach to business, and signified the shift to a service-oriented economy. The economy is continuing to evolve, and technological change, innovation, AI, and automation are bringing about a fourth industrial revolution (Industry 4.0) which will again fundamentally alter the nature of work.

To align with Industry 4.0, companies will be required to undergo a transformation whereby they digitise, automate, and interconnect many processes. The workforce will also need to change to match the digital skills required.[1] As a result of this next economic revolution, some jobs will be made redundant and demand for others will increase rapidly. The World Economic Forum reported the jobs that will experience the most growth to be computing and mathematical, architecture and engineering, management, and sales roles. The sectors expected to experience decline include installation and maintenance, construction and extraction, and manufacturing and production[2].

FIGURE 3: ECONOMIC EVOLUTIONS



Source: SGS Economics and Planning, 2022

The type of jobs and the associated industries are likely to transform, with the development of advanced manufacturing and a shift towards Net Zero Emissions technologies. The shift towards the digitisation of information and services interaction has additional impacts on the jobs and the economy of the future. RMIT[3] identified Industry 4.0 as an opportunity for Australia to manufacture low volume,

[1] Australian Government, The Prime Minister's Industry 4.0 Taskforce. (2017). Industry 4.0 Testlabs in Australia: Preparing for the Future.
[2] The World Economic Forum. (2016) The Future of Jobs: Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution.
[3] RMIT University. (2020) Demystifying Industry 4.0: An RMIT Advanced Manufacturing and Fabrication Enabling Capability Platform White Paper.

but highly customised, products delivered using advanced manufacturing techniques, as opposed to high-volume manufacturing which is increasingly dominated by China, the US, and Japan. This shift to advanced manufacturing will require highly skilled workers but may require fewer low-skilled jobs. In Victoria, and elsewhere in Australia, an uptake of advanced manufacturing could help to bring employment growth to regional areas.[4] Conversely, streamlining manufacturing through advanced technological innovations could provide flexibility for firms to locate in urban areas through the reduced need for land area (and therefore reduced costs).

Despite this anticipated boost to the manufacturing sector, Victoria's industrial base will continue to cede prominence to a service-based economy. Automation is also likely to affect jobs in the service sectors, such as food service, retail, and healthcare. This has been accelerated during the pandemic as many firms and workers had to adopt these emerging technologies to continue operating during restrictions. A report by McKinsey & Company estimated that between 25 and 46 per cent of current work activities in Australia could be automated by 2030[5]. Automation lessens the demand for physical and manual skills, providing opportunities for improved efficiency, productivity, and inclusivity in the workforce. Demand for workers in unpredictable and interactive roles, such as nursers and salespeople, will increase but demand will decrease for workers in more predictable roles, such as accountants and mechanics. [6]

This disruption to the workforce will play out differently across Victoria, with fewer changes to jobs likely to be seen in Melbourne's city centre due to the high proportion of professional services. For workers in professional services, the dawn of Industry 4.0 could up-end the entire concept of a 'typical person' having a single resident address and a single work location which they attend '9 to 5', five days a week. However, in outer suburban and rural regions of Victoria, where industries such as manufacturing and agriculture are more dominant, automation could leave residents vulnerable to unemployment. It is uncertain how these trends will evolve over time and therefore planning for the future of our urban areas needs to be cognisant and flexible to a range of possible futures.

[4] Advanced Manufacturing Growth Centre. (2018) Industry 4.0: An opportunity for every Australian Manufacturer. Submission to the Department of Industry, Innovation and Science.
[5] McKinsey & Company. (2019) Australia's automation opportunity: Reigniting productivity and inclusive income growth.
[6] McKinsey & Company. (2019) Australia's automation opportunity: Reigniting productivity and inclusive income growth.

2.3 Policy Directions

Metropolitan strategic land use and transport policy (noting the lack of a stand-alone transport plan) provides a shared vision of what Melbourne will aspire to be in the future and provides a basis to coordinate investment and policy decisions to achieve that vision. Such plans should, by their very nature, look beyond the immediate horizon to the long-term challenges of the city. In taking this perspective, such plans are informed by predictions of future challenges. They are also, however, inevitably influenced by the immediate challenges of the day as well as decisions made in the past.

Plan Melbourne 2017-2050 sets the vision to support planning policy direction for the growth of Melbourne to 2050, estimating that city's population will increase to 11.2 million by 2056.

To achieve sustainable growth, Plan Melbourne encourages residential development in and around activity centres, in proximity to services, jobs and transport. It also calls for more diverse housing and an increase in the supply of social and affordable housing.

This is reflected in Plan Melbourne's explicit 70/30 housing distribution target, which calls for 70 per cent of new housing to be provided within Melbourne's established areas and the remaining 30 per cent in greenfield areas. The 70/30 target seeks to shift a higher proportion of new housing development to land with existing infrastructure.

In relation to housing, Plan Melbourne seeks the following outcomes:

- Provides housing choice in locations close to jobs and services
- Is made up of inclusive, vibrant, and healthy neighbourhoods

These outcomes are supported by the following policies:

- Facilitate an increased percentage of new housing in established areas to create a city of 20-minute neighbourhoods close to activity centres, services, jobs, and public transport.
- Plan for and define expected housing needs across Melbourne's region.
- Provide certainty about the scale of growth in the suburbs.
- Create mixed-use neighbourhoods at varying densities.

The 2019 Addendum to Plan Melbourne provides an update on Melbourne's projected population, housing, and employment growth. It supersedes the projections set out in Plan Melbourne 2017-2050 and provides an update on key land use and transport planning that has occurred since 2017.

This includes key city shaping infrastructure project commitments including:

- Melbourne Metro; provides additional capacity in inner Melbourne from the south-east to north-west with the opportunity for additional inner city housing developments.
- West Gate Tunnel: facilitates improved road connections from the central city and existing inner city motorway network to the growing Western suburbs and western region of Greater Melbourne.
- North East Link: facilitates improved road connections in the north east of Melbourne.
- Melbourne Airport Rail Link: providing dedicated rail services to Melbourne Airport from the central city and activating the rail corridor.

- Suburban Rail Loop Stage 1 (now SRL East): promotes development of key centres in the east and south east of Melbourne.

The addendum also seeks to embed the 20-minute neighbourhood concept as part of major infrastructure projects to be able to connect people to their daily needs within 20 minutes of their home.

The combination of major city-shaping infrastructure projects and 20-minute neighbourhoods seek to inform urban development at both at city and region level in addition to local level and has implications for the location of population serving infrastructure and the formation of precincts and places.

2.4 Climate change and extreme weather events

Natural perils, such as bushfires, floods, storms and tropical cyclones are part of the Australian experience. However, human-induced climate change is resulting in increased extreme weather events which will present significant challenges for some parts of the country.[7] The risk of natural perils varies spatially due to a variety of factors and planning for mitigating these risks cannot be undertaken uniformly. In Victoria, 17.5 per cent of the population live in local government areas (LGAs) which contain communities at high to extreme risk of bushfire currently (see Figure 4).[8] The risk of flooding also heavily impacts Victoria, with Melbourne's central city at an extreme risk of flooding currently (see Figure 5) and in regional Victoria, on average, there is a high risk of flood and bushfire due to the many communities living in floodplains and close to vegetation.

The impact of these natural perils affects the everyday function of how we live and work. For example, storms and flooding can impact agricultural and mineral production, urban transport systems and air travel. Heavy rainfall also impacts the road network via reduced speeds, areas of flooding and more accidents. Extreme heatwaves threaten the liveability of urban areas where the urban heat island effect leads to public health risks and increased energy consumption. [9]As these events increase in severity and frequency, they will likely impact urban development patterns and create significant social and economic costs for firms and residents in impacted areas. [10]

It will be important to understand the impact of a changing environment on urban development patterns and, conversely, the impact of different urban development patterns on the environment.

Implications for future urban development

With increasing population and pressure to develop more land, households in high-risk areas may increase if development is allowed in vulnerable locations. Some land, however, has an unacceptably

[7] CSIRO and the Bureau of Meteorology. (2020) The State of the Climate 2020.
[8] SGS Economics and Planning. (2016) At what cost? Mapping where natural perils impact on economic growth and communities.
[9] Norman B. (2016) Climate Ready Cities. Policy Information Brief 2, National Climate Change Adaptation Research Facility, Gold Coast.
[10] SGS Economics and Planning. (2016) At what cost? Mapping where natural perils impact on economic growth and communities.

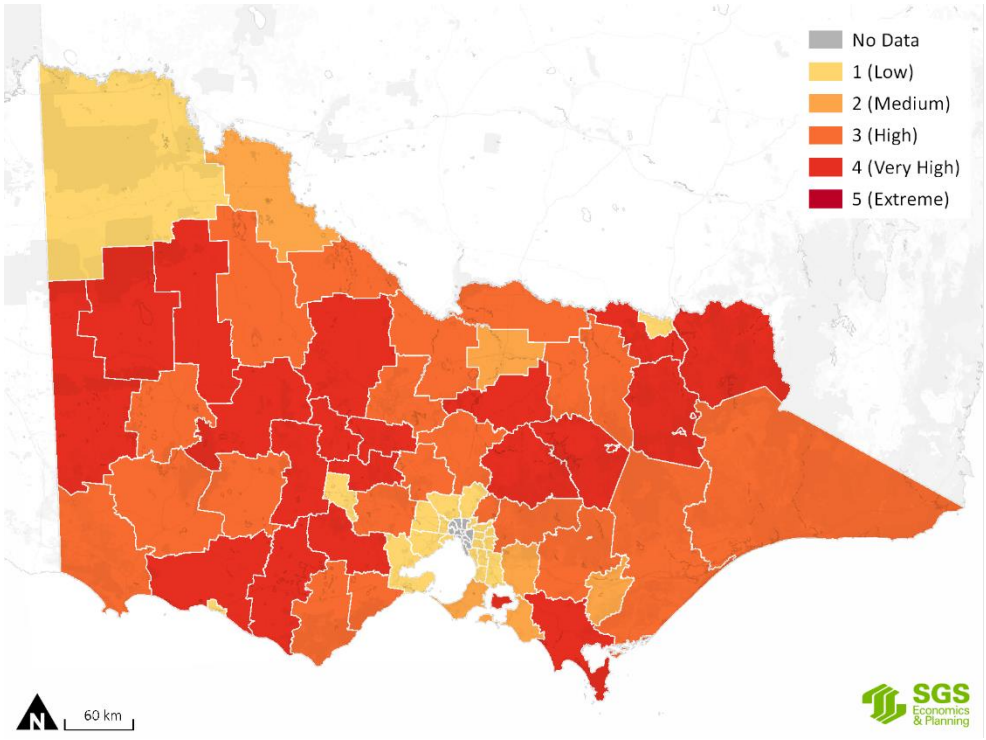
high risk of natural peril, and residential or commercial use on this land should be avoided. For example, coastal urban centres will be at high risk of erosion and inundation due to rising sea levels. [11]

The changing climate will require an understanding of what type of urban development patterns are resilient to the effects of climate change. Centralised urban development, for example, can mitigate climate change by reducing travel demands and increasing the efficiency of infrastructure.[12]

This has further implications for employment with potential jobs in climate change adaptation or an additional requirement for people to respond to emergencies in vulnerable areas as well as changes to the way our cities and regions are built. The tourism economy in in parts of regional Victoria is highly exposed to the effects of climate change and lifestyle changes that may reduce air travel and other related activities. In Victoria's alpine regions, downward trends in maximum snow depths have been observed since the last 1950s and are closely linked to rising temperatures.[13] The consequences of this less reliable snow cover include a shorter ski season which is a key contributor to the economy in the region.[14]

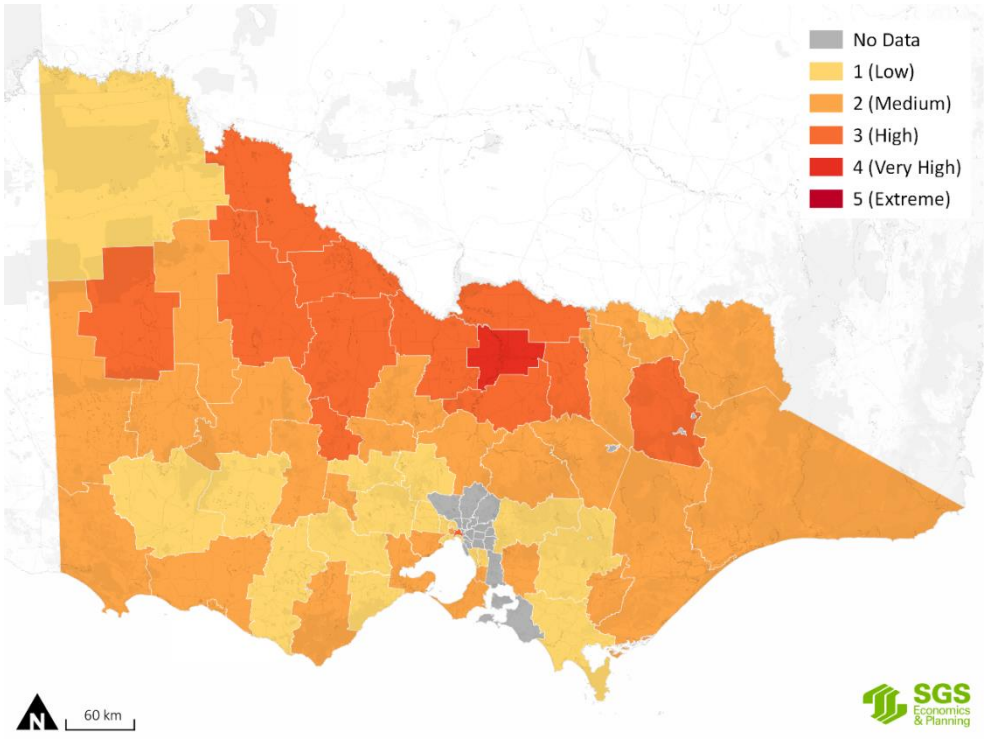
[11] Norman B. (2016) Climate Ready Cities. Policy Information Brief 2, National Climate Change Adaptation Research Facility, Gold Coast.
[12] SGS Economics and Planning. (2018) Improved management in the land use planning and building systems of natural hazards in light of climate change. Prepared for DELWP.
[13] CSIRO and the Bureau of Meteorology. (2020) The State of the Climate 2020.
[14] Harris, R.M.B., Remenyi, T. and Bindoff, N.L. (2016) The Potential Impacts of Climate Change on Victorian Alpine Resorts. A Report to the Alpine Resorts Co-ordinating Council. Antarctic Climate and Ecosystems Cooperative Research Centre, Hobart, Australia.

FIGURE 4: CURRENT BUSHFIRE RISK



Source: SGS 2016 based on ICA iLEAD data

FIGURE 5: CURRENT FLOOD RISK



Source: SGS 2016 based on ICA iLEAD data

3. Scenario Overview

The following section provides an overview of the rationale underpinning each scenario.

3.1 Scenario narratives

Scenario		Description
1	Compact City	The Compact City scenario reflects concentrated urban development in the inner city of Melbourne and housing development in places of high transport accessibility. This structure supports sustainable city outcomes, adapting to climate change impacts through policy and behavioural change. This leads to reduced car dependency and a focus on government investment in accessible and affordable housing. There will be a consolidation of both residential and employment growth, primarily in inner Melbourne and middle Melbourne along train corridors. This trend will accelerate from 2031, resulting in reduced growth across outer Melbourne and regional Victoria, particularly areas at risk of adverse climate change impacts. The central city and inner urban renewal precincts experience the largest population and employment growth, reaching their aspirational residential densities while also continuing to attract a large net inflow of workers.
2	Consolidated City	The Consolidated City scenario reflects a response to climate change through the development of key centres across Melbourne. Preferences favour local living and working, creating a polycentric city that balances the distribution of people and jobs across several high-density precincts. Both households and firms/workers maintain a preference for accessible and agglomerated locations, but find these needs met within key suburban precincts – Monash, Heidelberg, and Sunshine - which have benefitted from successful government investment. Much of the growth in population and population-serving jobs is drawn from growth that would have otherwise located in outer Melbourne (if current trends persisted). However, these precincts also compete with central Melbourne for employment in knowledge intensive services and the health and education sectors.
3	Dispersed City	The Dispersed City represents a dispersed urban structure with increased population in outer Melbourne. Melbourne's urban footprint expands as population growth spreads across outer Melbourne, peri-urban areas, and the new greenfield development areas at Melbourne's fringe Conversely, residential development slows across inner and middle Melbourne, with households choosing to live in outer Melbourne (including new growth

Scenario		Description
		areas, where the UGB expands along growth corridors) and in peri-urban towns, stretching along transport corridors from Melbourne to Torquay, Seymour, and Traralgon. While population serving employment moves proximate to residents, there will be less movement of knowledge sectors, which continue to be attracted to central Melbourne. More people work from home, but many still need to live within a reasonable distance of Melbourne, limiting migration to more distant regional areas.
4	Network of Cities	The Network of Cities scenario presents a future where housing affordability in metropolitan Melbourne, combined with heavily adopted remote working, leads to rapid growth of regional cities. Planning policy guides the development of these cities as higher density areas, and they become consolidated centres for living regionally with mass transit connections between these regional cities and Melbourne. These regional cities grow and densify attracting both population serving and knowledge intensive employment sectors. Increased agricultural employment across regional Victoria is also served by workers from regional cities. At the expense of metropolitan Melbourne, a large portion of Victoria's growth is accommodated in Geelong, Ballarat, and Bendigo. Traralgon also experiences an increased rate of population growth while smaller regional cities attract additional residents and associated population serving employment.
5	Distributed State	In the Distributed State scenario, population growth decentralises from existing settlements, with housing affordability in established areas leading people to settle regionally. This growth in regional areas is unmanaged and results in sprawling low density development across the state, particularly in low-density corridors which stretch from Melbourne to regional centres, and between regional centres. Agricultural production falls as export demand is lower, and farmland is used for urban sprawl. At the same time, companies return manufacturing and fabrication to Australia. This slows the decline of manufacturing (at the expense of business and government services).

3.2 Scenario outcomes

State-wide

Victoria's population is projected to increase by approximately 4 million residents between 2021 and 2056, corresponding to development of between 45,000-55,000 additional dwellings per year.

The rate of housing development (additional dwellings per year) is forecast to remain relatively stable over time, noting that this represents a declining rate of growth (see the figure below).

Employment is expected to increase by between 55,000-65,000 jobs each year from 2021 to 2056, driven by changes in population as well as shifting demographic (e.g., ageing population) and labour force participation trends.

Across scenarios, the state-wide *level* of growth is assumed to remain constant, while the *spatial distribution* varies.

FIGURE 6: OVERALL DWELLING GROWTH FORECAST

Source: SGS Economics and Planning, 2022

FIGURE 7: EMPLOYMENT GROWTH FORECAST

Source: SGS Economics and Planning, 2022

The following table compares Victoria's total population, dwelling, and employment growth expected across these periods, along with the annual rate of change and annual growth rates.

TABLE 1: STATEWIDE FORECAST RATES OF GROWTH

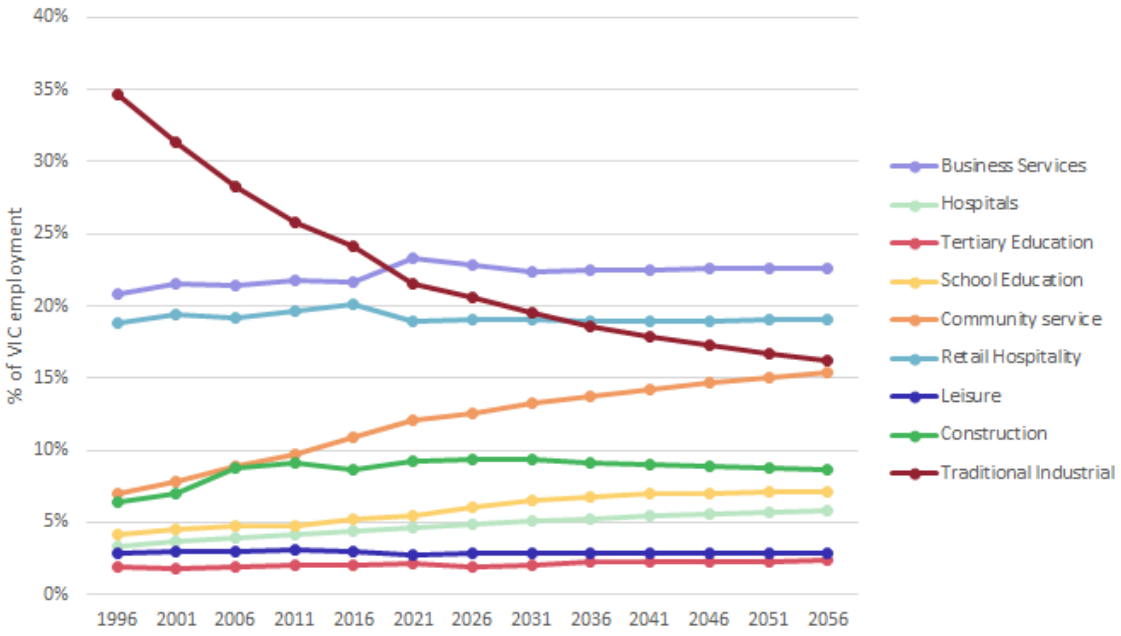
	2021-2036			2036-2056		
	Annual change	Total change	AAGR	Annual change	Total change	AAGR
Population	107,000	1,603,000	1.4%	119,000	2,387,000	1.3%
Dwellings	48,000	721,000	1.5%	54,000	1,087,000	1.3%
Employment	59,000	883,000	1.5%	58,000	1,154,000	1.2%

Source: SGS Economics and Planning, 2022.
Rounded to the nearest 1,000

The average annual growth rates of population and housing are broadly similar, reflecting no large changes in average household sizes. As noted above, employment growth is forecast to slow slightly in the longer term (more so than population growth), reflecting demographic shifts that leading to a lower proportion of the population being of working age or participating in the labour market.

The composition of employment for scenarios one and two is shown in Figure 8. This assumes the persistence of known trends and the shift towards a knowledge and services-based economy, away from traditional manufacturing (discussed in Chapter 2). The proportion of employment in traditional industrial sectors is forecast to continue declining, offset by increases in community services and, to a lesser extent, hospitals and education.

FIGURE 8: FORECAST EMPLOYMENT COMPOSITION (SCENARIOS 1-2)



Source: SGS Economics and Planning, 2022

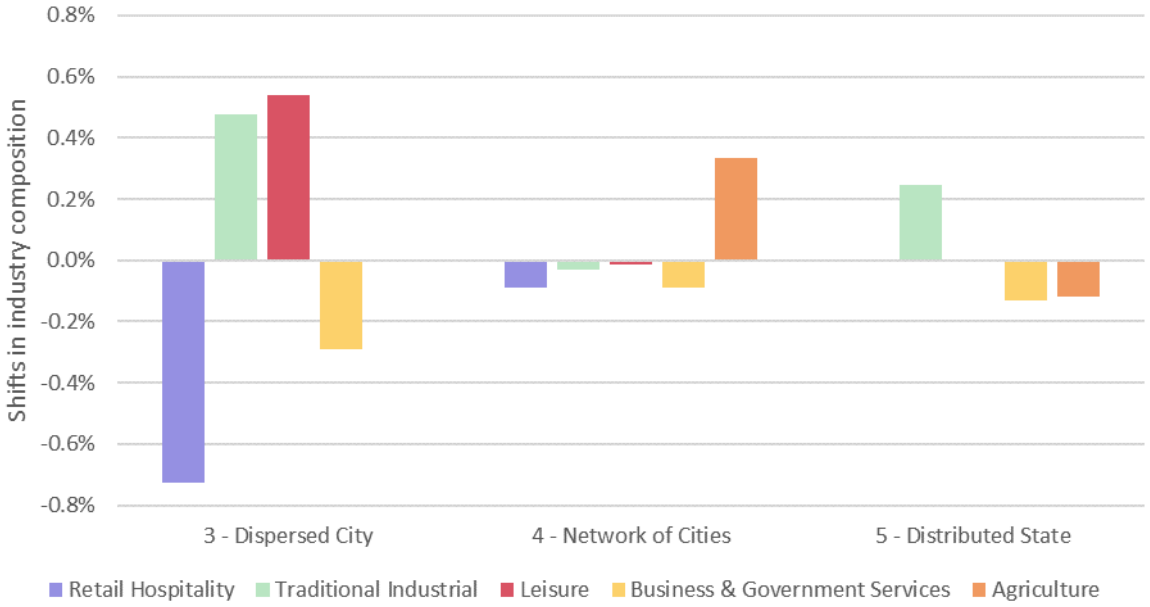
Scenarios three, four, and five assume alternate compositions of employment by industry, which are depicted in Figure 9.

Dispersed City: Higher traditional industry and leisure with other service industries growing. Retail declines and postal and warehousing increases with automated vehicles and remote service delivery.

Network of Cities: Increased focus and development of the agricultural sector with higher export demand and improvements in agricultural productivity through technology advancements.

Distributed State: Increases in traditional industries at the expense of agriculture as export demand reduces and manufacturing returns to Australia.

FIGURE 9: EMPLOYMENT COMPOSITION OF SCENARIOS 3-5 RELATIVE TO SCENARIOS 1-2 (2056)



Source: SGS Economics and Planning, 2022

Broad regions

Table 2 provides a comparison between the five scenarios across three broad regions for the location of population growth and housing development, including:

- Greater Melbourne/Regional Victoria Share – Proportion of growth occurring in Greater Melbourne compared to Regional Victoria.
- Established Melbourne/Growth Area Split - Of Greater Melbourne growth, this is the proportion that occurs in established areas (through increased density, infill and brownfield development, and renewal), compared to greenfield development on the urban fringes.
- Regional Centre/Other Split - Of Regional Victoria growth this is the proportion that occurs in major regional cities, compared to development in smaller towns (sprawling development around regional hubs and in more remote areas).

Table 3 provides similar statistics for employment growth, except that Greater Melbourne is split into inner Melbourne and the rest of Greater Melbourne.

The share of growth captured by inner Melbourne reflects the degree to which agglomeration economies are important influences of business and employment location. If working from home becomes dominant, or business place less value on the agglomeration benefits of a central location, this share would be expected to decrease.

TABLE 2: POPULATION GROWTH SHARES (2021-2056)

Scenario		Greater Melbourne		Regional VIC	
		Total share	Established Melbourne / Growth Area	Total share	Regional City / Other
Historical 96-16		82%	*	18%	44% / 56%
1	Compact City	86%	77% / 23%	14%	59% / 41%
2	Consolidated City	82%	68% / 32%	18%	55% / 45%
3	Dispersed City	76%	50% / 50%	24%	50% / 50%
4	Network of Cities	64%	61% / 39%	36%	69% / 31%
5	Distributed State	52%	59% / 41%	48%	37% / 63%

Source: SGS Economics and Planning, 2022.

* Excluded due to the shifting boundary of established Melbourne over time

TABLE 3: EMPLOYMENT GROWTH SHARES (2021-2056)

Scenario		Greater Melbourne		Regional VIC	
		Total share	Inner Melbourne / Rest of Greater Melbourne	Total share	Regional City / Other
Historical 96-16		83%	35% / 65%	17%	59% / 41%
1	Compact City	90%	40% / 60%	10%	54% / 46%
2	Consolidated City	86%	23% / 77%	14%	52% / 48%
3	Dispersed City	80%	19% / 81%	20%	49% / 51%
4	Network of Cities	65%	25% / 75%	35%	67% / 33%
5	Distributed State	54%	23% / 77%	46%	42% / 58%

Source: SGS Economics and Planning, 2022

Functional Urban Areas

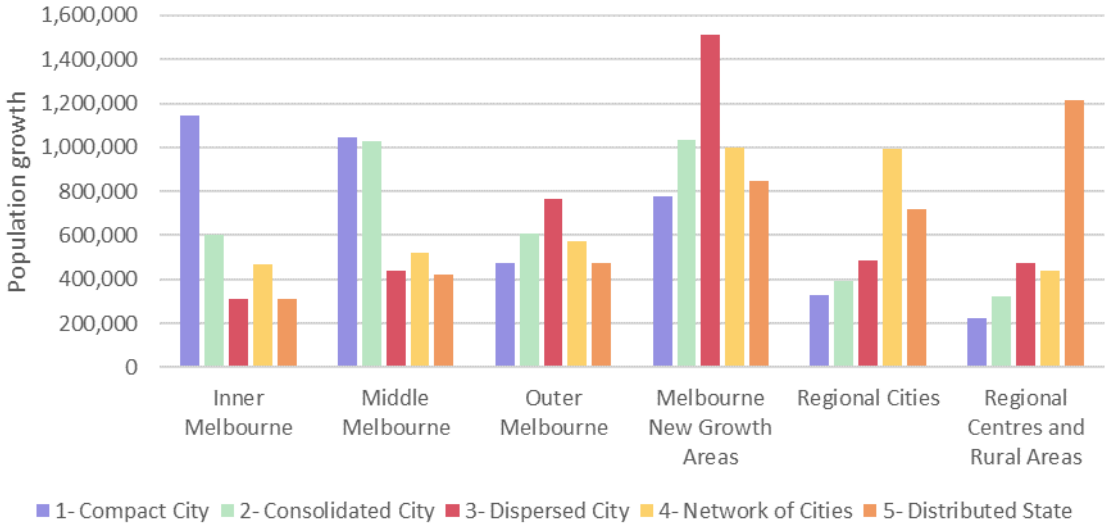
Functional urban areas (FUAs) provide a consistent spatial categorisation of the different parts of Victoria over which scenarios can be compared. These areas have been defined in consultation with Infrastructure Victoria.

The figures overleaf show the breakdown of population and employment growth, for each scenario, across Victoria's six FUAs. These figures provide a more detailed description of the growth shares provided above.

Overall, the following observations can be made about growth distribution under each scenario:

- Scenario 1 – Compact City reflects development focused within inner Melbourne, with vastly higher employment and population growth relative to other scenarios. Outer Melbourne, Melbourne's new growth areas, and regional Victoria receive the lowest shares of growth under this scenario.
- Scenario 2 – Consolidated City has a large share of both population and employment growth focused within middle Melbourne. Population growth for outer Melbourne, the Melbourne's new growth areas, and regional Victoria are relatively low (only being higher than under Scenario 1).
- Scenario 3 – Dispersed City is defined by substantial growth of both population and employment in outer Melbourne and Melbourne's new growth areas, at the expense of inner Melbourne and middle Melbourne. There is also a greater extent of development in regional centres and rural areas (compared to scenarios 1 and 2).
- Scenario 4 – Network of Cities allocates a large share of residential and employment growth to regional cities. Regional centres and rural areas also develop at a moderate rate, although significantly less than under Scenario 5.
- Scenario 5 – Distributed State sees rapid growth in the rural centres and regional areas FUA, reflecting employment and population growth spread broadly across regional Victoria. Regional cities also have very high growth rates, although lower than under Scenario 4.

FIGURE 10: POPULATION GROWTH BY FUA (2021-2056)



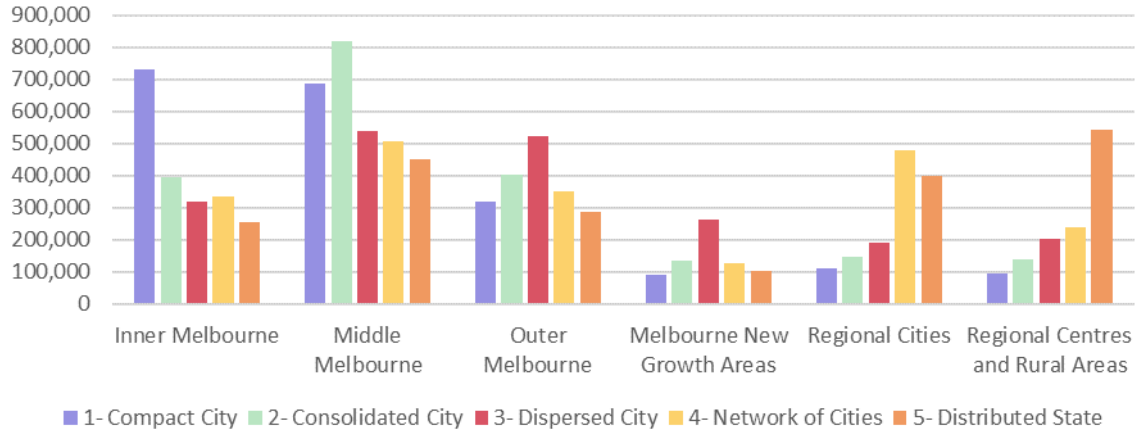
Source: SGS Economics and Planning, 2022

TABLE 4: POPULATION BY FUA (2056)

	Inner Melbourne	Middle Melbourne	Outer Melbourne	Melbourne New Growth Areas	Regional Cities	Regional Centres and Rural Areas
1- Compact City	1,974,000	2,752,000	2,333,000	1,340,000	1,010,000	1,260,000
2- Consolidated City	1,435,000	2,738,000	2,462,000	1,597,000	1,079,000	1,359,000
3- Dispersed City	1,140,000	2,149,000	2,619,000	2,079,000	1,168,000	1,514,000
4- Network of Cities	1,297,000	2,229,000	2,428,000	1,562,000	1,677,000	1,476,000
5- Distributed State	1,144,000	2,132,000	2,328,000	1,410,000	1,404,000	2,250,000

Source: SGS Economics and Planning, 2022

FIGURE 11: EMPLOYMENT GROWTH BY FUA (2021-2056)



Source: SGS Economics and Planning, 2022

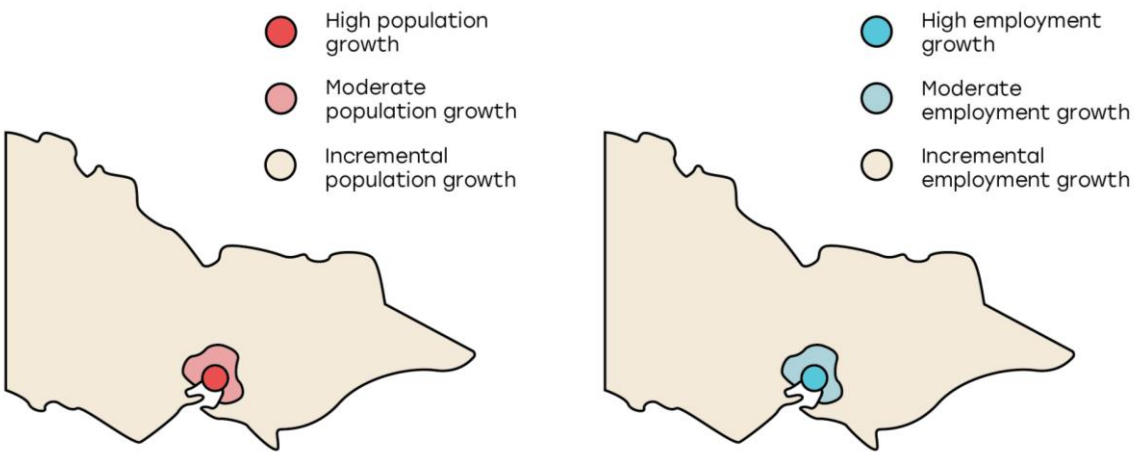
TABLE 5: EMPLOYMENT BY FUA (2056)

	Inner Melbourne	Middle Melbourne	Outer Melbourne	Melbourne New Growth Areas	Regional Cities	Regional Centres and Rural Areas
1- Compact City	1,695,000	1,476,000	1,158,000	200,000	477,000	494,000
2- Consolidated City	1,359,000	1,608,000	1,240,000	244,000	513,000	536,000
3- Dispersed City	1,282,000	1,326,000	1,361,000	371,000	558,000	603,000
4- Network of Cities	1,300,000	1,296,000	1,192,000	234,000	843,000	636,000
5- Distributed State	1,221,000	1,240,000	1,125,000	211,000	763,000	940,000

Source: SGS Economics and Planning, 2022

4. Scenario 1: Compact City

4.1 Narrative



Under this scenario, climate change adaptation and mitigation are priorities for both government and society, and sustainability becomes a key theme in shaping urban form.

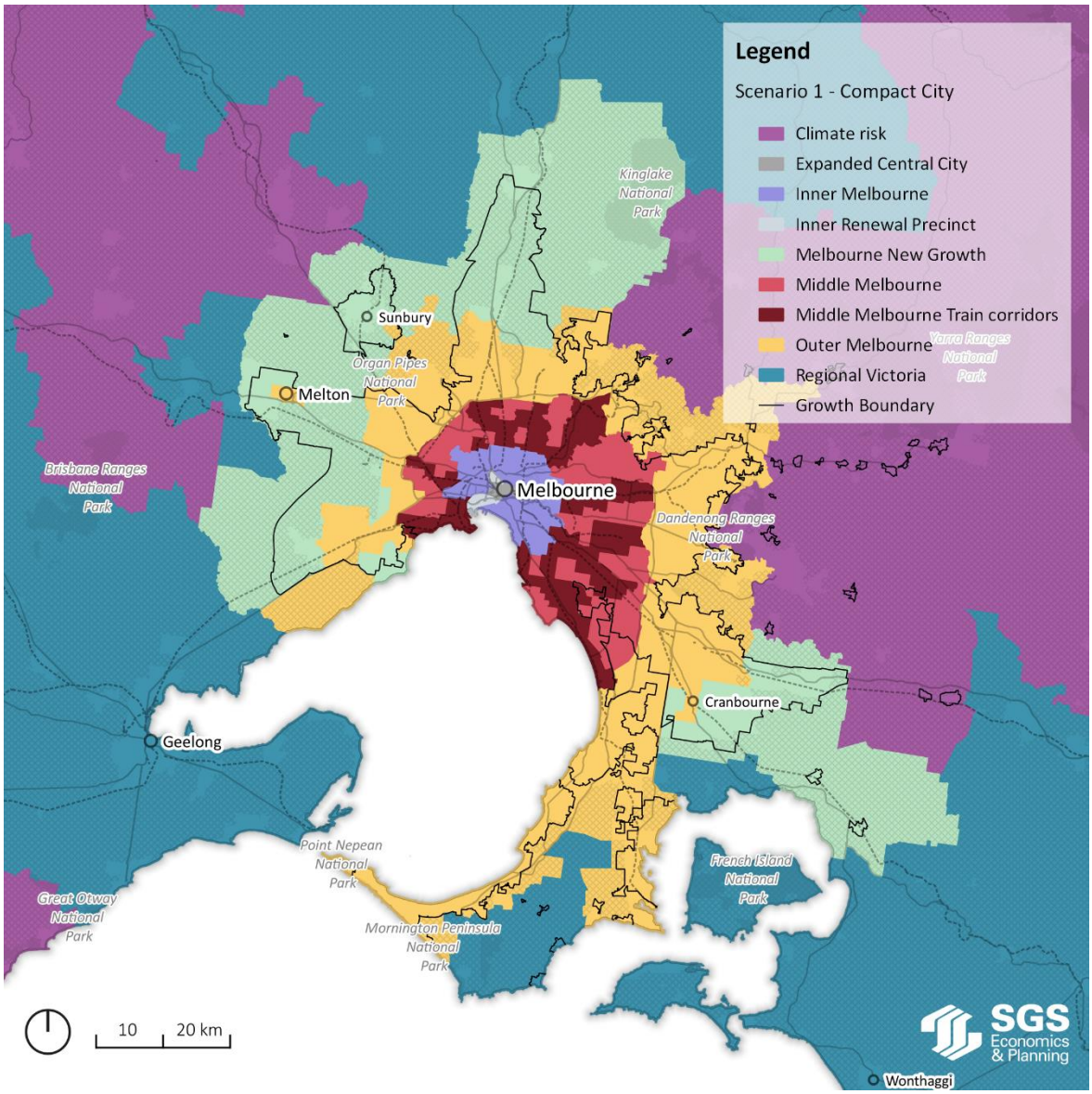
From 2031, new trends begin to play out in response to the effects of climate change, which constrain urban life through the 2020's. A shift in behaviours and policies leads to the adoption of a compact city structure to support sustainable city outcomes, such as a decline in car dependence. This leads population and employment growth to be consolidated in inner and middle Melbourne, supported by an injection of investment in the central city and inner suburbs of Melbourne through government-led infrastructure and policy incentives. Inner Melbourne experiences strong population growth as infill opportunities are realised and the central city is expanded, specifically into major urban renewal precincts. Regulation also supports the provision of family friendly medium and high-density affordable housing.

The consolidation of residential and employment growth in inner Melbourne reduces growth in outer Melbourne, Melbourne's new growth areas (greenfield development areas at Melbourne's fringe) and regional Victoria. In tandem, policies restrict development, and therefore population growth, in climate-risk areas. Remote working trends see people adopting hybrid working arrangements, which increases the effective total jobs capacity of the city and results in less competition for office space and lower rents. The hybrid nature of remote working means that firms and workers still desire physical agglomeration and connection to a central office location. Therefore, the central city, including Docklands, West Melbourne, East Melbourne and parts of Southbank, and the inner suburbs of Melbourne and surrounding urban renewal precincts continue to attract a large net inflow of workers, particularly those in knowledge-intensive industries.

Car dependency declines and focus is shifted to enabling active transport and public transit. Although electric and automated vehicle technology advances, people favour active and public transit in the face of supply chain issues and traffic congestion. The compact urban form reduces overall travel demand

and road space is reallocated to accommodate public and active transport. Residential and employment growth in inner and middle Melbourne, particularly along train corridors, is supported by investment in major public transport infrastructure such as Melbourne Metro One (MM1) and Two (MM2)

FIGURE 12: SCENARIO 1 (COMPACT CITY) CHANGE AREAS



Source: SGS Economics and Planning, 2022

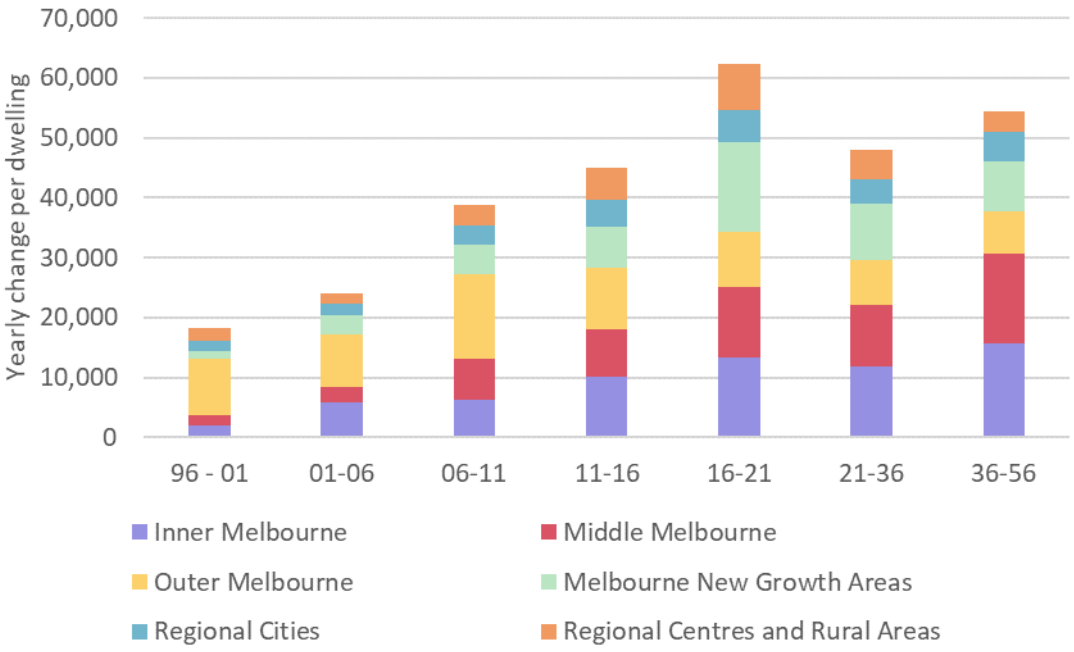
4.2 Detailed scenario outcomes

Population and dwellings

Figure 13 illustrates the expansion of inner Melbourne and the forecast growth under the Compact City scenario. Inner and middle Melbourne grow at an accelerating rate as the urban structure of the city

shifts to a compact form. In contrast, development in outer Melbourne and Melbourne's new growth areas slows as government and society reject the pattern of urban expansion that was prominent between 2016 and 2021. Between 2036 and 2056, annual dwelling growth in inner Melbourne reaches 16,000, surpassing the growth experienced in Melbourne new growth areas during its peak between 2016 and 2021 (14,900 annual dwellings).

FIGURE 13: DWELLING GROWTH BY FUA (S1)



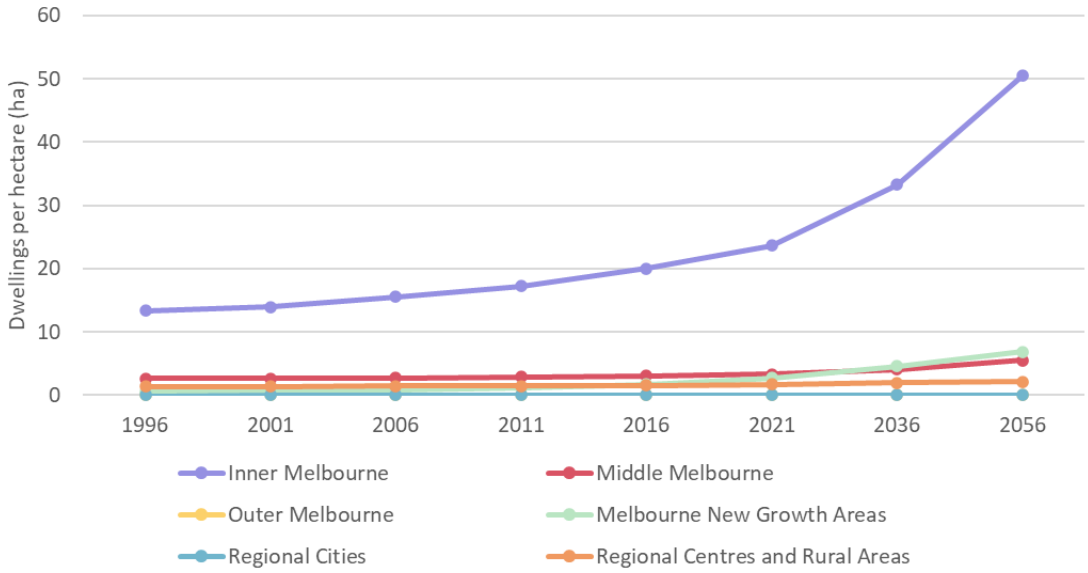
Source: SGS Economics and Planning, 2022

Residential density in inner Melbourne is forecast to increase significantly, as medium density dwellings are built to cater to young families. By 2056 inner Melbourne approaches a gross dwelling density of 51 dwellings/ha, over twice as high as the gross dwelling density in 2021 (see Figure 14)[15].

This increased density enables the city to embrace public and active transport. Residential density in middle Melbourne also rises, albeit to a lesser extent.

[15] Gross Dwelling Density refers to the Number of Dwellings per hectare, including all land available, not just residential, in the respective area

FIGURE 14: DWELLING DENSITY BY FUA (S1)

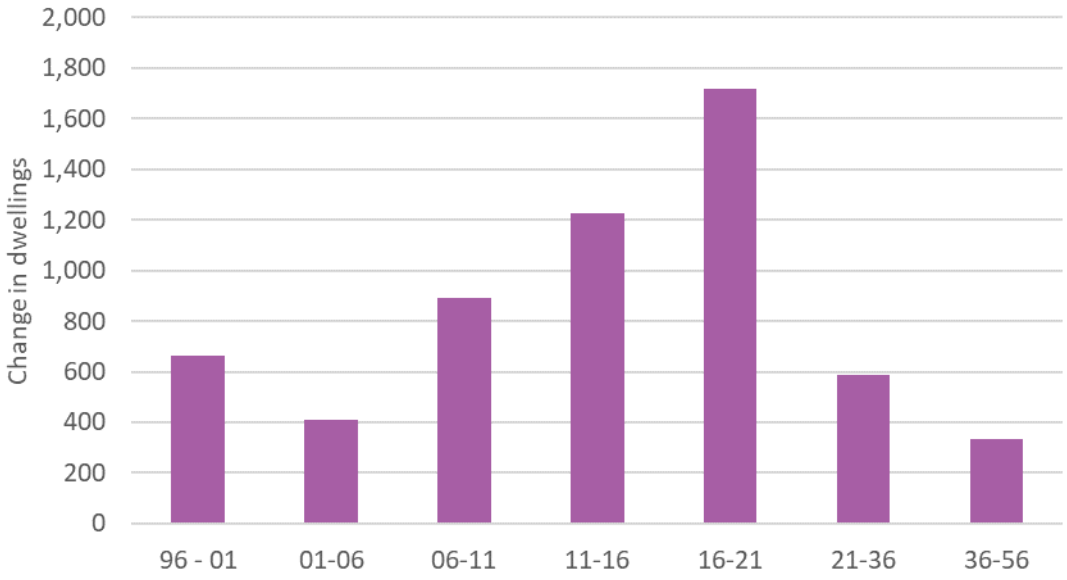


Source: SGS Economics and Planning, 2022

In line with the sustainable outcomes achieved by the compact urban form in this scenario, there is reduced development in climate risk areas.

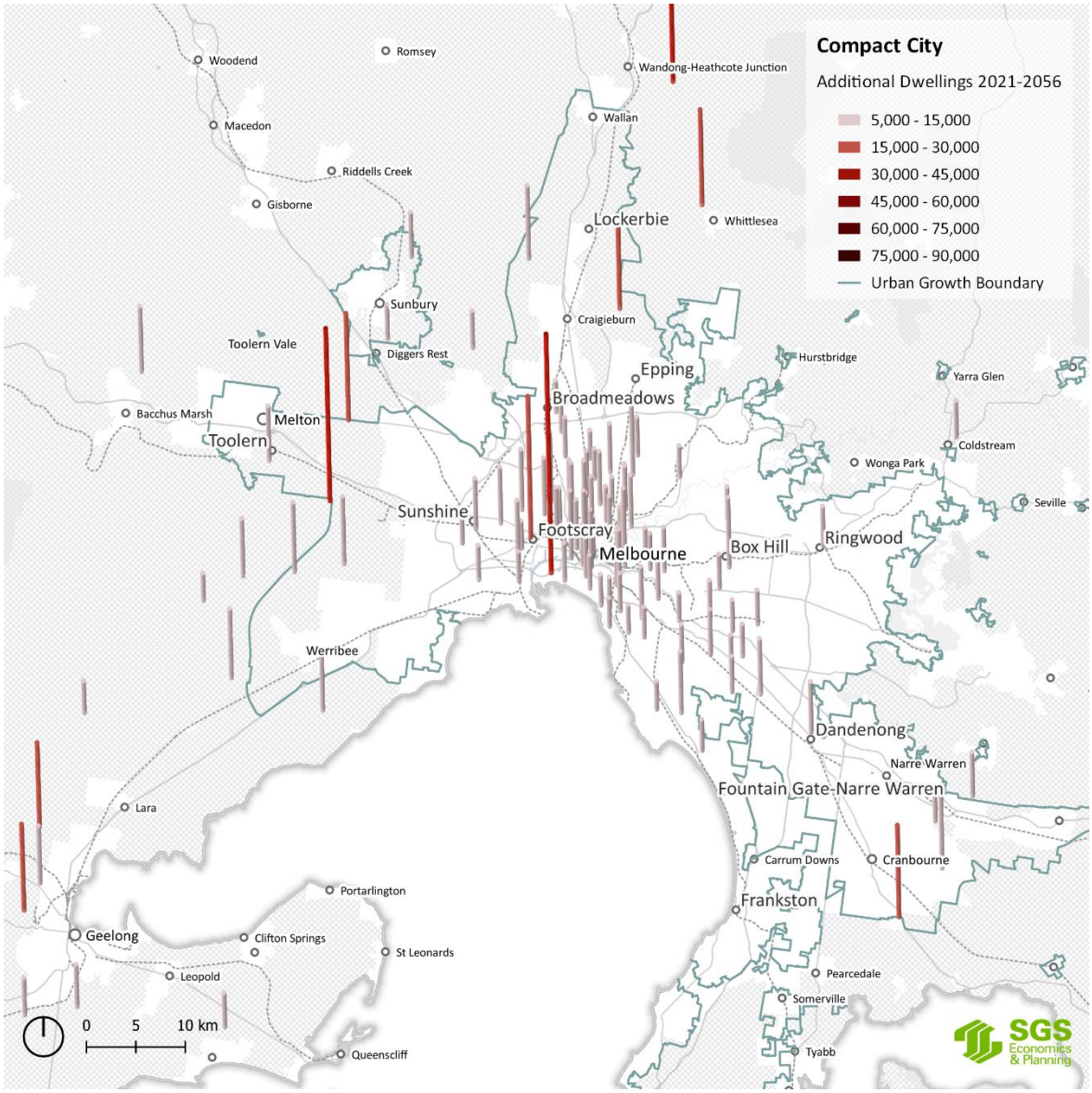
Annual dwelling growth in climate risk areas peaked between 2016 and 2021. In the Compact City scenario this is projected to decline to just over 300 annual dwellings between 2036 and 2056; around half of the growth realised in the previous period (see Figure 15). Figure 16 shows the spatial distribution of dwelling growth between 2021 and 2056.

FIGURE 15: DWELLING GROWTH IN CLIMATE RISK AREAS (S1)



Source: SGS Economics and Planning, 2022

FIGURE 16: DWELING GROWTH BY SA2, 2021-2056 (S1)



Source: SGS Economics and Planning, 2022.

Employment

Government investment in public transport has a strong impact on employment growth within inner and middle Melbourne. Greater accessibility to the city centre fuels economic agglomeration, particularly for knowledge-intensive industries such as business and government services (see Figure 17). Further, residents locating closer to the city centre also induce demand for population-serving employment within inner and middle Melbourne, such as retail and hospitality (see Figure 18).

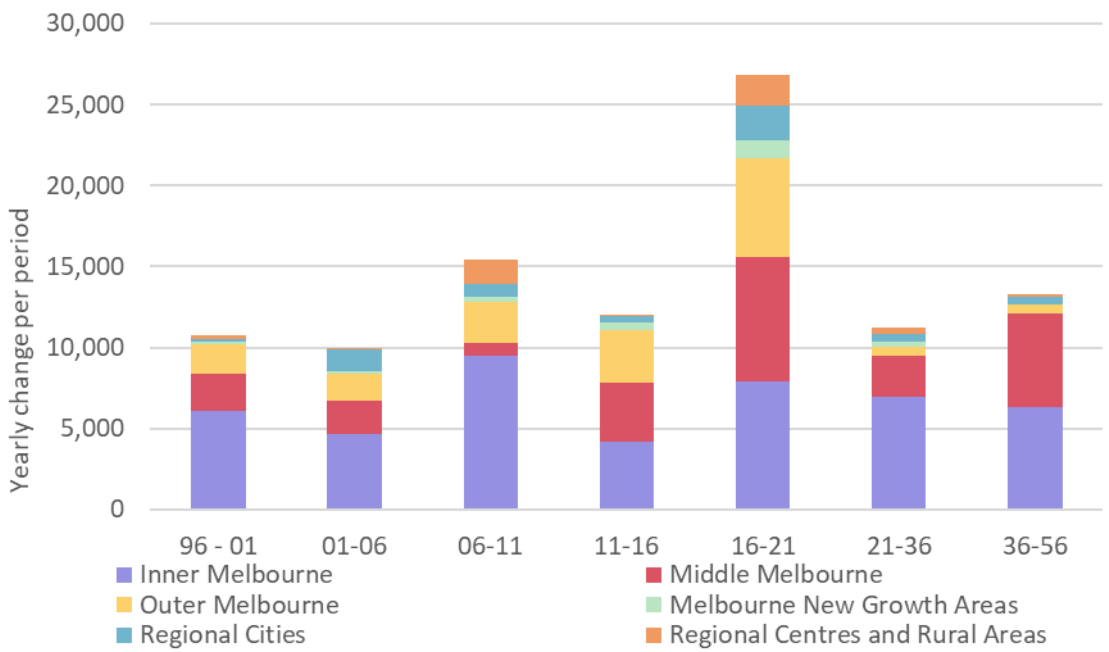
In contrast, outside of the city centre, employment growth slows considerably, being driven primarily by local demand for population-serving industries.

TABLE 6: TOTAL EMPLOYMENT GROWTH BY FUA (S1)

	2006-2021	2021-2036	2036-2056	Change 21-56	'06-21 CAGR	'21-56 CAGR
Inner Melbourne	257,000	333,000	398,000	731,000	2.1%	1.6%
Middle Melbourne	197,000	193,000	496,000	689,000	1.9%	1.8%
Outer Melbourne	291,000	177,000	142,000	319,000	2.9%	0.9%
Melbourne New Growth Areas	70,000	65,000	26,000	91,000	7.1%	1.7%
Regional City	80,000	57,000	55,000	112,000	1.7%	0.8%
Regional Centres and Rural Areas	67,000	59,000	37,000	96,000	1.2%	0.6%

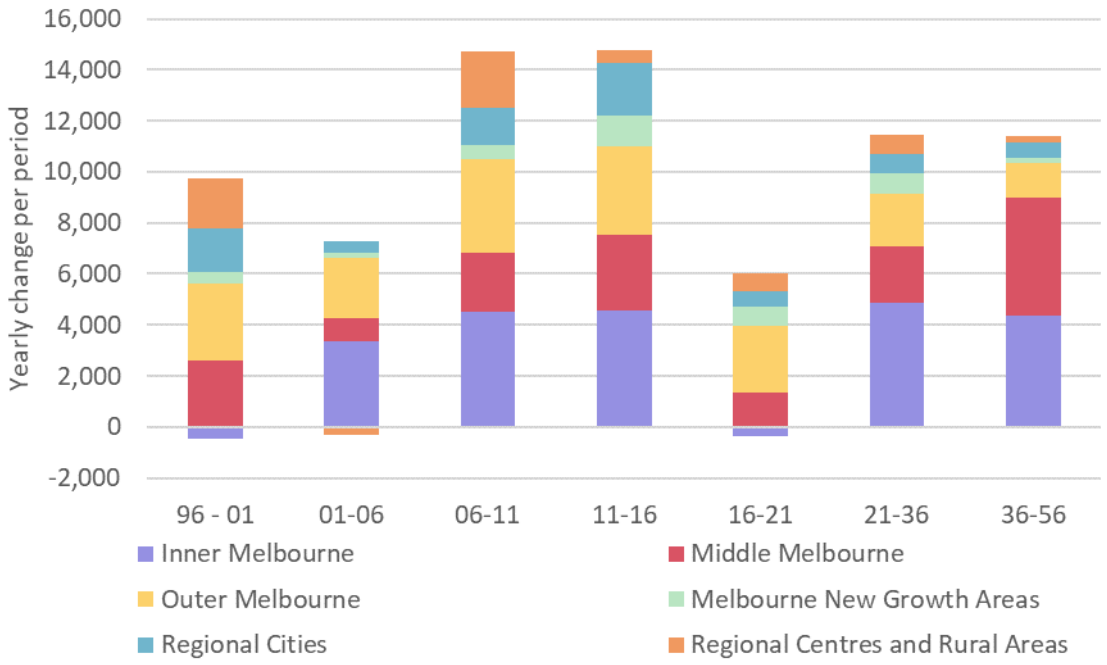
Source: SGS Economics and Planning, 2022.

FIGURE 17: BUSINESS & GOVERNMENT SERVICES GROWTH BY FUA (S1)



Source: SGS Economics and Planning, 2022

FIGURE 18: RETAIL AND HOSPITALITY GROWTH BY FUA (S1)

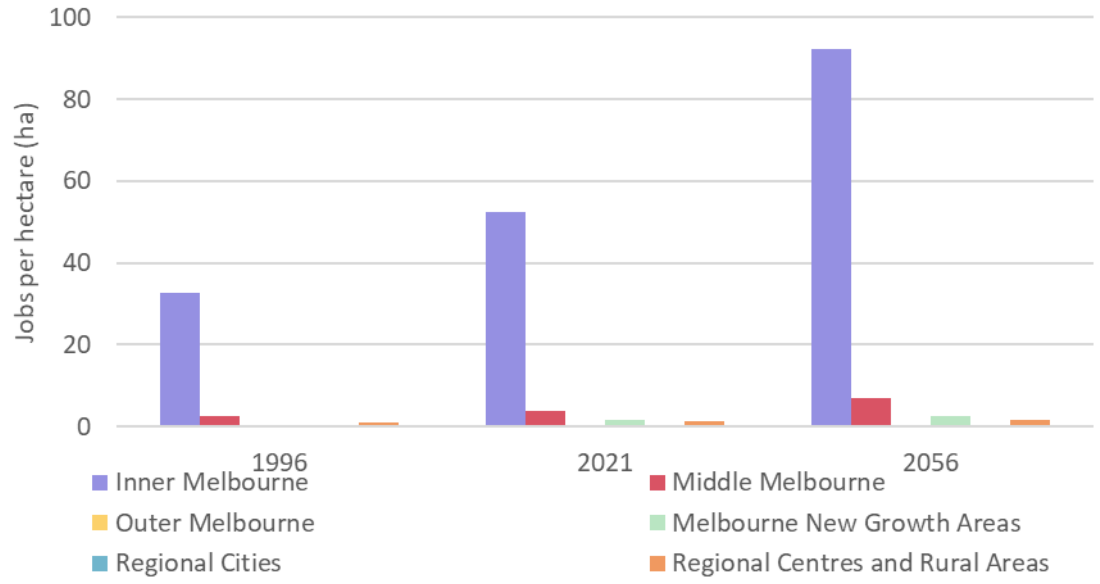


Source: SGS Economics and Planning, 2022

Like dwelling density, job density within inner and middle Melbourne rises sharply, leveraging the agglomeration economies that arise from concentrated employment within a city centre. Floorspace usage within the city centre is assumed to be more efficient due to the widespread availability of technology and flexible working practices. However, workers are still assumed to travel to an office on a few days each week. By 2056, inner Melbourne reaches a gross job density of approximately 92 jobs/ha, nearly double that of 2021 (52 jobs/ha).

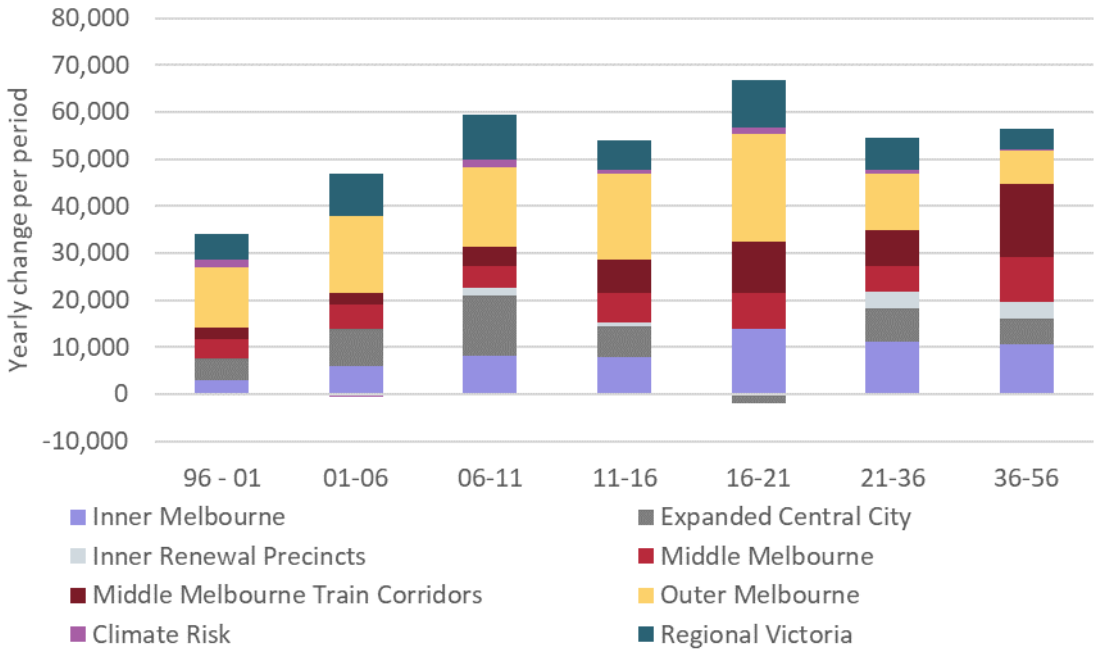
At a change area level (see Figure 12 and Figure 20), inner Melbourne will add over 10,000 jobs per annum, (continuing levels of growth seen in recent years from 2016-2021) while middle Melbourne train corridors attract close to 15,000 additional jobs per annum as more public transport comes online, leading to higher-density office developments. Inner renewal precincts, such as Fisherman's Bend and Arden, also see strong employment growth in line with the city becoming more compact. Conversely, employment growth across outer Melbourne, new growth areas and climate-affected change areas is only incremental. Figure 21 reflects this spatial distribution of job growth at an SA2 level.

FIGURE 19: JOB DENSITY BY FUA (S1)



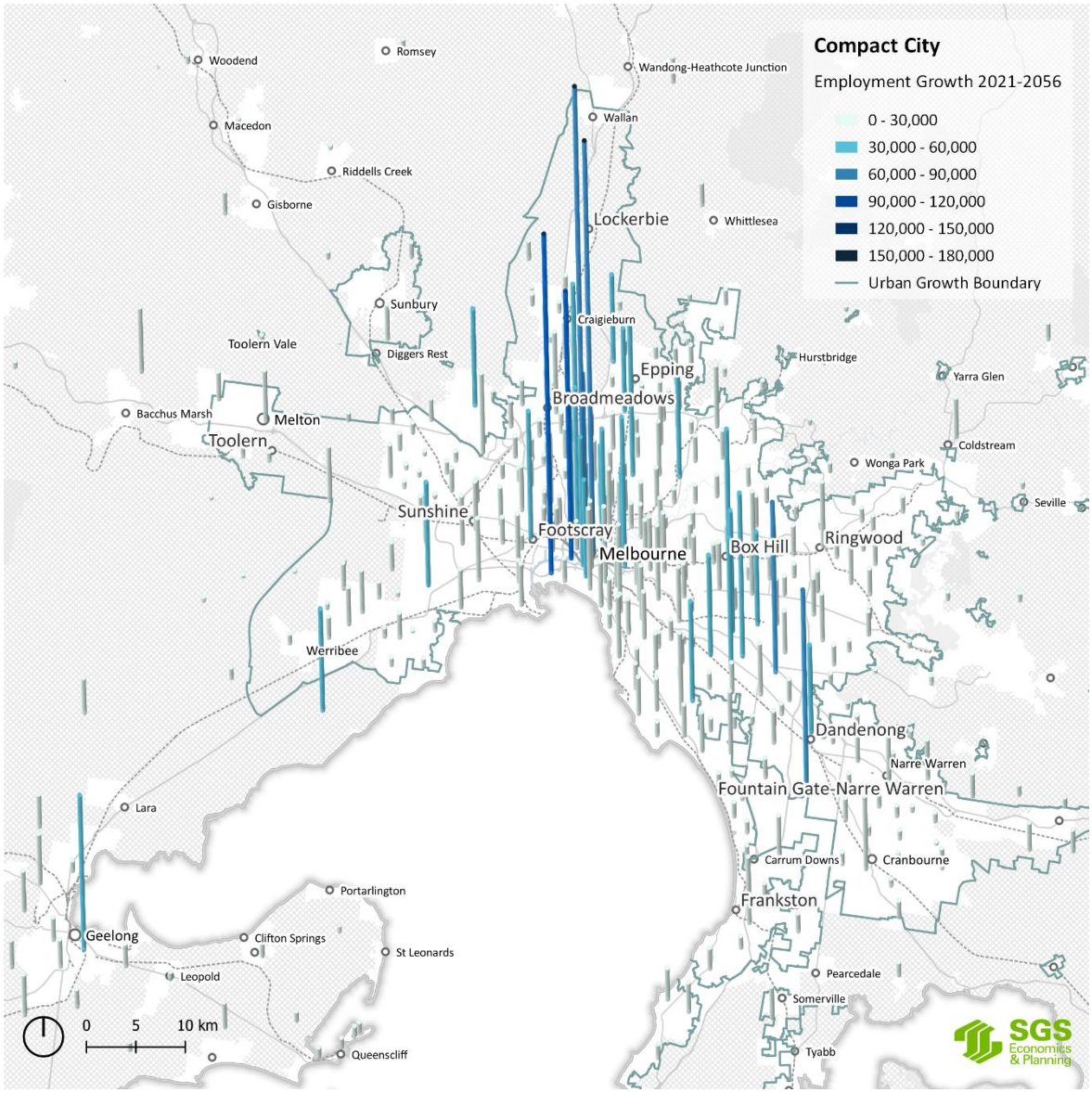
Source: SGS Economics and Planning, 2022

FIGURE 20: ANNUAL JOB GROWTH BY CHANGE AREA (S1)



Source: SGS Economics and Planning, 2022.

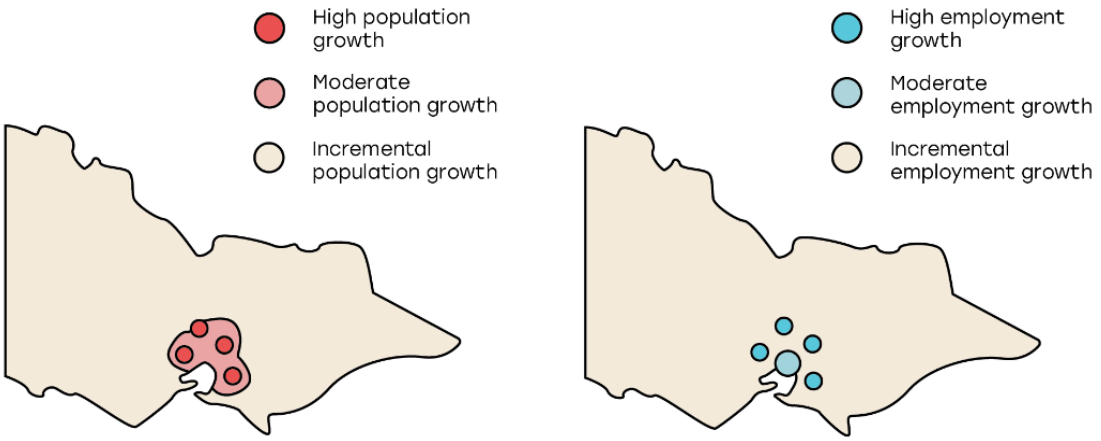
FIGURE 21: JOBS GROWTH BY SA2, 2021-2056 (S1)



Source: SGS Economics and Planning, 2022.

5. Scenario 2: Consolidated City

5.1 Narrative



Under this scenario, climate change is a key concern for government and society, and sustainability motivates decisions about how and where people live. The Consolidated City scenario balances the spatial distribution of population and job growth to form a city which delivers equitable and environmentally sustainable outcomes. A combination of government investment and policy, coupled with changing living and working preferences, mean that a polycentric city (or Consolidated City), with multiple high-density precincts, is realised.

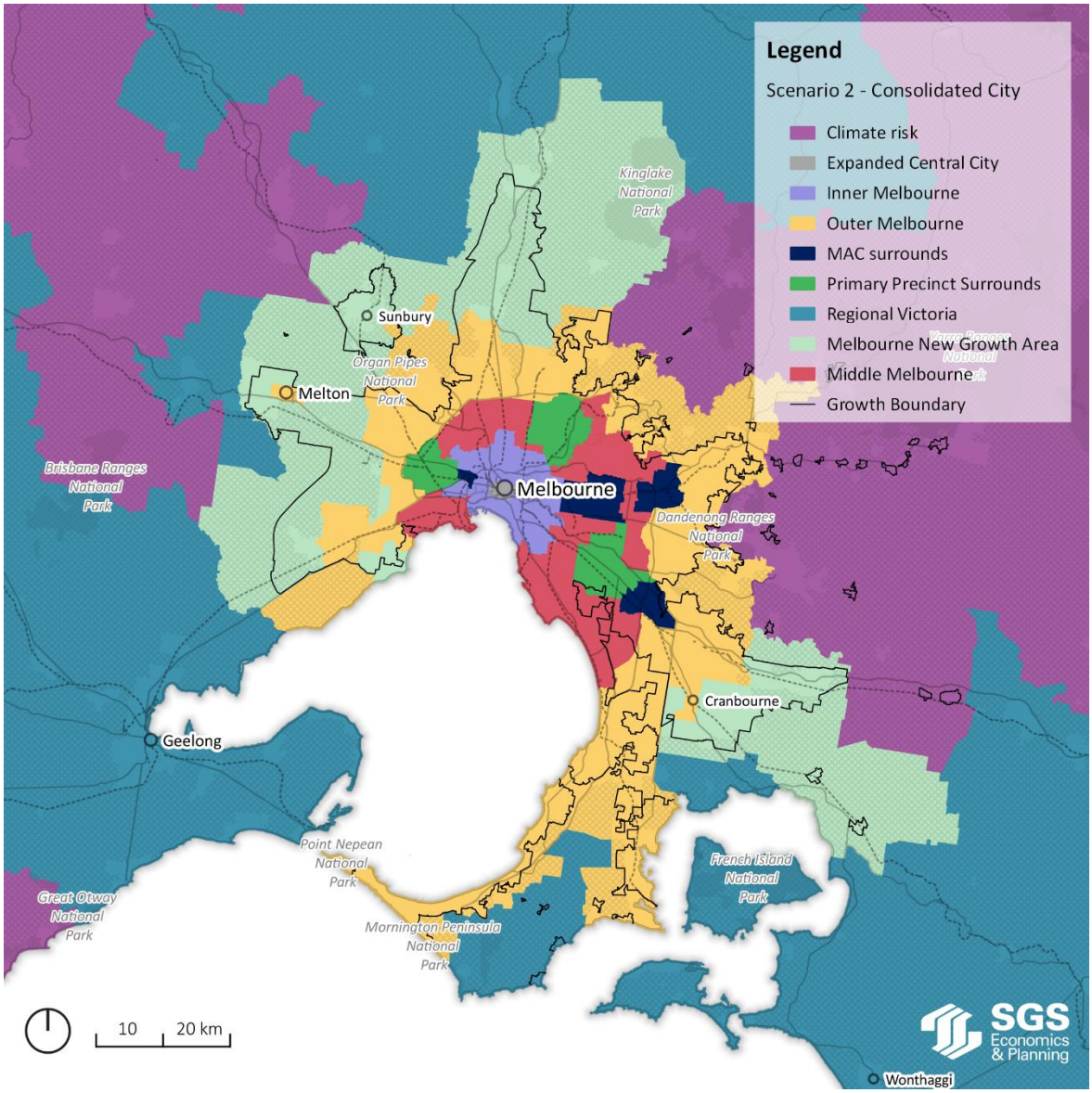
Supported by tax incentives and Government action in delivering medium and high-density affordable housing, urban development is consolidated in major precincts. These *primary growth precincts* of Monash, Heidelberg/Latrobe and Sunshine, which rapidly grow in both population and employment. Moderate growth in *secondary growth precincts*, including Dandenong, Box Hill, Ringwood and Footscray is also a feature of this scenario. The remainder of Melbourne and regional Victoria accommodates limited population growth, and Government-led climate adaptation restricts development in climate-risk areas.

The primary growth precincts develop sectoral specialities, attracting employment that would otherwise have been dispersed or in central Melbourne. Healthcare and education jobs are prominent in all primary growth precincts, with business and government service jobs locating in Monash, Heidelberg, and Sunshine.

The primary growth precincts function as small-scale CBDs, providing accessible jobs, healthcare, and education. With lower commuting time and reduced travel demand, a 30-minute city aspiration is realised, increasing accessibility to jobs and infrastructure for all residents in Melbourne. Accessibility between precincts is achieved through the completion of mass public transit projects such as the Suburban Rail Loop (SRL)

Central Melbourne continues to function as an important centre, with mass public transit again providing connectivity between central Melbourne and the primary growth precincts.

FIGURE 22: SCENARIO 2 (CONSOLIDATED CITY) CHANGE AREAS



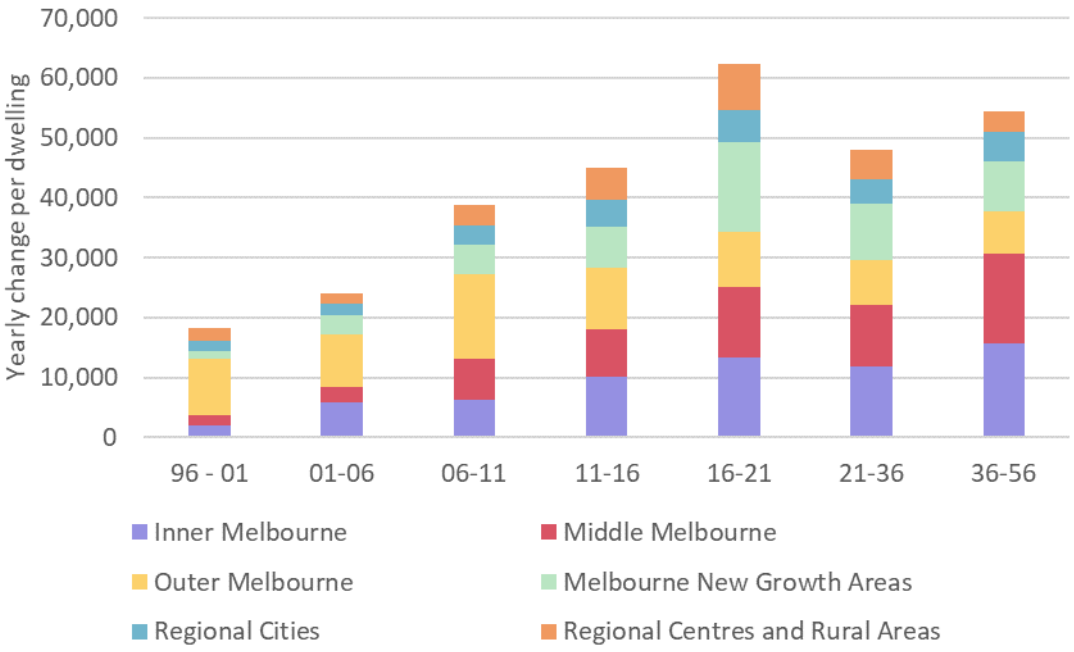
Source: SGS Economics and Planning, 2022

5.2 Detailed scenario outcomes

Population and dwellings

Figure 23 presents yearly dwelling growth by FUA and the trends that shape urban development under this scenario. Development accelerates in middle Melbourne, with growth of 9,000 dwellings annually between 2021-36 and 15,500 between 2036-56. Outer Melbourne, which contains the Dandenong and Ringwood MAC and surrounds, accelerates in development to accommodate 9,000 additional dwellings per year between 2021 and 2056.

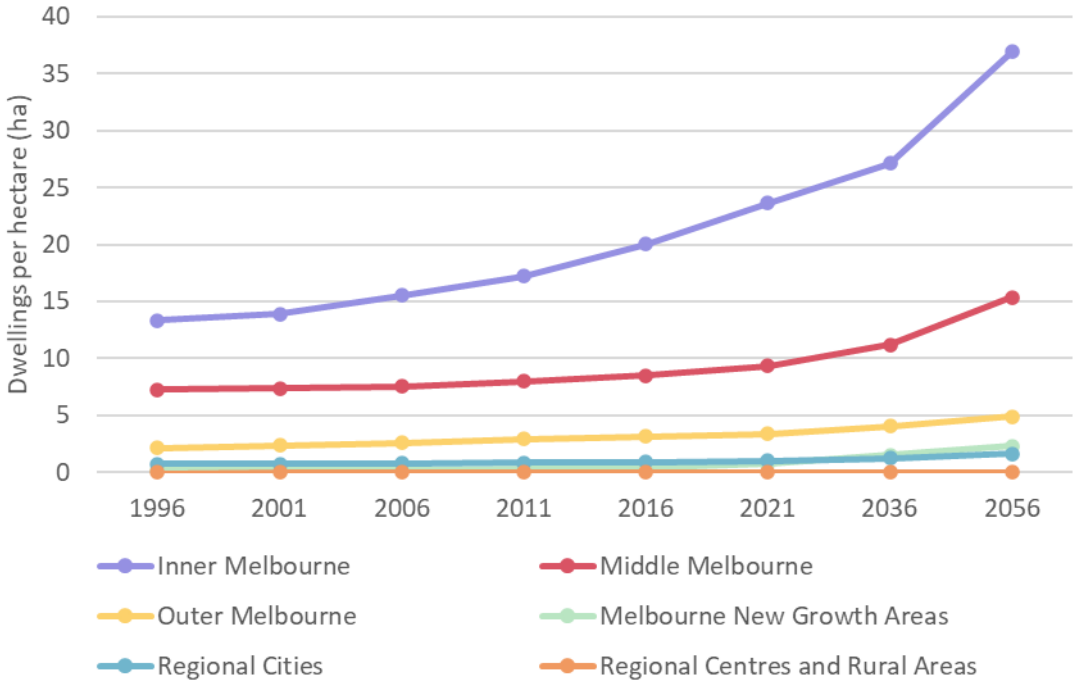
FIGURE 23: DWELLING GROWTH BY FUA (S2)



Source: SGS Economics and Planning, 2022

The concentration of development occurs in multiple high-density precincts that emerge in middle Melbourne in the mid-2020s. By 2056, middle Melbourne approaches a gross dwelling density of 15 dwellings/ha, similar to inner Melbourne in 2006 (see Figure 24). Government-led affordable housing initiatives enables an increase of high-density housing in these precincts.

FIGURE 24: DWELLING DENSITY BY FUA (S2)



Source: SGS Economics and Planning, 2022

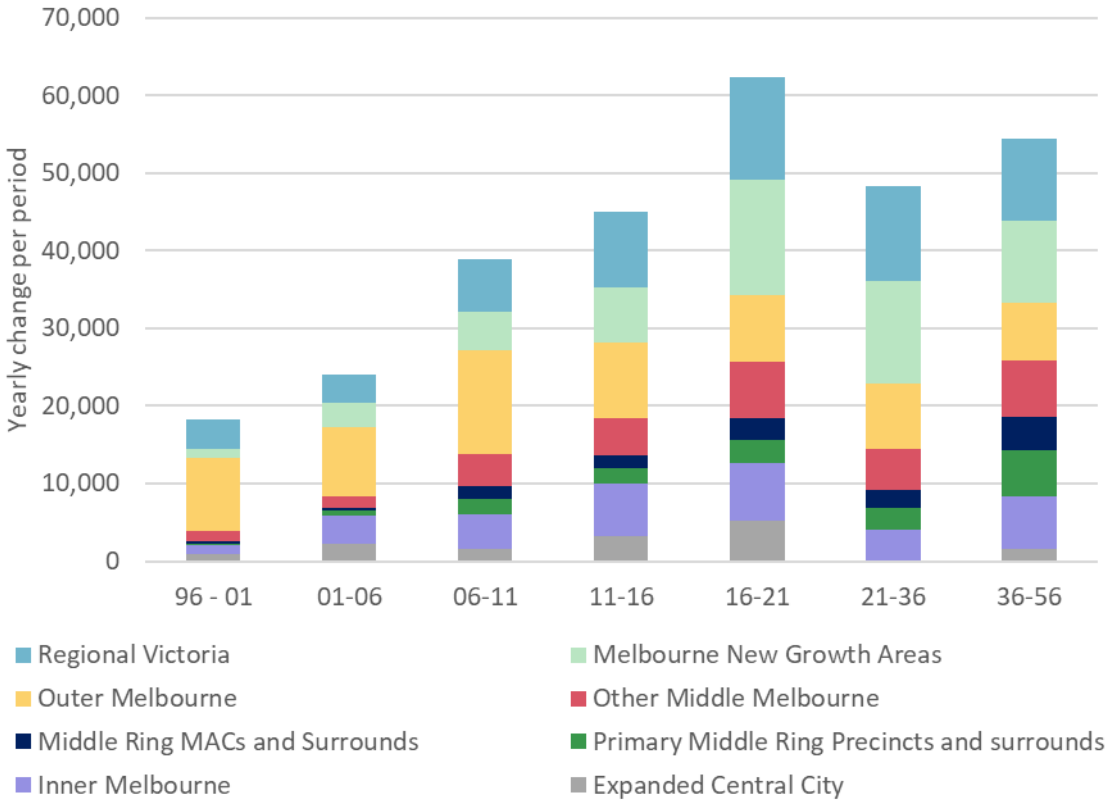
Figure 25 presents dwelling growth across change areas. In line with the environmental sustainability priorities that underpin this scenario, development in climate risk areas declines significantly after 2036. Between 2016 and 2021 the growth of dwellings in climate risk areas peaked at over 1,700 annually but began to decline in 2021 and is forecast to drop to 600 annually between 2036 and 2056.

Public transport projects have a catalytic impact, such as SRL, which supports development in urban renewal precincts in middle Melbourne between 2036 and 2056. The concentration of development in middle Melbourne is reflected in the growth of three primary middle ring growth precincts (Sunshine, Monash/Clayton and Heidelberg/Latrobe) and four middle ring MACs (Box Hill, Footscray, Dandenong and Ringwood).

In this scenario, the highest rates of growth take place in the three middle ring growth precincts, followed by the MACs. Increased growth also occurs in the SA2s surrounding each centre. For centres which will contain an SRL station (Clayton, Monash, Box Hill and Heidelberg), the population and employment in each SA2 has been adjusted to match the employment targets in the SRL Business Case. This growth is spread across multiple SA2s within around 1,600m of each SRL station.

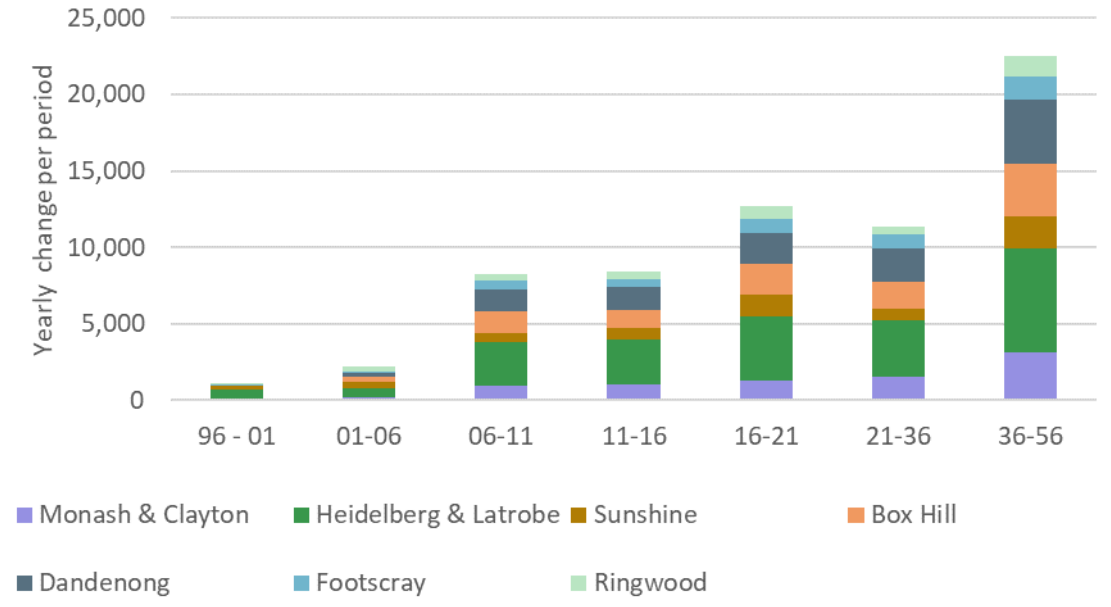
Population growth levels in each centre is shown in the figure below. Selected SA2s around each centre with high levels of growth are also included within the centre heading (for example, the Box Hill category in the figure includes most of the SA2s bordering Box Hill) as shown in Figure 22 around the MAC areas.

FIGURE 25: YEARLY DWELLING GROWTH BY CHANGE AREA (S2)



Source: SGS Economics and Planning, 2022

FIGURE 26: DWELLING GROWTH IN EACH MAJOR MIDDLE RING GROWTH CENTRE AND SURROUNDS (S2)

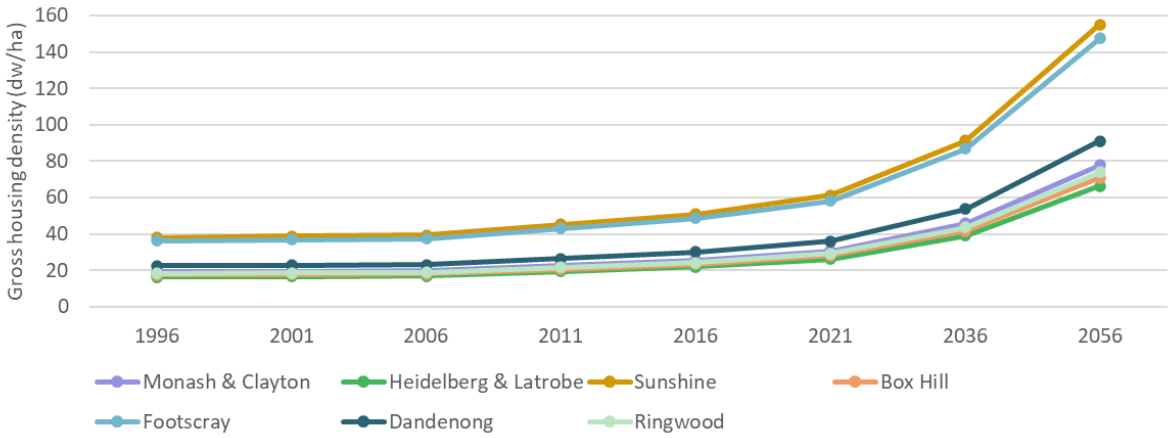


Source: SGS Economics and Planning, 2022

Development rates accelerate in these precincts in 2021-36 and 2036-56. Between 2036-56, approximately 3,100 dwellings per annum are delivered in Monash & Clayton, 3,400 in Box Hill, 6,800 in Heidelberg & Latrobe, and 2,100 in Sunshine (including the SA2s around these centres and precincts).

Figure 27 shows housing density in the core SA2s within these centres and precincts only. In all cases, density is expected to rise substantially. Density is likely to be higher than the quoted figures in parts of the SA2s, given that only some areas within the centres will be developed. Footscray and Sunshine have significant density increases post-2036. Heidelberg & Latrobe is spread over a comparatively large area comprising three SA2s, and so only achieves modest densities despite being a primary development precinct. Monash and Clayton experience stronger growth in the post-2036 period which is supported by improved public transport accessibility.

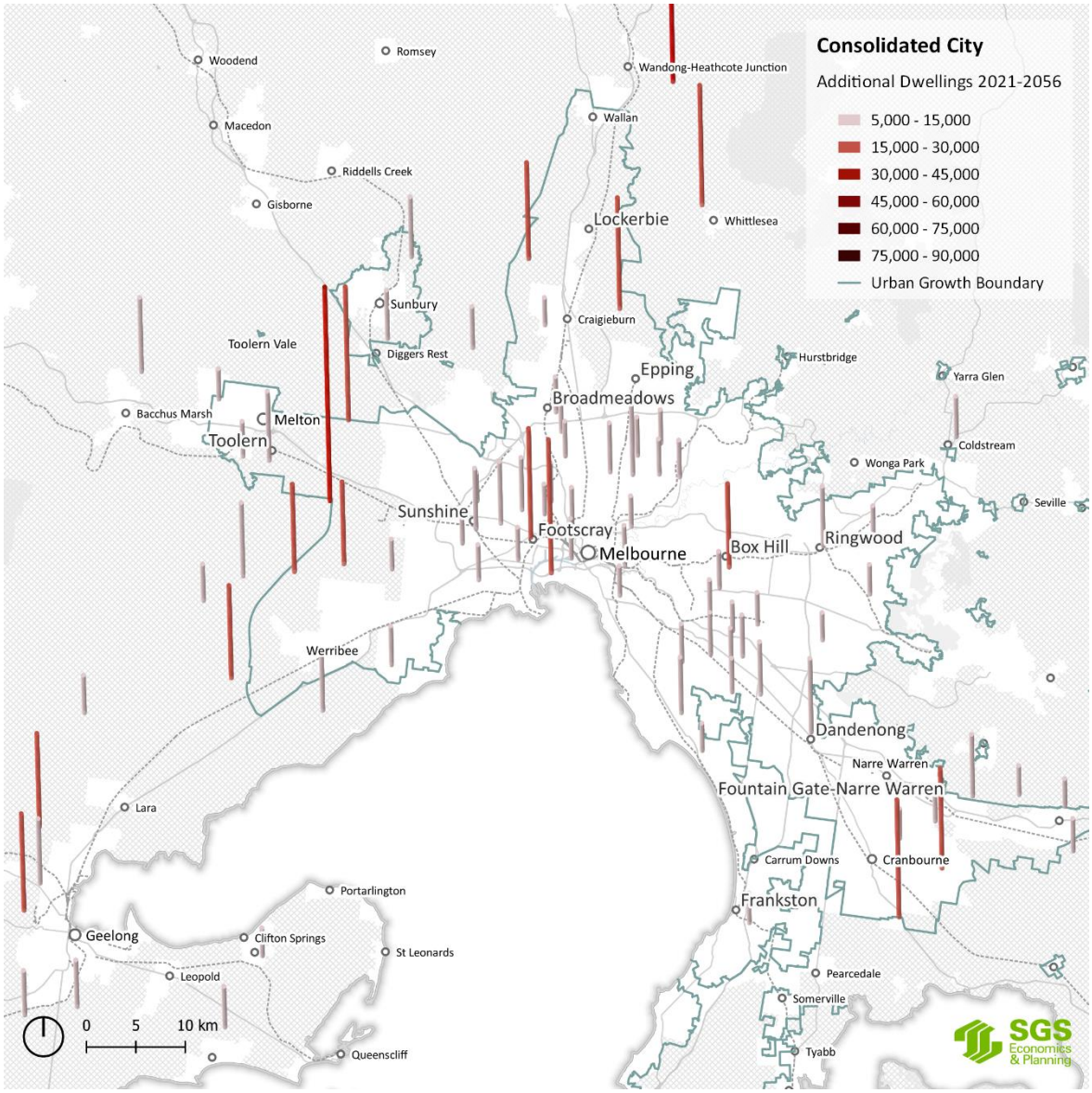
FIGURE 27: DWELLING DENSITY IN EACH MAJOR MIDDLE RING GROWTH CENTRE AND SURROUNDS (S2)



Source: SGS Economics and Planning, 2022

The spatial distribution of growth can be seen in Figure 28. This illustrates the geographical shift in development as growth in the expanded central city declines significantly after 2021 towards the middle ring precincts and MACs.

FIGURE 28: DWELING GROWTH BY SA2, 2021-2056 (S2)



Source: SGS Economics and Planning, 2022

Employment

Middle Melbourne precincts emerge as employment hubs in this scenario. Table 7 shows that the growth rate of employment in middle Melbourne increases post-2021, with an annual growth rate of 2.1 per cent between 2021 and 2056. Conversely, all other FUAs grow at a slower rate than their historical averages.

By 2056, middle Melbourne approaches an employment density of 15 jobs/ha, compared to 9 jobs/ha in 2021. In inner Melbourne, employment density continues to increase and reaches 37 jobs/ha in 2056, an increase from 24 jobs/ha in 2021.

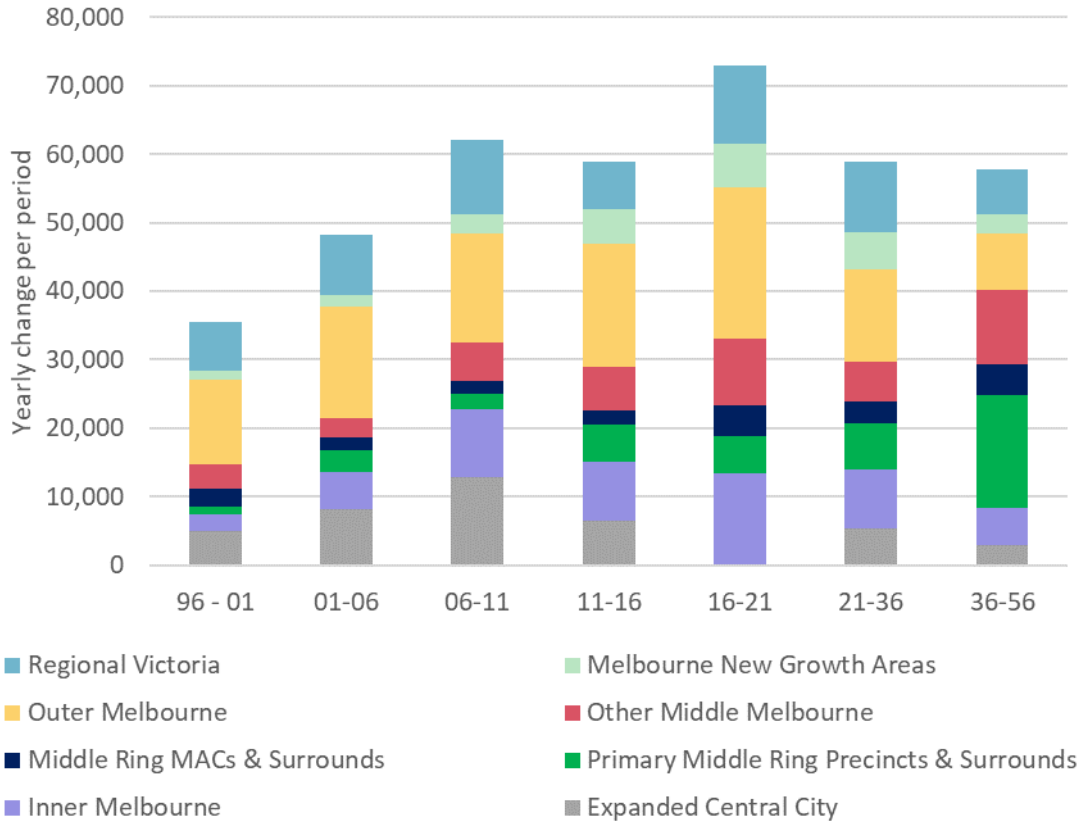
TABLE 7: TOTAL EMPLOYMENT GROWTH BY FUA (S2)

	2006-2021	2021-2036	2036-2056	Change 21-56	'06-21 CAGR	'21-56 CAGR
Inner Melbourne	257,000	218,000	177,000	395,000	2.1%	1.0%
Middle Melbourne	197,000	215,000	605,000	820,000	1.9%	2.1%
Outer Melbourne	291,000	215,000	186,000	401,000	2.9%	1.1%
Melbourne New Growth Areas	70,000	81,000	54,000	135,000	7.1%	2.3%
Regional City	80,000	74,000	74,000	148,000	1.7%	1.0%
Regional Centres and Rural Areas	67,000	81,000	57,000	138,000	1.2%	0.8%

Source: SGS Economics and Planning, 2022.

Figure 29 demonstrates the pattern of employment growth in the change areas under this scenario. The forecast shows that between 2036 and 2056, employment growth is shifting from inner Melbourne and outer Melbourne towards the primary middle ring precincts and other middle Melbourne.

FIGURE 29: EMPLOYMENT GROWTH BY CHANGE AREA (S2)

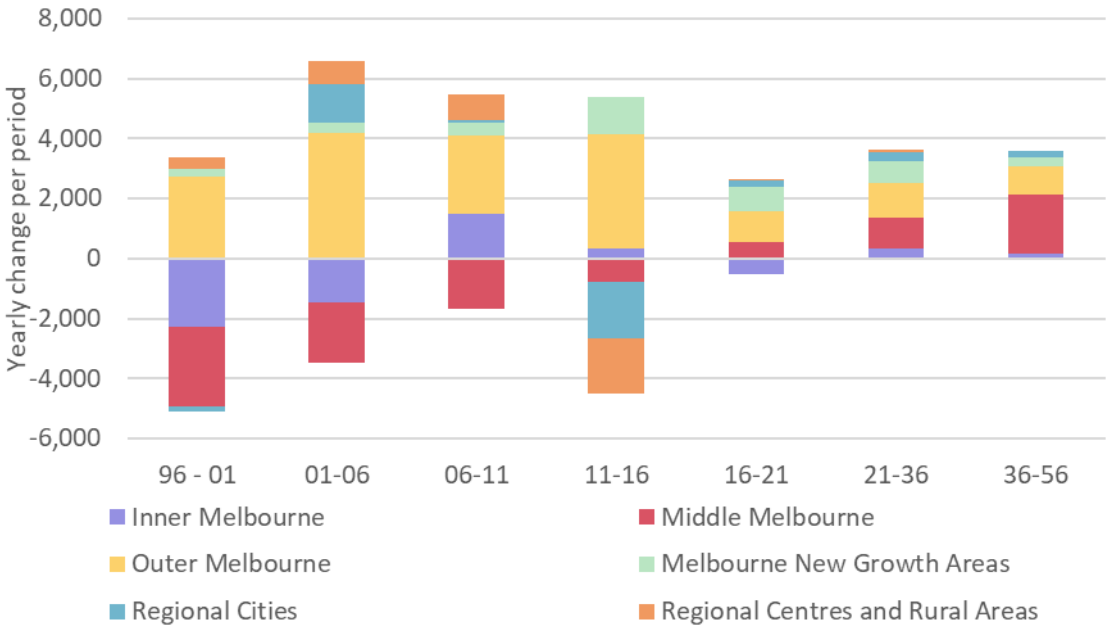


Source: SGS Economics and Planning, 2022

As Victoria transitioned from a post-industrial economy to a knowledge economy, employment growth in traditional industry declined. In circumstances where Victoria's traditional industry survived the effects of offshored manufacturing and globalisation, employment in the sector was historically concentrated in outer Melbourne.

Figure 30 shows that under this scenario, employment in traditional industry is forecast to increase in middle Melbourne. However, traditional industry does not reflect the labour-intensive manufacturing industry that helped shape Melbourne in the 19th century. Instead it reflects the knowledge-intensive advanced manufacturing sector to come from Industry 4.0 which benefits from locating proximate to centres of employment. Advanced manufacturing includes the production of clean energy technology. Spatially, this allows for more streamlined factories with fewer low-skilled workers and therefore firms can afford to take up a more central location and move to middle Melbourne.

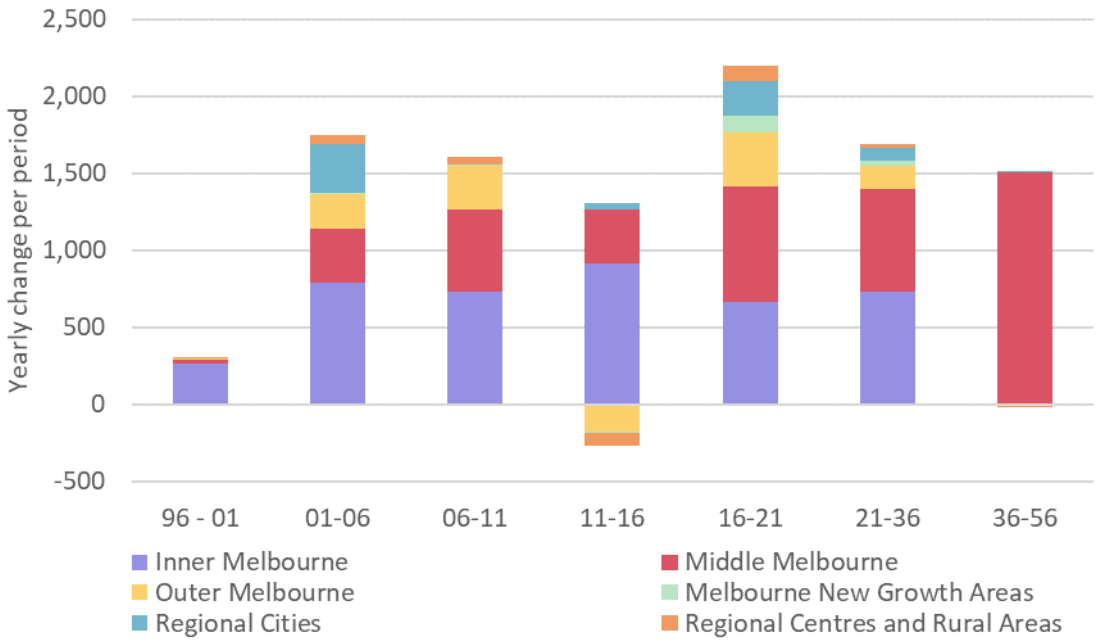
FIGURE 30: ANNUAL GROWTH IN TRADITIONAL INDUSTRY EMPLOYMENT BY FUA (S2)



Source: SGS Economics and Planning, 2022

Victoria's tertiary education sector has historically been dominant in Melbourne and its surrounding suburbs. Figure 31 shows the annual growth of employment in the sector for this scenario. Between 2011 and 2016, employment in the sector was focused in inner Melbourne, with negative growth registered in outer Melbourne and regional centres. This could be attributed to a rise in registered training organisations serving the metropolitan population. However, between 2036 and 2056 employment in tertiary education is consolidated in middle Melbourne in the primary middle ring precincts.

FIGURE 31: ANNUAL GROWTH IN TERTIARY EDUCATION EMPLOYMENT BY FUA (S2)



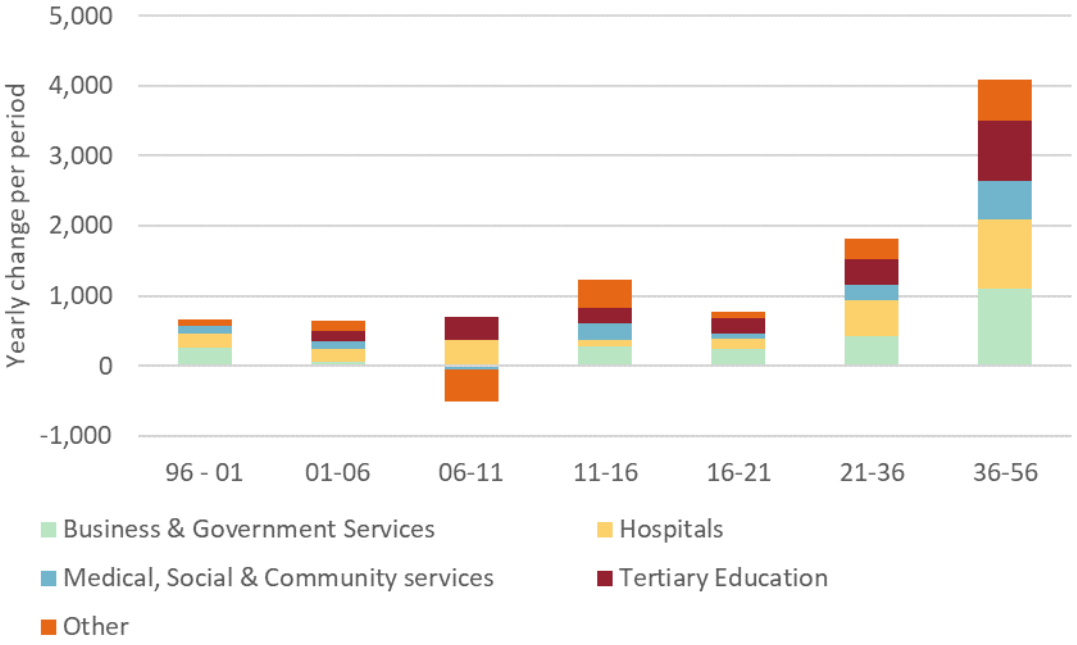
Source: SGS Economics and Planning, 2022

Figure 32, Figure 33, and Figure 34 show the employment growth forecasts, by industry, for each of the primary precincts. In the Monash precinct and Heidelberg & Latrobe precinct, employment growth intensifies between 2036 and 2056, driven primarily by business and government services, hospital employment, medical, social and community services, and tertiary education. The Sunshine precinct experiences less rapid growth which is more evenly distributed over and weighted more heavily towards retail and hospitality services.

The primary precincts established under this scenario increase in their employment self-containment over time, providing residents with local job opportunities and services in key sectors.

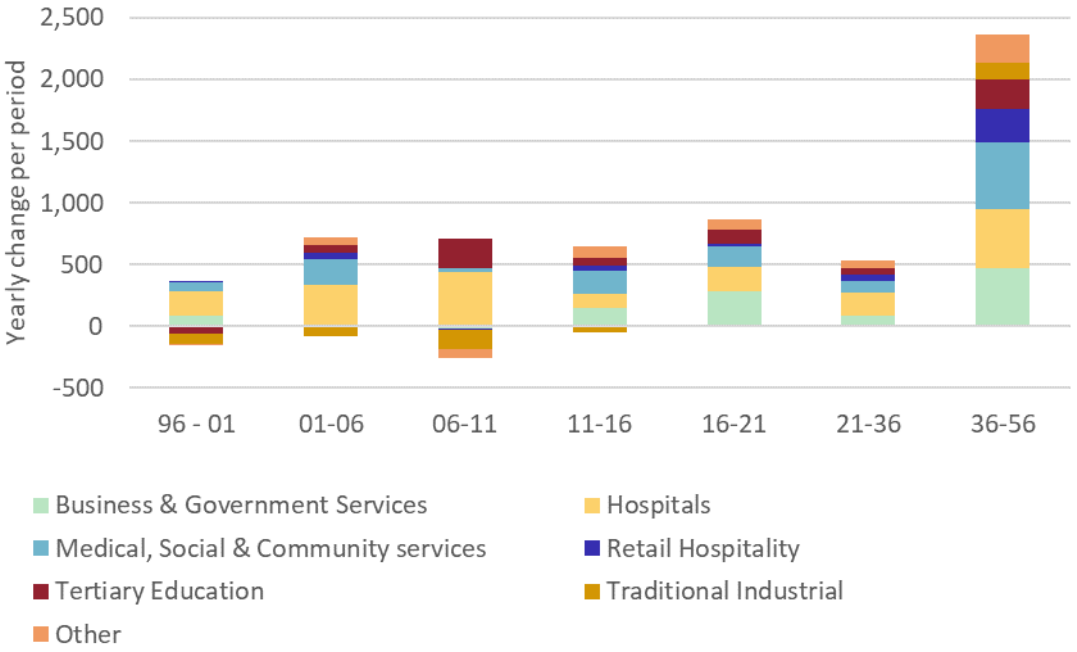
The spatial distribution of employment growth is represented in Figure 35. This map shows that while employment growth in the central city continues from 2021 to 2056, a far greater proportion (relative to the past and other scenarios) occurs in centres around middle Melbourne in 2056, including Monash, Sunshine, and Latrobe/Heidelberg.

FIGURE 32: ANNUAL EMPLOYMENT GROWTH PRIMARY PRECINCT - MONASH (S2)



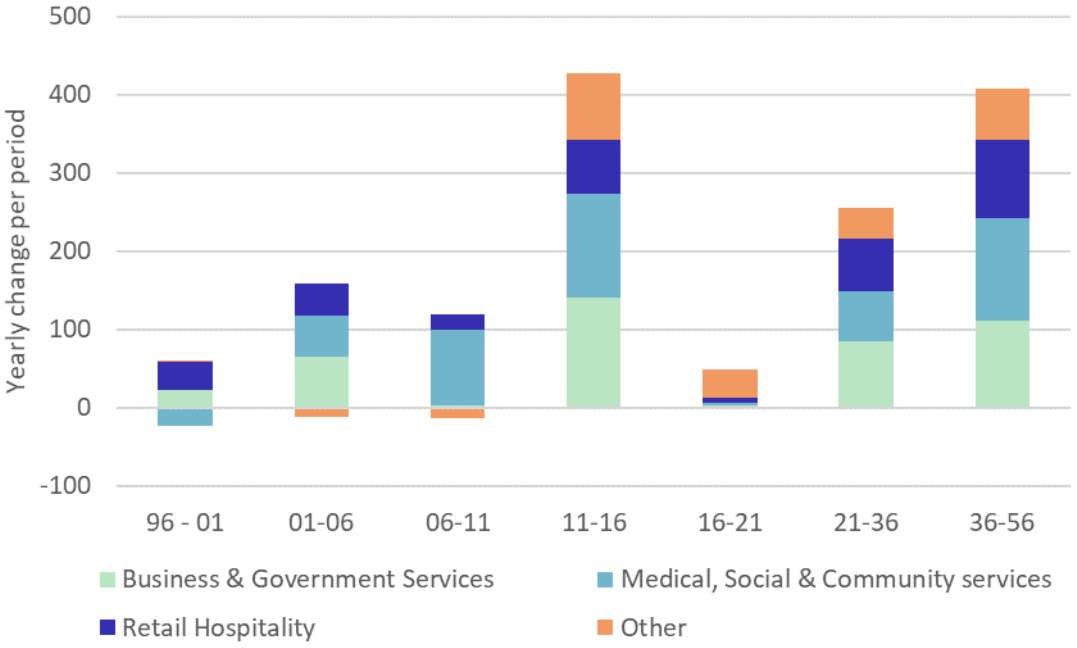
Source: SGS Economics and Planning, 2022

FIGURE 33: ANNUAL EMPLOYMENT GROWTH PRIMARY PRECINCT - HEIDELBERG & LATROBE (S2)



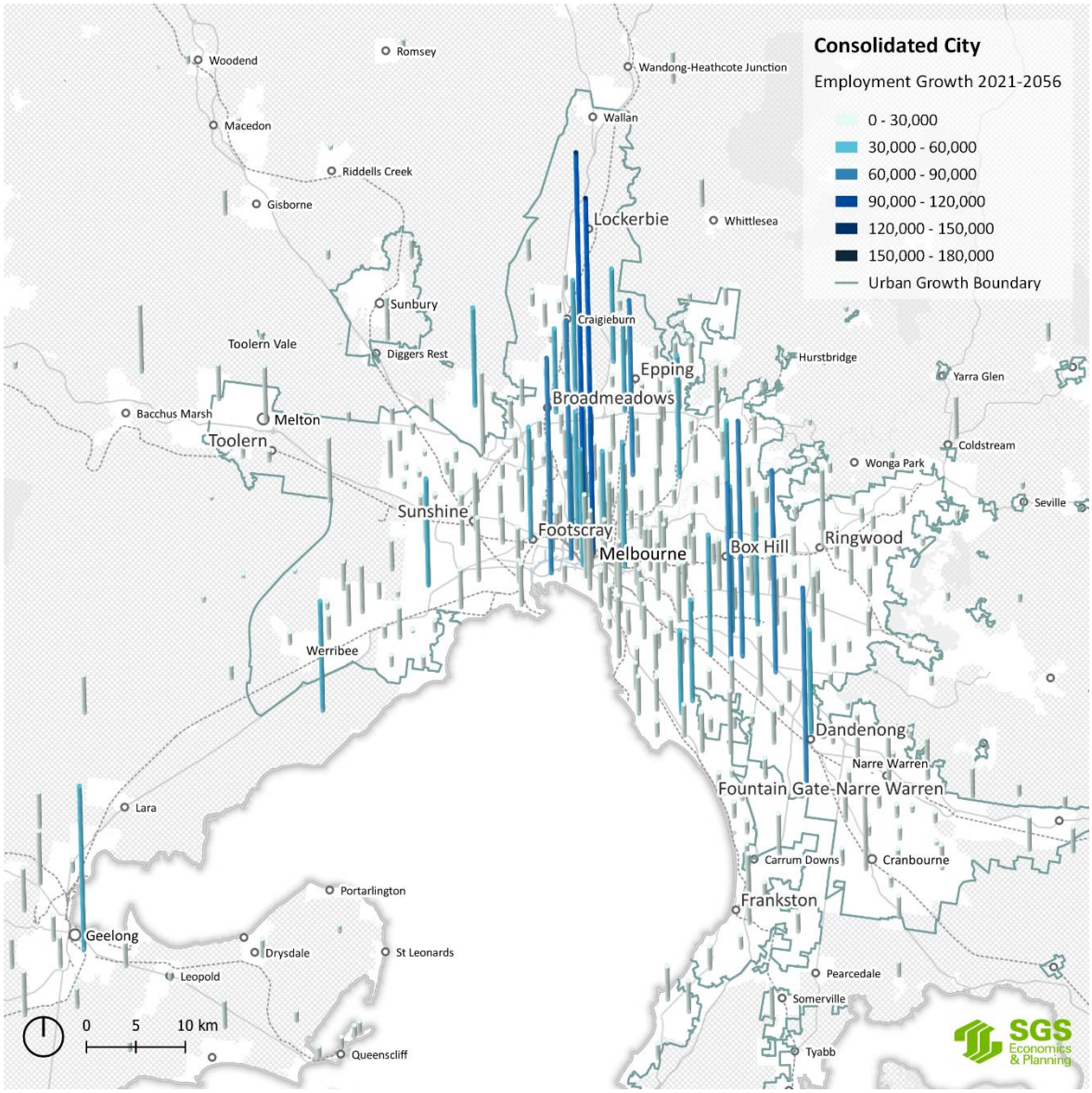
Source: SGS Economics and Planning, 2022

FIGURE 34: ANNUAL EMPLOYMENT GROWTH PRIMARY PRECINCT - SUNSHINE (S2)



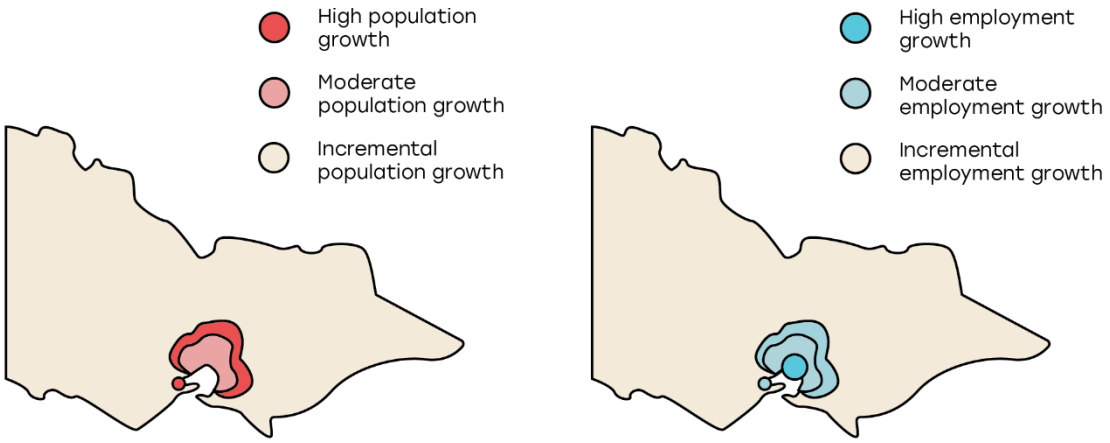
Source: SGS Economics and Planning, 2022

FIGURE 35: JOBS GROWTH BY SA2, 2021-2056 (S2)



6. Scenario 3: Dispersed City

6.1 Narrative



Under this scenario, Melbourne's urban footprint expands as population growth disperses across outer Melbourne, peri-urban areas, and new greenfield development areas. Inner and middle Melbourne's population grows only incrementally from the mid-2020s as residents are deterred by unaffordable housing and traffic congestion in the city. By the 2030s, the density in outer Melbourne reaches a point at which people seek lower density locations (as is their preference) for new residential development. Growth disperses further, beyond the urban growth boundary, to peri-urban towns stretching along transport corridors from Melbourne to Torquay, Seymour, and Traralgon.

The effects of climate change create an increasingly warm and wet climate, and risks of bushfires, flooding and coastal inundation pose a threat to residents. Market-led climate adaptation leads to development in some at-risk areas, including those beyond the current urban growth boundary. Additionally, private sector investment in climate technologies generate significant advancements in renewable energy technology, electric vehicles, automated vehicles, and remote service delivery, which enable the dispersed pattern of growth.

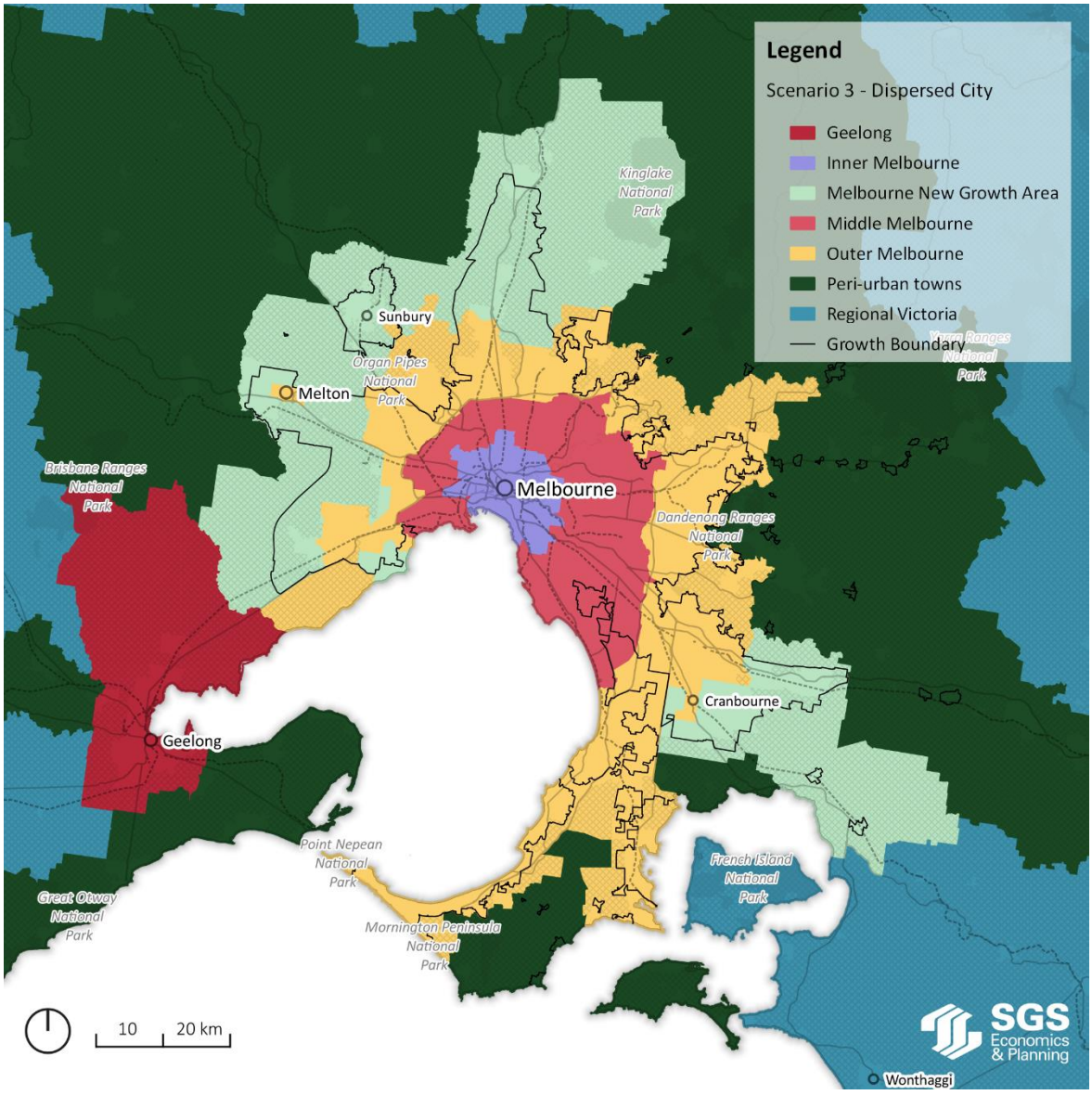
Despite technology advancements, automation does not replace workers in aggregate, but rather leads to a shift in industry and occupational composition. Most notably, the decline in retail is offset by growth in postal and warehousing as well as other 'experience' services.

Population serving employment growth is accommodated within dispersed centres in peri-urban towns and regional Victoria within co-working locations. Despite the dispersed population, employment in central Melbourne continues to grow (albeit at a slower rate), as it attracts knowledge jobs through less competitive floorspace demand (relative to present) induced by working-from-home trends and easier commuting (uptake in automated vehicles).

The increase in electric and automated vehicles, coupled with the pattern of urban expansion across the city, results in high levels of traffic congestion in central Melbourne. This is compounded by limited Government investment in public transport. Committed projects such as the Suburban Rail Loop (SRL)

are delivered but do not have a catalytic impact, and uncommitted public transport investments, such as MM2, are not delivered and lead to limited development in urban renewal precincts. Public-private partnerships (PPP) deliver toll road infrastructure as the costs of infrastructure for new development are increasingly pushed onto developers and homeowners.

FIGURE 36: SCENARIO 3 (DISPERSED CITY) CHANGE AREAS



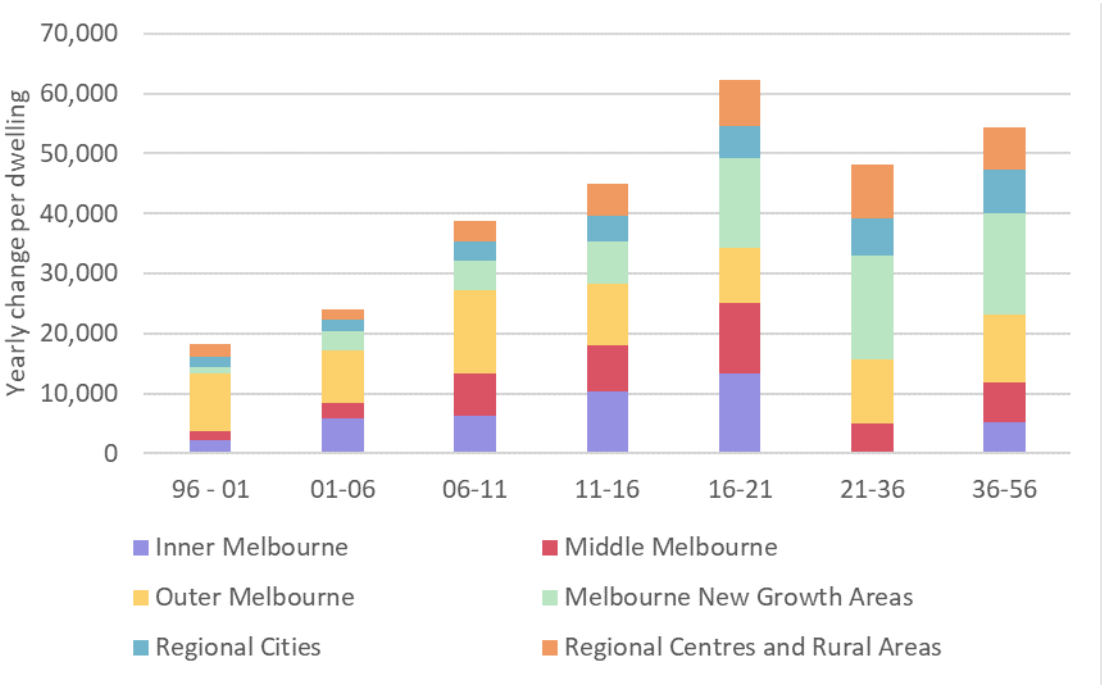
Source: SGS Economics and Planning, 2022

6.2 Detailed scenario outcomes

Population and dwellings

Under the Dispersed City Scenario, the dwelling growth experienced in inner Melbourne and middle-ring suburbs since the early 2000s slows. As illustrated in Figure 37 and Figure 38, Victoria's expansion occurs in the new growth areas within Melbourne as well as in peri-urban towns and Geelong.

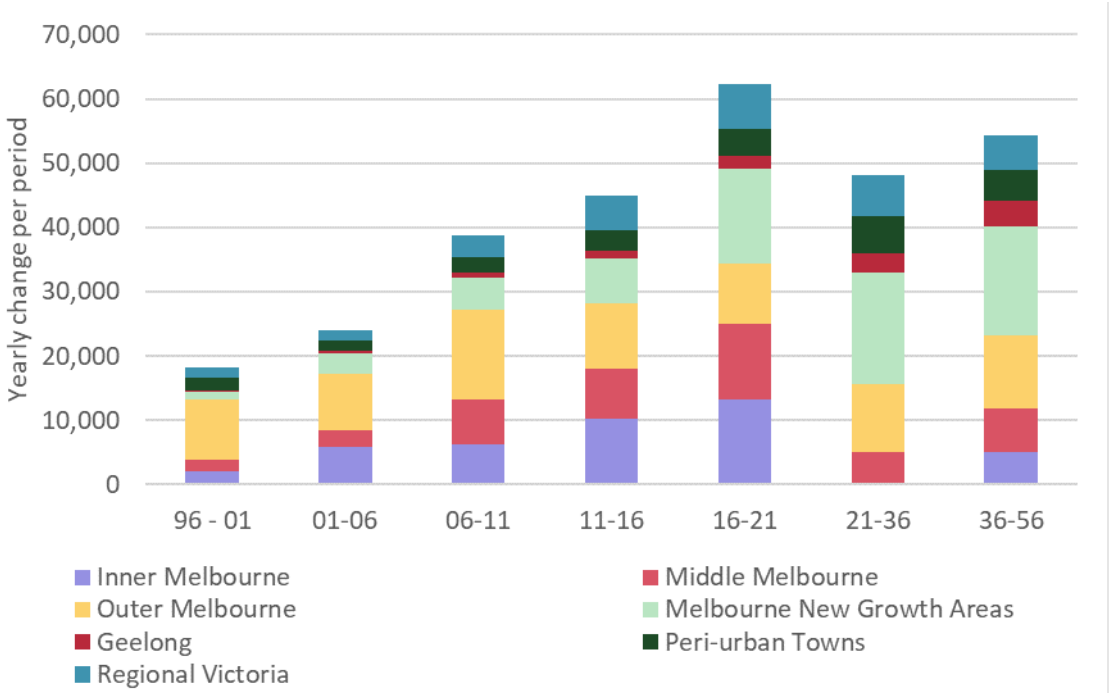
FIGURE 37: DWELLING GROWTH BY FUA (S3)



Source: SGS Economics and Planning, 2022

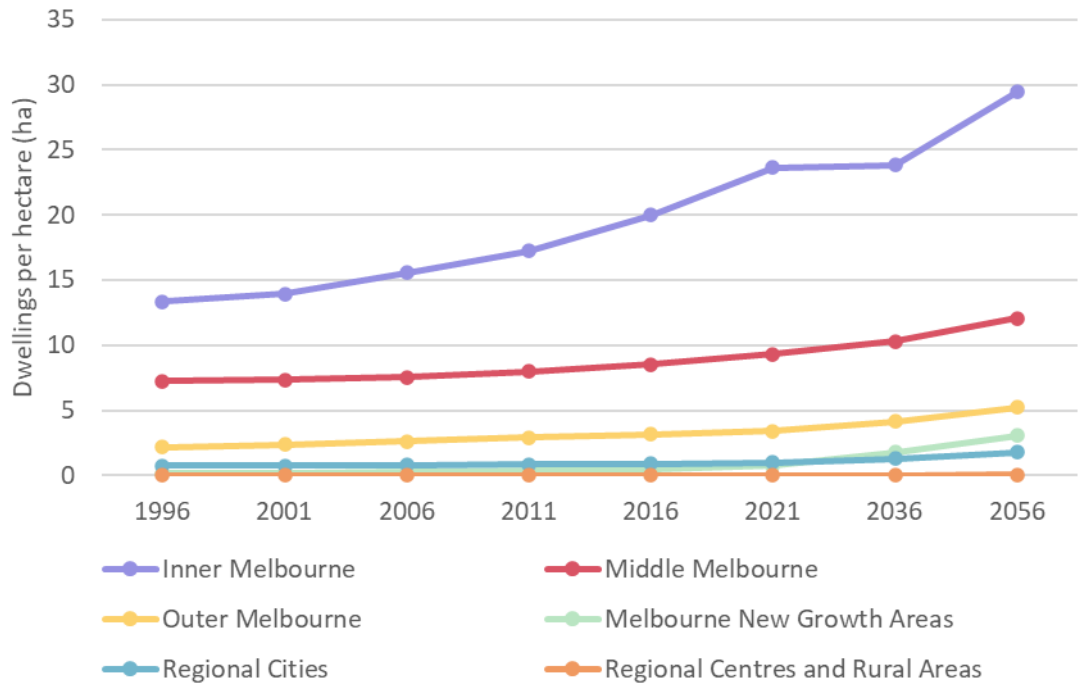
After a period of rapid development in inner Melbourne in the 2010s, infill developments slow. This is reflected in the gross dwelling density which remains constant between 2021 and 2036 (see Figure 39). In contrast, the dwelling density in Melbourne's new growth areas increases to 3 dwellings/ha in 2056, reaching a similar level to outer Melbourne in 2016 (3 dwellings/ha). This trend of densification also extends to Geelong and peri-urban areas, increasing the growth rate of regional Victoria as a whole (see Figure 38).

FIGURE 38: YEARLY DWELLING GROWTH BY CHANGE AREA (S3)



Source: SGS Economics and Planning, 2022

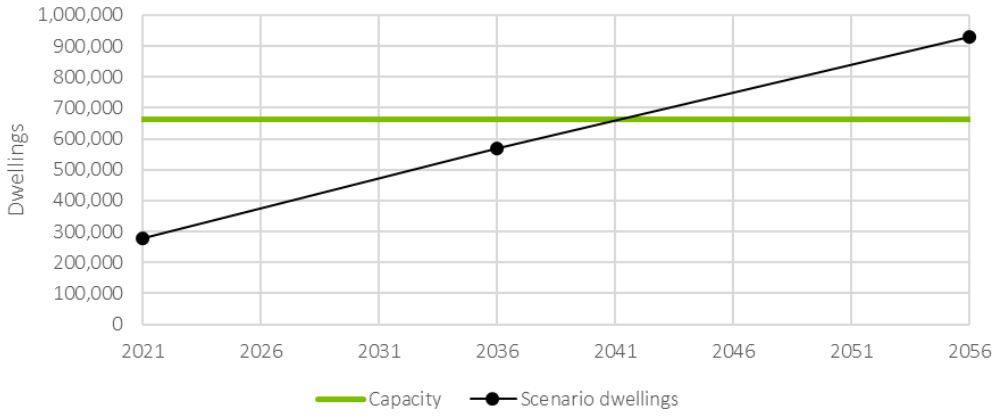
FIGURE 39: DWELLING DENSITY BY FUA (S3)



Source: SGS Economics and Planning, 2022

Current greenfield development areas within the urban growth boundary (UGB) are exhausted under this scenario. Additional low-density development occurs outside of the UGB, primarily along transport corridors and as an extension of existing growth fronts. This is illustrated in Figure 40, which shows the capacity and modelled number of dwellings in SA2s within the Melbourne new growth areas and outer Melbourne FUAs which contain major subdivisions or PSPs, and so have capacity restrictions. Some infill development is included within this total, as the SA2s are slightly larger than PSP boundaries. Nonetheless, this figure shows that greenfield capacity would be exhausted by 2041 in this scenario, with capacity for around 270,000 additional greenfield dwellings needed.

FIGURE 40: EXHAUSTION OF GREENFIELD CAPACITY WITHIN THE UGB (S3)

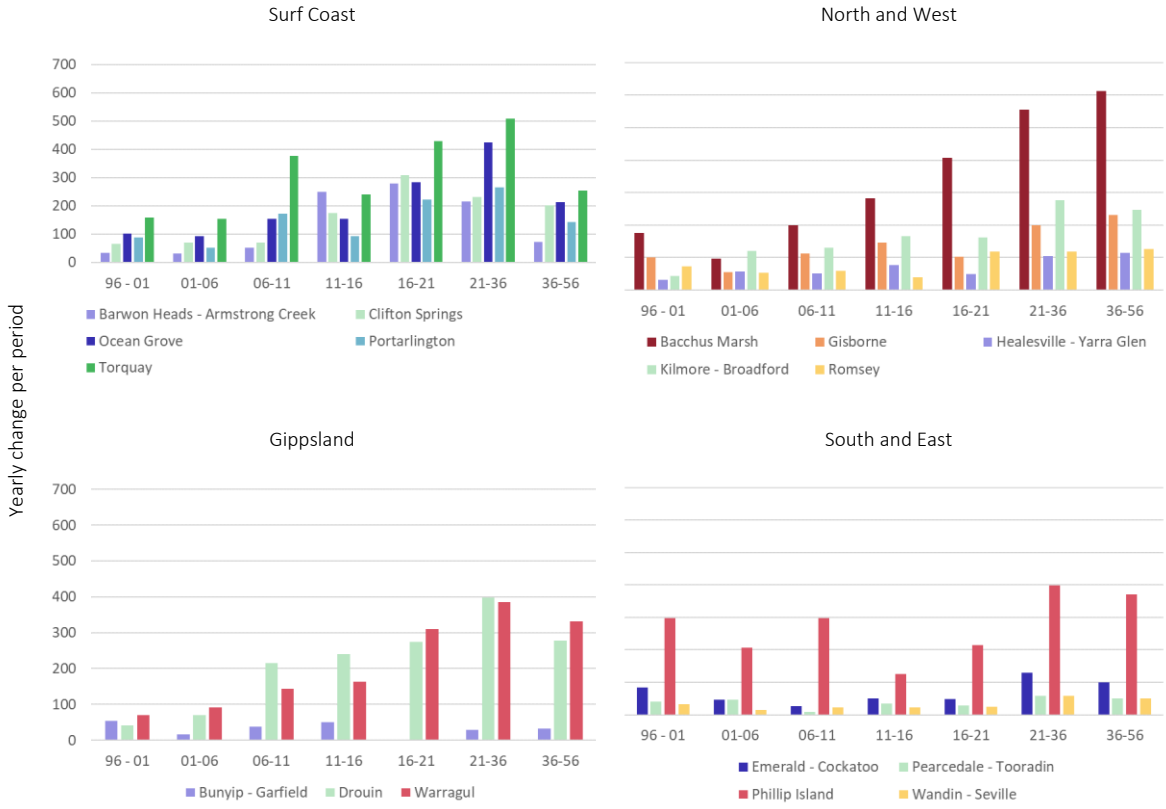


Source: SGS Economics and Planning, 2022

Peri-urban towns develop, leapfrogging greenfield developments in Melbourne's new growth areas. Figure 41 illustrates the yearly growth of dwellings in selected peri-urban towns under this scenario. Bacchus Marsh grows most rapidly with over 600 dwellings added each year between 2036 and 2056, double the dwelling growth between 2011 and 2016.

However, dwelling growth begins to slow in most other peri-urban towns between 2036 and 2056 after a period of high growth. The effects of climate change slow the growth of peri-urban towns along the coastline between 2036 and 2056 despite adaptation enabling development in other at-risk areas. Coastal inundation and more extreme storms experienced by coastal communities lead them to seek higher ground. This is evident in key coastal towns such as Torquay, Portarlington, and Clifton Springs where annual dwelling growth during this period falls below the growth experienced between 2021 and 2036.

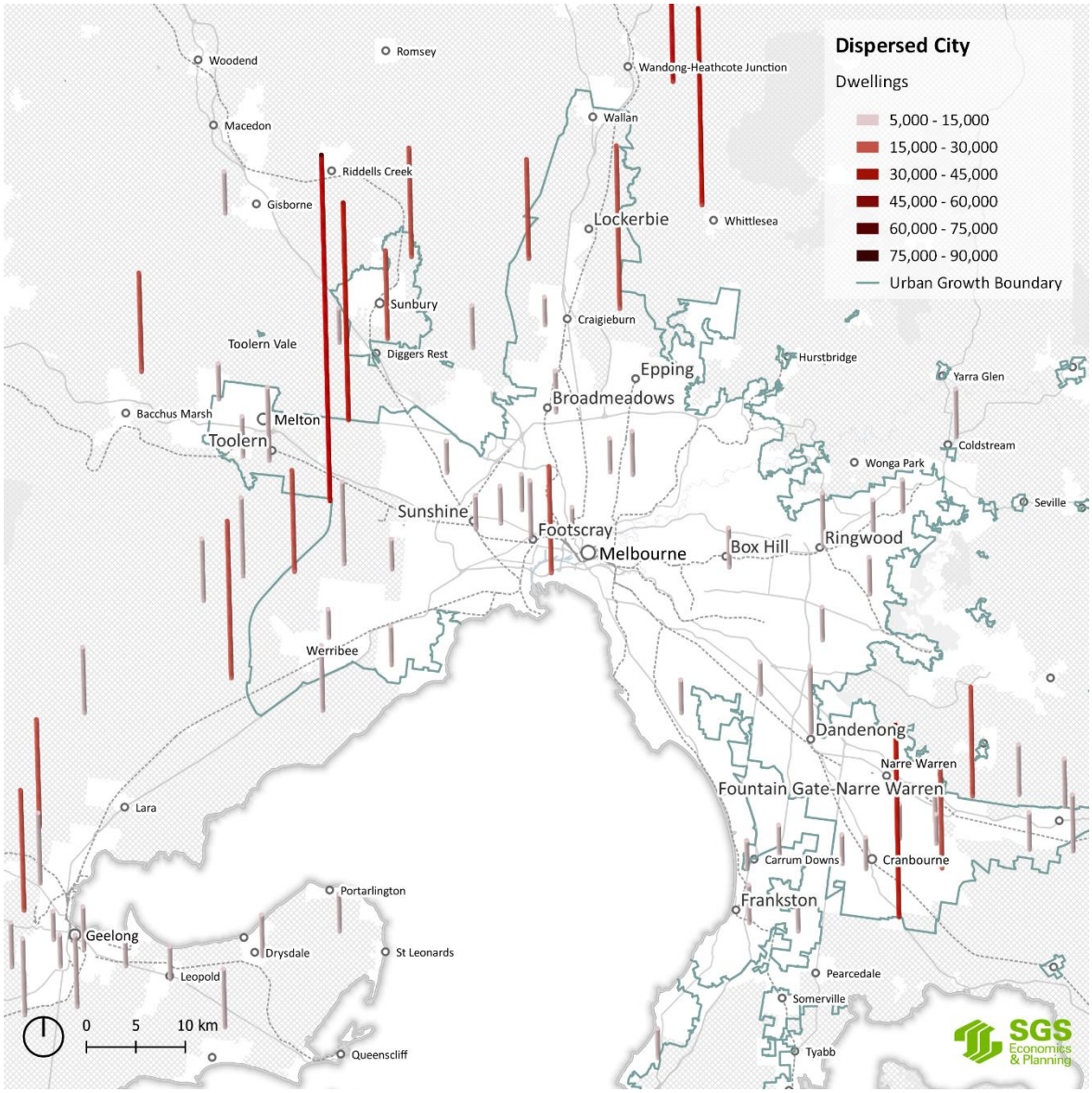
FIGURE 41: YEARLY DWELLING GROWTH IN KEY PERI-URBAN TOWNS (S3)



Source: SGS Economics and Planning, 2022

The spatial distribution of residential development in Victoria is illustrated in Figure 42 for this scenario. This shows the pattern of growth shifting outward from Melbourne's centre.

FIGURE 42: DWELING GROWTH BY SA2, 2021-2056 (S3)



Source: SGS Economics and Planning, 2022.

Employment

The dispersal of population to Melbourne's fringe, coupled with a lack of government investment in public transport, has notable effects:

- Slower employment growth within inner and middle Melbourne, with future jobs growth in these areas well below historic rates.
- Faster growth of population-serving employment, such as retail and hospitality, in the dispersed locations of population growth (see Figure 44).

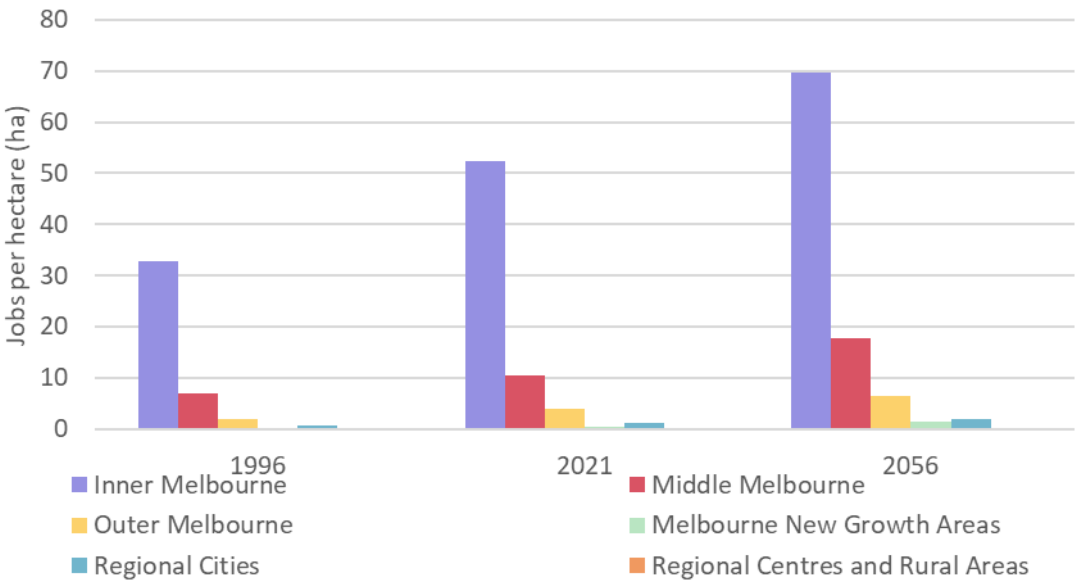
TABLE 8: TOTAL EMPLOYMENT GROWTH BY FUA (S3)

	2006-2021	2021-2036	2036-2056	Change 21-56	'06-21 CAGR	'21-56 CAGR
Inner Melbourne	257,000	186,000	132,000	318,000	2.1%	0.8%
Middle Melbourne	197,000	146,000	392,000	538,000	1.9%	1.5%
Outer Melbourne	291,000	243,000	279,000	522,000	2.9%	1.4%
Melbourne New Growth Areas	70,000	111,000	151,000	262,000	7.1%	3.6%
Regional City	80,000	93,000	100,000	193,000	1.7%	1.2%
Regional Centres and Rural Areas	67,000	104,000	101,000	205,000	1.2%	1.2%

Source: SGS Economics and Planning, 2022.

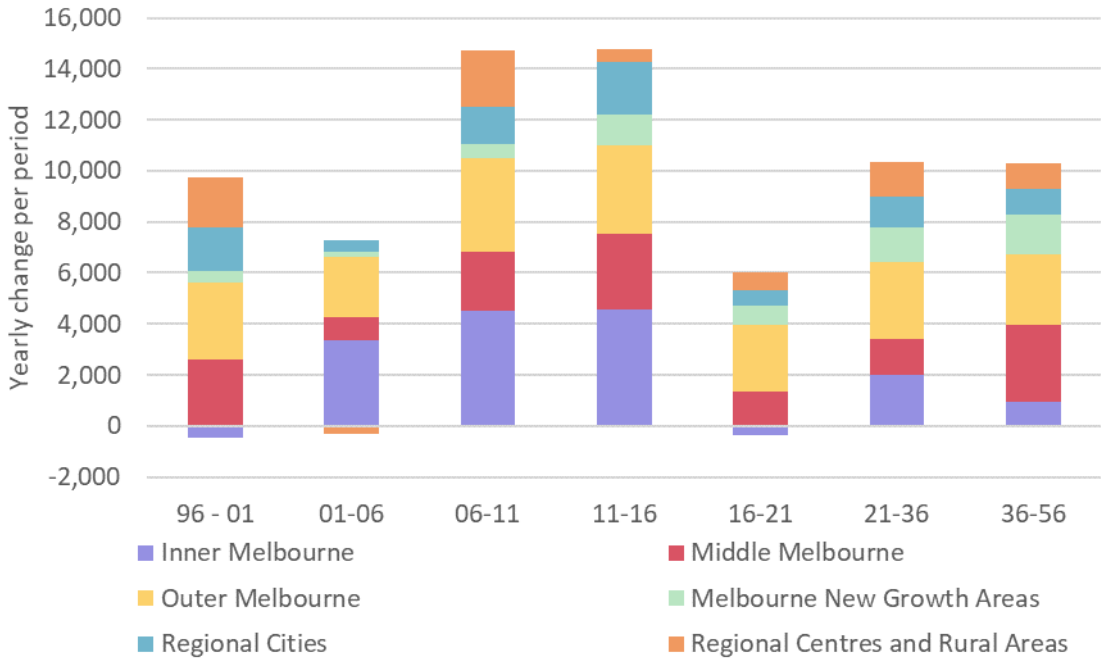
Job density in inner and middle Melbourne continues to increase, albeit not as rapidly as under current trends (see Figure 43). Inner Melbourne reaches a gross density of 70 jobs/ha by 2056, as knowledge-intensive services continue to locate within the area, while middle Melbourne reaches a density of 18 jobs/ha. Outer Melbourne grows to a job density of 7 jobs/ha by 2056, while the remaining areas in Victoria remain stable.

FIGURE 43: JOB DENSITY BY FUA (S3)



Source: SGS Economics and Planning, 2022

FIGURE 44: RETAIL AND HOSPITALITY GROWTH BY FUA (S3)

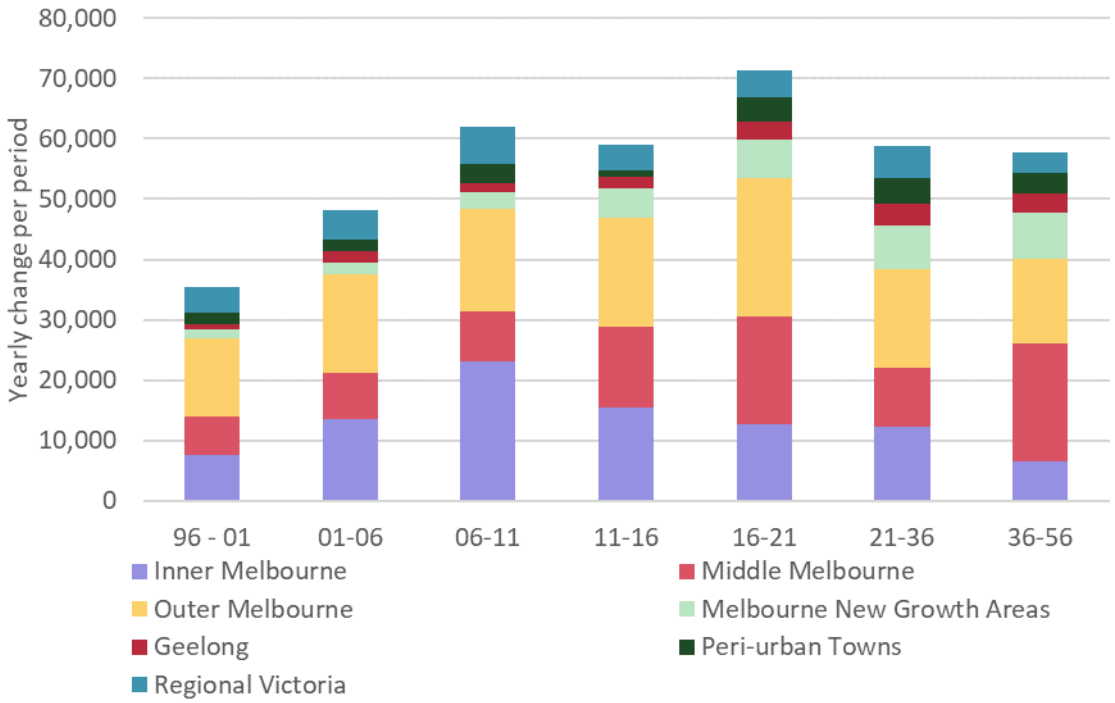


Source: SGS Economics and Planning, 2022

Peri-urban towns will undergo a transformation in their employment function, as population serving jobs are attracted to serve the influx of people who begin to reside in each town. They will, on average, grow by 4,000 jobs annually between 2036 to 2056. This growth is also reflected in the self-containment rate, which reaches over 40 per cent in 2056, increasing by over 5 per cent from 2016.

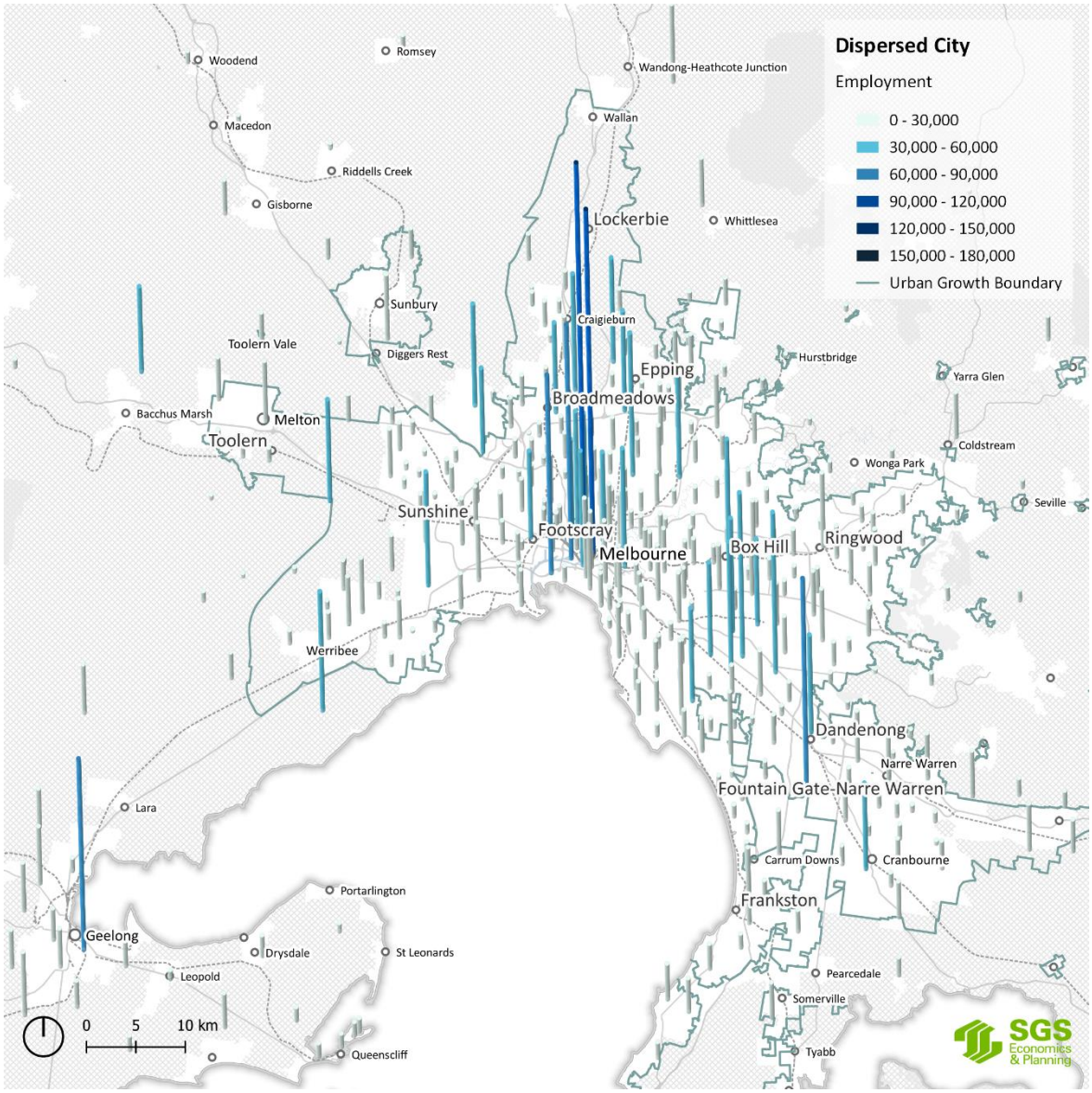
A similar level of employment growth will occur in Regional Victoria and, to a lesser extent, in Geelong (see Figure 45). Figure 46 reflects this spatial distribution of job growth at an SA2 level.

FIGURE 45: YEARLY JOB GROWTH BY CHANGE AREA (S3)



Source: SGS Economics and Planning, 2022.

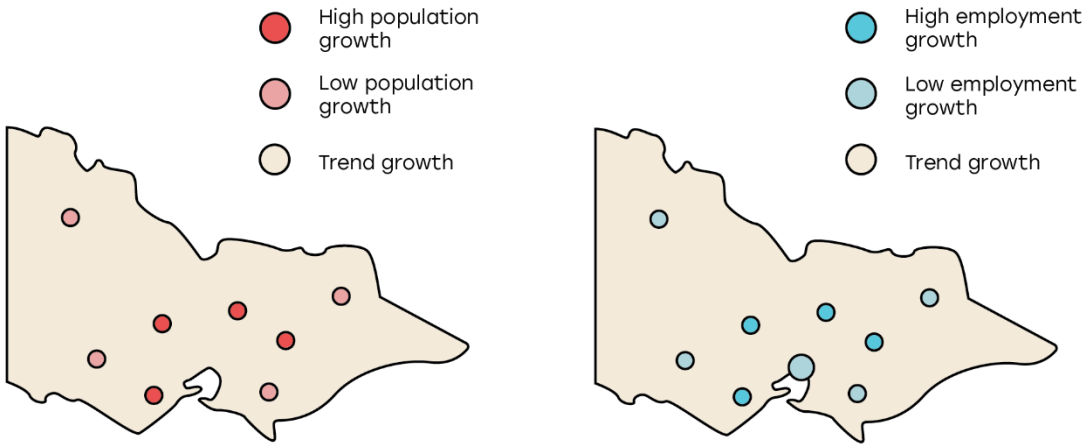
FIGURE 46: JOBS GROWTH BY SA2, 2021-2056 (S3)



Source: SGS Economics and Planning, 2022.

7. Scenario 4: Network of Cities

7.1 Narrative



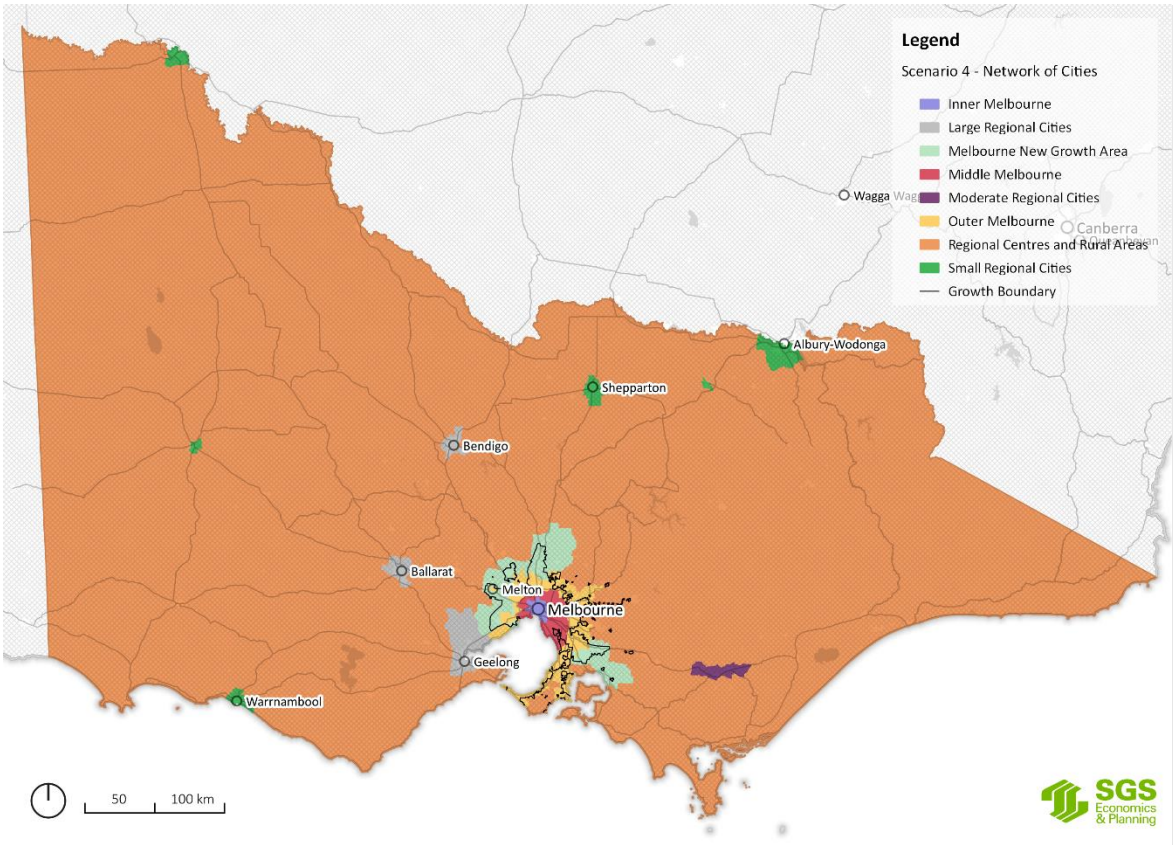
Under this scenario, metropolitan housing unaffordability combined with remote working trends lead to regional cities becoming far more attractive to households relative to metropolitan Melbourne. However, in a climate-conscious society, government (at all levels) adopt strong planning policies to ensure sustainable development patterns that avoid urban expansion and development in climate-risk areas. This results in the managed growth of key large regional cities (Geelong, Ballarat, and Bendigo) where population growth is consolidated. Smaller regional cities also present an attractive choice, particularly to those with a preference for lower density living.

Investment in public transport is crucial in facilitating these locational preferences, with a network of mass transit connections established between the large regional cities and Melbourne. While committed public transport projects within Melbourne, such as SRL, are still delivered, they fail to have the envisaged catalytic impact. As the changing trends in urban structure become evident, government investment is redirected away from longer-term uncommitted projects, such as Melbourne Metro Two, limiting the development potential of the associated urban renewal areas such as Fisherman's Bend.

This mass move to regional Victorian centres is partially enabled by remote working trends and technologies, which allow many employees in the knowledge economy to work from home, reducing barriers that currently favour physical agglomeration. In cases where a physical office is required, they are consolidated in each large regional city. The large regional cities become self-contained economic hubs with anchor health and education institutions, serving both their local population and those in the surrounding region.

Another shift in employment trends is the resilience of the agricultural sector, which is buoyed by both increased export demand and the adoption of technology advances improving agricultural productivity. This reinforces the role of regional cities, both large and small, which act as hubs for agricultural employees (i.e., place of residence) and centralised functions (e.g., offices or distribution centres).

FIGURE 47: SCENARIO 4 (NETWORK OF CITIES) CHANGE AREAS - VICTORIA



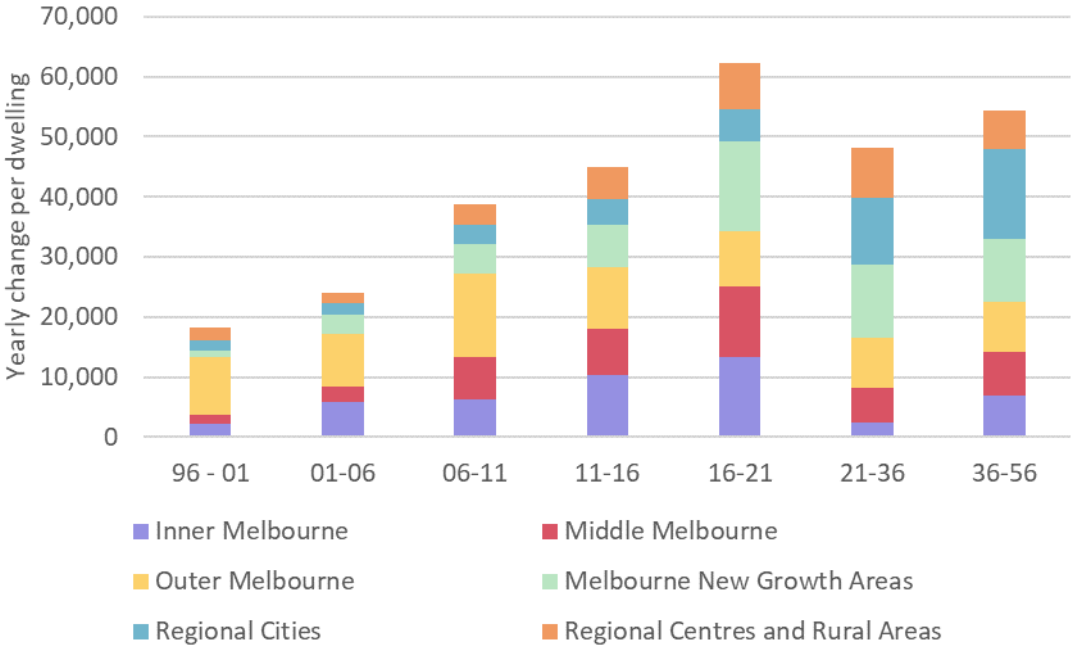
Source: SGS Economics and Planning, 2022

7.2 Detailed scenario outcomes

Population and dwellings

This scenario is defined by slowing development in the City's centre from the 2020's onwards, when housing unaffordability and remote working trends draw people to regional areas. As shown in Figure 48, dwelling growth in regional cities accelerates from 2021, with a corresponding reduction in growth in inner and middle Melbourne. Between 2036 and 2056, the annual growth of dwellings in regional cities exceeds 15,000, around 2,000 more than inner Melbourne experienced during its peak between 2016 and 2021.

FIGURE 48: DWELLING GROWTH BY FUA (S4)

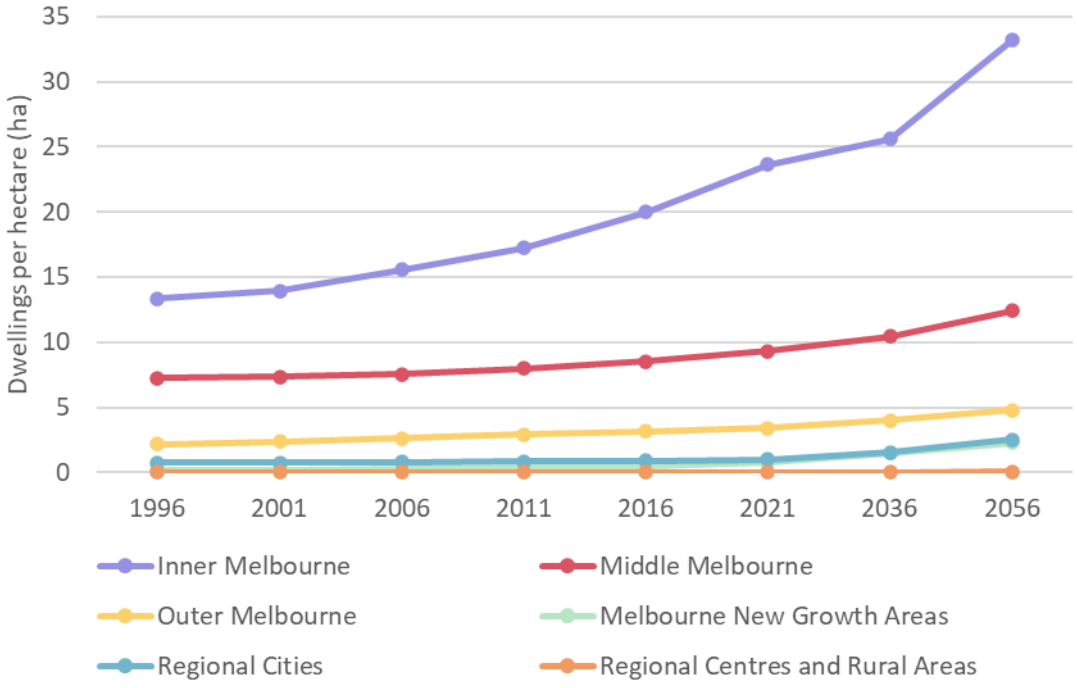


Source: SGS Economics and Planning, 2022

Despite the population rapid expansion of regional cities, the same transformation doesn't occur in smaller regional centres and rural areas due to the adoption of climate-conscious planning policies preventing urban expansion and development in climate-risk areas.

By 2056, regional cities approach a gross dwelling density of 2.5 dwellings/ha, comparable to outer Melbourne in 2006 (Figure 49). However, it should be noted that this represents an average across the geographic extent of the regional cities, and that most development is managed within core areas, representing densities of 7 to 12 dwellings/ha. This is reflective of the strict settlement boundaries put in place in regional cities to create sustainable patterns of urban growth and stimulate the provision of higher density housing.

FIGURE 49: DWELLING DENSITY (S4)



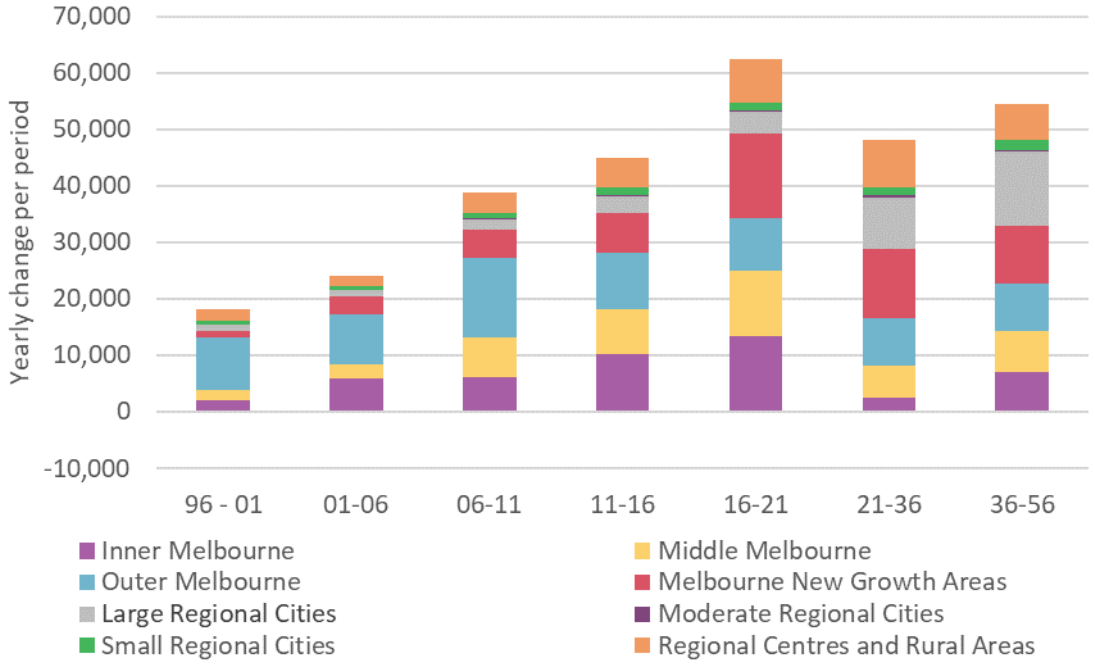
Source: SGS Economics and Planning, 2022

As people continue to move from Melbourne to the regions, cities such as Geelong, Ballarat, and Bendigo increase in size (Figure 50 and Figure 51). They benefit from their existing institutions, infrastructure, and amenities, building upon these to become self-contained hubs with health and education institutions, employment opportunities, and integrated transport networks.

Figure 51 shows the dwelling growth of the three large regional cities, including their surrounding suburbs. Geelong's population grows most rapidly, with over 5,800 new dwellings annually between 2036 and 2056. Ballarat and Bendigo are forecast to grow at a similar rate of 3,000 to 4,000 new dwellings each year. By 2056 Geelong, Ballarat, and Bendigo will reach approximately 270,000, 166,000, and 143,000 dwellings respectively.

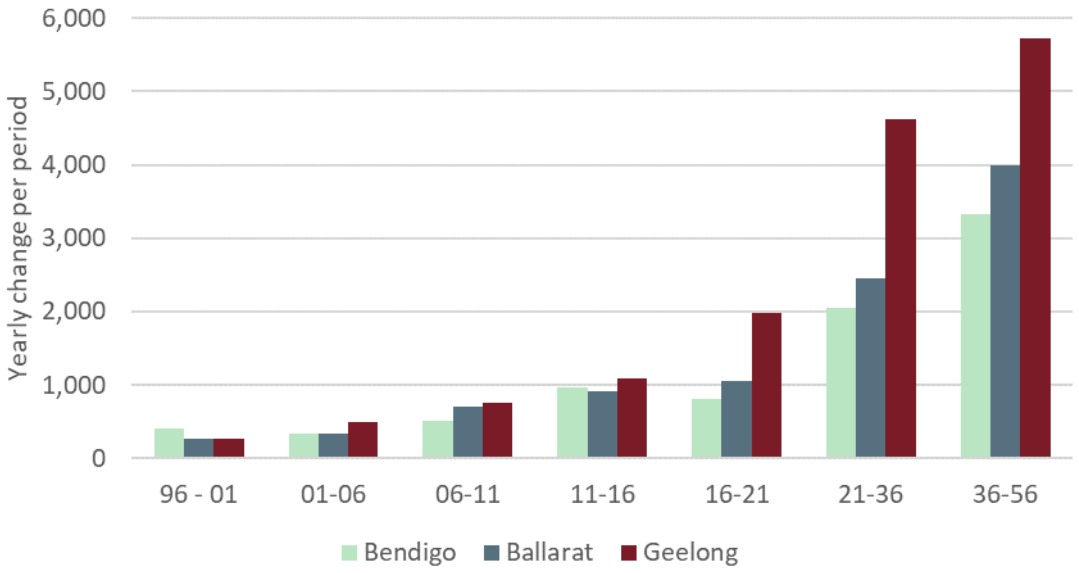
The spatial distribution of development under this scenario is shown in Figure 52. This illustrates the higher levels of growth in regional areas across Victoria, with significant levels in Geelong West by 2056.

FIGURE 50: YEARLY DWELLING GROWTH BY CHANGE AREA (S4)



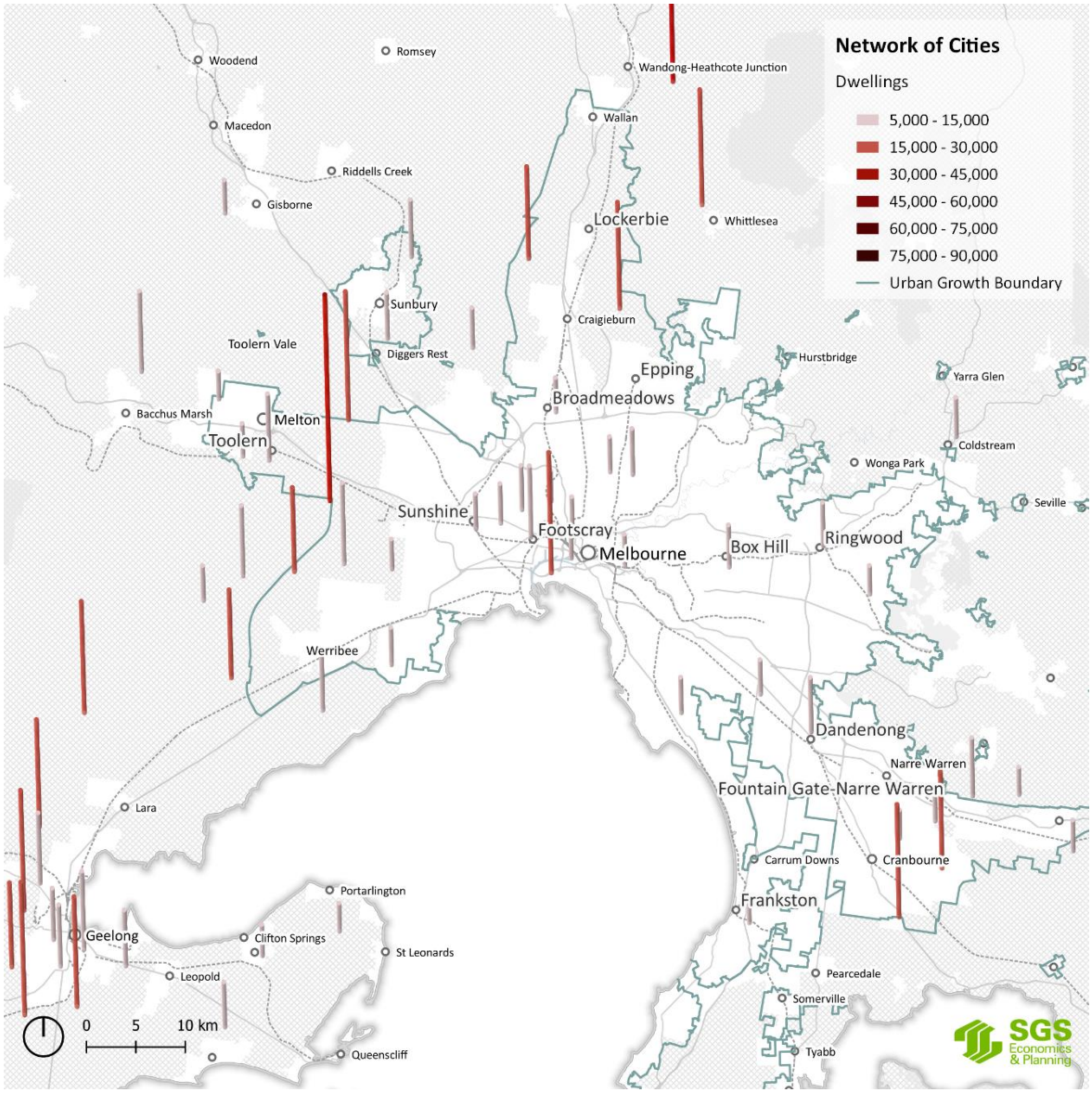
Source: SGS Economics and Planning, 2022

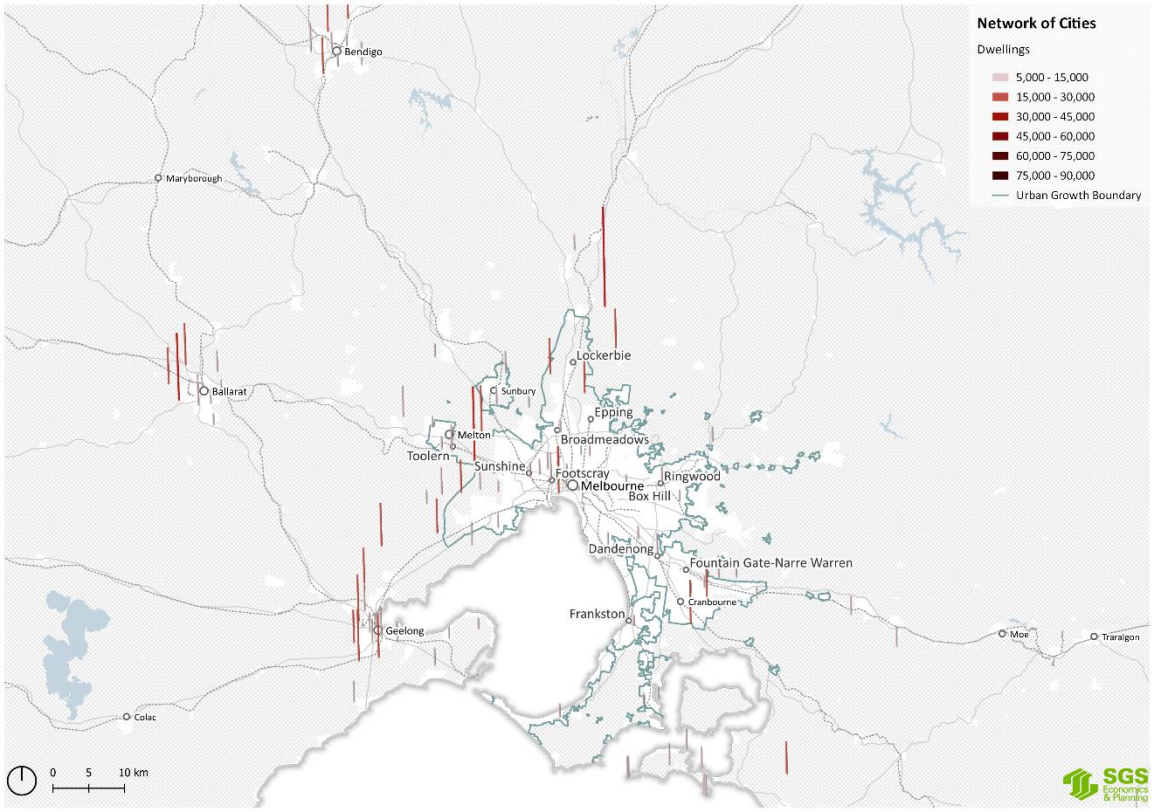
FIGURE 51: DWELLING GROWTH BY LARGE REGIONAL CITY (S4)



Source: SGS Economics and Planning, 2022

FIGURE 52: DWELING GROWTH BY SA2, 2021-2056 (S4)





Employment

As Victoria's population migrates to regional cities, the spatial distribution of employment follows a similar pattern. This results from the need for local population serving employment combined with remote working trends and technologies which reduce the need for physical agglomeration in central Melbourne.

Employment begins to grow in regional cities from the mid-2020s, which grow by over 2 per cent per annum, on average, between 2021 and 2056. This represents a rate of employment growth far beyond historical trends and comparable to that of inner Melbourne between 2006 and 2021.

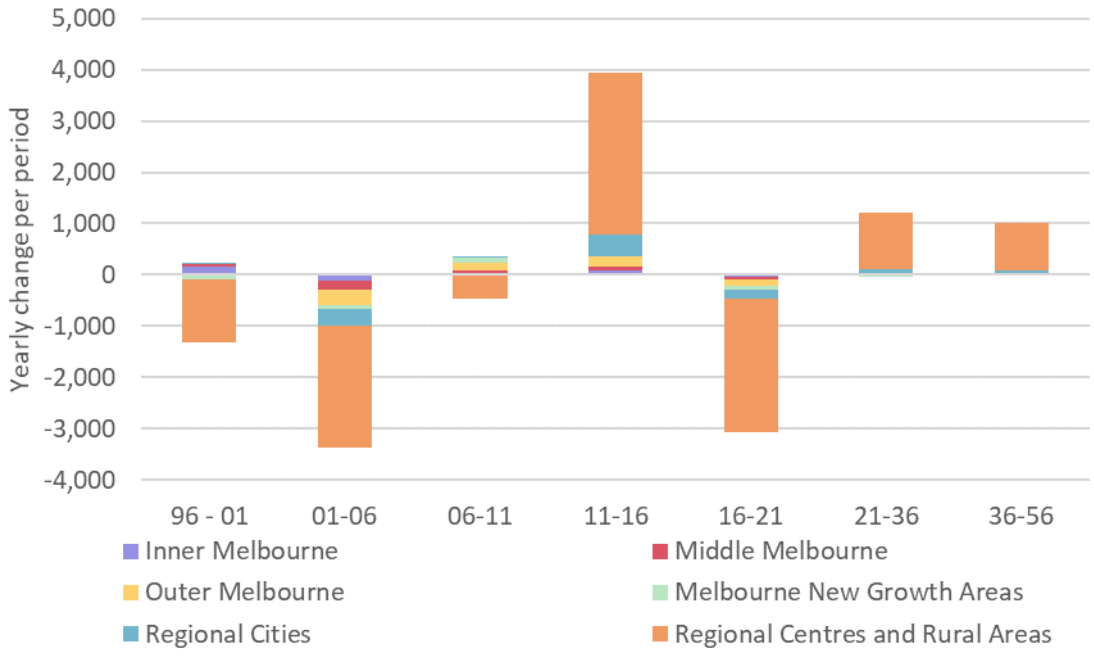
Conversely, as shown in Table 9, the annual growth rate of jobs in inner Melbourne declines significantly between 2021 and 2056 to 1 per cent, being less than half of what it was between 2006 and 2021. A similar pattern is seen throughout Melbourne, with the largest decline in Melbourne's new growth areas (after a period of high growth between 2006-2021).

TABLE 9: TOTAL EMPLOYMENT GROWTH BY FUA (S4)

	2006-2021	2021-2036	2036-2056	Change 21-56	'06-21 CAGR	'21-56 CAGR
Inner Melbourne	257,000	179,000	157,000	336,000	2.1%	0.9%
Middle Melbourne	197,000	130,000	378,000	508,000	1.9%	1.4%
Outer Melbourne	291,000	179,000	174,000	353,000	2.9%	1.0%
Melbourne New Growth Areas	70,000	75,000	50,000	125,000	7.1%	2.2%
Regional City	80,000	190,000	288,000	478,000	1.7%	2.4%
Regional Centres and Rural Areas	67,000	130,000	108,000	238,000	1.2%	1.3%

Source: SGS Economics and Planning, 2022. Rounded to the nearest 1,000th

FIGURE 53: ANNUAL GROWTH OF AGRICULTURE EMPLOYMENT BY FUA (S4)



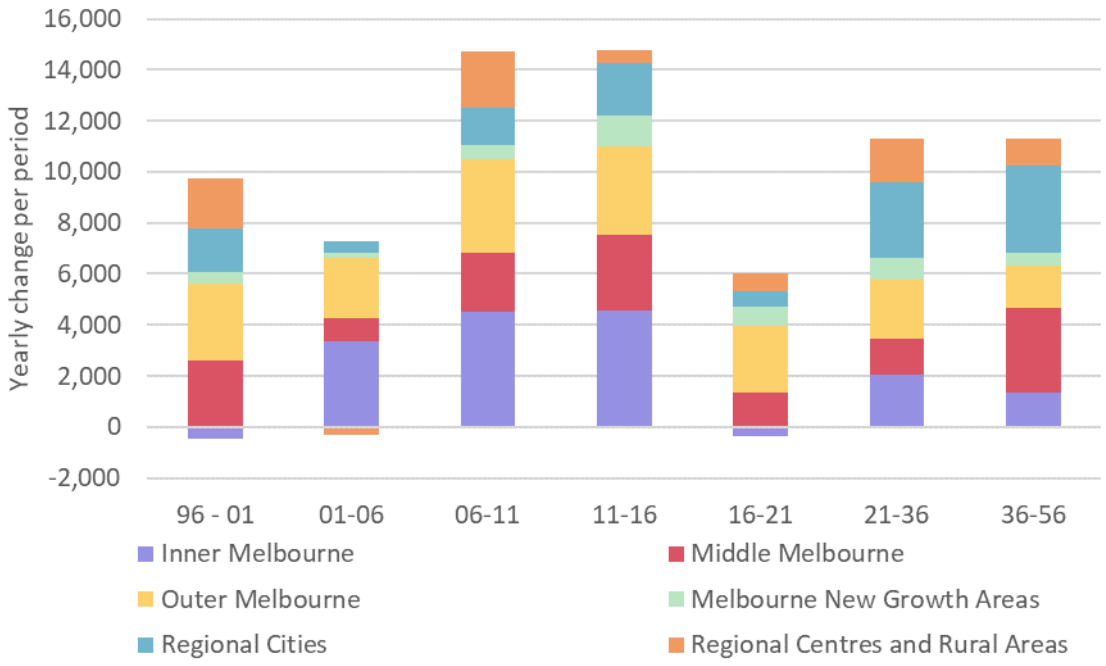
Source: SGS Economics and Planning, 2022

Stimulated by export demand and technological advancements, there is a resurgence of the agriculture sector, following the period of decline between 2016 and 2021. Figure 53 illustrates the spatial outcome, with employment growth primarily in regional centres and rural areas.

Service jobs in regional cities grow rapidly during the mid-2020s, after a period of only incremental growth between 2016 and 2021 (Figure 54). Between 2036 and 2056, regional cities add 3,400 jobs in Retail and Hospitality annually, more than inner Melbourne and middle Melbourne during the same period. A similar pattern of employment growth can be seen in sectors such as Medical, Social and Community Services, and School Education (see Appendix B).

By 2056, regional cities approach a gross employment density of 3 jobs/ha, equivalent to that of outer Melbourne in 2016. This regional employment growth is reflected in the self-containment rate[16] which, by 2056, reaches 55 per cent in regional centres and rural areas. This is comparable to middle Melbourne in 2016.

FIGURE 54: ANNUAL GROWTH OF RETAIL AND HOSPITALITY EMPLOYMENT BY FUA (S4)

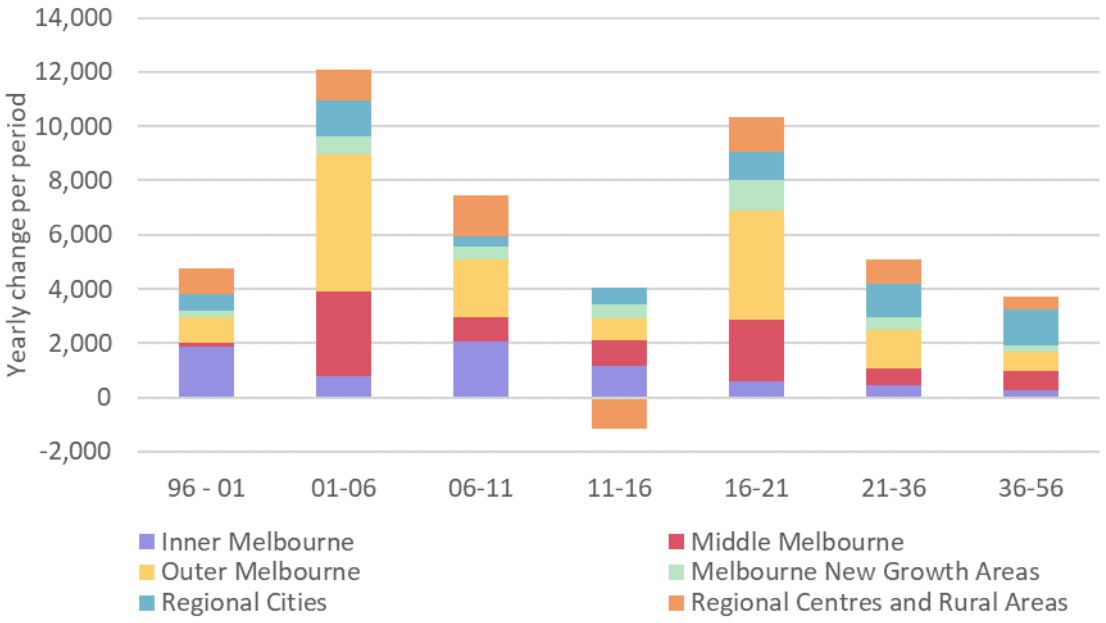


Source: SGS Economics and Planning, 2022

[16] Self Containment defined as the ratio of jobs to the available labour force.

Consistent with shifting patterns of both residential and employment locational choices is the spatial distribution of construction employment. Figure 55 indicates that from 2021, construction jobs are primarily located in regional cities.

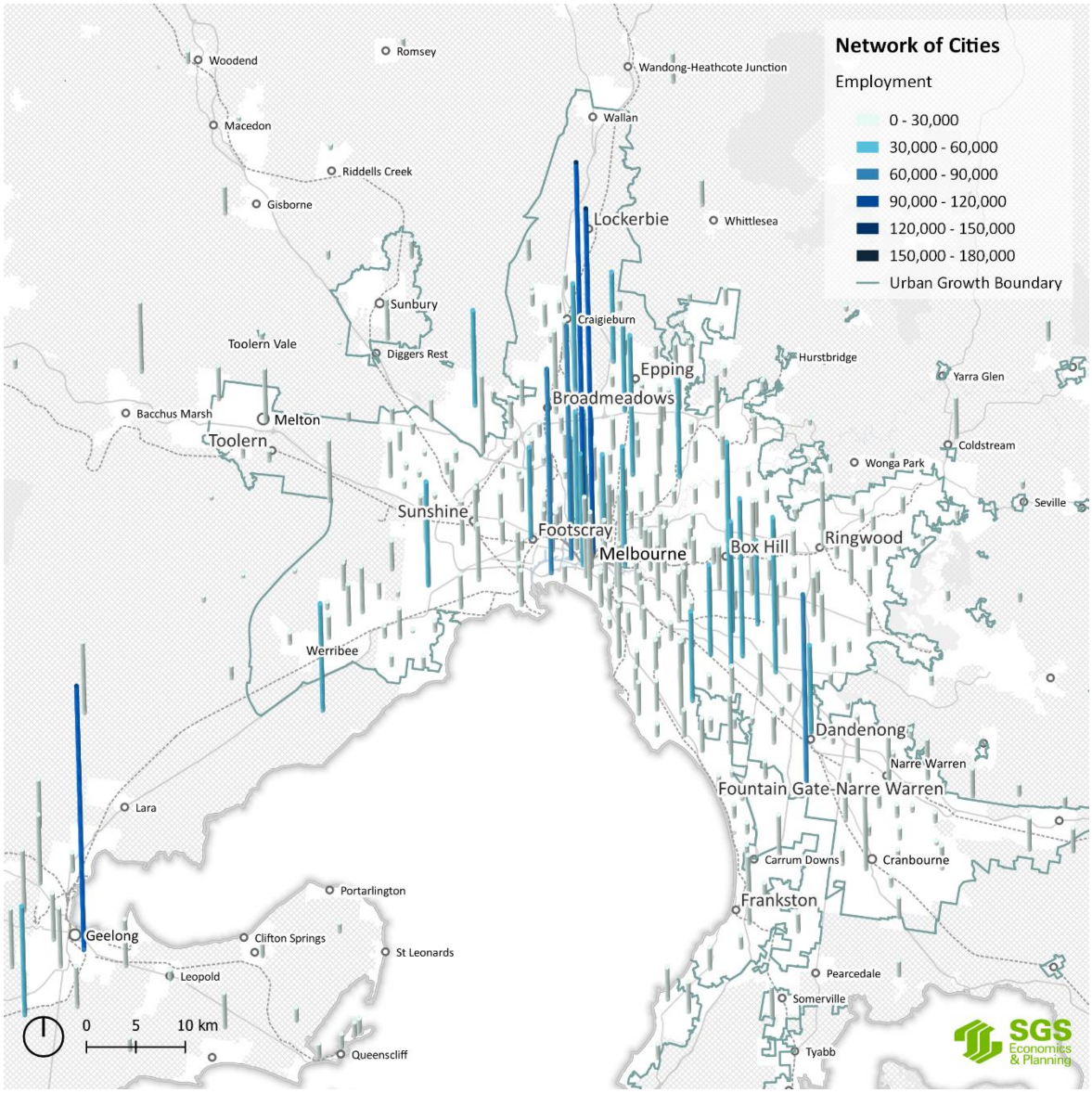
FIGURE 55: ANNUAL GROWTH OF CONSTRUCTION EMPLOYMENT BY FUA (S4)

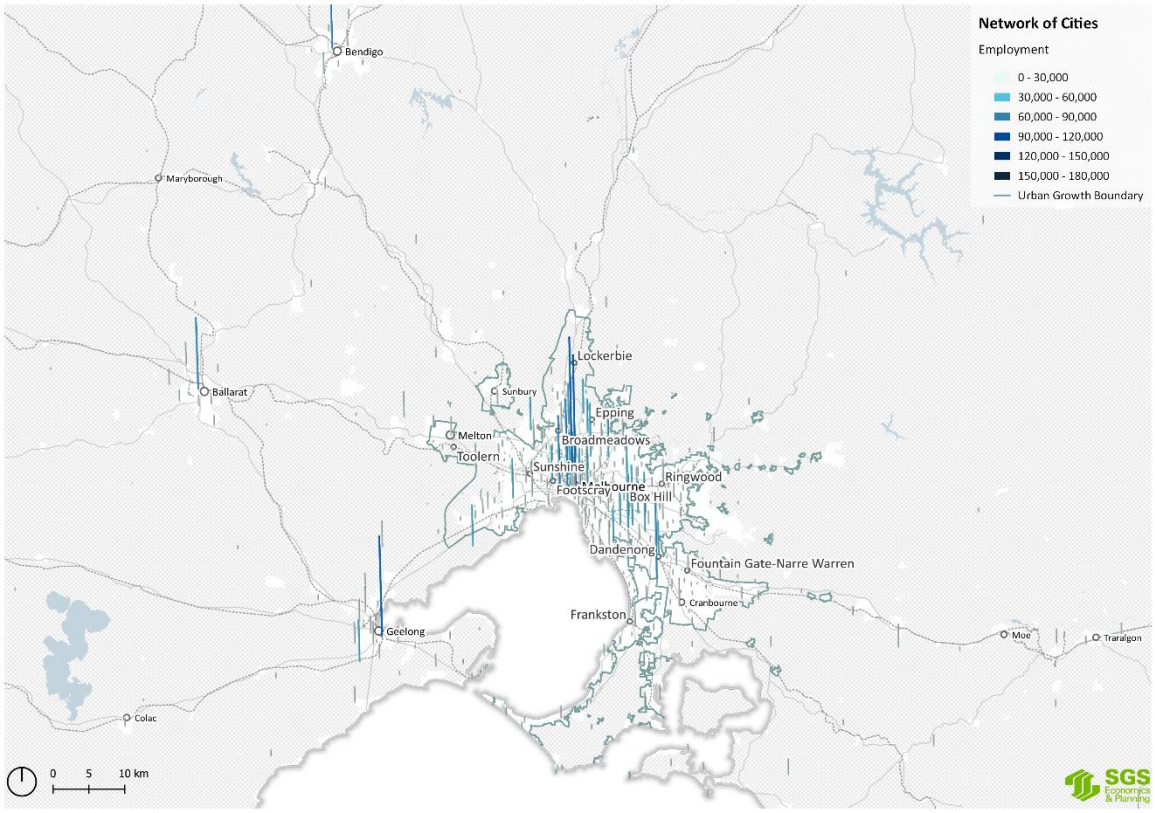


Source: SGS Economics and Planning, 2022

The spatial distribution of employment under this scenario is represented in Figure 56. This map highlights the high levels of employment growth in regional cities to 2056.

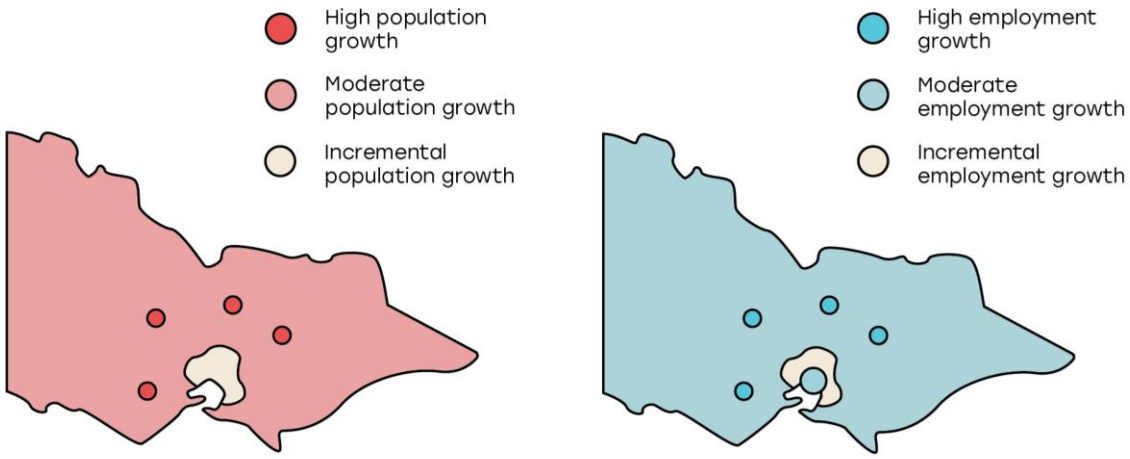
FIGURE 56: EMPLOYMENT GROWTH BY SA2, 2021-2056 (S4)




Network of Cities
Employment
0 - 30,000
30,000 - 60,000
60,000 - 90,000
90,000 - 120,000
120,000 - 150,000
150,000 - 180,000
Urban Growth Boundary
Bendigo
Maryborough
Ballarat
Lockerbie
Sunbury
Epping
Broadmeadows
Melton
Toolern
Sunshine
Footscray
Box Hill
Ringwood
Dandenong
Fountain Gate-Narre Warren
Cranbourne
Frankston
Geelong
Moe
Traralgon
Colac
0 5 10 km
SGS Economics & Planning

8. Scenario 5: Distributed State

8.1 Narrative



Under this scenario, population growth decentralises away from existing settlements in response to poor metropolitan housing affordability, high regional land availability, and unrestrictive planning policy. Metropolitan housing unaffordability peaks in the 2020s, forcing young families to prefer regional Victoria and, without government-led planning policies, development is unrestricted and unmanaged. Initially, this results in the build out of regional city growth areas at low densities, but from the 2030s low density growth extends beyond existing urban growth boundaries into peri-urban areas.

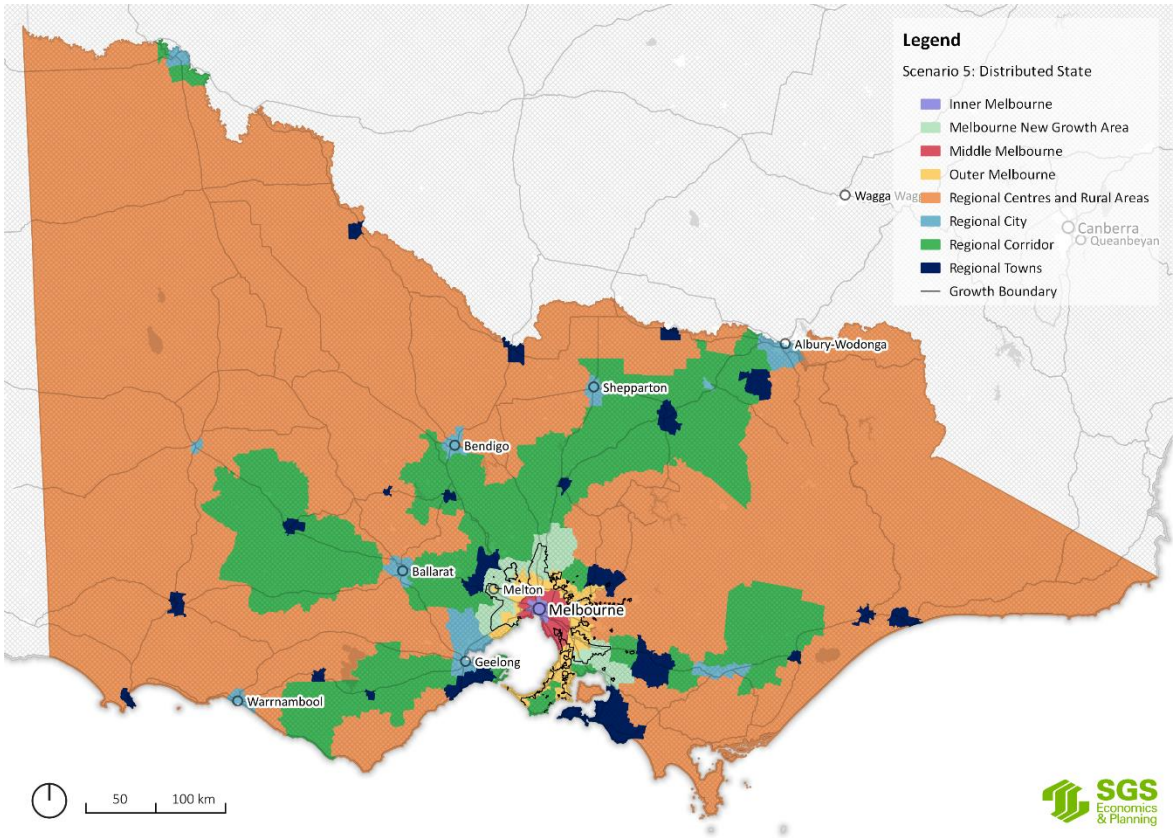
Geopolitical instability and reduction of globalisation see a decline in agricultural export demand, reducing the demand for agricultural land and leading to residential development which is facilitated by changes to the planning system that loosen requirements for rural subdivisions on agricultural land.

Employment grows rapidly in regional cities, which accommodate anchor health and education institutions, while remote working preferences and technology allow people to work from home full time, removing the need for physical agglomeration.

Inner Melbourne remains an economic mass, retaining jobs in the knowledge economy. By the 2030s, middle Melbourne grows as an economic hub supported by the delivery of committed transport projects such as the SRL. However, renewal precincts that were dependent on uncommitted public transport investments, such as MM2, experience significantly less development than current aspirations.

The unrealised public transport projects, coupled with unmanaged urban growth, reflect a low rate of climate change action. Climate change adaptation and mitigation were overshadowed by the housing affordability issues in the 2020s and 2030s, but as climatic conditions worsen in the 2040s, many new regional communities in climate-risk areas are poorly equipped to adapt.

FIGURE 57: SCENARIO 5 (DISTRIBUTED STATE) CHANGE AREAS - VICTORIA



Source: SGS Economics and Planning, 2022

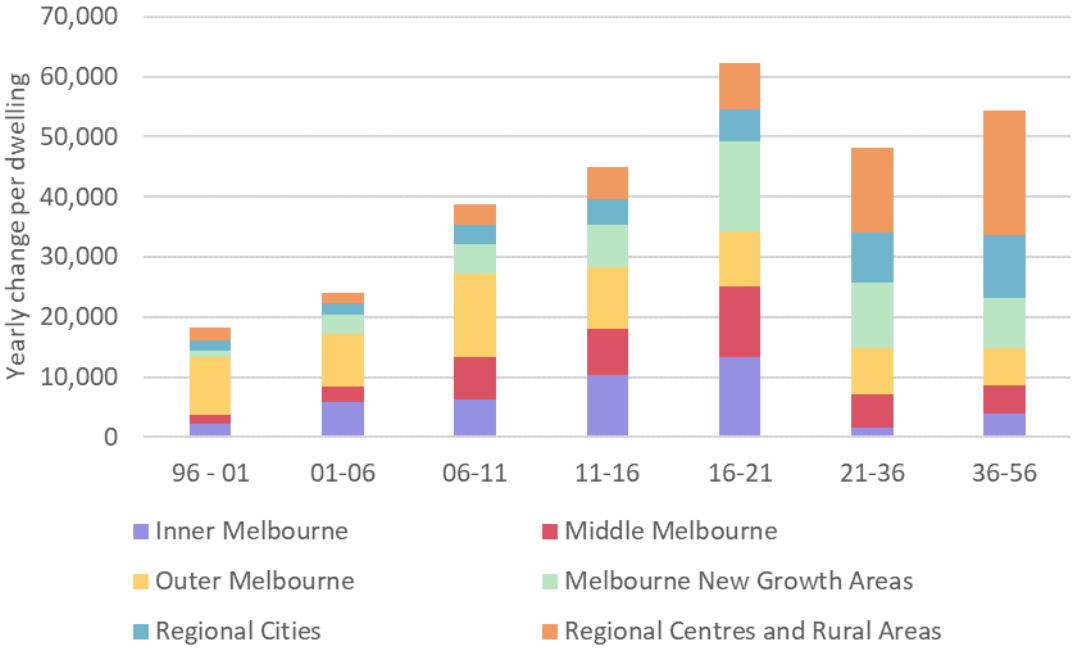
8.2 Detailed scenario outcomes

Population and dwellings

Under the Distributed State Scenario, the historic expansion of the CBD and surrounding suburbs (inner Melbourne) slow. As illustrated in Figure 58, Victoria's population growth shifts to regional Victoria, spurred by housing unaffordability in metropolitan areas.

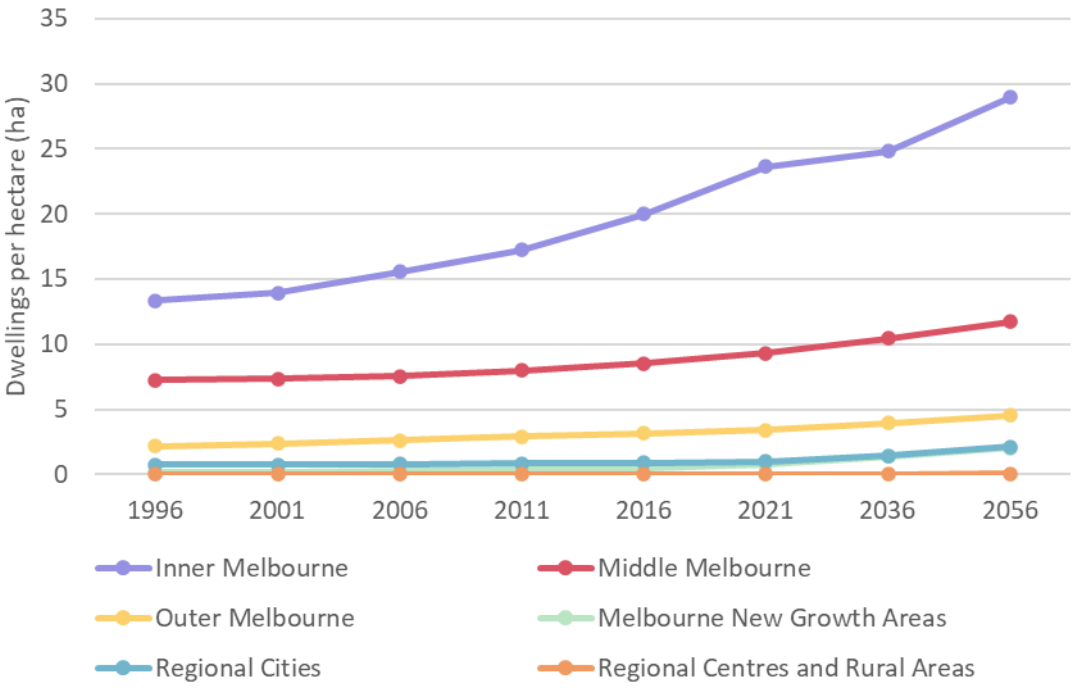
Between 2021 and 2036, dwelling growth in regional cities (10,000 per annum) reaches a level close to that of inner Melbourne (12,000 per annum) between 2011 and 2016. However, regional cities maintain a low gross dwelling density of 1.4 dwellings/ha in 2036 and 2.1 dwellings/ha by 2056. To sustain this low density, regional cities expand into their hinterlands (see Figure 59). Development in regional centres and rural areas reaches 14,000 dwellings annually between 2021 and 2036 and 21,000 annually in the following period as regional housing supply occurs at scale through greenfield development.

FIGURE 58: DWELLING GROWTH BY FUA (S5)



Source: SGS Economics and Planning, 2022

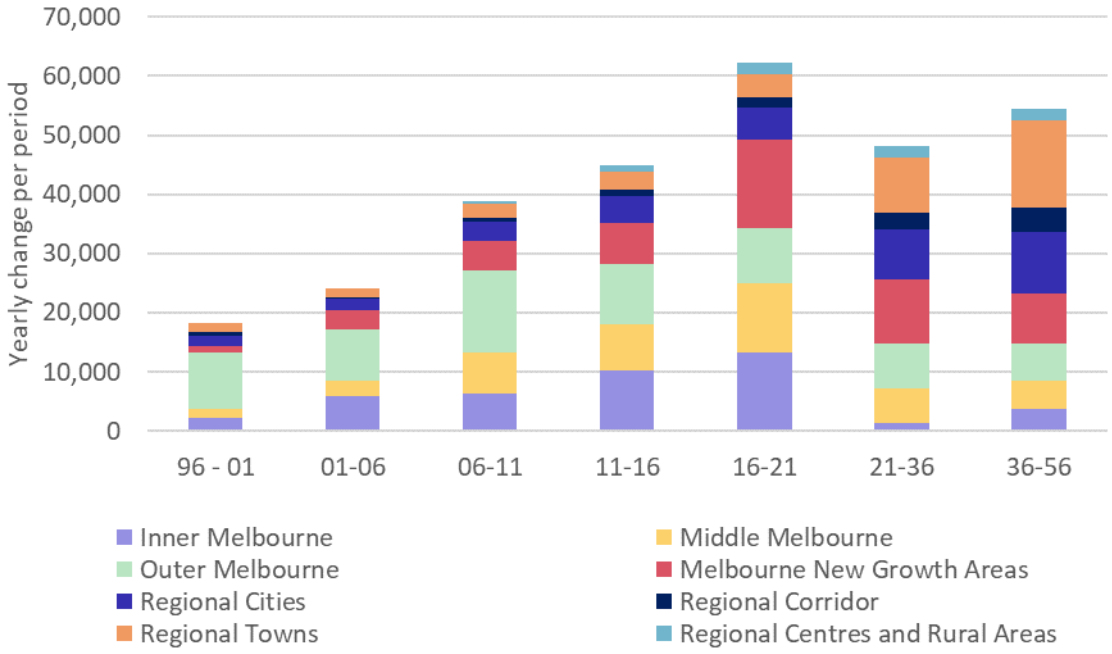
FIGURE 59: DWELLING DENSITY BY FUA (S5)



Source: SGS Economics and Planning, 2022

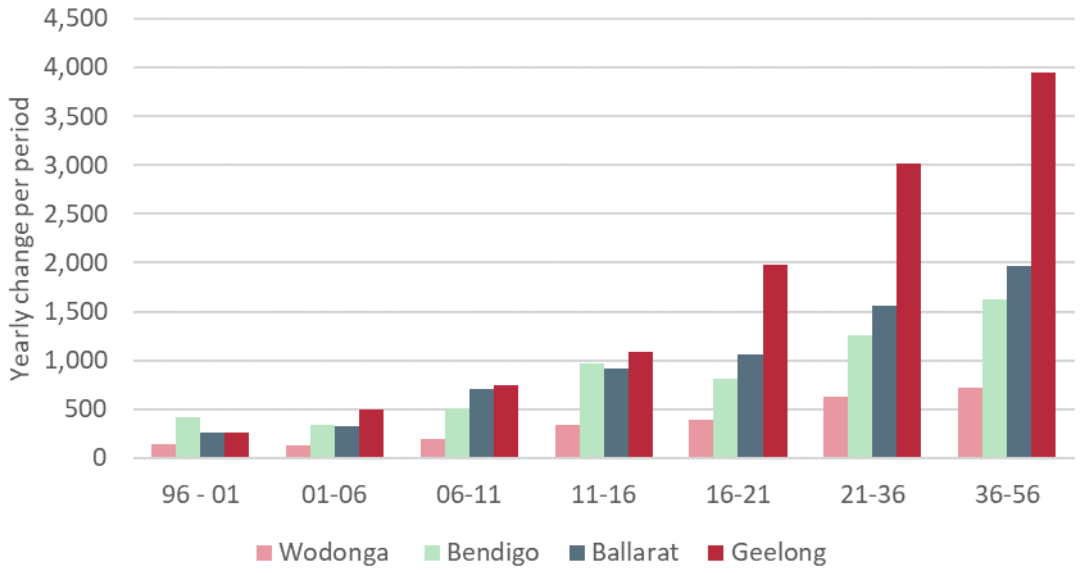
Regional towns and corridors emerge, connecting Melbourne and regional cities, and reach a yearly dwelling growth of over 2,800 between 2021 and 2036, surpassing that of inner Melbourne (1,600) during the same period (Figure 60).

FIGURE 60: YEARLY DWELLING GROWTH BY CHANGE AREA (S5)



Source: SGS Economics and Planning, 2022

FIGURE 61: YEARLY DWELLING GROWTH IN KEY REGIONAL CITIES (S5)

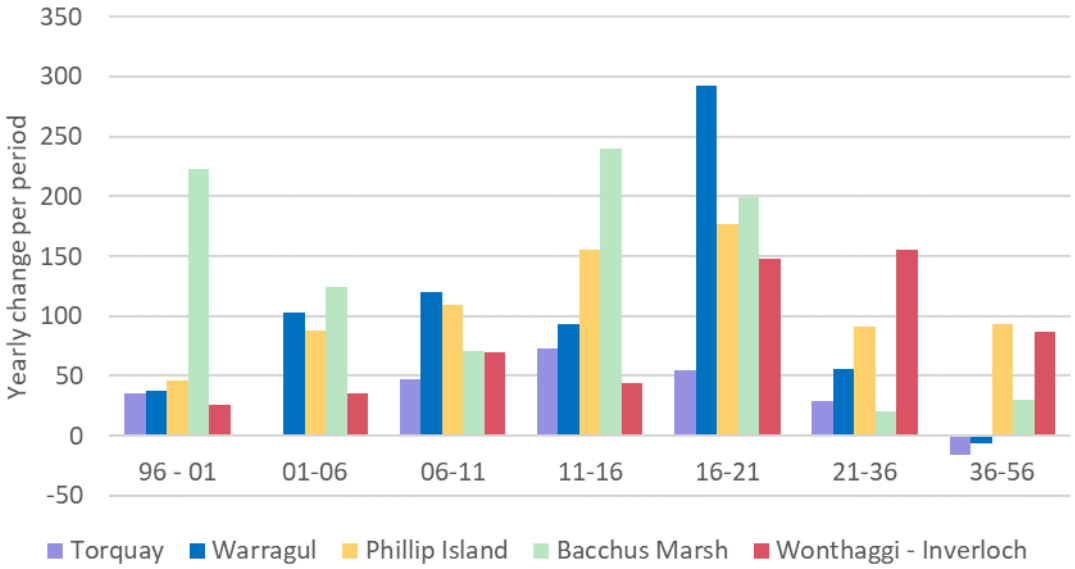


Source: SGS Economics and Planning, 2022

Figure 61 demonstrates the growth forecast in key regional cities and their surrounding suburbs under this scenario. Most significantly, the annual growth of dwellings in Geelong between 2036 and 2056 (over 4,000) is expected to double that of its annual growth between 2016 and 2021.

Particularly rapid dwelling growth occurs in regional towns such as Wonthaggi and Bacchus Marsh after 2021, as shown in Figure 62. The annual dwelling growth in Wonthaggi between 2036 and 2056 (over 1,600) is almost ten times the annual growth between 2011 and 2016.

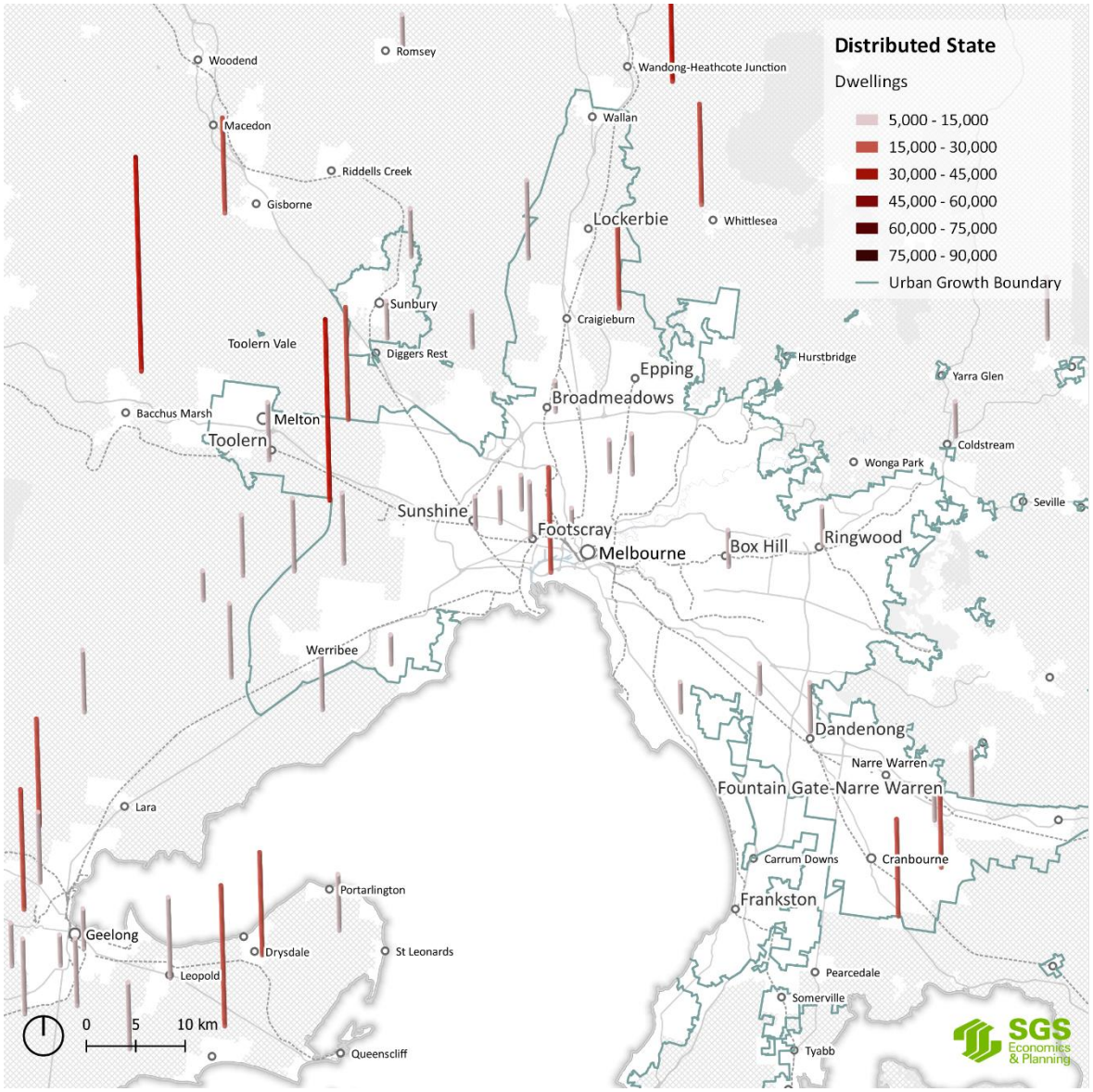
FIGURE 62: YEARLY DWELLING GROWTH IN KEY REGIONAL TOWNS (S5)

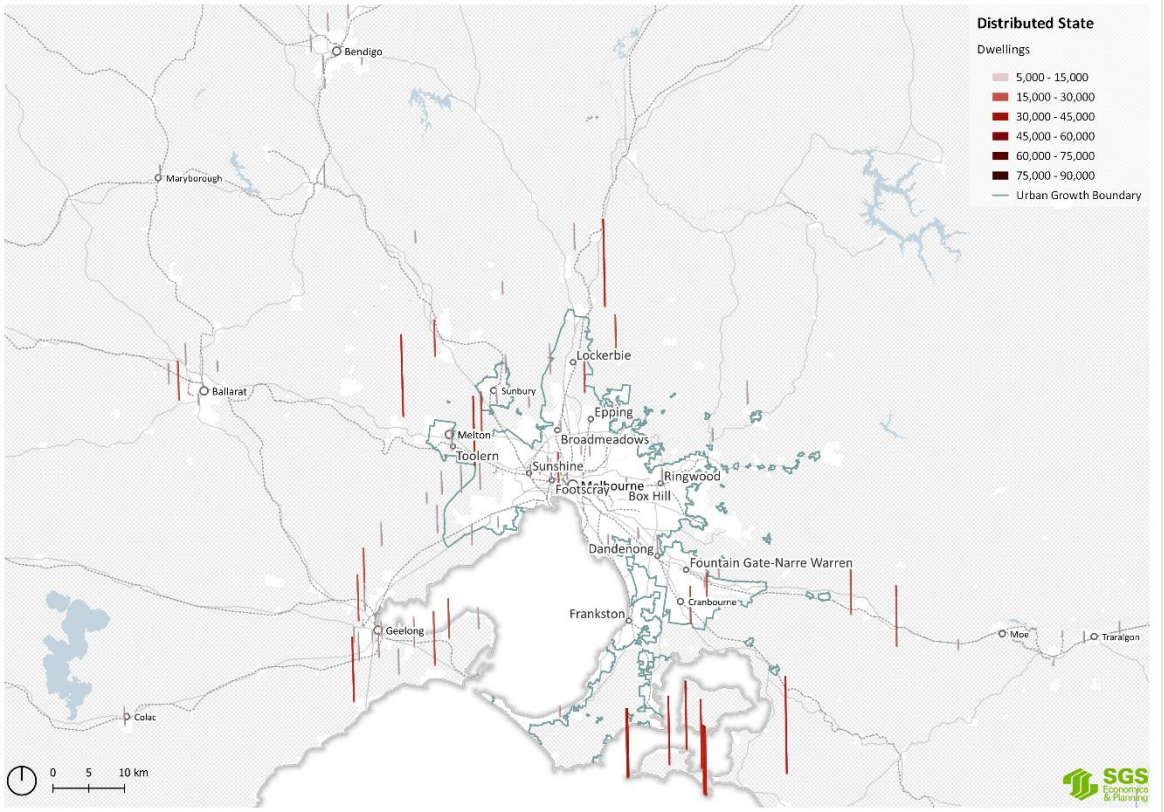


Source: SGS Economics and Planning, 2022

The spatial distribution of residential growth is also shown in Figure 63 which illustrates the outward pattern of growth that is dominant in Victoria by 2056.

FIGURE 63: DWELING GROWTH BY SA2, 2021-2056 (S5)





Employment

In the past, Melbourne was the economic powerhouse, dictating the pattern of urban development in Victoria and providing an economic hub as it transitioned to a knowledge economy. However, under this scenario, trends shift in line with the migration of populations to regional areas. As the expansion of inner Melbourne slows in the mid-2020s so too does employment. Although Melbourne remains an economic centre, the compound annual growth rate of jobs in inner Melbourne drops to 0.7 per cent between 2021 and 2056, under half of the annual growth rate experienced in the previous period.

A larger decline in jobs is experienced in Melbourne's new growth areas. Between 2006 and 2021, the annual growth rate was over 7 per cent. This declines sharply to under 2 per cent from 2021 onwards, resulting from remote working trends that allow people to work from home full time and the migration of people to regional cities. Population serving jobs also move from Melbourne's new growth areas to follow the pattern of migration.

A similar, though less pronounced, pattern occurs in outer Melbourne. Regional centres and rural areas experience a significant growth in jobs and have the highest annual growth rate between 2021 and 2056 at 2.5 per cent, surpassing that of inner Melbourne in the previous period.

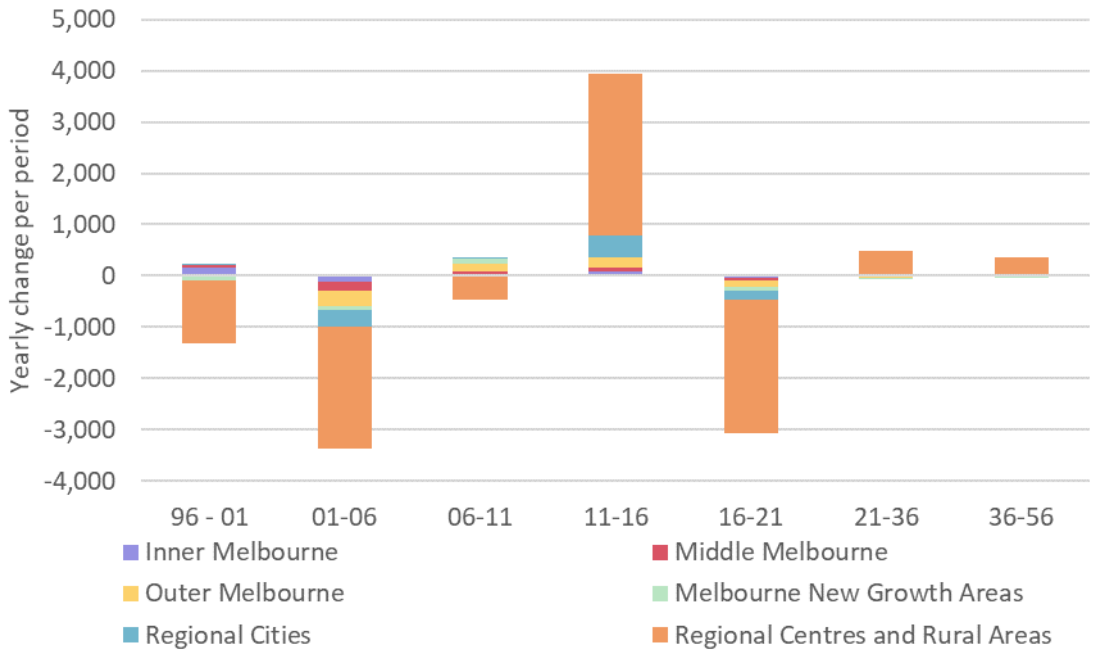
Figure 64 illustrates the decline in agricultural employment between 2016 and 2021 which grows only incrementally by 2056. This can be attributed to residential development in rural areas that encroaches on agricultural land from the mid-2020s in this scenario.

TABLE 10: TOTAL EMPLOYMENT GROWTH BY FUA (S5)

	2006-2021	2021-2036	2036-2056	Change 21-56	'06-21 CAGR	'21-56 CAGR
Inner Melbourne	257,000	162,000	95,000	257,000	2.1%	0.7%
Middle Melbourne	197,000	125,000	327,000	452,000	1.9%	1.3%
Outer Melbourne	291,000	166,000	120,000	286,000	2.9%	0.8%
Melbourne New Growth Areas	70,000	72,000	30,000	102,000	7.1%	1.9%
Regional City	80,000	166,000	232,000	398,000	1.7%	2.1%
Regional Centres and Rural Areas	67,000	194,000	348,000	542,000	1.2%	2.5%

Source: SGS Economics and Planning, 2022

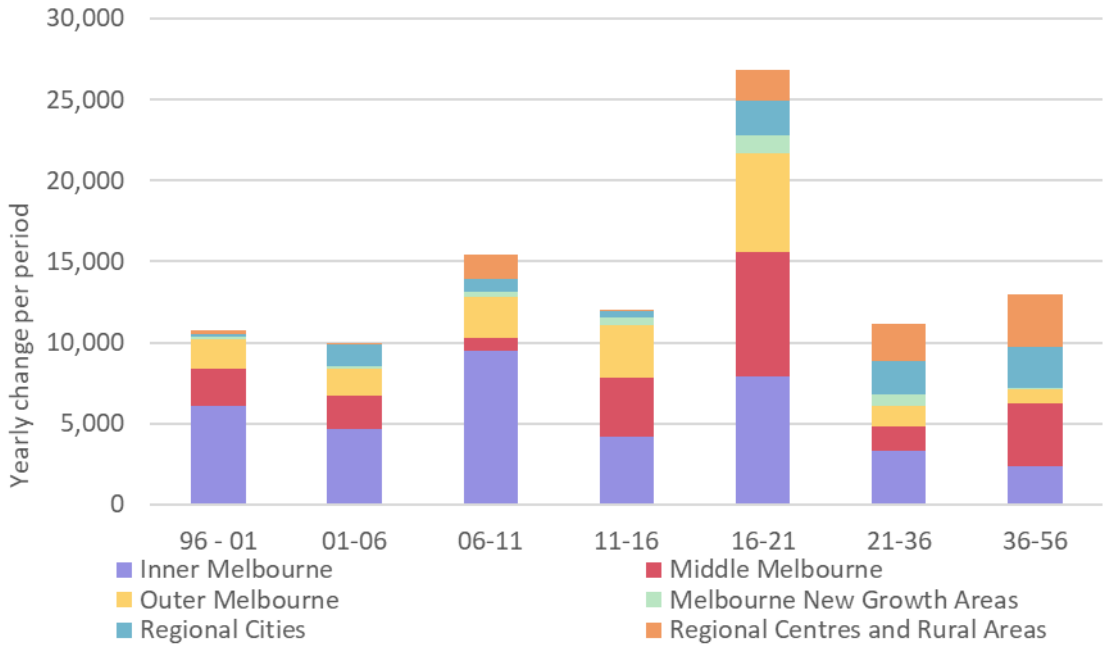
FIGURE 64: ANNUAL GROWTH IN AGRICULTURE EMPLOYMENT BY FUA (S5)



Source: SGS Economics and Planning, 2022

Employment growth in business and government services declines after 2021 as globalisation falters, reducing service exports and returning some industrial production to Australia. Any growth in business and government services is distributed relatively evenly between inner and middle Melbourne (6,300 annual jobs) and regional centres and rural areas (5,700 annual jobs). This reflects unprecedented population growth experienced in regional areas but also the stronghold inner and middle Melbourne retains in the knowledge economy.

FIGURE 65: ANNUAL GROWTH IN BUSINESS SERVICES EMPLOYMENT BY FUA (S5)

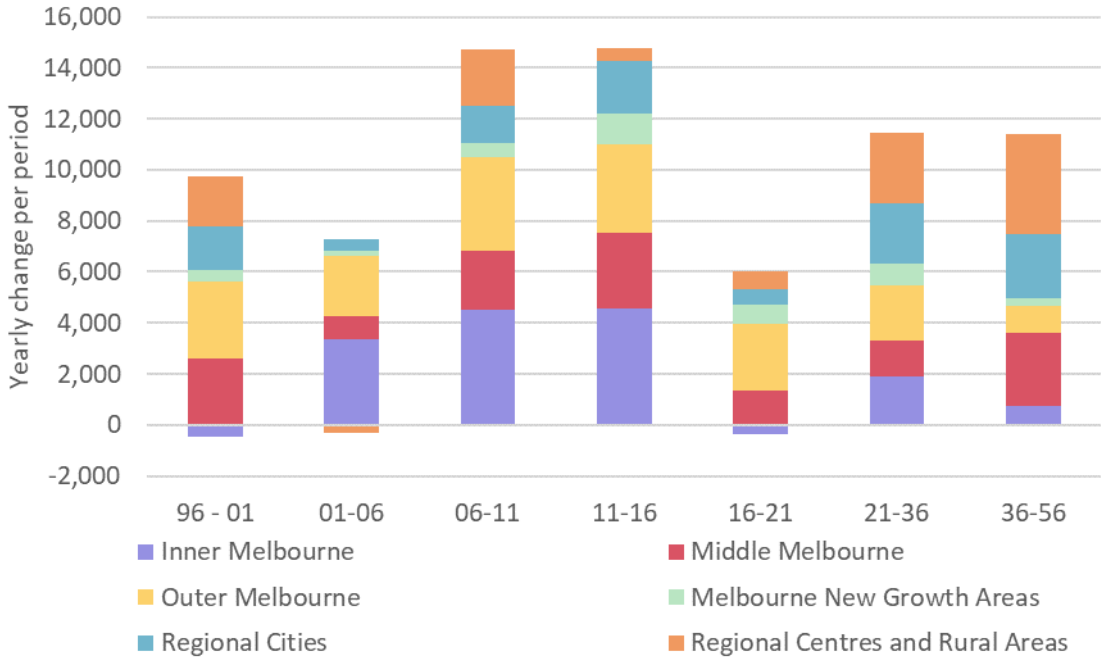


Source: SGS Economics and Planning, 2022

In other population serving sectors, employment growth follows the same spatial pattern as population. Figure 66 illustrates the spatial distribution of retail and hospitality employment growth under this scenario, showing the strong growth in regional centres and rural areas. By 2056, regional cities reach a self-containment[17] rate of 69 per cent compared to 72 per cent in middle Melbourne.

[17] Self Containment defined as the ratio of jobs to the available labour force.

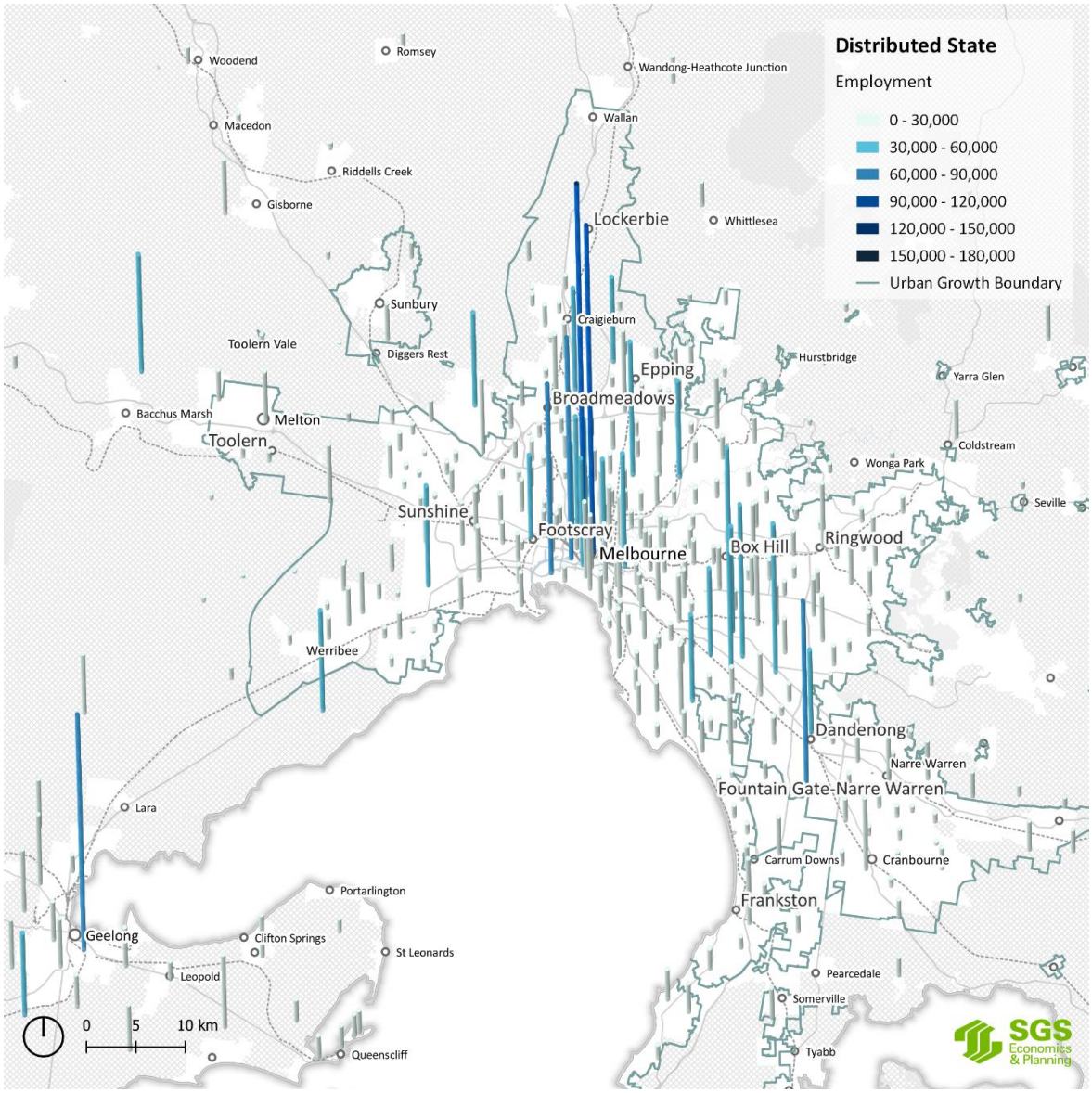
FIGURE 66: ANNUAL GROWTH IN RETAIL AND HOSPITALITY EMPLOYMENT BY FUA (S5)

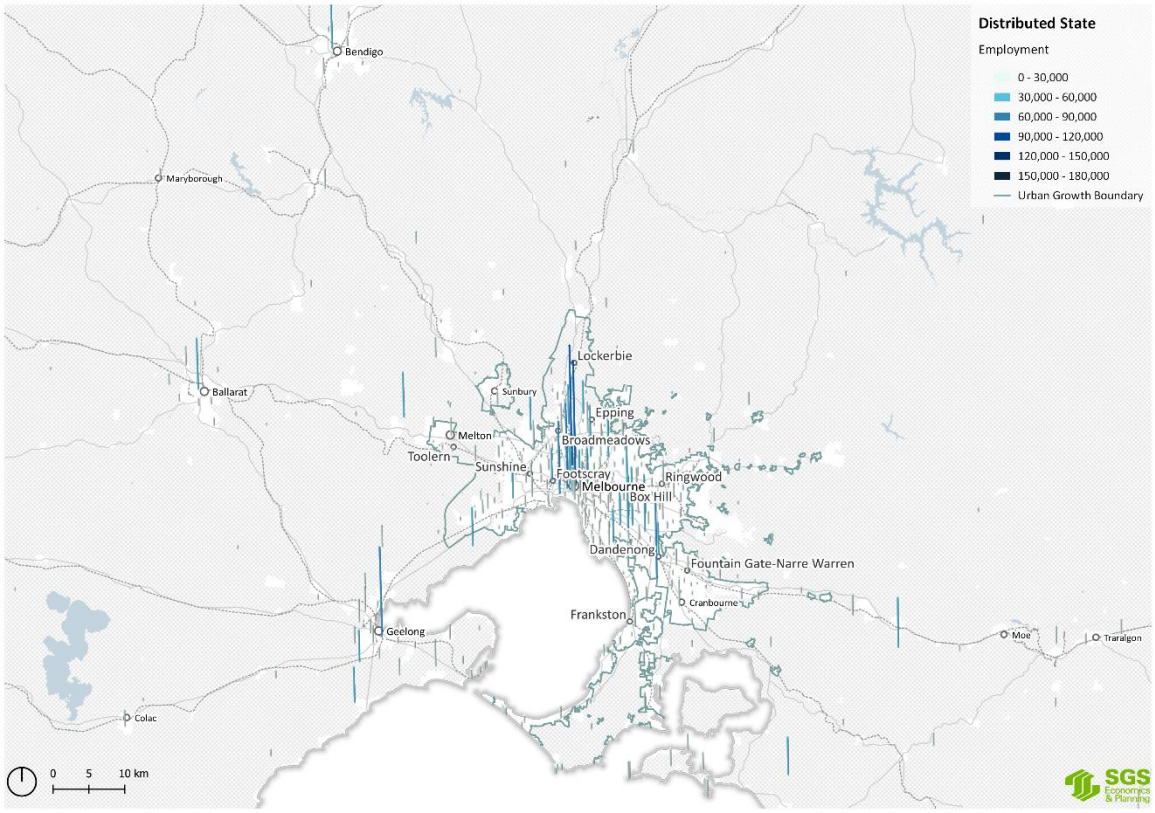


Source: SGS Economics and Planning, 2022

The spatial distribution of employment under this scenario is represented in Figure 67. This map highlights the emergence of employment in regional Cities and towns across Victoria in 2056 compared to the concentration of employment in inner Melbourne in 2021.

FIGURE 67: EMPLOYMENT GROWTH BY SA2, 2021-2056 (S5)




Distributed State
Employment
0 - 30,000
30,000 - 60,000
60,000 - 90,000
90,000 - 120,000
120,000 - 150,000
150,000 - 180,000
Urban Growth Boundary
Bendigo
Maryborough
Ballarat
Colac
Geelong
Lockerbie
Sunbury
Melton
Toolern
Sunshine
Epping
Broadmeadows
Footscray
Melbourne
Box Hill
Ringwood
Dandenong
Fountain Gate-Narre Warren
Cranbourne
Frankston
Moe
Traralgon
0 5 10 km
SGS Economics & Planning

9. Summary and Next Steps

The analysis of this report intends to show that there are several divergent urban development pathways for Victoria, with inter-related factors that can drive potential outcomes.

Policy and technology changes present an opportunity to pursue desired outcomes for the community that enables a liveable state for all.

The scenarios have assessed the various factors influencing urban development, particularly around the choices of the community to locate in metropolitan Melbourne or regional areas and the type of development that occurs, whether it be higher density living close to centres or in dispersed lower density development.

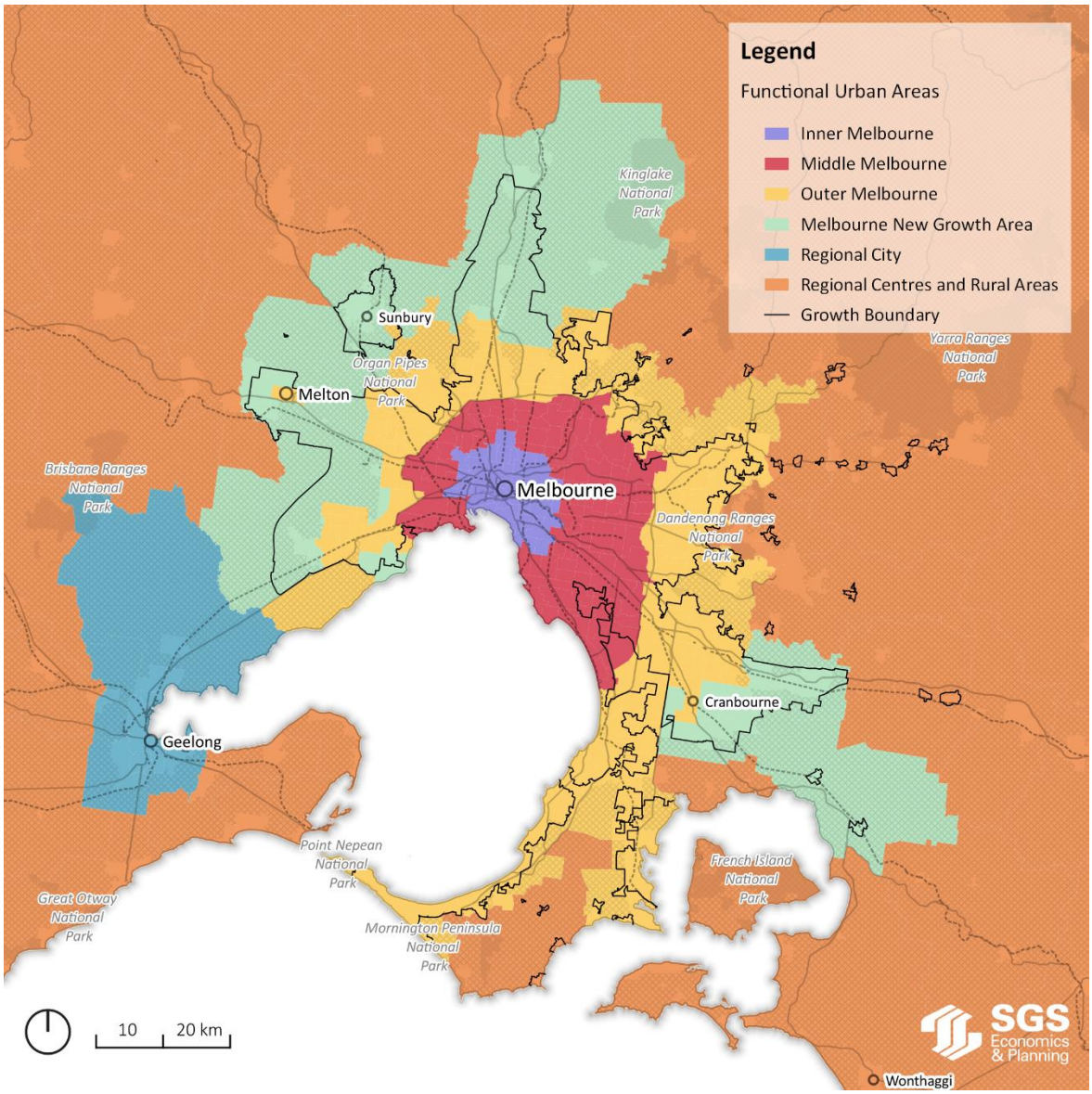
Victoria is projected to add approximately 2.4 million people, 1.1 million dwellings and 1.15 million jobs over the period from 2021-2056. The location and nature of these dwellings and jobs, and the infrastructure and services that connect them, will drive key outcomes for the people of Victoria and the economic conditions of the future.

The outputs and insights from the development of the five scenarios can be used as part of further assessments of how these futures would be experienced through utilising the methods and framework developed in Part B of this project can be used to determine how the population and employment distribution and composition would compare in a consolidated costs and benefits framework.

These scenarios can be further refined to a more granular level using additional bottom-up datasets to provide more details on place-based outcomes and growth trajectories, as well as incorporating up to date assumptions on the key trends and drivers shaping the urban future.

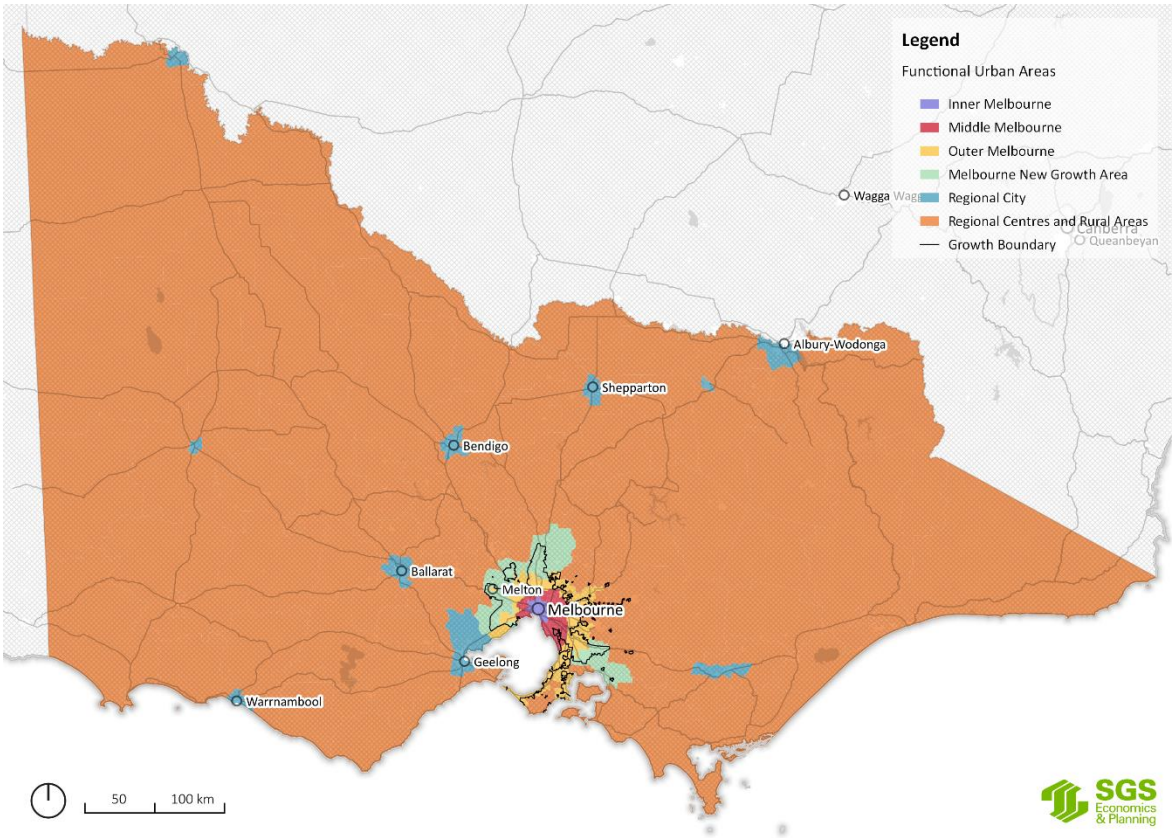
Appendix A: FUA and Change Area Maps

FIGURE 68: FUA, MELBOURNE



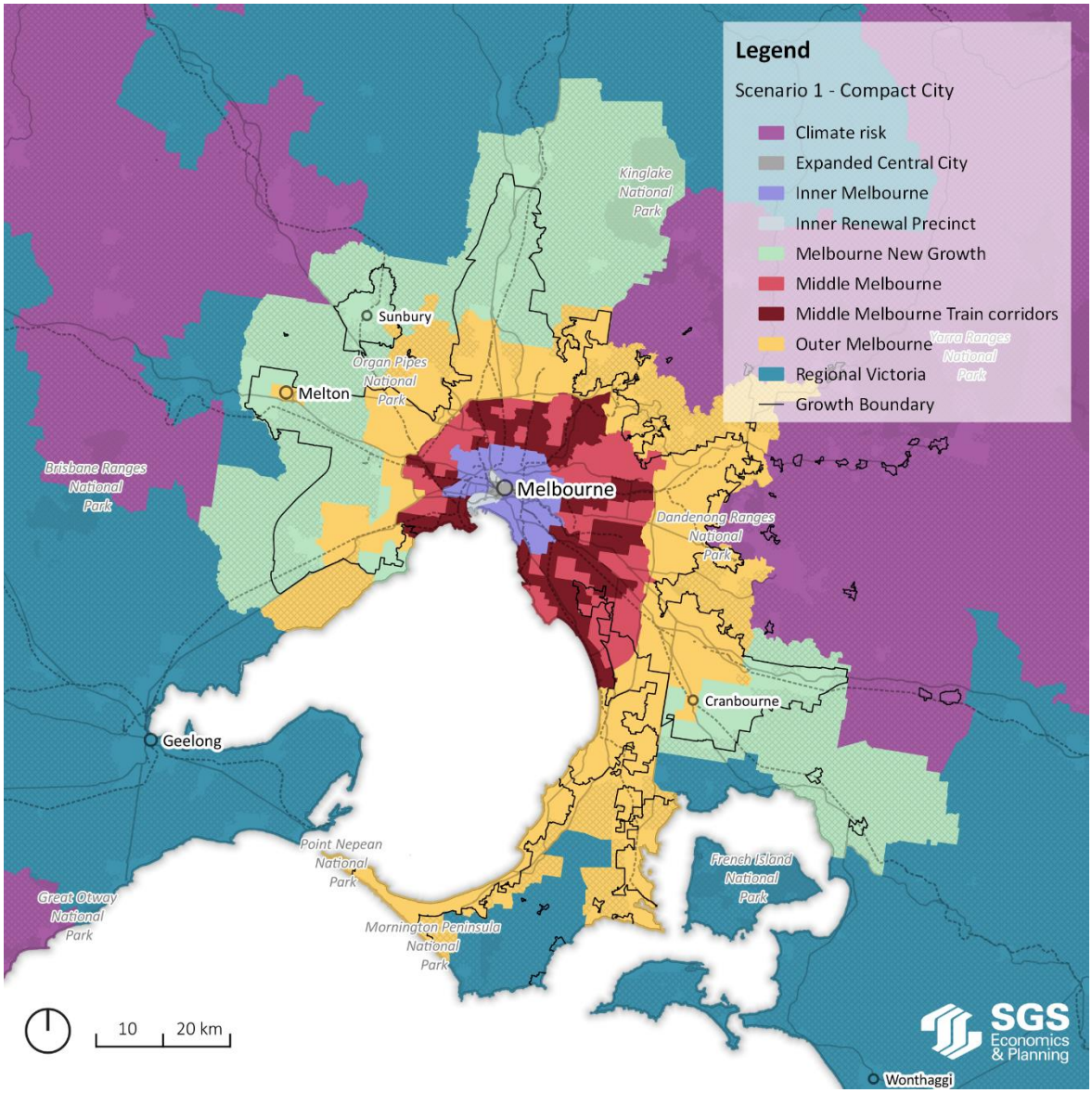
Source: SGS Economics and Planning, 2022

FIGURE 69: FUA, VICTORIA



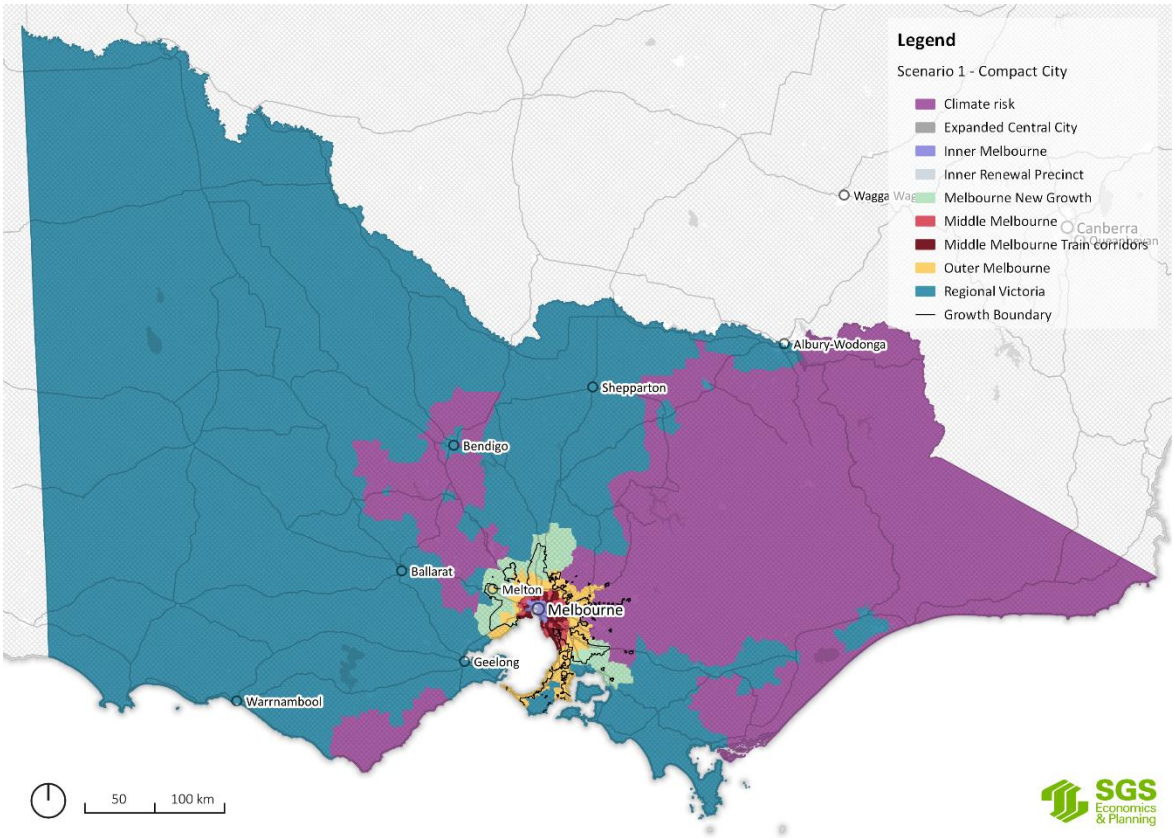
Source: SGS Economics and Planning, 2022

FIGURE 70: SCENARIO 1 (COMPACT CITY) CHANGE AREAS



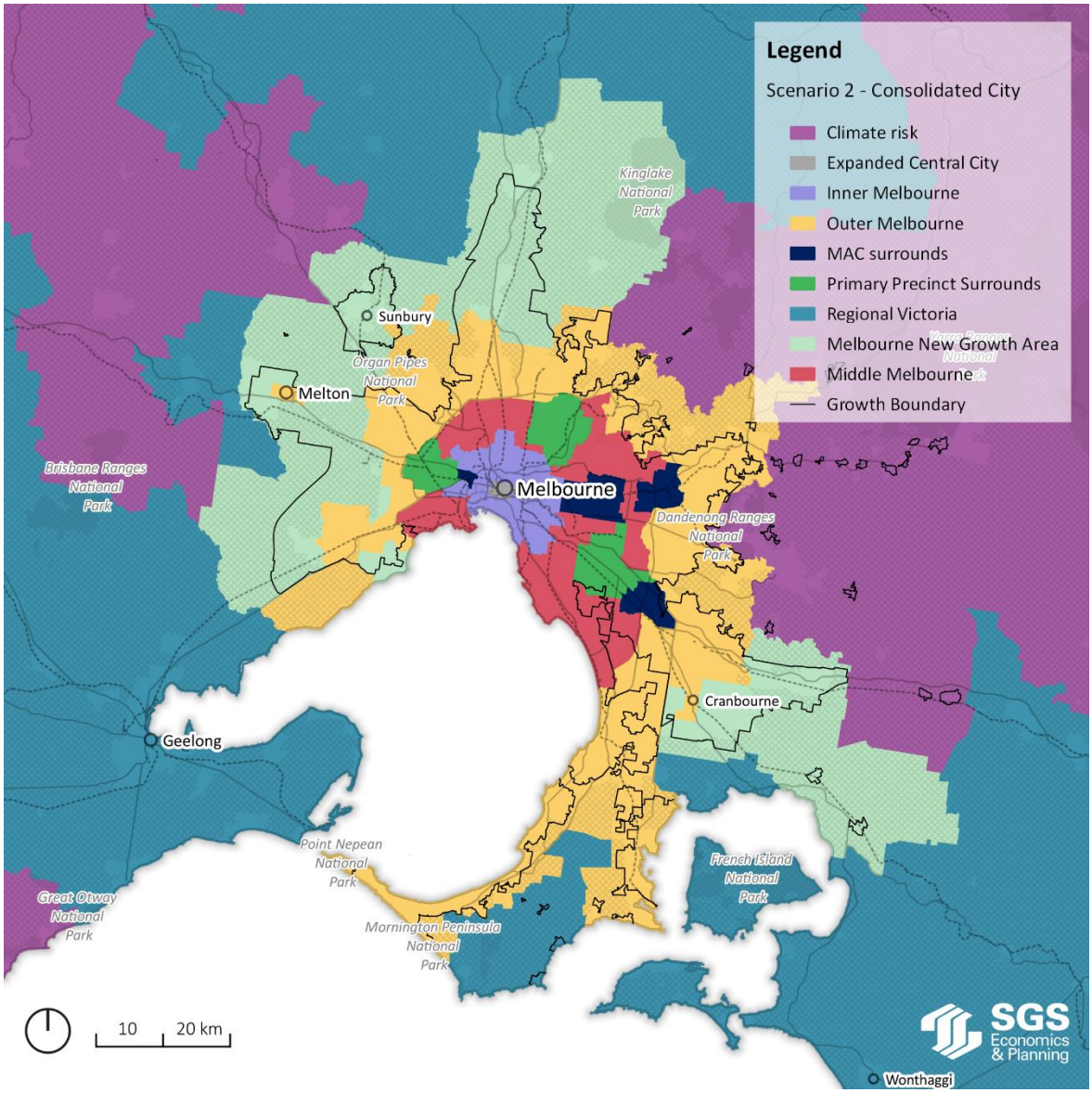
Source: SGS Economics and Planning, 2022

FIGURE 71: SCENARIO 1 (COMPACT CITY) CHANGE AREAS - VICTORIA



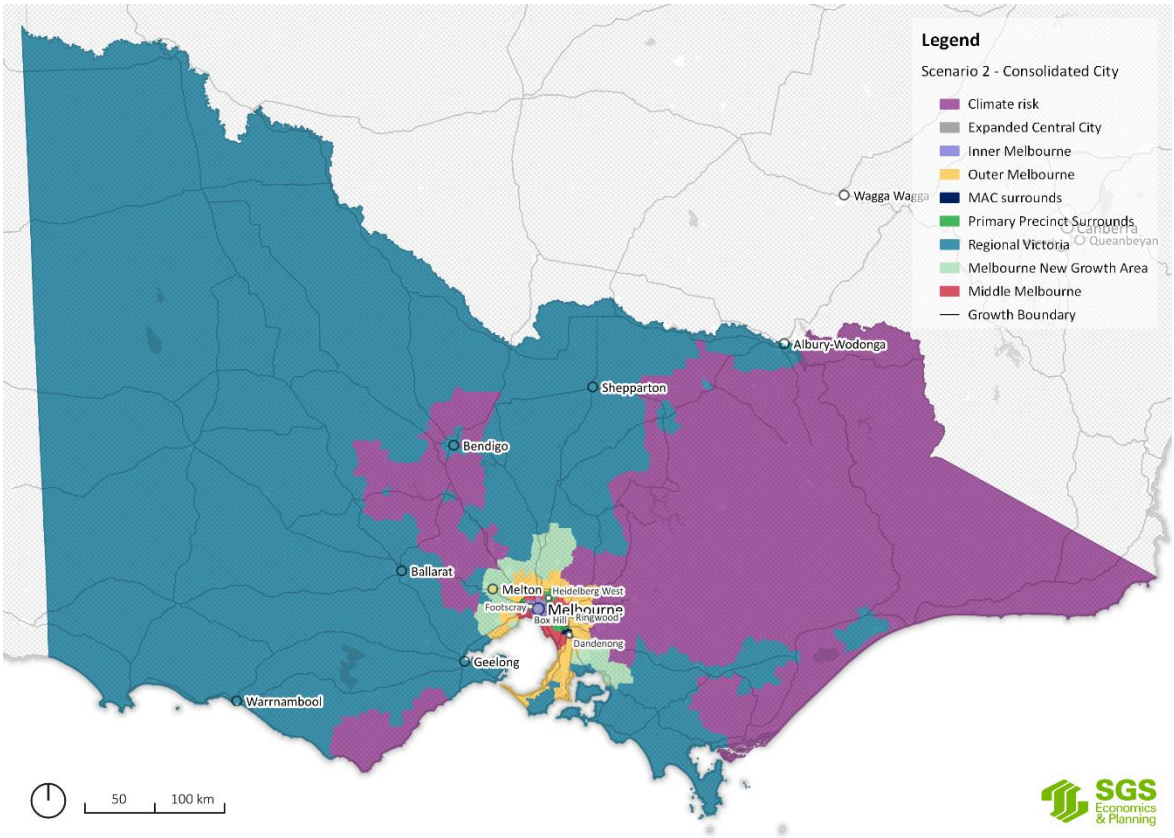
Source: SGS Economics and Planning, 2022

FIGURE 72: SCENARIO 2 (CONSOLIDATED CITY) CHANGE AREAS



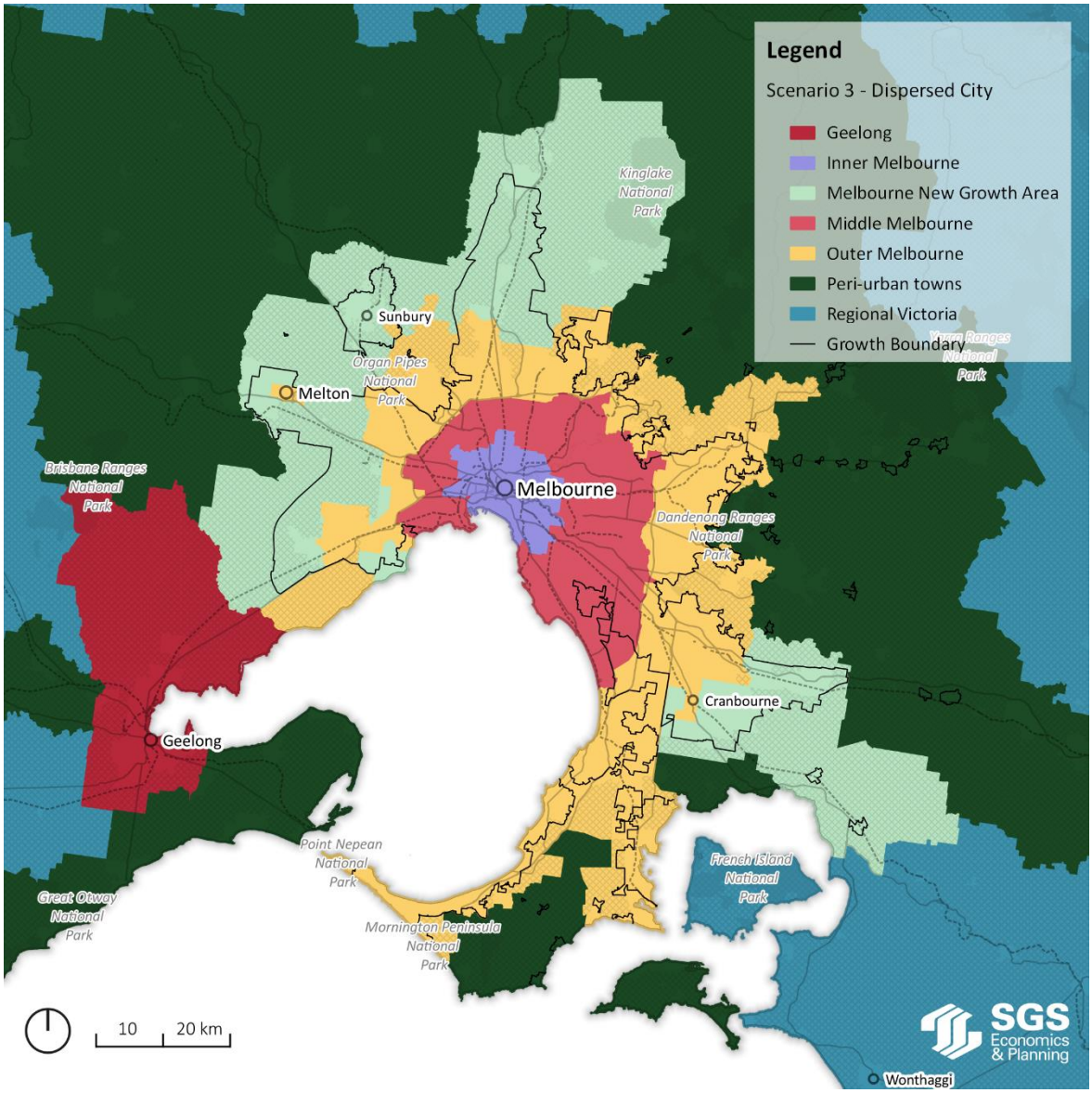
Source: SGS Economics and Planning, 2022

FIGURE 73: SCENARIO 2 (CONSOLIDATED CITY) CHANGE AREAS - VICTORIA



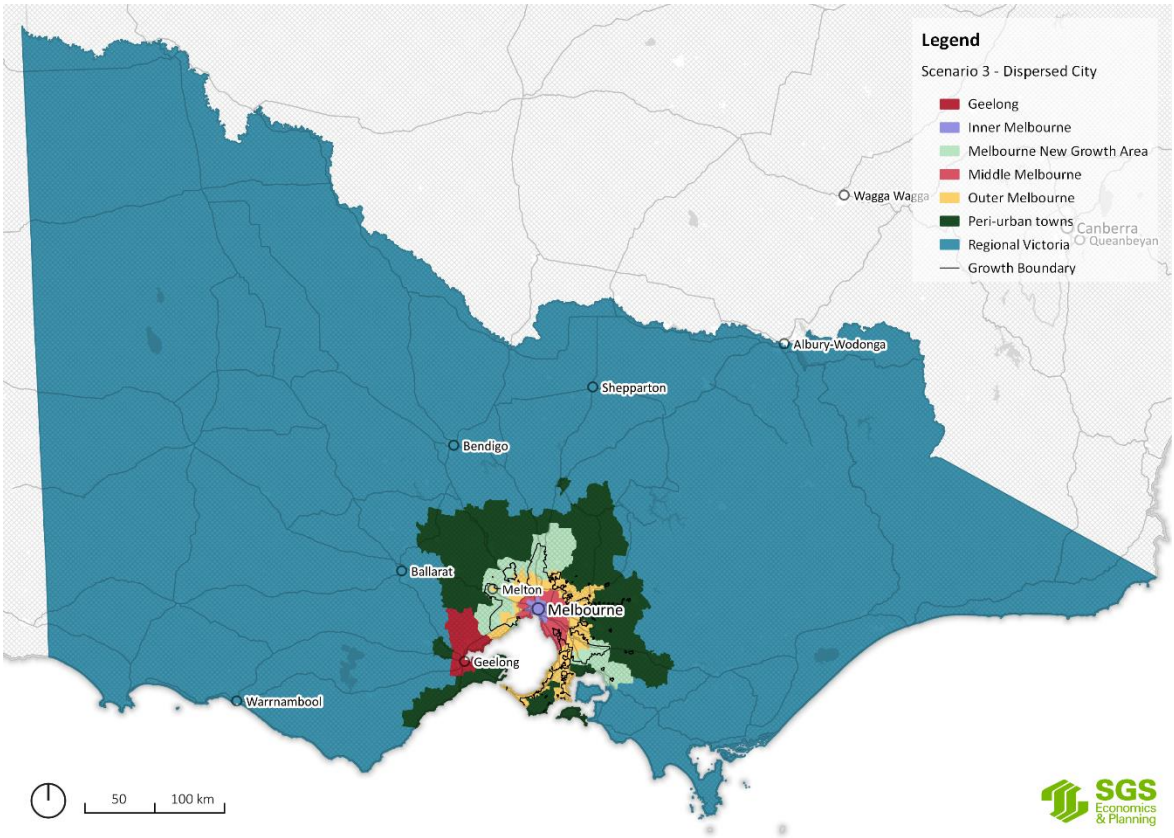
Source: SGS Economics and Planning, 2022

FIGURE 74: SCENARIO 3 (DISPERSED CITY) CHANGE AREAS



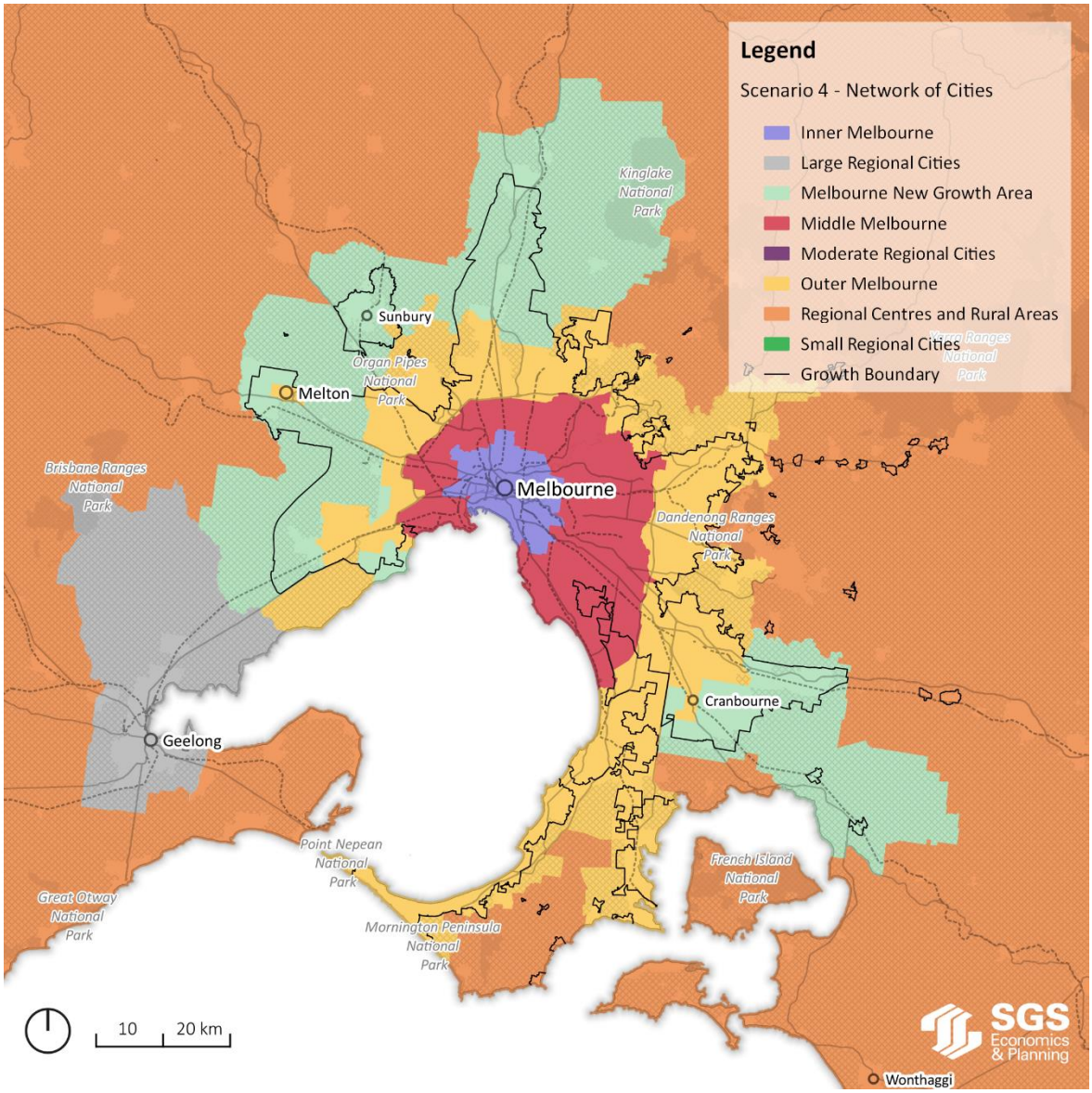
Source: SGS Economics and Planning, 2022

FIGURE 75: SCENARIO 3 (DISPERSED CITY) CHANGE AREAS - VICTORIA



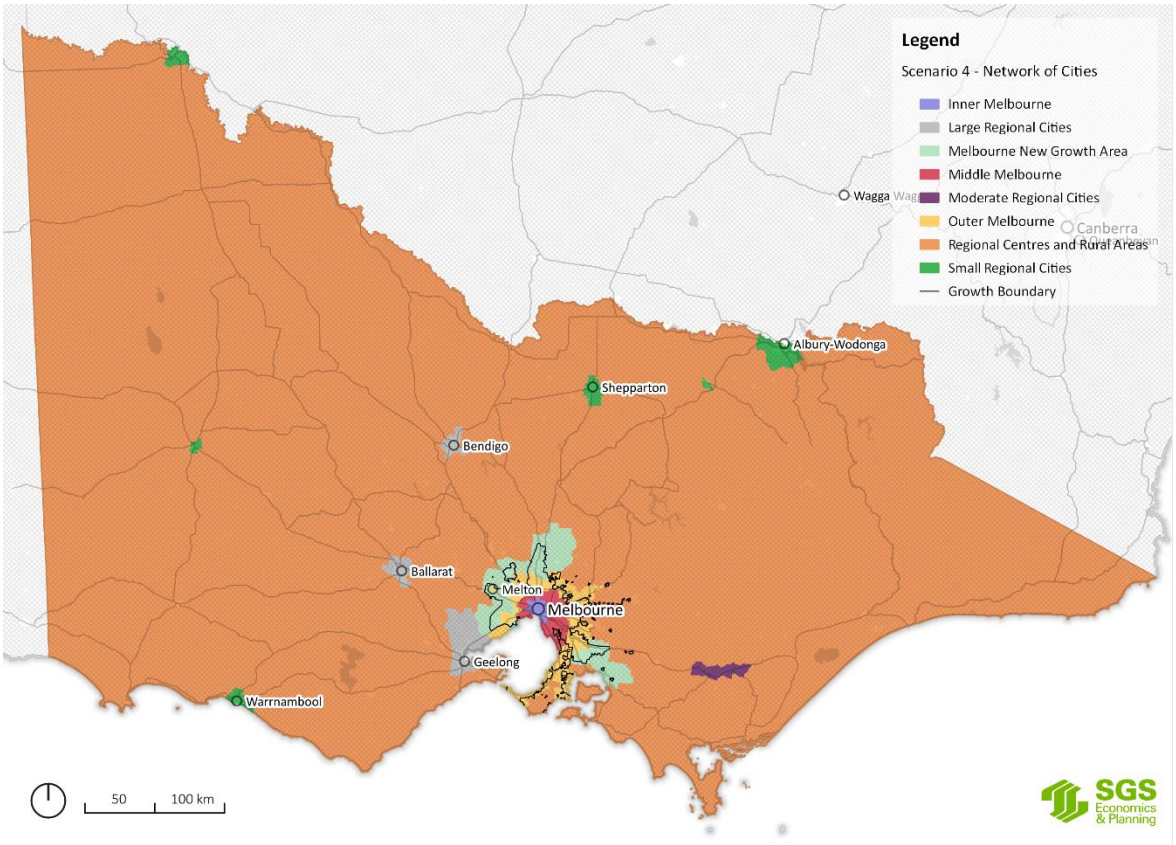
Source: SGS Economics and Planning, 2022

FIGURE 76: SCENARIO 4 (NETWORK OF CITIES) CHANGE AREAS



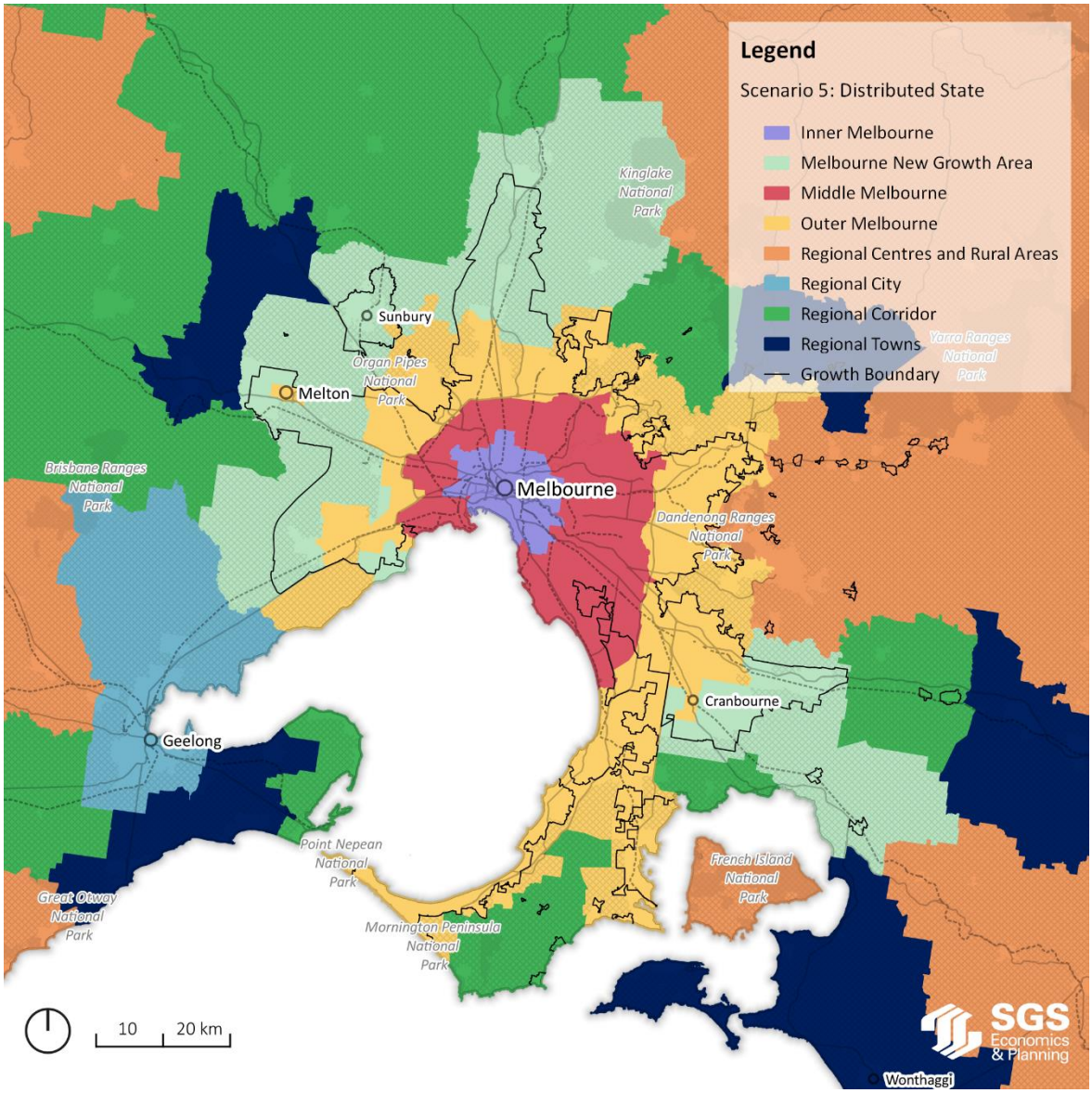
Source: SGS Economics and Planning, 2022

FIGURE 77: SCENARIO 4 (NETWORK OF CITIES) CHANGE AREAS - VICTORIA



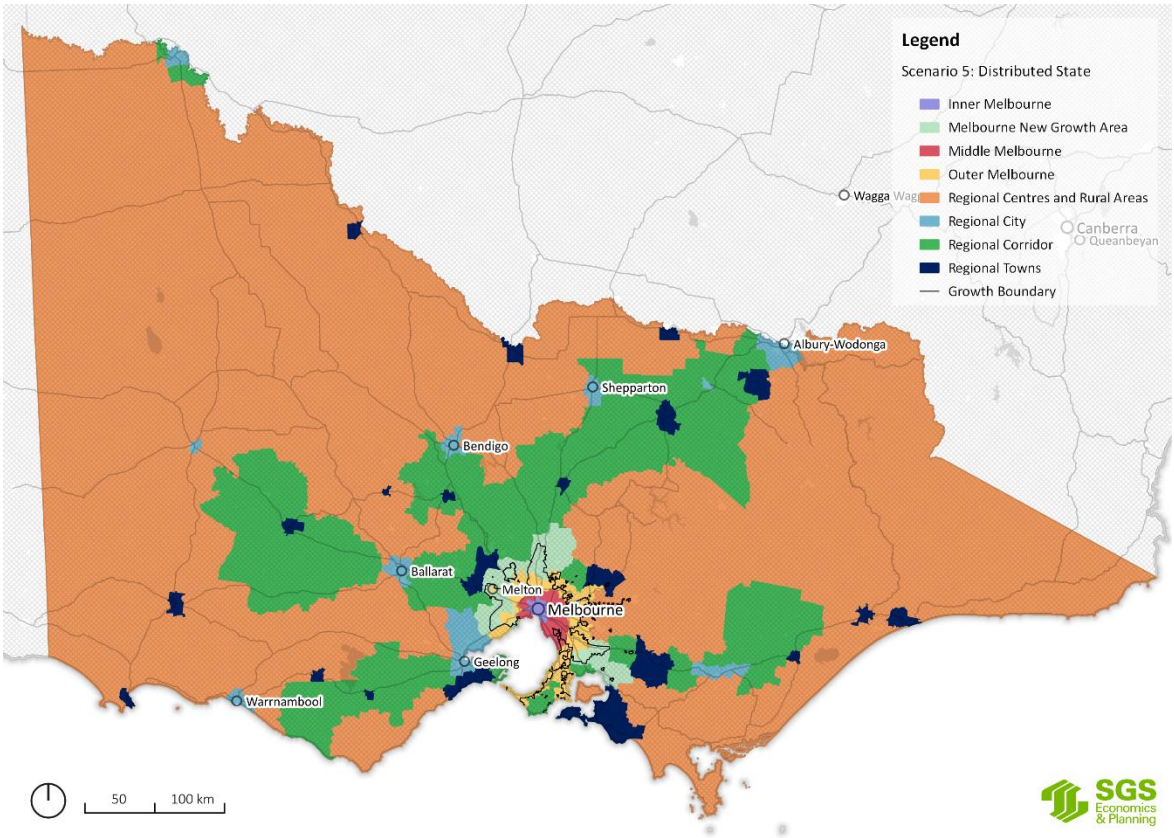
Source: SGS Economics and Planning, 2022

FIGURE 78: SCENARIO 5 (DISTRIBUTED STATE) CHANGE AREAS



Source: SGS Economics and Planning, 2022

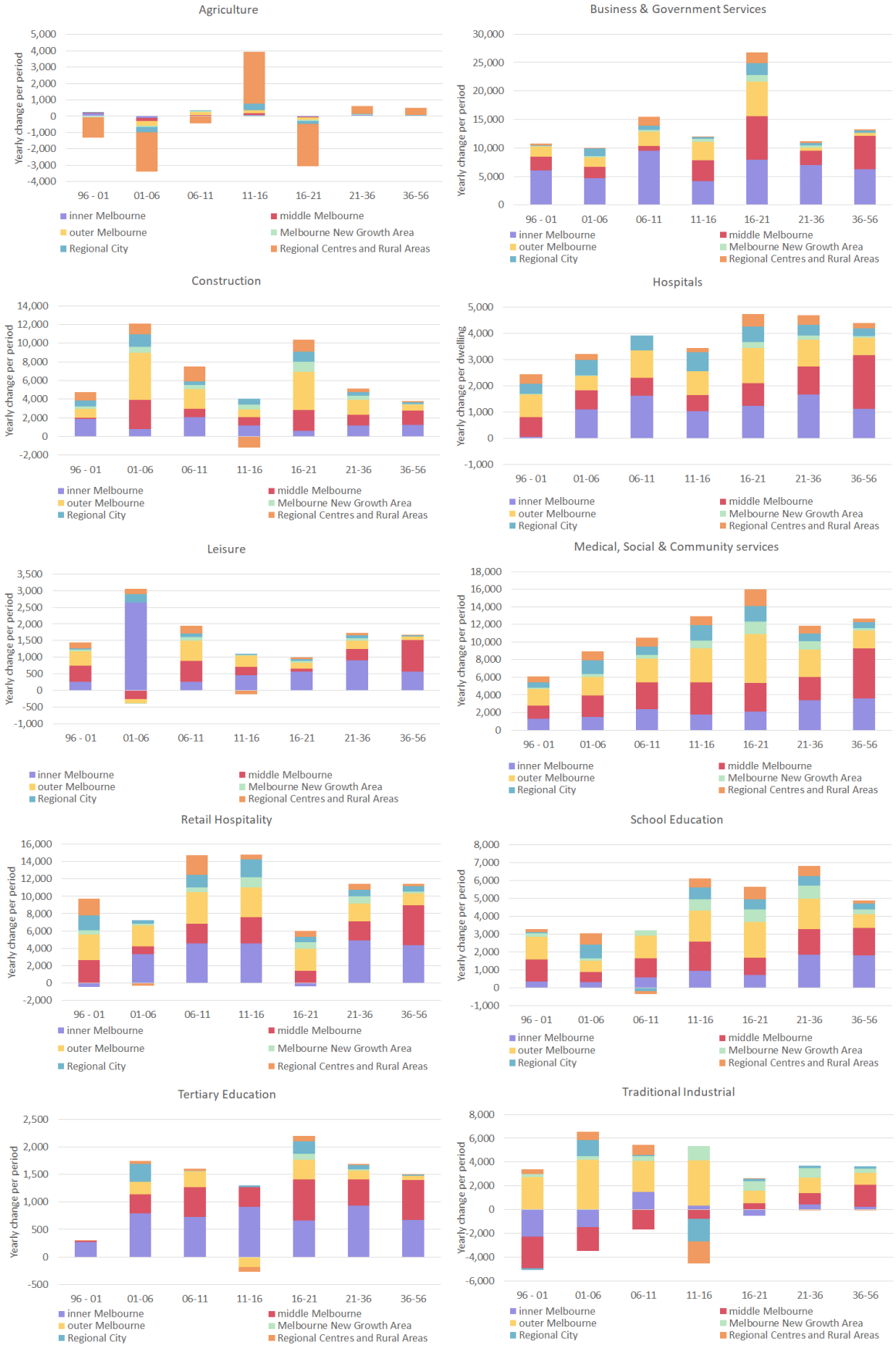
FIGURE 79: SCENARIO 5 (DISTRIBUTED STATE) CHANGE AREAS - VICTORIA



Source: SGS Economics and Planning, 2022

Appendix B: Additional Results

FIGURE 80: INDUSTRY GROWTH BY FUA (S1)



Source: SGS Economics and Planning, 2022

FIGURE 81: INDUSTRY GROWTH BY FUA (S2)

Source: SGS Economics and Planning, 2022

FIGURE 82: INDUSTRY GROWTH BY FUA (S3)

Source: SGS Economics and Planning, 2022

FIGURE 83: INDUSTRY GROWTH BY FUA (S4)

Source: SGS Economics and Planning, 2022

FIGURE 84: INDUSTRY GROWTH BY FUA (S5)

Source: SGS Economics and Planning, 2022

Appendix C: Definitions

TABLE 11: INDUSTRY CONCORDANCE

Broad Industry Category	ANZSIC 1-digit category (or 2-digit, where indicated in brackets)
Agriculture, Forestry and Fishing	Agriculture, Forestry and Fishing
Traditional Industrial	Mining
Traditional Industrial	Manufacturing
Traditional Industrial	Electricity, Gas, Water and Waste Services
Traditional Industrial	Wholesale Trade
Traditional Industrial	Transport, Postal and Warehousing
Traditional Industrial	Rental and Hiring Services (except Real Estate) **(2-digit)**
Traditional Industrial	Repair and Maintenance **(2-digit)**
Construction	Construction
Retail & Hospitality	Retail Trade
Retail & Hospitality	Accommodation and Food Services
Retail & Hospitality	Personal and Other Services **(2-digit)**
Retail & Hospitality	Property Operators and Real Estate Services **(2-digit)**
Business and Government Services	Information Media and Telecommunications
Business and Government Services	Financial and Insurance Services
Business and Government Services	Professional, Scientific and Technical Services
Business and Government Services	Administrative and Support Services
Medical, Social & Community services	Public Administration and Safety
Medical, Social & Community services	Other Education **(2-digit)**

Medical, Social & Community services	Residential Care and Social Assistance Activities **(2-digit)**
Medical, Social & Community services	Medical and Other Health Care Services **(2-digit)**
Tertiary Education	Tertiary Education **(2-digit)**
School Education	School Education **(2-digit)**
Hospitals	Hospitals **(2-digit)**
Leisure	Arts and Recreation Services

TABLE 12: DATA SPECIFICATION

Place of Count	Category	Variable
PUR	Population by Age	Persons 0-14
PUR	Population by Age	Persons 15-24
PUR	Population by Age	Persons 25-44
PUR	Population by Age	Persons 45-64
PUR	Population by Age	Persons 65-84
PUR	Population by Age	Persons 85+
PUR	SPD	Structural Private Dwellings
POW	EMP	Employment/Jobs - Agriculture
POW	EMP	Employment/Jobs - Business & Government Services
POW	EMP	Employment/Jobs - Construction
POW	EMP	Employment/Jobs - Hospitals
POW	EMP	Employment/Jobs - Medical, Social & Community services
POW	EMP	Employment/Jobs - Retail & Hospitality
POW	EMP	Employment/Jobs - Leisure
POW	EMP	Employment/Jobs - School Education
POW	EMP	Employment/Jobs - Tertiary Education
POW	EMP	Employment/Jobs - Traditional Industrial

Appendix D: Technical Appendix

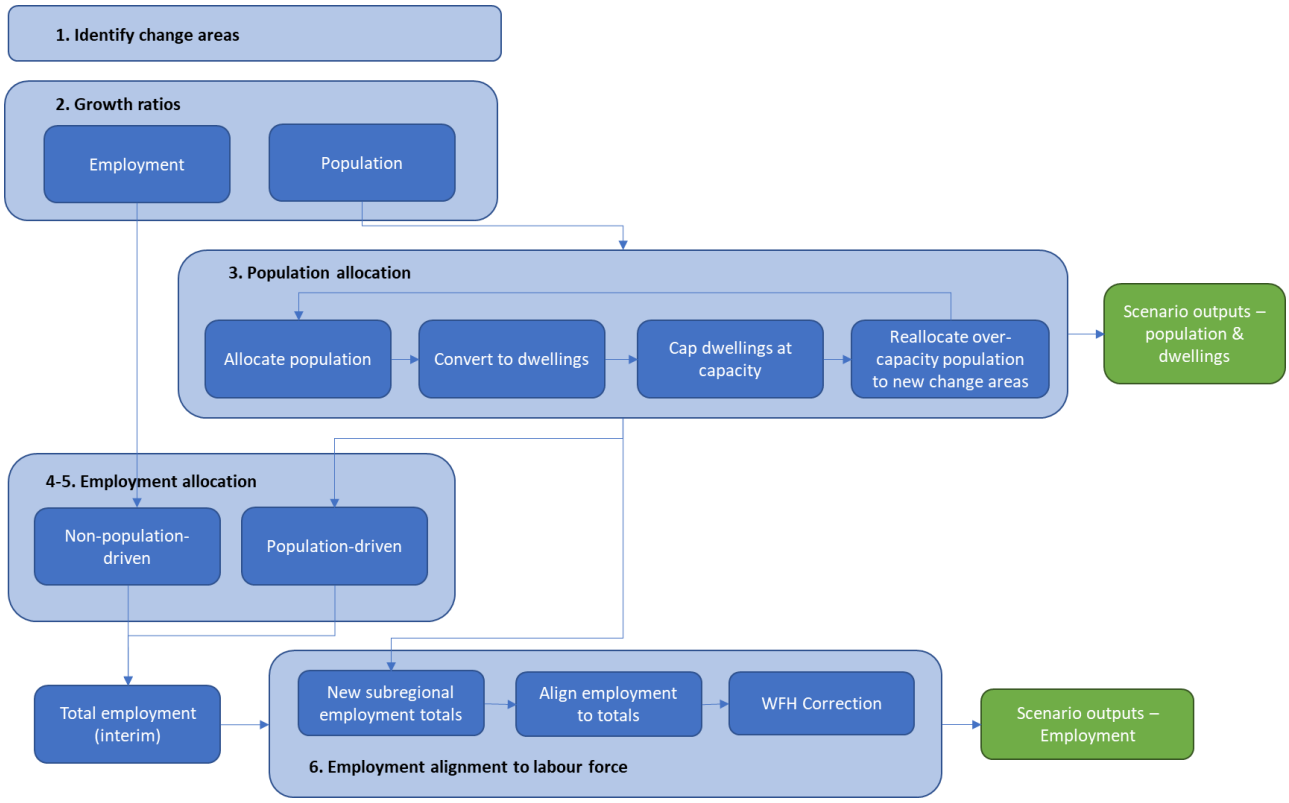
The method for creating scenarios had the following steps, which are discussed in more detail below. The steps included:

1. Change Areas - Develop change area boundaries.
2. Growth Ratios - Develop growth ratios and overall shifts in population and employment for each change area.
3. Population Allocation - Allocate population growth from change areas to SA2s, apply age breakdowns and convert to dwellings.

   In this step, growth is capped for selected SA2s which have a well-defined ultimate dwelling development capacity.
4. Employment Allocation (population-driven) - Calculate shifts in population-driven employment as a result of shifts in population growth.
5. Employment Allocation (all other sectors) - Allocate shifts in non-population-driven employment from change areas into individual SA2s.
6. Employment Alignment to Labour Force - Align total employment and labour force for Greater Melbourne and each other subregion in Victoria, with a correction for scenarios 4-5 to account for more people working from home.

The scenarios were created off a base case population and employment projection, for which SALUP22 was used. SALUP22 is a detailed small-area land use projection for population, labour force and employment across Victoria, which is widely used by the Victorian Government. It is aligned with the Victoria in Future population projections at the SA2 level. State-wide population and employment totals, as well as the population-age breakdown, from SALUP were maintained for each land use scenario.

This is also shown conceptually below:



Step 1. Change areas

Modelling was conducted using 2021 ABS SA2s as the base geography. These were grouped into change areas for each scenario. Change areas are broad parts of the state with similar growth drivers for a particular scenario, and for which a broad growth modifier can be used (as discussed in the next step).

The change areas used are mapped in Appendix A.

Step 2. Growth ratios

In this step, scenario narratives were converted into growth ratios, and then shifts in population and employment between each change area.

Population growth ratios

Population shifts for each scenario and change area were first described qualitatively for each change area in terms of the direction of change and size of change compared to the base case projection (e.g. large decrease from base case, small increase from base case, no change from base case).

Growth ratios were then created for each scenario, change area and time period, expressing how the level of growth would compare quantitatively to the base case. For example, a growth ratio of 1.5 would mean that there would be 1.5 times as much growth in that change area as under the base case and would represent a moderate or large increase, while a growth ratio of 0.9 would mean 10% less growth and could represent a small decrease. The sizes of these ratios were adjusted iteratively for each scenario based on the scenario narratives, growth drivers, past trends and expectations of the total scale of shift that could occur.

Growth ratios were applied to the whole population in each change area, without considering individual age groups.

Growth ratios were always assumed to be greater than zero. That is, the scenarios were not assumed to cause extreme enough shifts in population to drive any change area from an increasing population to a decreasing population.

The total population in Victoria was kept constant across all scenarios and for each time period. As a result, adjustments to population shifts (as described by initial growth ratios) were required to ensure that increases in growth were balanced by decreases in other areas, and so the total population was unchanged.

The overall growth ratios (2021 – 2056) for each scenario are shown in the following table. These are taken from after the adjustment to balance population increases and decreases.

Scenario 1		Scenario 2		Scenario 3	
Expanded central City	1.81	Inner Melbourne	0.94	Inner Melbourne	0.50
Inner Renewal Precincts	1.95	Primary Middle Ring Precincts - Heidelberg and Latrobe	1.40	Middle Melbourne	0.51
Inner Melbourne	1.84	Primary Middle Ring Precincts - Monash	1.40	Outer Melbourne	1.20
Middle Melbourne Train Corridors	1.27	Primary Middle Ring Precincts - Sunshine	1.35	Melbourne New Growth Areas	1.37
Middle Melbourne (Other)	1.11	Middle Ring MACs - Box Hill	1.40	Geelong	1.50
Outer Melbourne	0.75	Middle Ring MACs - Other	1.24	Peri-urban Towns	1.50
Melbourne New Growth	0.70	Primary Precinct Surrounds - Clayton	1.13	Regional Victoria	1.00
Climate Risk	0.25	Primary Precinct Surrounds - Heidelberg	1.26		
Regional Victoria	0.80	Primary Precinct Surrounds	1.21		
		MAC Surrounds - Box Hill	1.24		
		MAC Surrounds - Other	1.17		
		Middle Melbourne	1.13		
		Outer Melbourne	0.92		
		Melbourne New Growth Areas	0.93		
		Regional Victoria	1.00		
		Climate risk	0.61		

Scenario 4		Scenario 5	
Inner Melbourne	0.75	Inner Melbourne	0.50
Middle Melbourne	0.60	Middle Melbourne	0.49
Outer Melbourne	0.90	Outer Melbourne	0.74
Melbourne New Growth Areas	0.90	Melbourne New Growth Areas	0.76
Large regional cities	2.77	Regional Cities	1.82
Moderate Regional Cities	1.88	Regional Corridors	2.99
Small Regional Cities	1.55	Regional Towns	4.20
Regional Centres and Rural Areas	1.22	Regional Centres and Rural Areas	1.34

Employment growth ratios

The same process was followed to create employment growth ratios, with a ratio created for each combination of scenario, time period, change area and industry.

As with population growth ratios, all growth ratios were assumed to be positive. That is, none of the scenarios will cause shifts in employment great enough to mean that employment in an area growing in the baseline projection will shrink in the scenario.

Total employment across Victoria was kept constant in all scenarios. Employment within each industry was also fixed in scenarios one and two. This meant that as with population, adjustments to growth (as described by the initial employment growth ratios) were required to balance increases and decreases in employment state-wide and for relevant industries.

Small shifts in the overall industry composition were allowed in other scenarios. The size of these shifts were modelled by not performing the adjustment described above.

Step 3. Population allocation

In this step, shifts in population between each change area were allocated into SA2s, and a breakdown in age is added.

The previous step gave new population growth totals for each scenario, change area and time period. The following process was iterated to allocate this population growth into SA2s and calculate resulting dwelling requirements, with the process continuing until all growth is allocated.

1. Allocate population growth (or decline) into SA2s based on SALUP base case population and growth. The key assumption made here is that the growth distribution will be in line with the base case within each change area.
2. Convert population to structural private dwellings (SPD), assuming:
    - Occupancy rates will be the same as under the base case
    - Initial estimates of average household size are aligned with the base case
    - Household sizes vary based on the population age profile and 2016 demographic data on living arrangements from the ABS census
3. Cap dwellings in greenfield growth areas and major urban renewal precincts in line with established capacity figures (for example capacity under approved subdivisions, PSPs or structure plans).

    Caps were also applied to SA2s and parts of SA2s which are in the Melbourne new growth areas FUA to ensure that unreasonably high growth is not allocated to these areas. Where there was no relevant PSP from which a cap could be determined, a cap of 20% above the base case forecast growth to 2056 was applied.
4. Determine population growth that needs to be reallocated above the cap and return to step 2

    If an entire change area was full, additional growth was redistributed into another nominated change area. Additional growth from inner Melbourne urban renewal areas was redistributed into inner Melbourne, while additional growth from Melbourne new growth areas was redistributed into either outer Melbourne or peri-urban Melbourne depending on the scenario growth drivers.

Age information was added to the population totals in each SA2 by initially assuming that the age profile of each SA2 (i.e. % of people in each age group) would remain the same in each scenario as in the base case. The RAS method was then used to correct the population-age profiles in each SA2 so that the state-wide population-age profile, and the population total per SA2, were maintained.

Step 4-5. Employment allocation

Step 2 implies total employment growth (or decline) for each scenario, change area and time period. In this step, these changes in employment were allocated into SA2s.

Population-driven employment

A proportion of employment is associated with jobs that primarily serve the local population. The location of these jobs will primarily be driven by where population growth occurs.

For example, population-driven employment would include direct services to the population such as retail, hospitality, schools, local medical services and other services like banks, hairdressers, gyms and mechanics. There is also an additional portion of employment which is associated with these direct services (for example through the supply chain) and needs to be located near where people live.

To reflect this, employment growth projected in the base case and in each scenario was split into population-driven and non-population-driven sectors. This split was based on industry-specific ratios which capture the number of population-driven jobs in each industry per capita. These ratios are derived from historical employment and population data for Victoria and are the same as those used in the creation of the base case SALUP forecast.

It would not be reasonable to assume that all population-driven jobs associated with a particular SA2 would be located in that SA2. Instead, some services may be located in a nearby larger centre (for example retail and services in a subregional centre, or car mechanics in a nearby SA2 containing industrial precincts). By contrast, SA3s are big enough that they generally capture at least one large population services centre. As such, changes in population-driven employment were calculated at the SA3 level based on the per-capita ratios, and on the results of step 3. These changes in employment were then allocated from each SA3 into constituent SA2s to reflect baseline population and employment growth projections, and where population shifts would occur in each scenario.

Non-population-driven employment

Shifts in employment from step 2 (i.e. resulting from employment growth ratios) were assumed to be non-population-driven. That is, they were considered as strategic shifts in employment separate to the shifts in population which would occur solely as a result of shifts in population.

For each industry, this non-population-driven employment growth was allocated from change areas into SA2. This allocation was performed in line with the distribution of non-population-driven employment in the base case. The key assumption made here is that within each change area, the employment growth distribution for each industry will mirror that of the base case.

Step 6. Employment alignment to labour force

Outside of Greater Melbourne, each region of Victoria has a relatively self-contained labour market. That is, the vast majority of commutes are made within each subregion, with trips into and out of the subregion to work much less common than trips within the subregion. This means that for each subregion total employment is strongly related to the working age population, participation rate and unemployment rate. For this reason, overall employment is unlikely to increase markedly faster or slower than the working age population unless there are major changes in working circumstances (for example significantly increased working from home which is addressed in scenarios 4 and 5).

To ensure that population and employment growth remain in balance, ratios between the working age population and total employment were created for each year from the base case projection for Greater Melbourne, and for each of the SA4s outside of Greater Melbourne. These ratios are slightly higher for Greater Melbourne and lower for surrounding SA4s, reflecting lower labour force participation and some people commuting into Greater Melbourne from the surrounding regional areas. Under the base case they are forecast to shift slightly further towards Melbourne, deceasing in surrounding SA4s. It was assumed that the ratios will remain constant in scenarios 1,2 and 3.

Scenarios 4 and 5 assume large-scale movement of the population into regional Victoria associated with increased working from home and accelerated economic development of the regions. As a result, it would be expected that the rate of outflow of workers through commutes from Regional Victoria into Greater Melbourne would decrease. To reflect this, the working age population to employment ratios were varied for scenarios four and five to remove the base case shift towards Greater Melbourne from 2021-2056, and to reflect a reduction in commuting rates into Greater Melbourne of around one half.

These labour force employment ratios were applied to adjust the total employment in Greater Melbourne and each other SA4 in Regional Victoria, and allocated down to SA2s proportionally to their forecast employment.

The RAS method was then used to ensure that the state-wide employment composition by industry in each scenario matches the base case for scenarios one and two, or the adjusted composition for scenarios three, four and five, while maintaining total employment in each SA2.

Working from home correction

Under scenarios four and five, many more people will be working from home full-time rather than working full or part time in a separate workplace. In this case, the location of employment was adjusted to reflect people's place of residence rather than separate workplace location.

This adjustment took place by developing a high level assumption of the proportion of existing workers from each SA4 and industry who may work from home full time. It was further assumed that 50% of the uplift in business and government services jobs from the base case in these scenarios outside Greater Melbourne would be associated with working from home.

These assumptions yielded a proportion of people who may work from home in each industry and SA4. Employment across the SA4 was decreased by this percentage, and reallocated into the same SA4 proportionally to the overall population.

Variable Specification

The urban development scenarios are comprised of several variables, which describe the scale and distribution of residential and employment land uses. Residential variables include:

- **Estimated Resident Population (ERP)** segmented by the following age groups:
  - 0 – 14 years old
  - 15 – 24 years old
  - 25 – 44 years old
  - 45 – 64 years old
  - 65 – 84 years old
  - 85+ years old
- **Employment** at place of work, segmented by 10 categories (see Appendix C).
- **Time periods** of 2011, 2016, 2021, 2036, 2056.
- **Spatial units** defined by 2021 SA2s

Appendix E: Historical Urban Development

Drivers of urban development in 19th and 20th Century Victoria

Analysis of Victoria's historical development provides perspective to the long process of urban development and renewal and provides an understanding of the pathways that have led to the current urban form of Victoria and assist in understanding how these pathways may evolve in the future.

Early development

Transport investment has been a key factor in shaping Victoria and influencing the State's economic and population growth. Tramways, railways, and freeways have facilitated the development of Melbourne through either leading or responding to the urban development of areas. Investments made in the 1800s continue to influence the pattern of urban growth today.

Initially developing either side of the Yarra River, Melbourne began as a relatively compact settlement largely confined to what is now the CBD and inner suburbs. After an influx of wealth due to the gold rush of the 1850s and 1860s, large secondary cities emerged in Ballarat, Bendigo, and Geelong (although not directly related to the goldrush). Rail lines connected the secondary cities and Melbourne expanded rapidly along tram and rail networks, spreading development first to the east of the CBD and then to the west for industrial use. Development along rail networks led to urban expansion of more than 20 kilometres outwards from the CBD, giving the city a star shape and leaving vast areas between rail networks undeveloped.[18]

Post war period

In the 1960s, rising car ownership and high post-war population growth led to a period of road building which significantly expanded Melbourne's urban footprint and urban density. Development shifted from traditional public transport corridors, expanding further out into former rural and farming land and filling in the 'gaps' between rail networks. During this time, the suburbs not serviced by public transport became accessible with private transportation through road construction and Melbourne's expansive metropolitan area was filled by residents.[19]

The period from the late 1960s to the early 1990s was characterised by a dominant model of dispersed population and employment growth, with mass suburbanisation leading to a city today spread over an area of 2,500 square kilometres that is close to 100 kilometres wide and 100 kilometres long. Projects

[18] Frost, L., Gaynor, A., Gregory, J., Morgan, R., O'Hanlon, S., Spearritt, P and Young, P. (2016) Water, history and the Australian city: urbanism, suburbanism and water in a dry continent, 1788-2015, Melbourne, Australia: Cooperative Research Centre for Water Sensitive Cities.

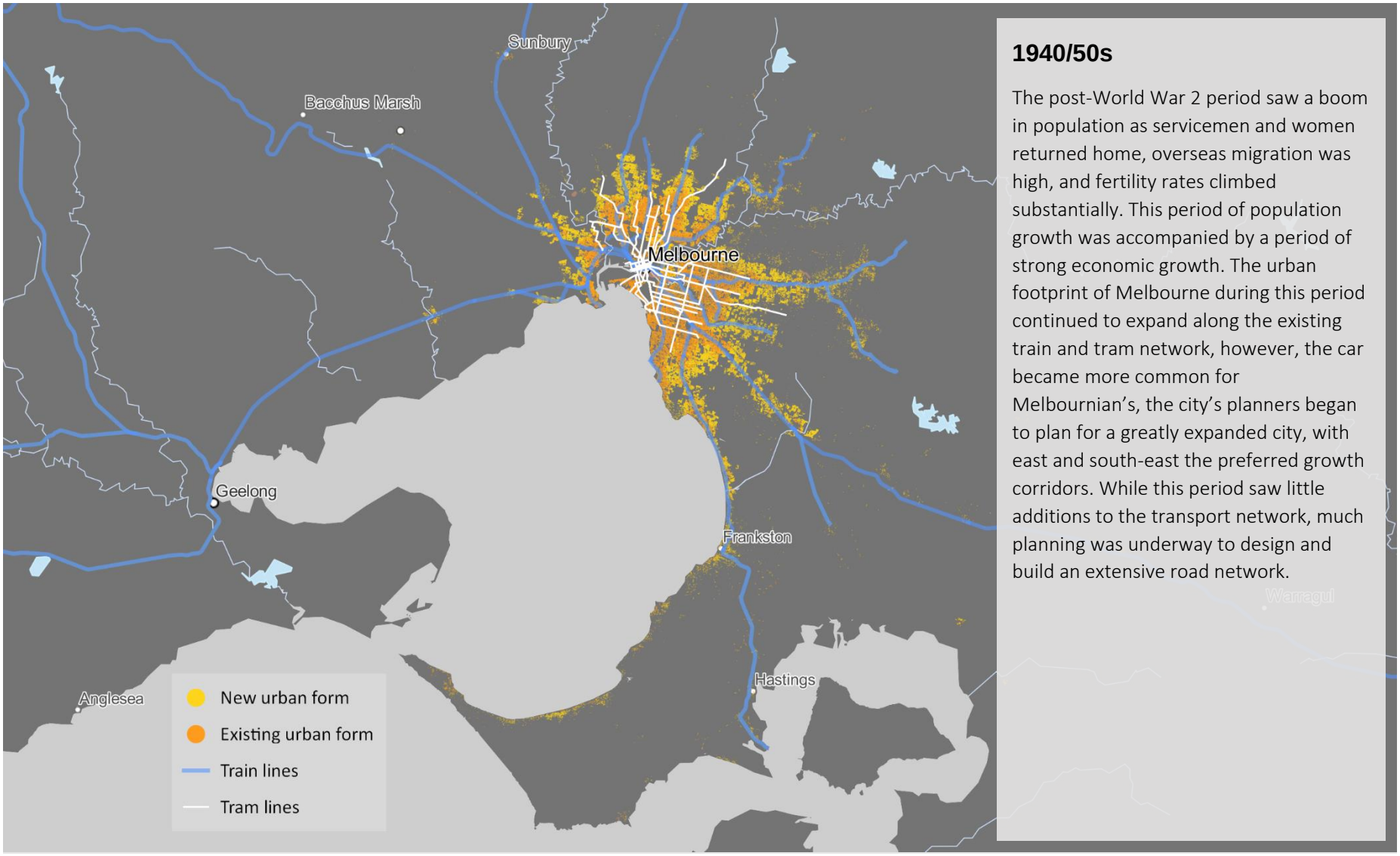
[19] Frost, L., Gaynor, A., Gregory, J., Morgan, R., O'Hanlon, S., Spearritt, P and Young, P. (2016) Water, history and the Australian city: urbanism, suburbanism and water in a dry continent, 1788-2015, Melbourne, Australia: Cooperative Research Centre for Water Sensitive Cities.

such as the West Gate Bridge and Western Ring Road also facilitated the spread of major residential development to the Western suburbs.

Melbourne's extensive road network facilitated and responded to an economic structure based on manufacturing. At its peak in 1966, manufacturing accounted for 37 per cent of total employment, some 27 per cent higher than the national average. [20] Demand for offices in the CBD rapidly increased at the same time. Due to a shortage of available sites and a locational preference for large lots on cheap land close to road networks, manufacturing precincts shifted from the CBD to the urban periphery. These precincts were situated around the city and provided a range of jobs, including high-paying positions, to their surrounding resident populations.

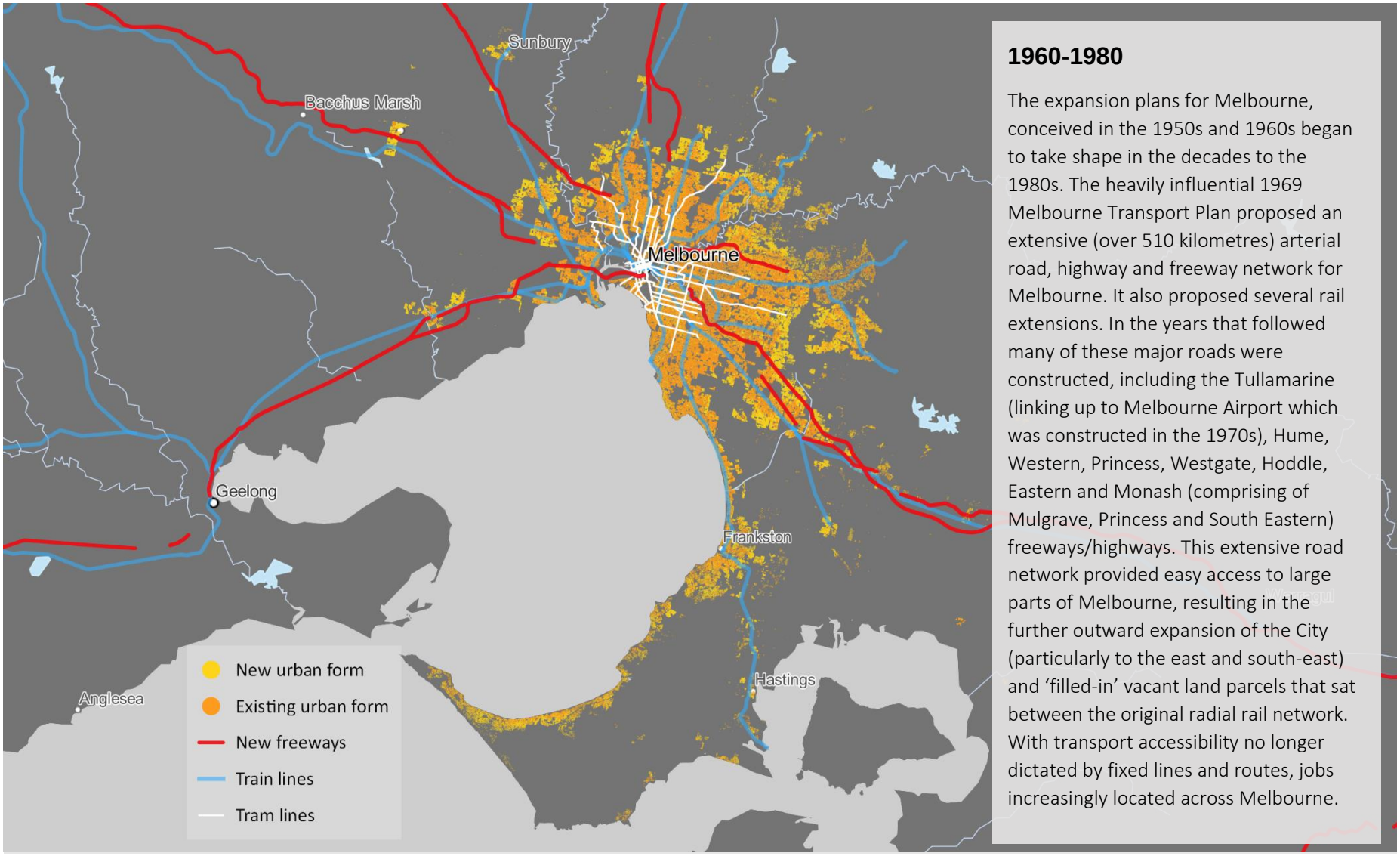
The following maps illustrate the urban development patterns of Melbourne from 1960s onwards.

[20] O'Connor, K. Tsutsumi, J. (2006). *Time Series Analysis of the Skyline and Employment Changes in the CBD of Melbourne*. The University Melbourne.



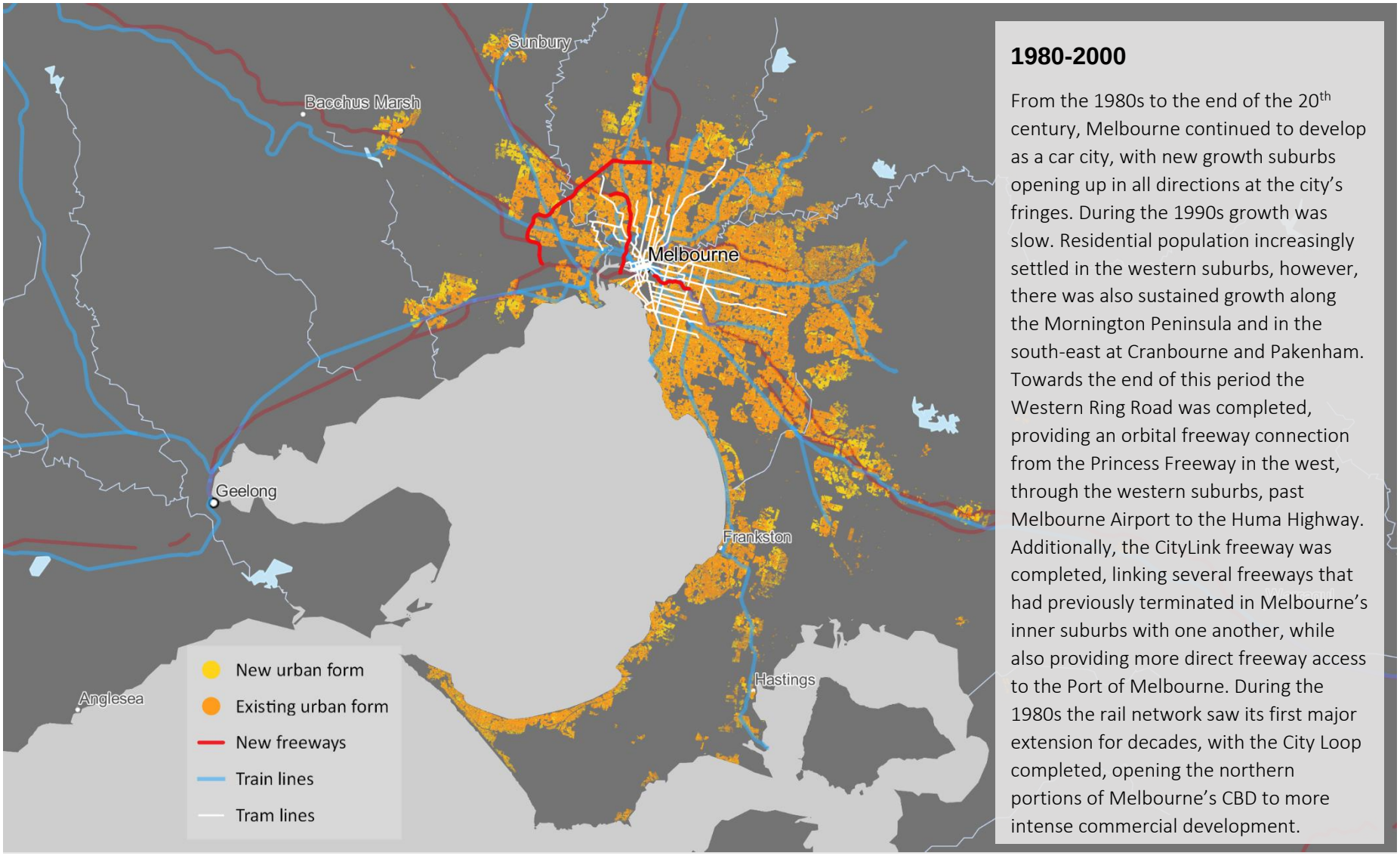
1940/50s

The post-World War 2 period saw a boom in population as servicemen and women returned home, overseas migration was high, and fertility rates climbed substantially. This period of population growth was accompanied by a period of strong economic growth. The urban footprint of Melbourne during this period continued to expand along the existing train and tram network, however, the car became more common for Melbournian's, the city's planners began to plan for a greatly expanded city, with east and south-east the preferred growth corridors. While this period saw little additions to the transport network, much planning was underway to design and build an extensive road network.



1960-1980

The expansion plans for Melbourne, conceived in the 1950s and 1960s began to take shape in the decades to the 1980s. The heavily influential 1969 Melbourne Transport Plan proposed an extensive (over 510 kilometres) arterial road, highway and freeway network for Melbourne. It also proposed several rail extensions. In the years that followed many of these major roads were constructed, including the Tullamarine (linking up to Melbourne Airport which was constructed in the 1970s), Hume, Western, Princess, Westgate, Hoddle, Eastern and Monash (comprising of Mulgrave, Princess and South Eastern) freeways/highways. This extensive road network provided easy access to large parts of Melbourne, resulting in the further outward expansion of the City (particularly to the east and south-east) and 'filled-in' vacant land parcels that sat between the original radial rail network. With transport accessibility no longer dictated by fixed lines and routes, jobs increasingly located across Melbourne.



1980-2000

From the 1980s to the end of the 20th century, Melbourne continued to develop as a car city, with new growth suburbs opening up in all directions at the city's fringes. During the 1990s growth was slow. Residential population increasingly settled in the western suburbs, however, there was also sustained growth along the Mornington Peninsula and in the south-east at Cranbourne and Pakenham. Towards the end of this period the Western Ring Road was completed, providing an orbital freeway connection from the Princess Freeway in the west, through the western suburbs, past Melbourne Airport to the Huma Highway. Additionally, the CityLink freeway was completed, linking several freeways that had previously terminated in Melbourne's inner suburbs with one another, while also providing more direct freeway access to the Port of Melbourne. During the 1980s the rail network saw its first major extension for decades, with the City Loop completed, opening the northern portions of Melbourne's CBD to more intense commercial development.

Population Growth since the 1990s

From the mid-1990s, the State continued to experience steady population growth, illustrated in Figure 85 increasing by approximately 2 million people (4.5 million to 6.5 million) over 25 years or an annual rate of approximately 6 per cent per year.

Age distribution has remained relatively consistent historically, with the largest cohort between of 25 to 44 years at approximately 30 per cent, followed by the 45- to 64-year-old demographic at approximately 21-24 per cent representing over half of the total population. There has been a gradual ageing of the population, with the proportion, over the age of 65, has increased most significantly since 1994, almost doubling from 1996 to 2021 to represent over a million Victorians. This reflects the worldwide trend in which the pace of population ageing has become much faster than in the past.[21] People are living longer due to advancements in health care and more supportive physical and social environments.

Historical fluctuations in population growth in Victoria are largely driven by net internal migration (NIM) and net overseas migration (NOM). Compared to Melbourne, Regional Victoria has a more stable population, with growth driven primarily by NIM and natural growth, whereas Melbourne attracts most international migrants moving to the state. Between 2016 and 2020, 67 per cent of population growth in Melbourne was contributed by NOM.[22]

[21] United Nations, Department of Economic and Social Affairs, Population Division (2019). World Population Ageing 2019: Highlights (ST/ESA/SER.A/430).
[22] ABS National. (2021) State and territory population, 2021

FIGURE 85: HISTORICAL POPULATION IN VICTORIA BY AGE (TOTAL AND % CONTRIBUTION)

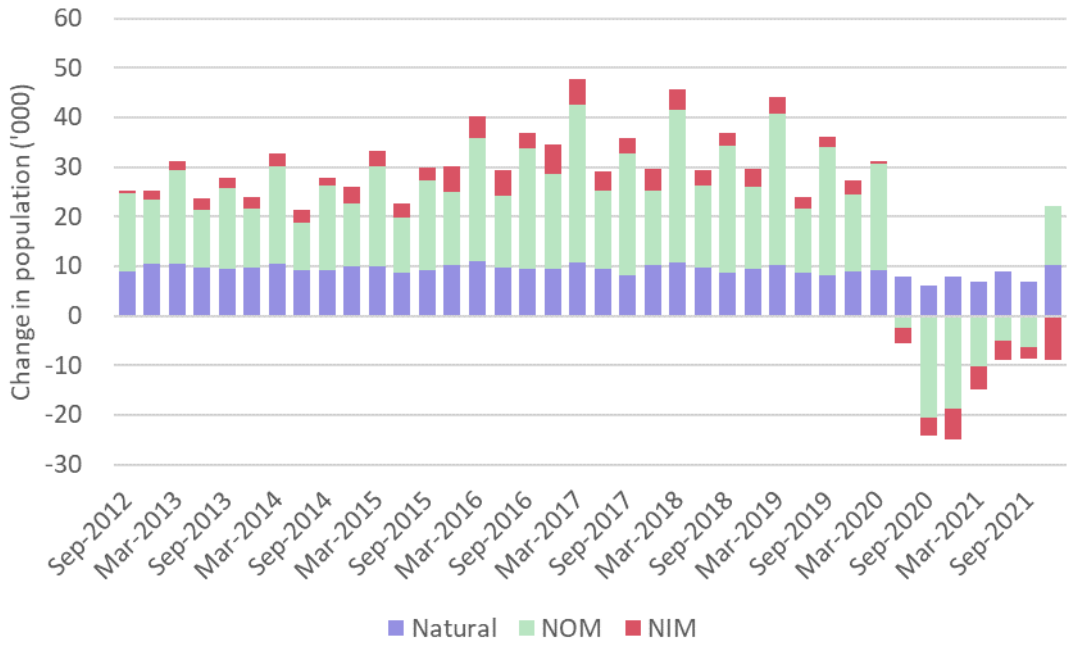
Source: ABS Regional ERP by Age and Sex, 2021

Changes in the components of population growth and household formation preferences

Economic shifts, combined with an ageing population also have profound impacts on population growth and household formation/preferences. For the first time in several decades Victoria experienced negative population growth during the pandemic period, due to declines in both overseas and interstate migration, as shown in Figure 86

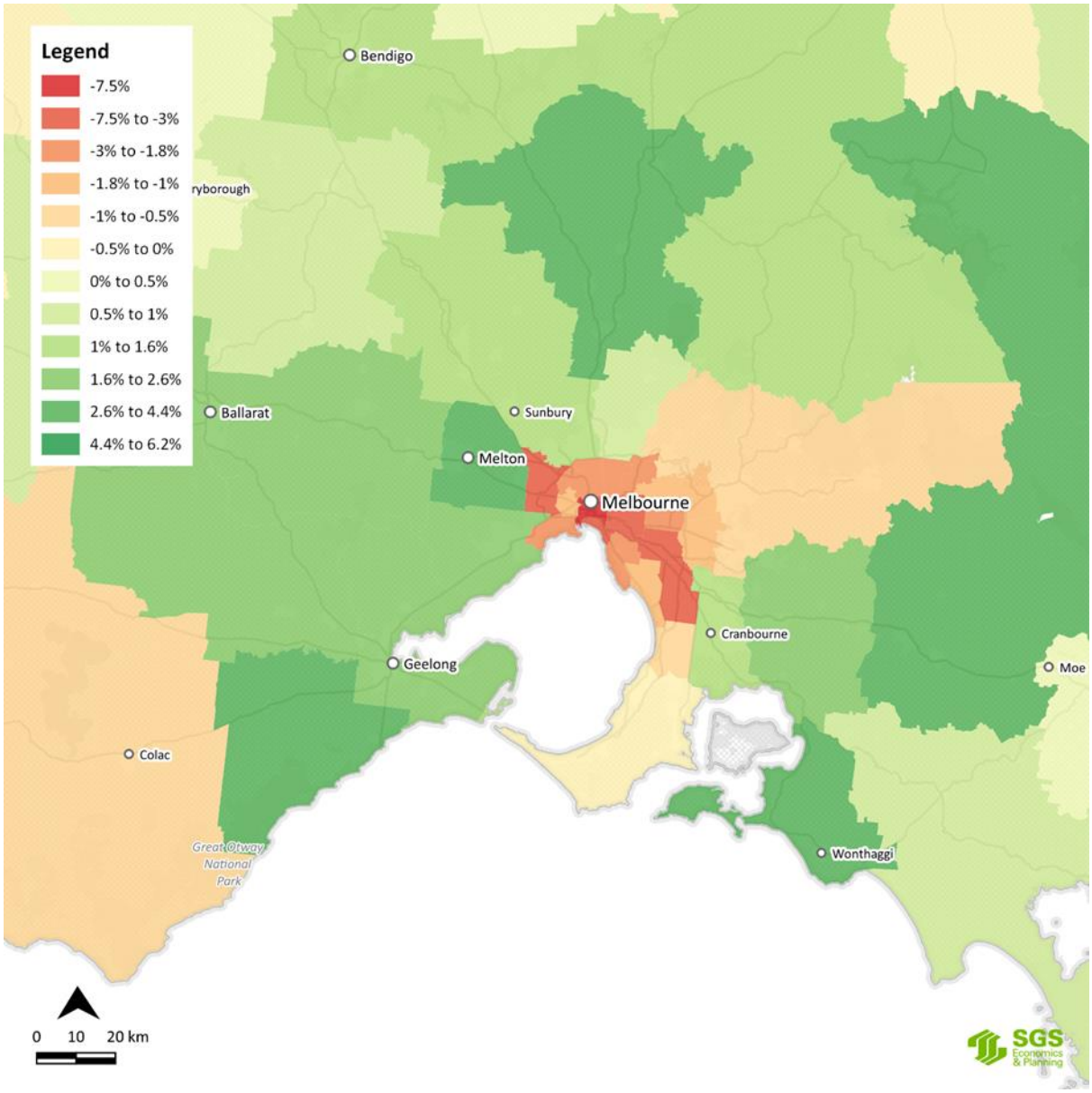
The decline was most acute in inner parts of Melbourne. Conversely, population in peri urban areas, with high amenity and good transport connections, grew at a faster rate compared to recent years. This is reflected in the net internal intrastate migration in Victoria between 2020 and 2021. This migration shift was exacerbated by differences in how areas experienced and responded to the pandemic, and may reverse to some extent in the future. This provides an insight into the preferences of households when the necessity of the CBD as an employment hub is reduced.

FIGURE 86: VICTORIAN COMPONENTS OF POPULATION GROWTH



Source: ABS National, State and Territory Population, 2021

FIGURE 87: 2020-21 ANNUAL POPULATION GROWTH RATES BY LOCAL GOVERNMENT AREA, GREATER MELBOURNE AND SURROUNDING REGIONAL AREAS



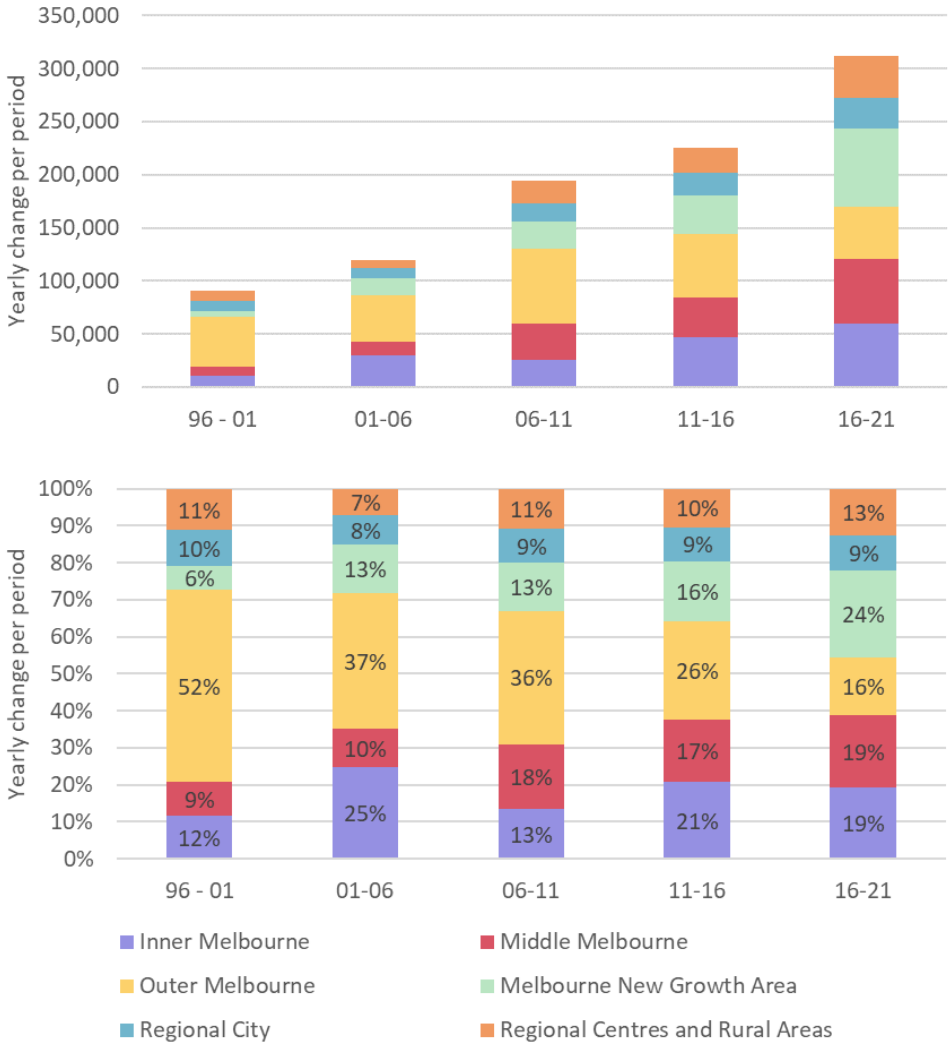
Source: ABS Regional Population, March 2022

Spatial Distribution of Population

Figure 88 illustrates the growth of dwellings in Victoria since 1996, broken down by functional urban area (FUA). A historically high proportion of greenfield development in outer Melbourne was spurred by the car-centric urban development and mass suburbanisation that characterised the period from the late 1960s to the early 1990s. However, from the mid-1990s, outward expansion slowed, and the inner city and locations along public transport corridors began to attract development.

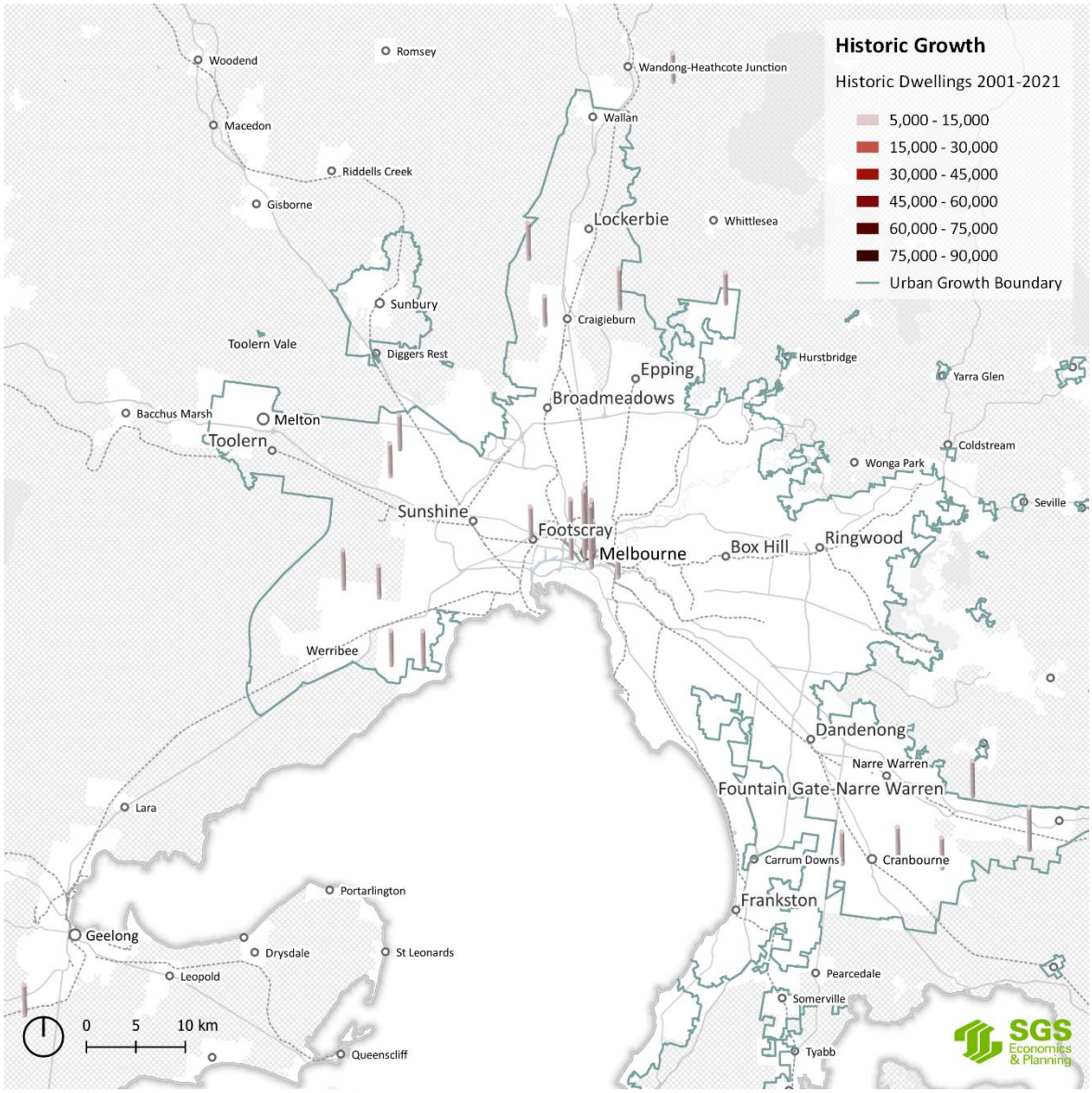
Between 2016 and 2021, dwelling development in inner and middle Melbourne increased on prior periods as infill development increased to high levels around the City's rail and tram network. During this period Melbourne's new growth areas also expanded rapidly to accommodate record population growth. While development in outer Melbourne slowed during this period, development in regional cities increased steadily and peaked between 2016 and 2021.

FIGURE 88: HISTORIC DWELLING GROWTH BY FUA



Source: SGS Economics and Planning, 2022

FIGURE 89: DWELLING GROWTH BY SA2 2011-2021



Source: SGS Economics and Planning, 2022

Historical Employment Growth

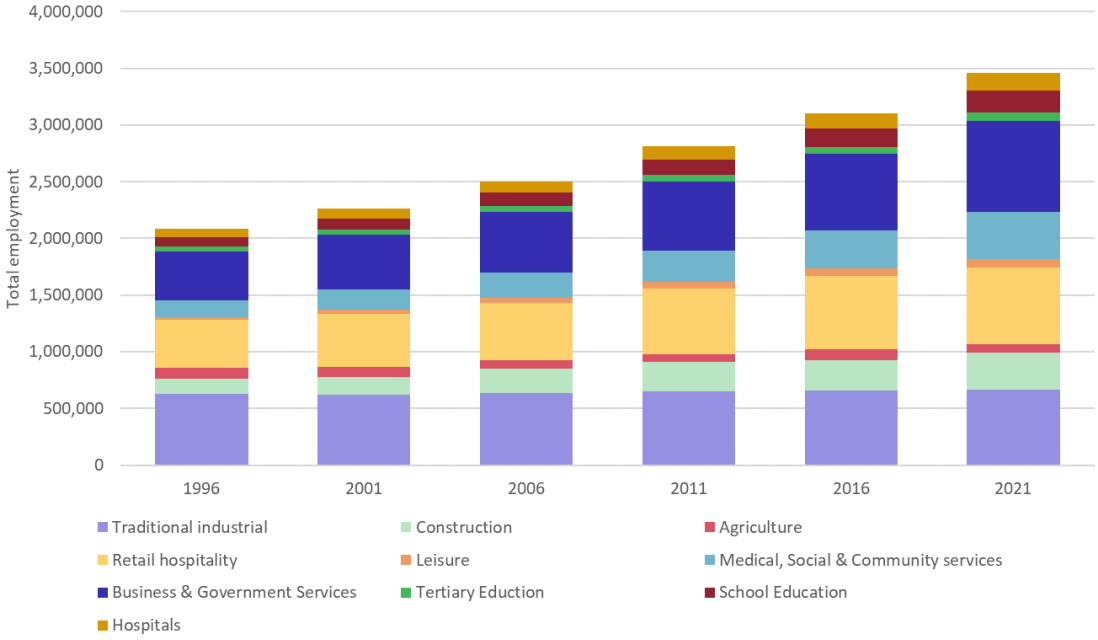
Total employment in Victoria has increased from approximately 2.1 million jobs in 1996 to 3.5 million jobs in 2021 representing an annual increase of approximately 7% per year, in line with overall population growth.

Figure 90 shows total employment in Victoria by industry. Employment in traditional industrial and agriculture remained relatively flat, with little growth from 1996 to 2021. This includes a steep decline in the manufacturing sector. This trend reflects Victoria's transition to a post-industrial economy from the mid-1990s, influenced by increased globalisation (e.g., offshore manufacturing and export of education services) and a growth of demand in knowledge intensive services. The knowledge intensive

services sector, as defined by the OECD, covers a broad range of activities that demand a high level of experience, understanding, information and skills. It includes services such as scientific research and development, financial services, and computer programming.[23] This broad cross-cutting sector provides the basis for a knowledge economy.

In Victoria, the transition from a manufacturing-based economy to a knowledge economy focused around financial and professional services resulted in a 370,000 increase in employment in business and government services between 1996 and 2021, as shown in Figure 91.

FIGURE 90: HISTORIC EMPLOYMENT BY INDUSTRY IN VICTORIA



Source: SGS Economics and Planning based on ABS data, 2022

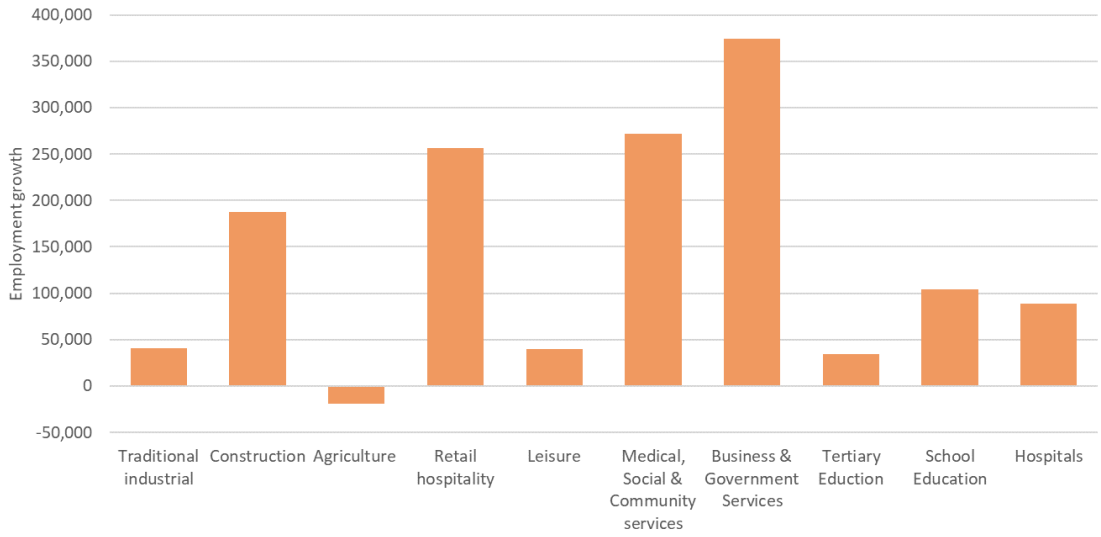
Well before COVID, Australia's (and Victoria's) economy had been undergoing structural changes that fundamentally shifted where and how people work. We have transitioned from an agricultural economy (in the early 1900s) to an industrial economy (in the mid-1900s) to a services economy (currently).

Population and knowledge-based services are now driving employment and economic growth and, importantly, they have very different spatial growth drivers to the industrial jobs and activity of the past.[24]

[23] OECD (2009), "Employment in Knowledge-Oriented Sectors", in OECD Regions at a Glance 2009, OECD Publishing, Paris.
[24] Yigitcanlar, Tan and O'Connor, Kevin and Westerman, Cara (2008) The making of knowledge cities: Melbourne's knowledge-based urban development experience. Cities 25(2):pp. 63-72.

They benefit from deep, diverse, and highly skilled labour markets and therefore have been attracted to well connected, economically diverse, and high amenity locations. [25] Centres with major institutional anchors, such as the CBD and regional centres, have captured the largest share of employment growth recently. Figure 91 summarises the growth by industry between 1996-2021, revealing the main growth industries to be population serving (e.g., retail, social and medical services) and knowledge-based jobs (e.g., business and government services) in addition to construction jobs.

FIGURE 91: GROWTH BY INDUSTRY (1996-2021)



Source: SGS Economics and Planning based on ABS data, 2022

Spatial Distribution of Employment

From the mid-1990s, in inner Melbourne, employment growth increased alongside productivity as the economic structure shifted towards a knowledge-based economy; after 30 years of stagnation, employment in inner Melbourne boomed. This transition resulted in a concentration of higher paying employment in the CBD and population serving employment in the suburbs.

These structural changes in the economy had notable spatial implications; Figure 92 illustrates the historic distribution of employment growth in Victoria. The growth of employment in inner Melbourne in the 2000s reflets the expansion of the Central City with the redevelopment of port land in Docklands. Etihad Stadium was the first project undertaken at Docklands. High-density commercial and residential buildings were developed. Business and government service jobs have been attracted to inner and middle Melbourne as these areas offer competitive advantages through agglomeration economies.

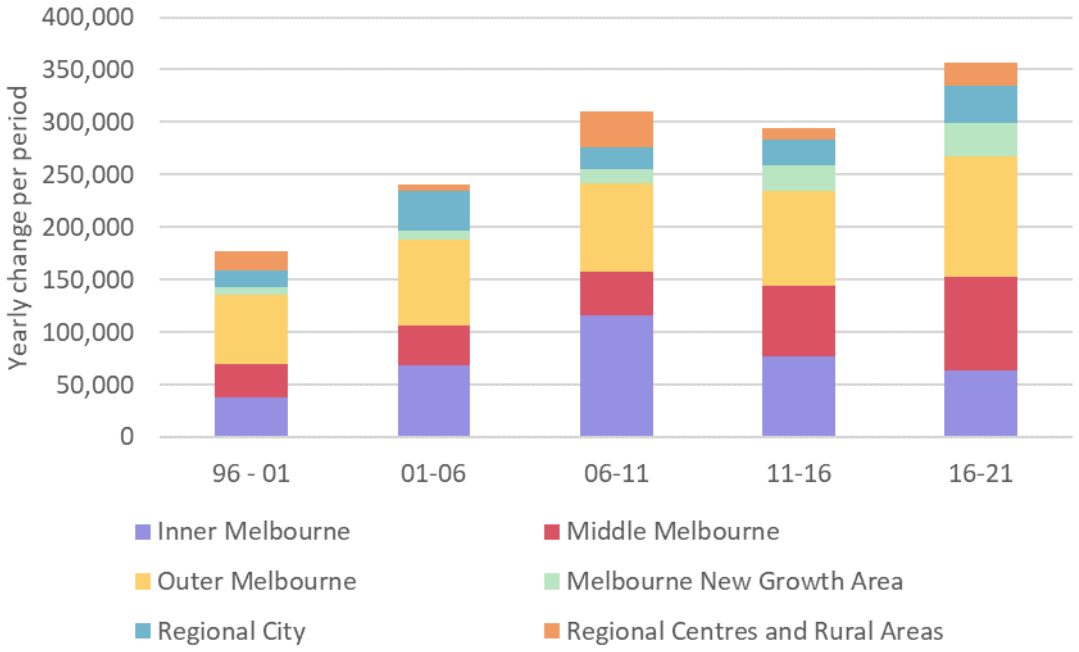
Employment growth in inner Melbourne peaked between 2006 and 2011 before slowing over the next decade. This decline can be explained, in part, by the rise in value of land in inner Melbourne, rapid

[25] Yigitcanlar, Tan and O'Connor, Kevin and Westerman, Cara (2008) The making of knowledge cities: Melbourne's knowledge-based urban development experience. Cities 25(2):pp. 63-72.

population growth in outer Melbourne (including growth areas), and by the transport investments (e.g., EastLink) which made Melbourne's outer and south-east more accessible to both firms and households.

Beyond inner Melbourne, the pattern of employment distribution is somewhat more complex and harder to geographically define. Although the density of employment is lower in the middle Melbourne, new growth areas, and outer Melbourne, there are centres where the absolute quantum of employment is relatively high compared to the CBD. These diverse locations accommodate employment in the suburbs, including institutions (schools, universities, hospitals), business parks and industrial precincts. In comparison to high level knowledge-based jobs serving clients, which tend to be concentrated in the inner city, population serving jobs are more dispersed to serve the resident population.[26]

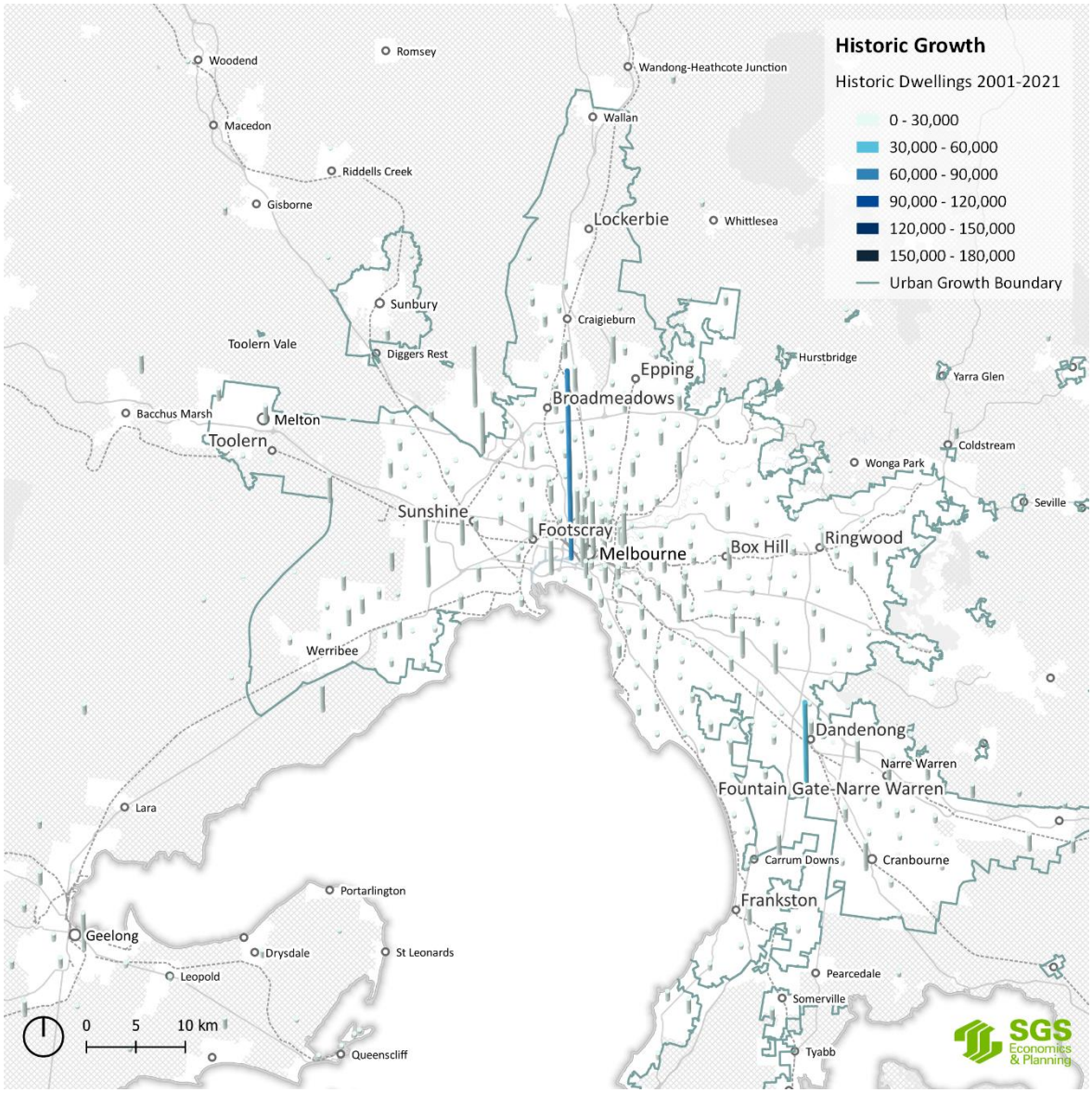
FIGURE 92: HISTORIC EMPLOYMENT GROWTH BY FUA



Source: SGS Economics and Planning, 2022

[26] Davies, A. (2011). Suburban Employment Trends: A Melbourne Case Study. M/C Journal, 14(4). https://doi.org/10.5204/mcj.358

FIGURE 93: EMPLOYMENT GROWTH BY SA2 2011-2021



Source: SGS Economics and Planning, 2022

Appendix F: Dwelling type forecast method report

1. Dwelling type method

SGS were engaged to forecast dwellings by type for five possible future land use scenarios for 2036 and 2056. This involved taking the total dwelling forecasts and breaking them down into categories including separate houses, attached dwellings, apartments (low, medium and high rise) and other dwelling types. This appendix outlines the approach and assumptions used to estimate dwellings by type.

1.1 Relationship between dwelling density and dwelling composition

The method used to estimate the number of dwellings by type in each SA2 was based on the relationship between dwelling density and percentage dwelling composition at the SA2 level.

Average SA2 dwelling composition

There are a variety of different ways of achieving a particular density across a broad area. For example, in an existing suburb of predominately separate houses a small amount of medium rise apartment development may increase overall density to the same level as a moderate amount of attached housing development. However, on average there is a clear relationship between the percentage dwelling composition and the dwelling density (especially weighted density), and to a lesser extent to the employment density.

Figure 1 shows the average percentage composition of each housing type at a range of weighted housing densities in SA2s in Victoria and Greater Sydney[1]. It reveals that on average, lower density forms of housing make up most of an SA2's housing stock at lower densities. There is a transition to a mixed housing profile at moderate densities, and then to predominately medium and high rise apartments at high densities common in CBDs and adjacent areas. In more detail:

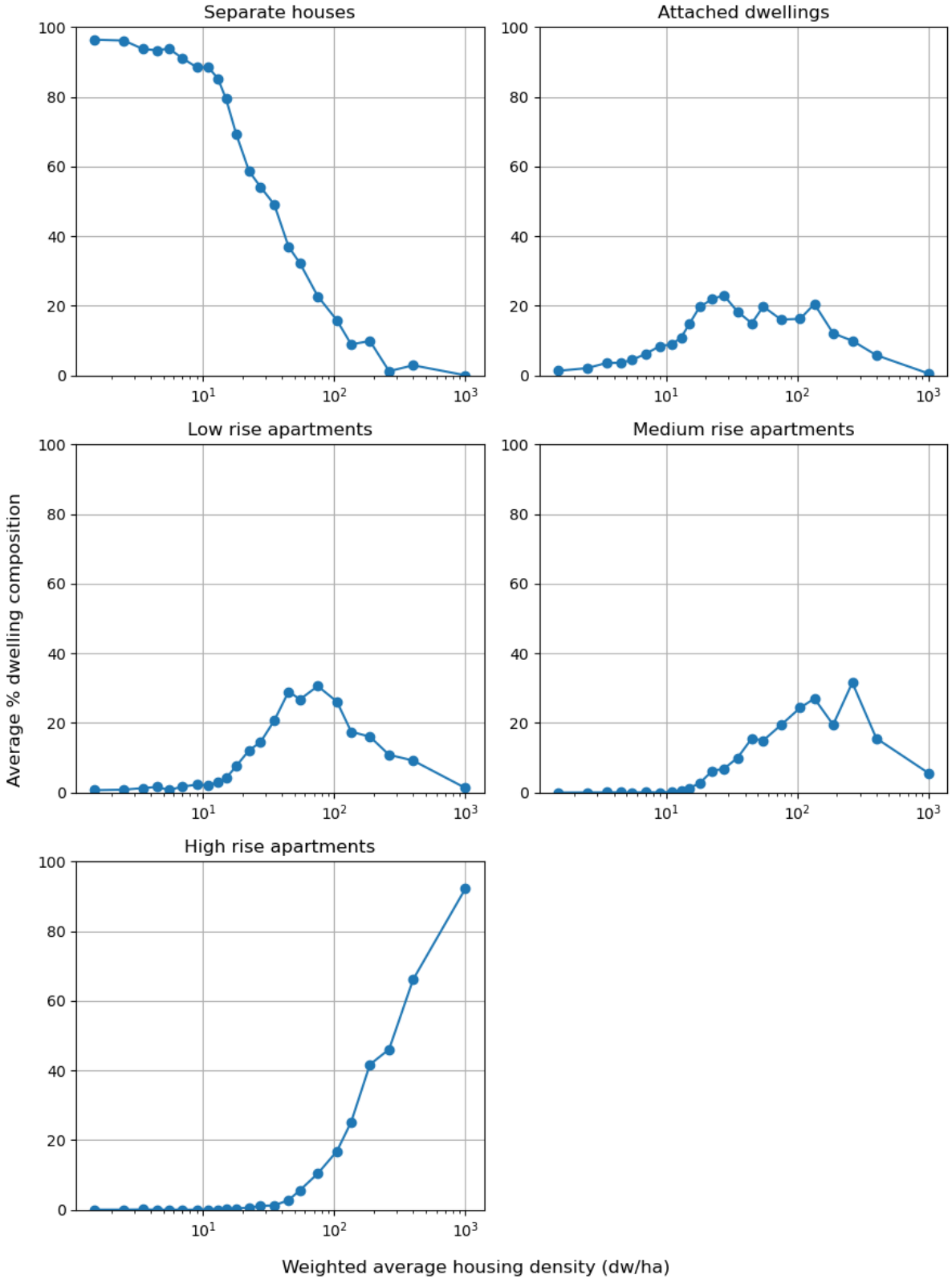
- At low housing densities, almost all dwellings are separate houses. Up to around 10 dw/ha the percentage of dwellings which are separate houses is relatively stable and decreases slowly.
- Above a weighted dwelling density of 10 dw/ha, the average proportion of dwellings which are separate houses decreases more quickly, and relatively uniformly, towards close to 0% between 200 and 1,000 dw/ha
- Attached dwellings become more common as the density increases at low densities, up to a peak at around 25 dw/ha. The share of attached dwellings remains relatively stable up to densities of approximately 100 dw/ha, and then decreases beyond this.

[1] Greater Sydney has been included as it provides insight into relationships at density ranges which are not currently common in Victoria (but will emerge in the future).

- Low rise apartments are very uncommon at low densities until around 15 dw/ha. Above this density they become more common until a peak at around 70 dw/ha. As densities increase past this point, they become less common in favour of medium and high rise apartments.
- Similarly, medium rise apartments are very uncommon until around 15 dw/ha, and then peak in terms of the proportion of all dwellings at between 100 – 300 dw/ha.
- High rise apartments remain uncommon until above 50 dw/ha, but in very high density precincts make up the vast majority of all dwellings.

The method used assumes that if the dwelling density of an SA2 changes, the dwelling composition should change generally in line with the corresponding changes in average SA2 dwelling composition, taking account of the functional urban area (FUA) in question and the starting dwelling composition.

FIGURE 1: DWELLING COMPOSITION BY SA2 DWELLING DENSITY (AVERAGE), VICTORIA AND GREATER SYDNEY



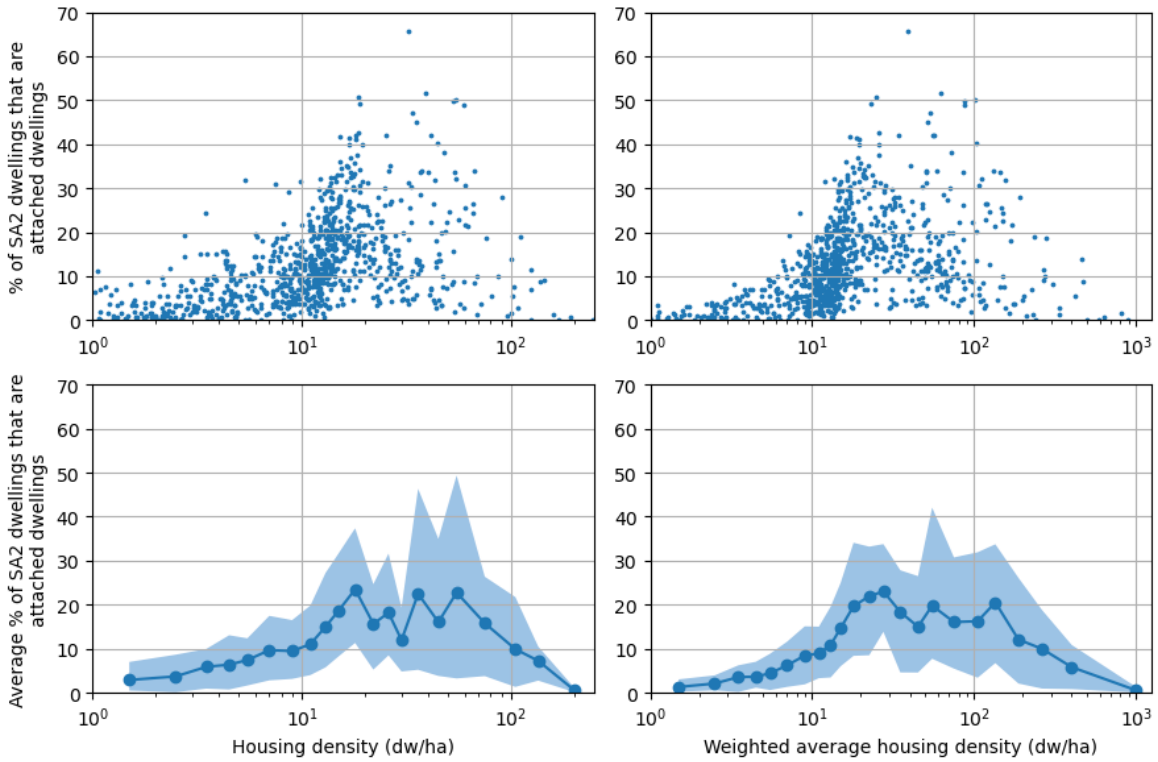
Source: SGS 2022 using ABS Census 2021

Range of different SA2 dwelling compositions

The following figure illustrates the variance in dwelling composition across SA2s. The upper panels of Figure 2 show scatter plots of all SA2s in Victoria and the Sydney Greater Metropolitan Area (above a density threshold for inclusion). The bottom panels show the average percentage compositions at a range of densities (points and solid lines), as well as the region between the 10th and 90th percentiles as a shaded area.

Overall, while there is substantial deviation in dwelling profiles of individual SA2s, they mostly fall within a window on either side of the average behaviour, with this window following the broad characteristics as the average line.

FIGURE 2: ATTACHED DWELLING PREVELANCE BY SA2 HOUSING DENSITY, VICTORIA AND GREATER SYDNEY



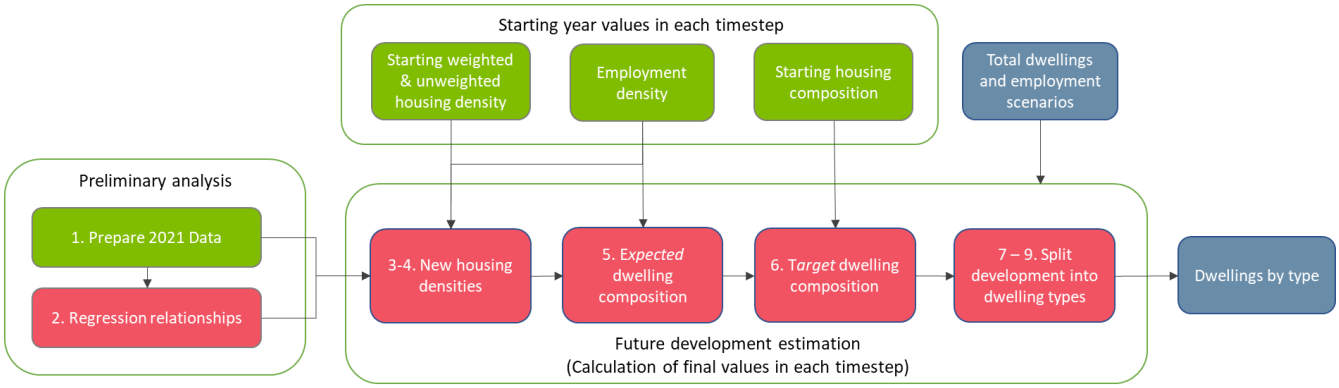
Source: SGS 2022 using ABS Census 2021

Figure 2 also shows the way in which the use of weighted average housing densities rather than unweighted densities reduces the number of outliers and provides a clearer predictor of dwelling composition (how weighted densities were calculated is discussed in the detailed method section).

1.2 Method overview

The method is split into two parts: preparatory analysis using data on current dwelling composition and housing and employment densities; and estimation of future dwelling composition and development. The method is depicted in the figure below, and then listed in more detail. The following sections provide further detail about each step.

FIGURE 3: METHOD OVERVIEW



Source: SGS 2022

The first of these parts comprised the following steps:

1. **Prepare 2021 base data** for each SA2, including residential and employment area, starting dwelling composition and starting weighted dwelling density
2. **Calculate regression relationships** from base data allowing prediction of:
   - Weighted dwelling density from overall dwelling density, and
   - Percentage dwelling composition based on dwelling density, and in some cases employment density, total dwellings, and total employment.

   Linear regression models were used, with higher order terms and terms besides dwelling density (employment density etc) added only where they significantly improved predictive power. Separate regressions were created for different FUAs, and for ranges of densities in which different dwelling composition trends were present.

The second part was applied for each time step in the data (2021–2036 and then 2036-2056) and for each SA2:

3. Adjust residential and employment areas where appropriate and **calculate new overall dwelling density.**
4. **Estimate new weighted density** based on change in overall density.

5. Predict *expected* dwelling composition (only based on regression, not considering starting composition) in starting and final year based on densities and in some cases total dwellings and employment.
6. Calculate *target* dwelling composition (considering starting compositions) by modifying the starting dwelling composition to reflect how the predicted dwelling composition changes.
7. Split dwelling development into housing types to get as close as possible to *target* dwelling composition.
8. Apply limits and reasonableness checks on development for each dwelling type.
9. Calculate final dwellings by type and dwelling composition.

Model dimensions

The model was applied to the housing, population and employment scenarios previously created, which are split into three years (2021, 2036 and 2056), five scenarios, and have a spatial resolution of SA2s.

The dwelling predictions from the scenarios were split into the following categories for each SA2 aligned with the ABS census:

- Separate houses
- Other dwellings including the ABS categories of:
  - Caravan
  - Cabin, houseboat
  - Improvised home, tent, sleepers out
  - House or flat attached to a shop, office etc.
- Attached dwellings comprised of semi-detached, row or terrace houses, townhouses etc.
- Low rise apartments: Flats or apartments in one, two or three storey blocks, as well as flats or apartments attached to a house
- Medium rise apartments: Flats or apartments in blocks of four to eight storeys
- High rise apartments: Flats or apartments in blocks of nine or more storeys

1.3 Detailed method – Base data

Prepare 2021 base data

For each SA2, the ABS Census was used to estimate the 2021 dwelling composition, broken down into the categories specified above.

Meshblock land use categories were used to calculate the residential and employment area of each SA2, allowing overall housing and employment densities to be calculated (using the 2021 dwelling and employment estimations from the scenarios).

Dwelling weighted housing densities were also calculated for each SA2 (discussed elsewhere in this section as weighted densities). These are calculated using meshblock areas and counts of dwellings and are calculated for each SA2 as:

$$\sum_{\text{Meshblock in SA2}} \frac{\text{Dwellings}_{\text{Meshblock}}}{\text{Total SA2 dwellings}} \times \text{Dwelling density}_{\text{Meshblock}}$$

Where the dwelling density for each meshblock is calculated as the number of dwellings within the meshblock divided by its area. Weighted dwelling densities represent the average dwelling density as experienced for each dwelling.

Weighted dwelling densities reduce the significance of large areas within an SA2 with few dwellings and consequently low densities (for example rural or undeveloped parts of an SA2). While a traditional dwelling density measurement would be roughly halved if half the SA2 was undeveloped or used for non-residential purposes, this area would be given a very low weighting in a weighted dwelling density, and so would have very little impact on the result.

Regressions

Dwelling density

Using SA2-level data from Victoria and the Greater Sydney[2], regression coefficients were calculated relating weighted dwelling density to total dwelling density.

Dwelling composition

Separately, regression coefficients were calculated relating the following dwelling types to weighted density, and in some cases to one or both of employment density and total employment:

- Separate house and other dwellings combined
- Attached dwellings

[2] Including data from Greater Sydney increases the number of datapoints available for each regression, reducing the effect of outliers, especially at high densities. It also provides data on a greater range of analogous dwelling densities, as those in Greater Sydney and surrounding regional cities are, on average, currently higher than those in Greater Melbourne and surrounds (which will reach these in the future).

- All apartments for Rural and Regional Victoria, regional cities below a density threshold and new growth areas
- Low rise apartments, medium rise apartments and high rise apartments separately for other FUAs and for regional cities above a set density threshold

Regressions were run separately for the following groupings of FUAs:

- Regional Centres and Rural Areas
- Regional Cities, with additional prediction data from Outer and Middle Melbourne, Sydney Regional Cities and Outer and Middle Sydney used only at higher densities outside of those currently seen in Regional Victoria
- Melbourne New Growth Areas
- Middle and Outer Melbourne considered together, with additional prediction data from Middle and Outer Sydney and Inner Melbourne and Sydney for high densities only.
- Inner Melbourne

These different categories of FUAs have dwelling composition percentages which follow distinct patterns at different densities and exhibit different ranges of values. As a result, using separate regression models for different FUAs better reflects housing contexts and provides more reasonable predictions of likely future dwelling composition.

Linear regression models were used in all cases. For most regressions only linear effects (i.e., a degree of one in the predictor variables) were included, but in some cases high-order effects were modelled by adding degree two factors in the predictor variables only where this would significantly increase the R-squared, and where extrapolation beyond the range of predictor values was not expected.

For each FUA, the average relationship between weighted density and dwelling composition was first visualised. For each housing type and FUA, weighted densities were then split into different domains in which similar effects were seen, and in which the percentage of all housing either decreased or increased but not both (for example, the separate house % may decrease slowly up to 10%, and then more quickly after that, with effects relatively linear in each case). A separate linear regression model was created for each of these domains, meaning that several linear models were able to be used to capture the full range of densities where otherwise a more complicated set of models would be required.

In some cases where a better fit was generated, the logarithm of the density or weighted density was used as the primary predictor variable instead of the density or weighted density. This was particularly necessary where a wide range of densities was considered.

1.4 Detailed method – predicting the future

Calculating new densities

Once the new residential and employment areas were identified in each future year, total residential and employment densities were calculated for each SA2.

Weighted densities were then predicted based on the regression coefficients of density and other variables where included. Starting weighted densities in each time step were scaled to reflect the change in predicted weighted density. Limits were applied to ensure weighted densities would not deviate too far from total density.

In most cases it was assumed that the residential and employment area of each SA2 would remain fixed in the future. Some adjustments have been made where necessary, as described below.

For new growth areas, the total future residential area is known as it is covered by current and future precinct structure plans (PSPs) (assuming that PSPs yet to be created will have a similar land use split to existing PSPs). As such, this additional residential area was phased into relevant SA2s in 2036 and 2056.

The residential and employment area was also adjusted for Fishermans Bend reflecting the wholescale change in land use that will occur there, and that the Port Melbourne Industrial SA2 (which covers Fishermans Bend) is currently almost entirely non-residential.

In the following cases, it was assumed that additional land would be rezoned to meet increased housing demand, and so the residential area was increased in future years as a proportion of the forecast percentage change in dwellings:

- Regional Centres and Rural Areas, and the developed/rural interfaces of Regional Cities in all scenarios. In these places growth was assumed to be predominately (but not exclusively) through an expansion of existing towns and cities rather than a large increase in densities.
- The developed/peri-urban interface of Outer Melbourne (not including Melbourne New Growth Areas) under the Dispersed City scenario, which would likely require some further expansion of the existing urban footprint.

Predicted and target dwelling composition

For each SA2, a ***predicted*** initial and final dwelling composition in each timestep was calculated based on the regression coefficients and the predicted weighted density, and employment and employment density if relevant.

These predicted values based on regressions show what the dwelling composition in each SA2 would be if it were statistically average for its FUA designation. However, there is a wide range of dwelling compositions in different SA2s, and a wide range of ways to achieve a given density. As such, the starting composition of an SA2 may deviate substantially from the predicted initial values. As a result, it cannot be assumed that the dwelling composition in each SA2 in each future year will be exactly equal to the statistical prediction.

To account for this, a ***target*** dwelling composition was calculated for each SA2 and future year. This target composition is intended to be a more likely future dwelling composition, reflecting the starting dwelling composition as well as the change in densities.

Target dwelling compositions were created by:

1. Calculating the ratio between the *predicted* initial and final dwelling compositions in each time-step (e.g. apartments may be predicted to double from 1% to 2% in a given SA2 given its densities etc).
2. Modifying these ratios to reflect how close or far an SA2 is from the initial prediction (e.g. if apartments already make up 5% of all dwellings in each SA2, and would be predicted to double from 1% to 2% given its starting and final densities, the target density should not double from 5% to 10% and a smaller increase would be warranted).
3. Scale the starting dwelling compositions by the modified ratios for each dwelling type.
4. Prevent any dwelling becoming less common as a percentage of all dwellings if it is already much less common than would be predicted.
5. If any dwelling type is predicted to make up 5% or more of the final composition but is not initially present, assume it will be present in the final dwelling composition at a reduced fraction of its predicted final percentage.

The resulting target compositions are normalised so that they add up to 100% for each SA2 in each year.

Dwelling development calculation

In each SA2 and for each timestep, the total dwelling development level was calculated (i.e. the final dwellings minus the initial dwellings).

These were split into dwelling types so that the SA2 is as close as possible to the target dwelling composition at the end of the timestep.

It is assumed that:

- In SA2s where greenfield development is not possible, additional separate houses cannot be built.
- Any predicted increase in separate houses which cannot occur will instead take place through an increase in attached dwellings.
- In SA2s where greenfield development is not possible, separate houses must decline to reflect the infill development of other dwelling types which replace the separate houses (ratios are used to determine how large this decline should be).
- The number of apartments in any category (i.e. low rise, medium rise and high rise) cannot decline if the SA2 is growing.
- The number of attached dwellings can only decline slightly if there is a large increase in the number of apartments, as apartments could be developed in place of attached dwellings but this is relatively unlikely in comparison to infill redevelopment of separate houses or existing centres, or to brownfield development.

Additional assumptions

It is assumed that:

- The split between low rise and medium rise and high rise apartments in new growth areas and rural areas and regional centres will reflect the average 2021 split between these dwelling types in these FUAs.
- In almost all cases the number of dwellings is predicted to rise in each SA2. However, there are a few cases where the scenarios predict a small decline in dwellings. In these cases, the percentage composition of dwellings is kept the same, and the number of dwellings of all types is shrunk to reach the new total. This ensures that any temporary declines in dwellings in the scenarios do not substantially alter the dwelling composition.

Glossary

Brownfield development – Redevelopment of previously developed land that is not currently in use, typically land which formerly housed industrial land uses.

Dwelling – A habitable structure which is intended to house one household (note that in this document only private dwellings are discussed – as opposed to non-private dwellings like hospitals, prisons, residential colleges etc in which people live communally).

Dwelling composition – The percentages of dwellings in a given SA2 (or other area) which fall into each dwelling type category.

Dwelling density – The number of dwellings in a given location (e.g. a meshblock or SA2) divided by the area of the location. This is generally measured in dwellings per hectare, which is shortened to **dw/ha**.

Dwelling type – In this document this term is used to refer to the structure of a private dwelling, broken down into separate house, attached dwelling, low rise apartment, medium rise apartment, high rise apartment and other.

Expected dwelling composition – In this document, this term is used to refer to the dwelling composition that would be expected in an SA2 in the future based on its forecast weighted dwelling density and employment density without considering the actual housing composition in the past (as discussed in Section 1.4).

Functional urban area (FUA) – A broad categorisation of Victoria into the functional types of Inner Melbourne, Middle Melbourne, Outer Melbourne, Melbourne New Growth Areas, Regional Cities, and Rural Areas and Regional Centres. This categorisation has taken place at the SA2 level for the purpose of scenario modelling.

Greenfield development – Subdivision and housing development in an area which previously contained rural land, and which was not developed at suburban or urban densities. Generally this occurs on the urban fringe of Greater Melbourne.

Infill development – Redevelopment of existing housing and urban areas at higher densities, typically replacing existing separate houses on suburban land parcels.

Meshblock – As defined by the Australian Bureau of Statistics, the smallest geographical areas in the Australian Statistical Geography Standard.

PSP – Precinct Structure Plan. These are a land use and infrastructure plan to guide the development of an area over time.

SA2 – Statistical Area Level 2 (as defined by the Australian Bureau of Statistics).

Target dwelling composition - In this document, this term is used to refer to the projected dwelling composition in an SA2 in the future based on an adjustment of the expected dwelling composition after considering data on housing composition in the SA2 from the most recent Census (as discussed in Section 1.4).

Timestep – The duration between two adjacent points in time which are used in a model. In this case, the model includes the years 2021, 2036 and 2056 so the timesteps are 2021-2036 and 2036-2056.

Weighted dwelling density – A measure of the density of dwellings in an SA2 calculated using every meshblock in the SA2, and in which the density of each meshblock is weighted by the number of dwellings it contains. This is a measure of the average density experienced for an individual dwelling in the SA2. It overcomes some of the problems of variations in density within an SA2 or the distortions in dwelling density created by the presence of large areas at low density.

IV Urban Development Scenarios – Travel zone forecasts

Infrastructure Victoria

31 | 03 | 2023

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Contents

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1. Introduction

Infrastructure Victoria is leading a research project that investigates five possible future urban development scenarios for the state. These scenarios are defined at an SA2 geographic scale.

SGS Economics and Planning (SGS) were engaged to use these scenarios to produce travel zone land use inputs for the purpose of strategic transport modelling. The outputs were produced for two future time periods, 2036 and 2056. This document outlines the methodology which leverages two sources:

- The SA2 land use outcomes of each scenario, referred to in this report as scenario control totals.
- The 2022 Small Area Land Use Projections (SALUP22) travel zone projections, referred to in this report as the *reference case*.

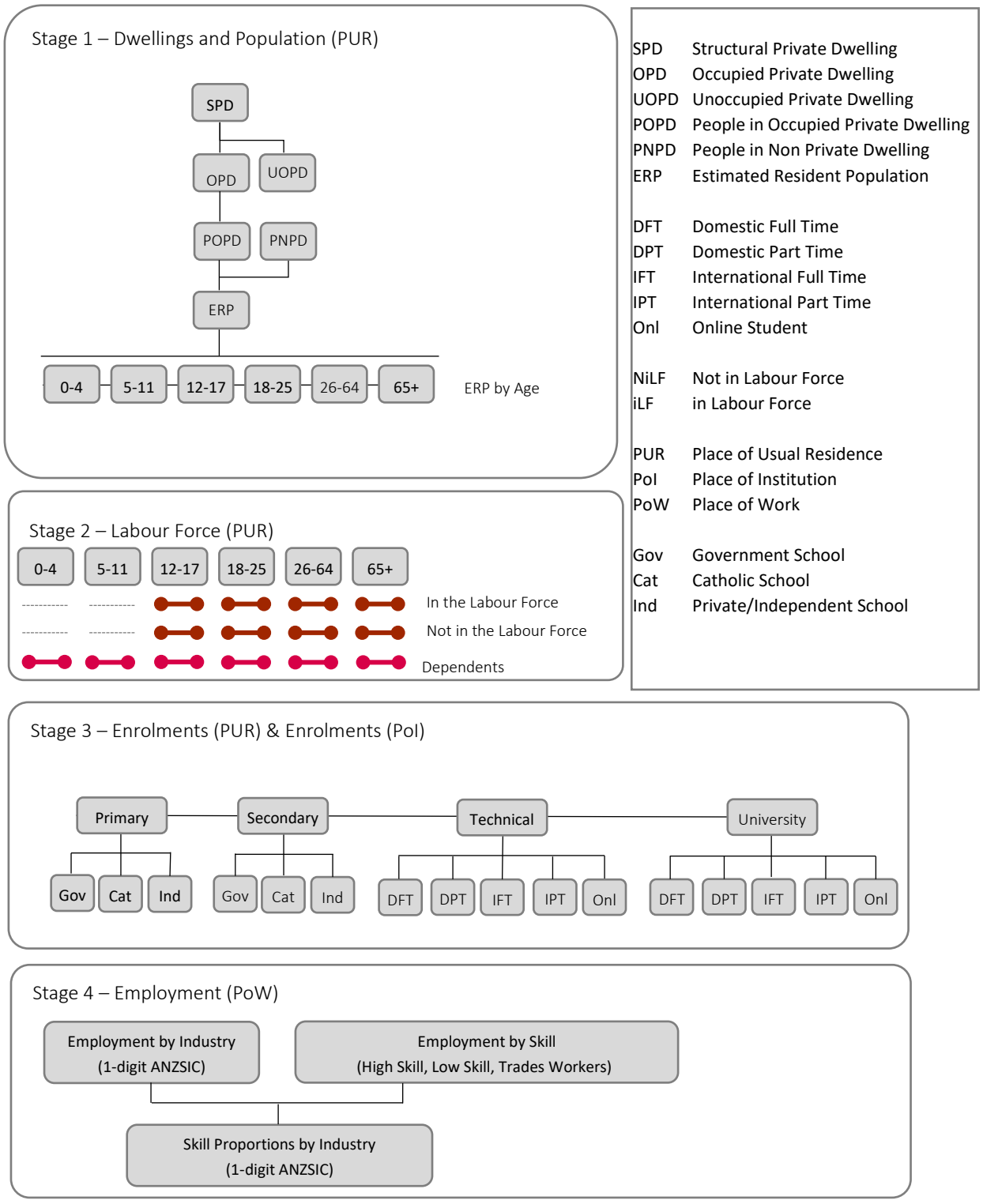
Figure 1 shows the relationship between the main variables that form SALUP22.

For each scenario, the control totals which represent the scenario outcomes at a high level (at an SA2 scale and by broad variable categories) are disaggregated into the full set of required land use variables (at a travel zone scale) based on the detailed distributions (e.g., demographic, industry, spatial, etc) of the reference case.

The approach (summarised in Figure 1) is designed to produce results which align with the control totals of each scenario while maintaining consistency with the reference case (both at a statewide level and in detailed distributions), and includes five key steps:

- The control totals for dwellings and population (by age) are distributed to travel zones based on the reference case spatial distribution within each SA2 for each time period.
- Based on reference case distributions at a travel zone level, these dwelling and population variables are disaggregated into the broader set of the place of usual residence (PUR) variables (including students).
- The control totals for employment are first disaggregated from broad industry category to ANZSIC 1-digit categories at a statewide scale and then to travel zones, both processes based on reference case distributions.
- Remaining place of work (POW) variables are created, at a travel zone scale, based on reference case distributions.
- Place of institution variables (i.e., enrolments) are based on the reference case forecasts, adjusted by changes in resident demand (i.e., students) between the reference case and each scenario at a broader spatial scale (SA3 for schools and GCCSA region for higher education).

FIGURE 1 VARIABLE STRUCTURE



Source: SGS Economics and Planning

2. Technical method

This section describes the methodology used in creating the travel zone land use inputs, organised by the following broad tasks:

- Disaggregating dwelling and population by age scenario control totals to travel zone geographies and estimating supplementary variables (e.g., households, labour force, dependents, etc) which are required travel zone land use variables but not included in the control totals for each scenario.
- Disaggregating employment scenario control totals to travel zone geographies and estimating employment by skill and industry proportions[1], which are required travel zone land use variables but not included in the control totals for each scenario.
- Estimating enrolments, both at place of residence and place of institution (noting that, unlike dwellings, population and employment, enrolment scenario control totals by SA2 are not a constraint).

2.1 Dwellings and Population and Labour Force

Age categories used in the scenario control totals (0-14, 15-24, 25-44, 45-64, 65-84, 85+) are converted to the required travel zone age categories (see Figure 1). This process includes the following steps:

- For each SA2, population for each scenario control total age group is split into 5-year age groups based on reference case age distributions.
- A uniform distribution (within 5-year age group) is assumed in cases where further disaggregation is required (e.g., the 12-17 age category).
- An Iterative Proportional Fitting (IPF) function[2] is used to ensure each SA2 aligns with scenario control totals for total population (for each scenario) and that each age group aligns with statewide totals (constant across all scenarios and the reference case).

Population by age is distributed from SA2s to travel zone geographies based on the reference case spatial distribution. Households and dwellings are estimated based on their respective reference case metrics (e.g., occupancy rates and household size) within each travel zone. This involves the following key steps:

- SA2 population by age is distributed to the travel zone level based on the reference case spatial distribution.

[1] Employment by skill is referred to as employment by collar in the SALUP22 technical documentation and within the Victorian Integrated Transport Model (VITM). Trades workers refers to blue collar, high skill jobs refer to white collar high skill and low skill jobs refer to white collar low skill.
[2] The IPF function takes the statewide totals for each 5-year age group, as well as the SA2 total population, and aligns the within-SA2 population by age estimates such that they satisfy both totals.

- For each travel zone, reference case ratios for private/non-private dwelling population, and household sizes are used to estimate the population in occupied private dwellings and number of households.
- Similarly, the occupancy rate for each travel zone is used to estimate unoccupied private dwellings (UOPD) and total dwellings (SPD).
- Dwellings (both occupied and unoccupied) within each travel zone are scaled to ensure consistency with scenario control totals for dwellings (SPD) by SA2.
- Finally, an IPF function is used to ensure that statewide totals for occupied and unoccupied private dwellings remain consistent with the reference case.

A similar process is used to estimate labour force variables, where:

- Labour force variables, by age group, are first estimated for each SA2, using the reference case as a base which is scaled by the ERP (by age group) change of each scenario (relative to the reference case).
- These labour force estimates are then distributed to travel zone geographies based on the reference case spatial distribution and an IPF function is used to ensure that statewide totals for each variable remain consistent with the reference case.
- Labour force by skill for each travel zone is estimated by scaling reference case values by the relative change (each scenario relative to the reference case) of the 'In Labour Force' variable. An IPF function is used to ensure that statewide totals for labour force by skill variables remain consistent with the reference case[3].
- Dependents are constructed with two factors:
  - The sum of population that are under 15 years of age.
  - The sum of population 15 years of age or older, that are either not in the labour force or unemployed.

[3] Note that this consistency only applies to scenarios 1 and 2. Scenarios 3, 4, and 5 differ from the reference case in employment composition, and therefore also occupational (i.e., trades workers, high and low skilled jobs) composition.

2.2 Employment

Employment variables for each scenario require three transformations: industry disaggregation, spatial disaggregation, and occupation (i.e., skill) disaggregation. These are constructed using the following process:

- For each SA2, the broad industry categories (4), by which the scenario control totals are defined, are disaggregated into the 37 sub-categories from which they are formed[4] based on the reference case distribution.
- These are then distributed to travel zone geographies based on the reference case spatial distribution within each SA2.
- A set of IPF functions (one for each of the four broad industry categories) are used to ensure that each SA2 has the correct total employment by broad industry (for each scenario) and correct statewide totals (noting that these differ to the reference case for scenarios 3, 4, and 5).
- These estimates are aggregated to ANZSIC 1-digit industry categories.
- For each ANZSIC 1-digit industry category, an estimate of employment by industry by skill is constructed using an IPF function and the reference case distribution (i.e., employment by industry by skill by travel zone) and scenario employment by industry estimates (created in prior step).
- This is used to generate the variables of employment by skill and proportion by industry.

2.3 Enrolments

Place of usual residence (PUR) enrolments are estimated via the following process:

- For each travel zone, enrolments are scaled based on changes in relevant age groups (0-11 for primary school, 12-17 for secondary school, and 18-25 for tertiary).
- Each enrolment category is scaled to ensure that statewide totals remain consistent with the reference case.

Place of Institution (POI) enrolments are estimated using the previously estimated PUR enrolment variables, constrained by a degree of regional self-containment. This process involves:

- For each scenario, PUR enrolment differences relative to the reference case are assumed to translate to an equivalent change in POI enrolments at a regional level (defined as SA3 for primary/secondary and as GCCSA for tertiary).
- These changes in POI enrolments within each region (relative to the reference case) are distributed to constituent travel zones proportionally, based on the reference case spatial distribution[5].

[4] Definitions available in the Urban Development Scenarios Part A Report, Appendix C.
[5] As an example, if the primary school PUR enrolments within an SA3 increased by 100 students relative to the reference case, then those 100 students will be added to the schools in that SA3, proportional to their enrolment sizes under the reference case.

CANBERRA / NGAMBRI / NGUNNAWAL

Level 2, 28-36 Ainslie Avenue
Canberra ACT 2601
+61 2 6257 4525
sgsact@sgsep.com.au

HOBART/ NIPALUNA

PO Box 123
Franklin TAS 7113
+61 421 372 940
sgstas@sgsep.com.au

MELBOURNE / NAARM

Level 14, 222 Exhibition Street
Melbourne VIC 3000
+61 3 8616 0331
sgsvic@sgsep.com.au

SYDNEY / WARRANG

Suite 2.01/50 Holt Street
Surry Hills NSW 2010
+61 2 8307 0121
sgsnsw@sgsep.com.au

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Urban Development Scenarios
Part B: Impact Assessment Framework Report

Infrastructure Victoria

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SGS Economics and Planning Pty Ltd
ACN 007 437 729
www.sgsep.com.au

Offices in Canberra, Hobart, Melbourne, and Sydney, on Ngunnawal, muwinina, Wurundjeri, and Gadigal Country.

Contents

APPENDICES

Executive summary

Infrastructure Victoria is leading a research project that investigates future urban development scenarios for the state. This working report summarises the methodology and findings for Phase Two, Part B. Objectives of Part B are to:

- Establish a reference context for assessing urban development scenarios through a broad scan of the literature;
- Identify the potential environmental, social, and economic impacts associated with the urban development scenarios defined in Phase Two, Part A; and
- Develop a framework that classifies the different impacts and identifies how they can be assessed/measured.

A broad scan of the literature relevant to assessing the social, economic, and environmental impacts of different urban development scenarios was undertaken to establish a reference framework for the project. The literature review identified five local and international comparable urban development impact assessment frameworks to be used as key sources:

- Australian Transport Assessment and Planning (ATAP) 2016
- United Nations Sustainable Development Goals Global Indicator Framework (2019)
- World Bank Urban Growth Scenarios Guidebook (2018)
- SGS Plan Melbourne Monitoring and Reporting Framework (2016)
- SGS Peri-Urban Economic Develop Strategy (2018)

Findings from the review of the key framework sources identified are summarised according to seven themes which formed the basis for the assessment framework. These themes are categorised according to four impact types, summarised in the table below.

Impact type	Headline impact
Environmental	Development of environmentally sensitive land
	Environmental outcomes
Social	Housing diversity and choice
	Access to jobs and services
Economic	Economic performance
	Socioeconomic equity
Costs	Required investment

Under each headline impact, measures (quantitative metrics) are identified which enable assessment of the urban development scenarios. Measures were drawn from the literature review of key sources, and others identified in consultation with Infrastructure Victoria. For all measures included in the framework, the report details a method to undertake basic or complex modelling, identifying required steps and data sources.

The report also explores flow-on effects—the qualitative consequences of headline impacts. These are often more difficult to quantify, may be influenced by various externalities, and are often interdependent with each other and with numerous framework measures. They then feed back to global mega-trends and influences, creating a circular effect between urban development and its consequences.

The framework outlined in this report therefore establishes a comprehensive approach to assessing the impacts of urban development scenarios that can be reasonably quantified and forecast. It will be further refined once the scenarios are fully developed. Future stages of work may include modelling of the measures identified as well as of distributional impacts, and a more detailed investigation of flow-on effects.

1. Introduction

1.1 Project context

Infrastructure is leading a research project that investigates future urban development scenarios for the state. The project comprises three consecutive Phases:

- Phase One: define a set of plausible scenario concepts;
- Phase Two: refine and develop these scenarios further (Part A) and prepare a framework to assess the impacts of each (Part B); and
- Phase Three: undertake detailed modelling of impacts according to the assessment framework.

1.2 Purpose of this report

This working report summarises the methodology and findings for Phase Two, Part B. The objectives of Part B are to:

- Establish a reference context for assessing urban development scenarios through a broad scan of the literature;
- Identify the potential environmental, social, and economic impacts associated with the urban development scenarios defined in Phase Two, Part A; and
- Develop a framework that classifies the different impacts and identifies how they can be assessed/measured.

Later refinements will be made to this report once the scenarios from Part A are further defined and finalised.

1.3 Report Structure

This report is structured as follows:

- Section 2: Literature Review findings from reference frameworks
- Section 3: Concepts and Definitions
- Section 4: Overview of framework approach
- Section 5: Measurement Approach
- Section 6: Additional Research, Modelling and Next Steps

2. Literature Review

This section contains a summary of the methodology, findings, and implications of the literature review of comparison frameworks conducted for the project.

2.1 Methodology and scope

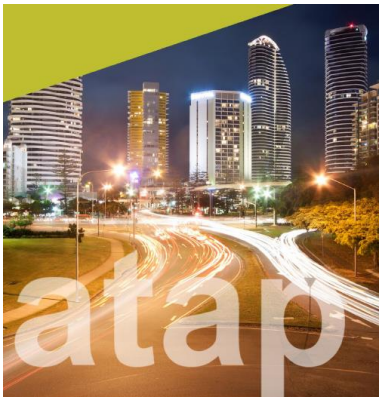
A broad scan of the literature relevant to assessing the social, economic, and environmental impacts of different urban development scenarios was undertaken to establish a reference framework for the project. The literature review identified five local and international comparable urban development impact assessment frameworks to be used as key sources. The purpose and scope of each are summarised below.

Some are performance-based frameworks that benchmark impacts against an established set of targets or goals, while others identify potential indicators and measures for assessing future scenarios in an exercise similar to this project.

The review is structured according to the headline impacts identified for the urban development scenarios, which are defined at section 3 of this report.

2.2 Key sources

TABLE 1: LITERATURE REVIEW KEY SOURCES SUMMARY

	*Australian Transport Assessment and Planning (ATAP) 2016* The national guideline for best practice for transport planning and assessment in Australia. ▪ The ATAP appraisal system includes a cost-benefit analysis methodology. ▪ The guidelines document the benefits of both active and public transport, such as reduced congestion, changes in travel time, and improved physical health. ▪ The framework includes a methodology for undertaking an economic appraisal of the different transport types.

United Nations Sustainable Development Goals Global Indicator Framework (2019)

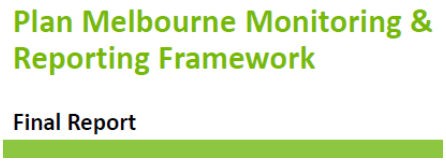
An exhaustive framework of indicators to measure the progress of the goals and targets from the 2030 Agenda for Sustainable Development.

- Includes economic, social, environmental, and governance indicators.
- The 17 Sustainable Development Goals (SDGs) are focussed on ending poverty, improving health and education, reducing inequality, and supporting economic growth.
- Indicators are a mix of population wellbeing and access to goods and services, environmental protection, economic performance, and government actions/investment.
- Indicators that are relevant to more than one goal repeat in the framework.

World Bank Urban Growth Scenarios Guidebook (2018)

Outlines the actions necessary to model urban growth scenarios, in an approach similar to that of the modelling undertaken for this project.

- Includes a methodology with 16 indicators detailling how the different impacts of scenarios may be measured.
- Acknowledges the complex relationship between of scenario inputs and impacts.
- Some indicators are more simple measures, while others require more complex modelling.



SGS Plan Melbourne Monitoring and Reporting Framework (2016)

Previous work from SGS that identifies appropriate metrics to track the progress of development in metropolitan Melbourne against the direction and goals of Plan Melbourne.

- Identifies relevant SDGs that align with each indicator
- For each indicator, a quantitative measure and the relevant data source is identified.
- All indicators rely on available metrics already collected or committed to be collected by government, annually or more frequently, so that the monitoring and reporting can be undertaken on a regular basis for the lifetime of the Plan.

PERI-URBAN ECONOMIC DEVELOPMENT STRATEGY FINAL REPORT SEPTEMBER 2018 | Prepared for Peri-Urban Group of Rural Councils	*SGS Peri-Urban Economic Develop Strategy (2018)* Previous work from SGS that identifies performance indicators to support the Peri-Urban Group of Councils in achieving sustainable growth of the region. ▪ Complements Plan Melbourne, with a focus on growing the regions outside the metropolitan area. ▪ As with the Plan Melbourne Monitoring and Reporting Framework, it links to UNSDGs. ▪ The Economic Development Strategy includes a framework with indicators relevant to the Strategy's priorities and compares current performance with target performance.

2.3 Findings

Findings from the review of the key framework sources identified are summarised according to seven themes; these themes have formed the basis for the headline impacts in the framework developed to assess scenarios.

Development of environmentally sensitive land

The consumption of agricultural and natural/conservation land is one of the more significant and direct impacts of urban development at the city fringe and in regional areas. The Peri-Urban EDS, United Nations SDG, and World Bank frameworks all include consideration of this impact. This can also include development in areas that are considered high-risk to life and property due to climate change.

Beyond land consumption, development of sensitive landscapes is also associated with impacts to biodiversity, soil degradation, water quality, and other detriments to ecosystem services.

Environmental outcomes

Consideration of greenhouse gas emissions is consistent across all frameworks. The World Bank and ATAP frameworks focus on emissions as a function of transport, building, lighting, and other energy-consuming services, while the performance-based frameworks seek to mitigate/reduce emissions by reducing vehicle dependency and transitioning to renewable energy sources. Air pollution is frequently utilised as an indicator of greenhouse gas emissions.

In addition to emissions, the World Bank framework includes energy consumption as a key indicator, expressed as total kilowatt hours of energy consumed per person per year for public lighting, water supply waste management, electricity, and transport (including vehicles). The Plan Melbourne framework also contains energy consumption per capita as an indicator. Water consumption is similarly measured in the World Bank framework.

Exposure to hazards due to living near sources of pollution is another impact associated with urban expansion in the World Bank framework.

Housing diversity and choice

The United Nations SDGs highlight the importance of access to appropriate housing to meet population needs. This is also a key direction of Plan Melbourne, which emphasises diversity and affordability.

Access to jobs and services

Access to jobs, transport, and social infrastructure is a prominent component of the World Bank framework, which measures access by proximity to different types of infrastructure identified. The Plan Melbourne framework measures access by not only proximity but also the share of jobs available. Employment, education, and training access is particularly important in the context of regional economic development according to the Peri-Urban EDS framework.

Regarding social infrastructure, some frameworks also consider government investment as a measure of access to services in addition to proximity.

The ATAP framework outlines in greater detail the range of benefits associated with access to public and active transport infrastructure, including reduced travel times, lower household expenditure, improved physical health, as well as benefits to the broader community such as reduced congestion.

Economic performance

The performance-based frameworks all include indicators to measure economic performance. This typically includes productivity and share of jobs and investment. This is also associated with the attractiveness and competitiveness of a state/region. Some indicators are tied to specific sectors such as knowledge and innovation or science and technology, dependent on the relevant goal or target.

Socioeconomic equity

Reduced inequality is a key goal of the United Nations framework. This is measured by myriad indicators relevant to educational attainment, employment/income, and health. The framework also recommends that all indicators should be disaggregated where possible by sex, race, migratory status, and other differentiating population indicators to understand distributional impacts.

Although they do not include indicators specific to social and economic equity, both Plan Melbourne and the Peri-Urban EDS include discussion around the importance of maximising health and wellbeing outcomes and opportunity across all groups.

Infrastructure costs

All frameworks consider costs or government investment across different infrastructure types. ATAP acknowledges that significant investment is typically required to deliver transport services and initiatives, while Plan Melbourne includes an indicator to measure investment in social infrastructure.

The Peri-Urban EDS framework does not include an indicator that measures dollar investment directly, but relies on proxy measures such as educational attainment and share of tourism jobs to gauge investment in these sectors, which is a direction of the EDS. Similarly, the United Nations SDGs framework incorporates a range of indicators to assess investment in rural infrastructure to support development.

The World Bank framework considers infrastructure costs associated with both upgrading existing capacity (infill development) as well as for urban expansion in order to quantify infrastructure costs of different urban development scenarios.

2.4 Discussion and limitations

With the exception of ATAP, the frameworks typically include a set of measures or indicators to assess a mix of social, environmental, and economic impacts. The United Nations SDGs framework also contains governance indicators related to transparency and democratic participation.

The World Bank Guidebook contains the most direct exemplar framework for the purposes of this project, outlining a clear conceptual pathway for how urban development scenarios can be modelled and assessed. However, it acknowledges the complex relationship—at times interdependency—between the many input variables and output indicators, where any one input can be associated with a range of impacts across different indicators.

The World Bank Guidebook also illustrates the need to undertake more detailed analysis in order to understand the extent of scenario impacts. For example, to quantify infrastructure costs across the various scenarios, it is first necessary to understand the costs of delivering infrastructure in different contexts (greenfield/expansion vs. infill).

Three of the five are performance-based frameworks intended to measure outcomes in real-time. Many of the indicators from these frameworks cannot be directly transferred to the Urban Development Scenarios as they rely on measures that cannot be forecast or modelled, such as community satisfaction with government services.

This framework compiles those impacts and measures that can be modelled/forecast and do not rely on real-time indicators of performance. It outlines an appropriate methodology for undertaking the required modelling using scenario outputs and other available sources of information.

3. Concepts and Definitions

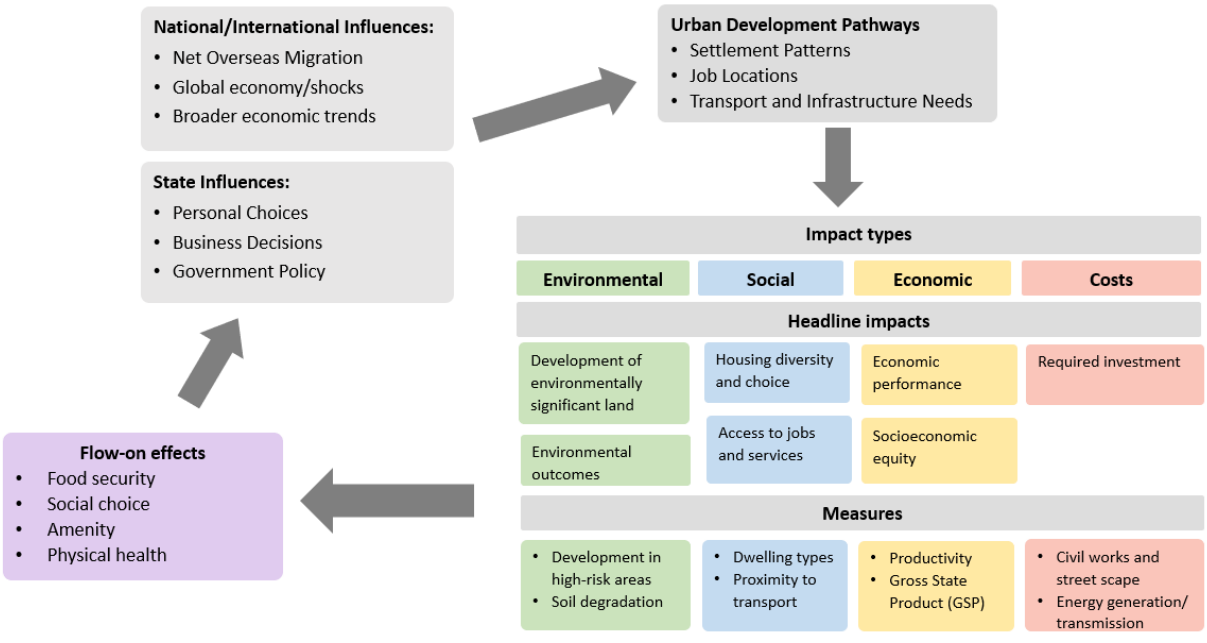
This section defines the concepts and terms used in the assessment framework and illustrates the relationships between them.

3.1 The input-output continuum

Macro factors and trends at the national/international scale such as migration patterns, government policy, and global economic shocks influence the different pathways that urban development may take. Built into these pathways are assumptions regarding urban form/function, population, settlement, and infrastructure provision. Impacts are the consequences of these scenario pathways to the environment, people, and the economy. These impacts then have flow-on effects which, in aggregate, form the basis for new trends and influences on future urban development.

Figure 1 depicts the circular nature of modelling urban development scenarios and assessing the extent of the impacts they are associated with.

FIGURE 1 CONCEPTUAL FRAMEWORK OF IMPACTS



Note: measures shown are only a selection of those included in the framework

3.2 Framework terms

Definitions for the terms used in the assessment framework are contained in Table 2.

TABLE 2: DEFINITION OF TERMS USED IN THE ASSESSMENT FRAMEWORK

Headline impacts	Measures	Measure type	Flow-on effects
Direct consequences to result from one or more of the Urban Development Scenarios. These can be measured—to varying degrees—with a range of quantitative metrics. Impacts are classified as environmental, social, economic or infrastructure provision costs.	The key quantitative metrics which measure the headline impacts of the Urban Development Scenarios. Measures were drawn from the literature review of key sources, and others identified in consultation with Infrastructure Victoria.	Identifies whether the measure is a scenario assumption (i.e., directly 'passed-through' from the scenarios to the assessment framework) or requires basic or complex modelling.	The qualitative consequences of headline impacts. These are often more difficult to quantify, may be influenced by a number of externalities, and are typically related to numerous measures identified in the framework. In reality, these often have a feedback effect into the mega-trends of Urban Development Scenarios.

Impact Types

Environmental refers to the consumption of land and other natural resources in Victoria to accommodate urban settlement and population growth, as well as pollution and waste generated.

Social refers to the consequences of the urban development scenarios for the people of Victoria. All social impacts are characterised by access to housing, infrastructure, and services.

Economic refers to how the economic output of Victoria and socioeconomic equity of its communities is impacted by the urban development scenarios.

Infrastructure Provision Costs refers to the investment cost to government or essential services providers associated with providing the infrastructure necessary to support the development envisioned in different scenarios.

Modelling types

Simple refers to modelling that can be undertaken through quantitative analysis with secondary (available) data – much of which is already built into the scenario modelling.

Complex refers to modelling which may require some primary data collection and complex quantitative analysis with multiple variables and dimensions, and may be led by multidisciplinary teams of highly-specialised researchers.

4. Evaluation Framework

This section discusses the headline impacts, associated measures, and flow on effects, organised according to each impact type.

4.1 Headline impacts

Table 3 categorises the headline impacts according to the impact types. The Environmental, Social, and Economic impact types each include two headline impacts. Costs is the fourth impact type, with one headline impact.

TABLE 3: HEADLINE IMPACT SUMMARY

Impact Type	Headline impact
Environmental	Development of environmentally sensitive land
	Environmental outcomes
Social	Housing diversity and choice
	Access to jobs and services
Economic	Economic performance
	Socioeconomic equity
Infrastructure Provision Costs	Required investment

Descriptions of the headline impacts, measures, and flow-on effects is outlined in the following sections. The full assessment framework and a detailed breakdown of the approach to assessing each measure included in the framework, with relevant data sources, units of measurement, and a step-by-step methodology is contained at section 5.

To assist with focussing the assessment under Phase 3 of the project, one measure has been identified under the Environmental, Social, and Economic impact types as offering the likely best indication of scenario performance overall. These measures have been underlined in the framework.

4.2 Environmental

A summary of headline impacts, measures, and flow-on effects of the Environmental impact type is shown at Table 4.

TABLE 4: SUMMARY OF ENVIRONMENTAL HEADLINE IMPACTS, MEASURES, AND FLOW-ON EFFECTS

Impact type	Headline impact	Measure	Flow-on effects
Environmental	Development of environmentally sensitive land	Agricultural land consumption	▪ Ecosystem services ▪ Biodiversity loss ▪ Natural landscape values ▪ Food security ▪ Economic loss to disasters ▪ Insurance costs ▪ Building costs ▪ Exposure to extreme events - mental/ physical health ▪ Canopy tree cover ▪ UHI effect
		Natural landscapes/ conservation land consumption	
		Native title land consumption	
		Development in high-risk areas	
	Environmental outcomes	Energy consumption	
		Air quality	
		Water quality	
		Soil degradation	
		Waste	
		Greenhouse Gas Emissions (C02/Methane)*	
		Noise pollution	
		Water Consumption	

Headline impacts and flow-on effects are discussed below; measures are detailed at Section 5.

Development of environmentally sensitive land (headline impact)

Development of environmentally sensitive land includes peri-urban and rural agricultural lands as well as natural landscapes. Some of these areas may also be Native Title lands with Aboriginal rights and interests, or high-risk areas where settlements would be particularly vulnerable to the effects of climate change such as sea level rise, flooding, erosion, and bushfires. Under the scenarios, development of this land is the alternative to infill development concentrated in established urban areas. Its consumption is relatively simple to model based on the proportion of different types of land development under the scenarios.

While agricultural practices can have their own detrimental impact on ecosystems – unless regenerative methods are used – conversion of farmlands to urban development represents a significant intensification of use, with greater impacts on biodiversity and potential for ecosystem services. Agricultural land is therefore considered environmentally sensitive in the context of the scenarios.

Environmental outcomes (headline impact)

Environmental outcomes are those impacts related to the consumption of materials and the impact this consumption has on the environment. The outcomes are linked to the development of environmentally sensitive land. Under the scenarios, different levels of development in established (infill) vs. greenfield areas and dominant transport modes can generate higher or lower noise pollution and greenhouse gas emissions (CO2/methane), and therefore influence the preservation or degradation of soil, air, and water quality. The greenhouse gas emissions measure is likely the best indication of scenario performance according to the environmental impact type.

Regarding consumption of resources, population growth generates additional demand for energy and water as well as waste, but the extent would differ spatially across scenarios as well as by the size of industries and dwelling types. Assessment of energy consumption can also be disaggregated as renewables and non-renewables to further understand environmental outcomes.

The methodology to assess the environmental outcomes varies between measures but is broadly a function of personal consumption/industrial production and their negative externalities. They are highly interdependent and would require more complex modelling.

Flow-on effects

Environmental impacts are linked to a number of flow-on effects that are difficult to quantify or cannot be forecast in the long term.

With more people living in high-risk areas comes greater risk of exposure to extreme events, which can cause harm to physical and mental health. Living in high-risk areas is also associated with financial costs, including increased building costs to meet resilience standards, increased insurance costs for buildings, and economic loss associated with disaster events.

Development of sensitive lands and the quality of soil, water and air would have implications for biodiversity as habitats shrink, human activity increases, and more pollutants are released into the environment. However, biodiversity loss will also be a function of the changing climate.

These outcomes may then also influence our cultural values regarding the environment and landscapes. All fall under the umbrella of ecosystem services, which refers to the many benefits to humans provided by the natural environment. Due to the complexity of ecosystem services and the unpredictable nature of climate change events, the extent of these impacts cannot be forecast in a quantitative sense.

While agricultural productivity can be estimated with complex modelling, the flow-on effects for food security overall are more nebulous. Food security is determined by whether people have access to sufficient food to meet dietary needs and would be influenced by reliance on interstate and overseas imports as well as other mega-trends related to the environment and health.

Canopy tree cover and the Urban Heat Island (UHI) effect are closely related and would be significantly influenced by urban design practices that seek to avoid loss of vegetation and cool urban areas. Accordingly, these would need to be measured in real-time.

4.3 Social

A summary of framework headline impacts, measures, and flow-on effects of the Social impact type is shown at Table 5.

TABLE 5: SUMMARY OF SOCIAL HEADLINE IMPACTS AND MEASURES

Impact type	Headline impact	Measure	Flow-on effects
Social	Housing diversity and choice	Dwelling types	▪ Tenure types ▪ Homelessness ▪ Housing security ▪ Household agency/ choice ▪ Cost of living ▪ Housing affordability ▪ Transport disruption ▪ Social choice ▪ Social cohesion ▪ Amenity ▪ Safety ▪ Physical health ▪ Mental health
		Housing suitability	
		Households stress	
	Access to jobs and services	Proximity to transport	
		Proximity to open space	
		Proximity to health/education/ other social infrastructure	
		Effective job density (EJD)	
		Labour force participation	
		Youth engagement	
		Individual/household income	
		Human capital	
		Transport network performance	
		Cultural/recreational participation	

Headline impacts and flow-on effects are discussed below; measures are detailed at Section 5.

Housing diversity and choice (headline impact)

Housing diversity and choice encompasses different forms of dwellings that are available to households, as well as the appropriateness and affordability of these dwellings.

Dwelling type refers to whether a dwelling is a separate (detached) house, a semi-detached house (e.g. townhouse), or flat/apartment of varying density, and is an input to as well as a consequence of the scenarios. This would vary under each scenario according to where and what type of development occurs.

Housing suitability and stress are related to how well a dwelling aligns with a household's profile and income, respectively. Housing suitability can be measured for scenarios in the same way that it is measured in the census – as a match between the relationship, age, and sex of household members

and the number of bedrooms in the dwelling. Meanwhile, household stress across scenarios could be measured as an extrapolation of current patterns as an indicator of housing affordability.

Access to jobs and services (headline impact)

Access to jobs and services allows people to engage in work, education, recreation, and social activities. It is a function of proximity to jobs as well as a range of community spaces and services. Proximity to transport, social, and recreation infrastructure can be measured simply from the scenario outputs by calculating the number of residents/dwellings within defined catchment areas of the different infrastructure types. Proximity is also the principal indicator of cultural/recreational participation. Beyond proximity, access is also determined by the performance of the transport network, which would need to be assessed through more complex transport modelling of various modes, as successful transport provision includes multi-modal options.

Effective job density (EJD), or the relative concentration of employment in an area, measures access to jobs in an area. Importantly, this indicates the distribution of economic opportunity under the scenarios. It also provides insight to access to services in an area, as a high concentration of jobs in healthcare would be associated with a high level of access to health services. The measure is likely the best indication of scenario performance under the social impact type.

Human capital takes a similar approach to EJD to measure the concentration of specialisation, knowledge and skills present in a population. Youth engagement is also a similar measure, specific to young people, which measures their access to educational institutions. The opportunities available to people then influence labour force participation. These are more complex to model.

Closely related to these measures as well as the economic headline impacts and measures is individual/household incomes, which determines whether households can afford goods and services. Income can be calculated from the employment distribution and average weekly earnings by industry. This measure is closely related to household stress and the economic headline impacts.

Flow-on effects

Social measures are associated with a broad range of flow-on effects regarding choice, amenity, and wellbeing. Tenure type—whether a dwelling is owned outright, owned with a mortgage, rented, or occupied under another arrangement—is dependent on the provision of social housing from the government, profit, and not-for-profit sectors. Homelessness is a function of this as well as other social measures and flow-on effects such as cost of living.

Housing choice (appropriateness and accessibility to households based on preferences), affordability, and security more broadly, are highly complex. The scenarios make some high-level assumptions around housing affordability (in aggregate for the metropolitan area) and relevant government intervention, but a detailed breakdown of affordability and other associated flow-on effects are influenced by a number of household and individual consumption choices, subject to market factors and trends that cannot be forecast in the long term.

Housing choice is one form of social choice, or the ability of people in a society to make decisions and choices which reflect desired outcomes. It is therefore an expression of preferences, interests, and values. Cohesion refers to the strength of relationships between community members. These are highly complex to define and measure in real-time let alone to forecast.

The transport modelling would give an indication of access as well as other potential benefits to society such as reduced congestion and travel times. However, disruptions associated with climate change impacts/events could not be forecast under this same model. As noted, these impacts/events are unpredictable in nature, and while the scenarios would allow for vulnerable areas of the network to be identified, it would not be possible to identify the severity, frequency, or duration of disruptions in advance of their occurrence.

Amenity is often used to refer to access to employment and essential infrastructure. However, it can also refer to a more comprehensive assessment of how desirable an area is, encompassing access as well as design aesthetics, green infrastructure activation, and even characteristics of residents. These factors tend to be more intangible as well as highly subjective. Safety is correspondingly influenced by a combination and measurable and immeasurable factors at a highly localised scale (e.g. the implementation of urban design principles to prevent anti-social behaviours) and national scale (e.g. organised crime).

Physical and mental health are linked to all other flow-on effects and measures identified here, influenced by environmental, social, and economic outcomes. While modelling could indicate how certain measures would influence specific health outcomes (e.g. proximity to open space and physical activity), forecasting overall health with indicators such as Health-Adjusted Life Years (HALY) is highly complex and interdependent in nature, and would require sophisticated modelling.

4.4 Economic

A summary of framework headline impacts, measures, and flow-on effects of the economic impact type is shown in Table 6. Note that the headline impact of socioeconomic equity is also included here, which is considered a mix of the social and economic impact types.

TABLE 6: SUMMARY OF ECONOMIC HEADLINE IMPACTS AND MEASURES

Impact type	Headline impact	Measure	Flow-on effects
Economic	Economic performance	Labour productivity	▪ Attractiveness (brand) ▪ Competitiveness ▪ Tourism ▪ Wealth ▪ Intergenerational equity ▪ Gender equity ▪ Racial/ethnic equity ▪ Accessibility ▪ Inclusion ▪ Labour force skill requirements
		GSP	
		Agricultural productivity	
	Socioeconomic equity	Spatial equity/ concentrated disadvantage	

Headline impacts and flow-on effects are discussed below; measures are detailed at Section 5.

Economic Performance (headline impact)

This headline impact refers to the performance of the economy at the macro level. This can be measured by Gross State Product (GSP) and productivity. GSP is the goods and services output for Victoria, calculated as the sum of the Gross Value Added (GVA) across different industries and regions. The GSP measure is likely the best indication of scenario performance according to the economic impact type.

Labour productivity, a key indicator of economic performance, can be measured as output per worker. Productivity growth is a key driver of improved living standards.[1] Agricultural productivity (one component of overall productivity) may decrease with the loss of agricultural land (environmental impact of consumption) as land can no longer be used for food production. To quantify this would require complex modelling that takes into account the total land area as well as potential technological advances, and environmental factors such as climate change and the quality of water, air, and soil in order to estimate yield.

[1] Australian Government Productivity Commission 2022, https://www.pc.gov.au/what-is-productivity

These measures will indicate whether the economy is better or worse off under each scenario.

Socioeconomic equity (headline impact)

Both social and economic factors contribute to equity in a society. Equity can differentiate between groups as well as between areas. In international development, it is most often measured via the Gini coefficient, which is a measure of income distribution that can be applied across time and place. This framework assesses equity through a more holistic lens, with a measure that considers income distribution as well as educational attainment, unemployment, and access to services within an area. This approach is similar to that of the ABS Socio-economic Index for Areas (SEIFA).

Flow-on effects

Attractiveness and competition are additional indicators of prosperity. A strong economy would attract businesses and workers, and be highly productive, but these macro-scale indicators are both relative to other economies and societies and can therefore not be modelled for Victoria alone. Similarly, tourism is highly vulnerable to global trends and influences, as evidenced by the recent impacts to the sector resulting from border closures throughout the height of the COVID-19 pandemic.

While the income differential can be quantified under the scenarios, wealth is influenced by more complex forces in the overall economic market—forces which are highly interdependent, at times creating a circular effect with other measures and flow-on effects, including those relevant to housing. Wealth is also closely related to intergenerational equity as property and other assets are often passed on through inheritance. Intergenerational equity is also a function of the comparative access to jobs, housing, and goods and services between generations, which would require modelling beyond the scenarios to measure equity over a protracted period.

Outcomes are not only experienced differently across generations, but also across racial/ethnic groups and cultural backgrounds, genders, and abilities. This includes Aboriginal and Torres Strait Islander people, who may experience different social and health outcomes under different scenarios. Impacts first need to be understood for the overall population before these distributional impacts could be measured; this could be undertaken at a later stage of work that incorporated more detailed demographic analysis, as the current scenarios do not make assumptions for different population groups based on individual characteristics.

Accessibility and inclusion are highly relevant to socioeconomic advantage/disadvantage as well as many of the social measures and are also influenced substantially by social policies and norms. Accessibility of the urban environment is also determined through fine-grained design. Accordingly, these cannot be forecast for the scenarios.

4.5 Infrastructure Provision Costs

A summary of framework headline impacts, measures, and flow-on effects of the economic impact type is shown in Table 7 as well as the entities that may be responsible for likely costs both in construction and development and ongoing. Costing and funding is complex and may involve a range of parties and would need to be looked at in detail separately once specific projects were being identified and assessed.

TABLE 7: SUMMARY OF INFRASTRUCTURE COSTS HEADLINE IMPACTS AND MEASURES

Measure	Federal	State	Local	Private Sector	Community
Energy generation/ transmission requirements	Provides capital grants for some projects from targeted funds.	Provides capital grants for some projects from targeted funds		Responsible for funding capital and operational expenditure under regulated market arrangements.	Private sector costs recovered through consumer user charges
Water	Provides capital grants for some projects from targeted funds	State Government water authorities fund capital and operational expenditure under regulated market arrangements. State government provides capital grants for some projects from targeted funds			Water authority costs recovered through consumer user charges
Gas					*As Per Energy Requirements* ✓
Transport	✓	✓	✓	✓	Private and government costs partially recovered from

Measure	Federal	State	Local	Private Sector	Community
					road tolls, vehicle registration and PT fares
Health/education/social services		✓		✓	Private sector costs recovered from consumer through user charges
Digital communication (ICT, broadband, telecommunications etc)	✓	✓		✓	Private sector costs recovered from consumer through user charges
Justice	✓	✓			
Emergency services		✓			
Waste			✓		Partially recovered from the consumer through council rates
Culture and recreational		✓	✓	✓	Partially recovered from the consumer through user charges
Civil works and street scape		✓	✓		Part of State and local Government budgets
Blue and green infrastructure (including open space)		✓	✓		Part of State and local Government budgets

Measure	Federal	State	Local	Private Sector	Community
Freight (ports, rail, and airports)	✓	✓	✓	✓	Aviation a key focus of Federal Government, private sector investment in Port and Airports as well as Freight Rail

The headline impact and flow-on effects are discussed below; measures are detailed at Section 5.

Required Investment

This refers to the investment required to deliver the infrastructure, hard and soft, to support the development that is forecast for each scenario. Investment in different types of infrastructure would differ significantly across the scenarios, influenced by policy as well as urban form. The framework acknowledges this by including each infrastructure type as a measure to allow for individual estimation of costs.

To model costs associated with each scenario, an assessment of the needs of residents and workers would first need to be undertaken to understand demand for different types of infrastructure. Demand for the various types of infrastructure will directly influence the costs under each scenario. Estimated costs could then be combined to understand the total investment required.

Flow-on effects

The only significant flow-on effects with additional infrastructure provision is the potential additional jobs created through further infrastructure spending, however this is likely captured as part of overall scenario assumptions and the transient nature of construction as well as ongoing maintenance jobs and further analysis would be required regarding the net additional jobs. In addition, outcomes associated with this, e.g. increased opportunity/access and participation, are covered under other impact types.

5. Measurement Approach

This section breaks down how each measure can be modelled/assessed and considers how complex the required modelling may be.

5.1 Full Assessment Framework

The full assessment framework is shown in Table 8. A detailed approach to assessing each measure is contained in the subsequent sections.

TABLE 8: FULL ASSESSMENT FRAMEWORK

Impact Type	Headline impact	Ref Code	Measure(s)	Measure Unit/Form	Desired	Level of Modelling Required
Environmental	Development of environmentally sensitive land	Env1	Agricultural land consumption	% of developed land	Lower %	Scenario
		Env2	Natural landscapes/ conservation land consumption	% of developed land	Lower %	Scenario
		Env3	Native title land consumption	% of developed land	Lower %	Scenario
		Env4	Development in high-risk areas	% of developed land	Lower %	Scenario
	Environmental Outcomes	Env5	Energy consumption	Energy (PJ) consumed	Lower PJ	Basic
		Env6	Air quality	Not identified	TBD by specialist	Complex
		Env7	Water quality	Not identified	TBD by specialist	Complex
		Env8	Soil degradation	Not identified	TBD by specialist	Complex
		Env9	Waste	Waste (t) generated	Lower tonnage	Basic
		Env10	Greenhouse Gas Emissions (C02/Methane)	GHG produced	Lower CO2e	Basic
		Env11	Noise pollution	Not identified	TBD by specialist	Complex
		Env12	Water Consumption	Water (GL) consumed	Lower GL	Basic
Social	Housing diversity and choice	S1	Dwelling types	% of stock for each type	Neutral	Basic
		S2	Housing suitability	# or % of households	Higher # or %	Basic

Impact Type	Headline impact	Ref Code	Measure(s)	Measure Unit/Form	Desired	Level of Modelling Required
		S3	Households stress	# or % of households	Higher # or %	Basic
	Access to jobs and services	S4	Proximity to transport	# or % of population	Higher # or %	Basic
		S5	Proximity to open space	# or % of population	Higher # or %	Basic
		S6	Proximity to health/education/ other social infrastructure	# or % of population	Higher # or %	Basic
		S7	Effective job density	# of jobs accessible	Higher #	Complex
		S8	Labour force participation	% of participation	Higher %	Basic
		S9	Youth engagement	# of education places accessible	Higher #	Complex
		S10	Individual/household income	$ of income earned	Higher $	Basic
		S11	Human capital	# of people accessible	Higher #	Complex
		S12	Transport network performance	VKT/trip numbers/travel times	Reduced travel times/VKT	Complex
		S13	Cultural/recreational participation	% of participation	Higher %	Basic
Economic	Economic performance	Eco1	Productivity	GVA ($) per capita	Increased $	Basic
		Eco2	GSP	GSP ($) generated	Increased $	Basic
		Eco3	Agricultural Productivity	Not identified	TBD by specialist	Complex
	Socioeconomic equity	Eco4	Spatial equity/concentrated disadvantage	Composite score	Higher score	Basic
		C1	Energy Generation/Transmission Requirements	Cost per job/capita	Lower cost	Complex

Impact Type	Headline impact	Ref Code	Measure(s)	Measure Unit/Form	Desired	Level of Modelling Required
Infrastructure Provision Costs	Required Investment	C2	Water	Cost per job/capita	Lower cost	Complex
		C3	Transport	Cost per job/capita	Lower cost	Complex
		C4	Health/Education/Social Services	Cost per job/capita	Lower cost	Complex
		C5	Digital communication	Cost per job/capita	Lower cost	Complex
		C6	Justice	Cost per job/capita	Lower cost	Complex
		C7	Emergency services	Cost per job/capita	Lower cost	Complex
		C8	Waste	Cost per job/capita	Lower cost	Complex
		C9	Culture, sport and community	Cost per job/capita	Lower cost	Complex
		C10	Civil works and street scape	Cost per job/capita	Lower cost	Complex
		C11	Airports	Cost per job/capita	Lower cost	Complex

5.2 Environmental

Development of environmentally sensitive land

Measure	Env1 – Agricultural land consumption
Description	To measure the amount of agricultural land consumed for non-agricultural purposes.
Justification/ purpose	Agricultural land plays a significant role in Victoria's economy and plays a vital role in supplying food and products both locally and further abroad. Land consumption across the different development scenarios varies greatly and it is important to understand the amount of agricultural land consumed for development across each development scenario.
Related measures	Agricultural productivity Housing diversity and choice may be drivers of land consumption Development can lead to soil degradation and possibly affect water quality
Measure guidance	
Measure type & level of skill required	Scenario Assumption – can be determined from scenario results; specialist skills not required
Measure unit and direction	% of developed land area located within land zoned for agricultural uses. Desired: Lower %
Calculation approach	Step 1: Calculate an average land parcel size based on population densities relating to the development scenario. The population to land area ratio may change across the scenarios based on densities. Step 2: Calculate the amount of developed land area located within land subject to Zones for agriculture (Farming Zone, Rural Living Zone, Rural Activity Zone and Green Wedge A Zone), divided by the total amount of land that can be used for agricultural production.
Data sources	Population outputs Planning Overlays, zones including FZ, GWAZ, RLZ, and RAZ. Consultation with Industry Additional research into land usage patterns

Limitations	Measuring agricultural land consumption would benefit from outputs of the development scenarios being shown at the SA1 level for greater understanding of the location of development, land parcels and densities across the scenarios. The population to land area ratio may change across the scenarios based on densities. Not all land zoned for agricultural uses may actually be used for agriculture, so additional analysis/assumptions about current and future land uses may be required. Inversely, some land that is already designated and zoned for urban development (within the Urban Growth Boundary or existing township boundaries) but is currently used for agricultural purposes would not be captured.

Measure	Env2 – Natural landscapes/conservation land consumption
Description	To measure the amount of land considered as significant natural landscapes and conservation land consumed for urban development.
Justification/ purpose	Natural landscapes hold significance and value for a combination of historic, aesthetic, scientific, cultural, and social reasons. There are a number of identified significant natural landscapes and areas of conservation throughout Victoria and it is important to measure and understand the amount of land consumed within these areas across each development scenario.
Related measures	Housing diversity and choice may be drivers of land consumption Development can lead to soil degradation and possibly affect water and air quality
Measure guidance	
Measure type & level of skill required	Scenario Assumption – can be determined from scenario results; specialist skills not required
Measure unit and form	% of developed land area located within Planning Zones for nature conservation Green Wedge Zone, Rural Conservation Zone, Public Conservation and Resource Zone. Desired: Lower %
Calculation approach	Step 1: Calculate an average land parcel size based on population densities relating to the development scenario. The population to land area ratio may change across the scenarios based on densities. Step 2: Calculate the amount of developed land area (using land parcels) located within land subject to the Significant Landscape Overlay and Green Wedge Zone,

	divided by the total amount of designated significant landscapes and green wedge zone.
Data sources	Population outputs Significant landscape overlay Green Wedge Zone
Limitations	Measuring natural landscapes/conservation land consumption would benefit from outputs of the development scenarios being shown at the SA1 level for greater understanding of the location of development, land parcels and densities across the scenarios. The dwelling to land area ratio may change across the scenarios based on densities. May not capture areas that have special uses, historical zones, or zoning errors/anomalies where natural landscapes may be present, or natural landscape areas that have already been rezoned for urban development.

Measure	Env3 – Native title land consumption
Description	To measure the amount of Aboriginal cultural significant land lost to development.
Justification/ purpose	Developments and other high impact activities in culturally sensitive landscapes can cause significant harm to Aboriginal cultural heritage. Because the urban development scenarios vary in the amount of land consumed for development it is important to understand how much native title land consumption is likely to occur in each development scenario.
Related measures	Housing diversity and choice may be drivers of land consumption
Measure guidance	
Measure type & level of skill required	Scenario Assumption – can be determined from scenario results; specialist skills not required
Measure unit and form	% of developed land area located in areas of Cultural Heritage Sensitivity. Desired: Lower %
Calculation approach	Step 1: Calculate an average land parcel size based on population densities relating to the development scenario. The population to land area ratio may change across the scenarios based on densities.

	Step 2: Calculate the amount of land consumed for development (using land parcels) within areas of the Aboriginal Cultural Heritage Sensitivity Overlay, divided by the total area of Aboriginal Cultural Heritage Sensitivity in Victoria.
Data sources:	Population outputs Aboriginal Cultural Heritage Sensitivity Overlay
Limitations	Measuring native title land lost through land consumption would benefit from outputs of the development scenarios being shown at the SA1 level for greater understanding of the location of development and densities across the scenarios. The dwelling to land areas ratio may change across the scenarios based on development densities.

Measure	Env4 – Development in high-risk areas
Description	To measure the amount of urban development in high-risk areas
Justification/ purpose	Land consumption across the different development scenarios varies greatly. If more land is released for development, the number of households in vulnerable locations may increase. It is important to understand the amount of development that occurs in areas considered to be high-risk and how this changes between the urban development scenarios.
Related measures	Natural landscapes/conservation land consumption Housing diversity and choice may be drivers of land consumption Development can lead to soil degradation and possibly affect water quality
Measure guidance	
Measure type & level of skill required	Scenario Assumption – can be determined from scenario results; specialist skills not required
Measure unit and form	% of developed land area located in areas subject to flood, bushfire and erosion management overlays Desired: Lower %
Calculation approach	Step 1: Calculate the amount of developed land area by converting population densities into an average land parcel size relating to the development scenario.

	Step 2: Calculate the amount of developed land area (using land parcels) located within areas subject to bushfire, flood and erosion management overlays, divided by the total amount of developed land area in the development scenario.
Data sources	Population outputs Bushfire management overlays, overlays relating to flooding (including special building overlays, land subject to Inundation overlays, floodway overlays and urban floodway zones) and erosion management overlays
Limitations	Using overlays does not consider for future sensitivity of lands, especially as low risk areas shift to becoming more vulnerable and affected by climate change. Overlays may also not be based on current climate scenarios and this approach could potentially underestimate the population at risk. This may be important to consider due to long time horizons of development scenarios. Measuring development in high risk areas would benefit from outputs of the development scenarios being shown at the SA1 level for greater understanding of the location of development, parcels sizes and densities across the scenarios. The dwelling to land areas ratio may change across the scenarios based on development densities.

Environmental outcomes

Measure	Env5 – Energy consumption
Description	To measure energy usage (and by type) generated by industry and dwellings
Justification/ purpose	Energy consumption is an important environmental consideration across the scenarios. Especially considering the state of the national electricity market and the risk of climate change effects, usage is essential, as well as the type of energy resource (non-renewable or renewable). Scenarios will differ across the level of development required to transform cities and regions to make liveability viable. Transport, residential and non-residential buildings will be required to be built and maintained, which uses an intense amount of energy. Industries all differ across energy usage due to their operational requirements, while households use energy for heating, cooling and other appliances. Levels can vary by a range of factors such as dwelling size, insulation efficiency, consumer behaviour and more.
Related measures	Directly impacts greenhouse gas emissions Strongly linked to access to jobs and service measures and economic performance measures

Measure guidance	
Measure type & level of skill required	Basic Modelling – Quantitative data analysis skills required
Measure unit and form	Volume of energy units (PJ) of fuels consumed Desired: Lower PJ
Calculation approach	**Industry** Step 1: Align employment industries to industries grouped in the Australian Energy Statistics (AES) dataset. Step 2: Calculate energy usage per worker by industry, and multiply with employment forecasts to calculate total energy used across all industry activity **Households** Step 1: Convert population forecasts to average household sizes by regions Step 2: Align regions to their corresponding Climate Zones (1-7) Step 3: Calculate energy use per household by multiplying the annual energy consumption (climate zone) of their respective household size. To understand regional consumption, multiply this by the number of total households in the region. Step 4: Repeat Steps 1-4 for Gas consumption **Total** Step 1: Convert Household to PJ to understand the total industry and household energy consumption at the regional level
Data sources	**Industry** DISER Australian Energy Statistics (Table K) Employment outputs ABS Australian Industry (RQ1) **Households** Population Outputs AER Simple electricity and gas benchmarks
Limitations	Per industry worker is a high-level approach to understand economic direction across the scenarios, it does not consider industry utilisation and productivity. The high-level approach does not consider changes in consumer behaviour, technological innovation and structural (building) efficiencies over time. This will be

	a large factor across time, e.g. increased reliance on solar PV and reduced gas use. Efficiencies can be understood by assessing time-series to understand the annual reduction per worker, which can be feed as assumptions into the method. Household component only considers electricity usage and gas; some other indirect consumption (e.g. transportation) will be captured by industrial utilisation. It also does not consider residents' occupancy, as such energy demand for second homes or holiday rentals may be unaccounted for. Department of Energy does not report renewable/non-renewable mix by industry type. More research will be required to explore renewable consumption. Renewable usage can be estimated by factoring in uptake rates by region. Population model may need to be refined to calculate household sizes by region. This measure considers energy as it is used and doesn't consider embodied energy in other areas of the supply chain.

Measure	Env6 – Air quality
Description	To measure how clean or polluted the air is.
Justification/ purpose	Air pollution has long been recognised as an environmental impact of urbanisation. Combustion engine vehicles, electrical power generation and other industrial facilities create emissions and pollutants that reduce air quality. Levels of air pollution are often measured for several common pollutants that can affect human health.
Related measures	Links with development in conservation lands and economic performance measures.
Measure guidance	
Measure type & level of skill required:	Complex modelling – environmental specialists are required to determine appropriate unit, form, and approach to measuring impact across scenarios

Measure:	Env7 – Water quality
Description	To measure water quality
Justification/ purpose	Water is a vital natural resource in both urban and natural contexts. Victoria has a wide range of marine and freshwater environments integral to the State's flora, fauna and human population. Waterways are impacted through urbanisation with contaminants entering waterways. The development scenario outputs include

	various changes in land use and different scales of development and infrastructure that would affect water quality differently.
Related measures	Development in conservation, agricultural lands
Measure guidance	
Measure type & level of skill required	Complex modelling – environmental specialists are required to determine appropriate unit, form, and approach to measuring impact across scenarios

Measure	Env8 – Soil degradation
Description	To measure the quality of soil
Justification/ purpose	Soil degradation is the decline in soil condition caused by its improper use or poor management, usually for agricultural, industrial or urban purposes. Soil degradation can be the loss of organic matter, decline in soil fertility, decline in structural condition, erosion and chemical changes. The quality of soil also directly affects agriculture and food production.
Related measures	Development in high-risk areas, agricultural productivity
Measure guidance	
Measure type & level of skill required	Complex modelling – environmental specialists are required to determine appropriate unit, form, and approach to measuring impact across scenarios

Measure	Env9 – Waste
Description:	To measure the amount of waste generated by dwellings and industries
Justification/ purpose	Disposal of waste to landfill has many environmental impacts including release of methane and greenhouse gases. The environmental and economic externalities of the disposal of waste are complex. A measure that can be used to compare the amount of waste generated across each development scenario is important to gain an understanding of the relationship of urban development patterns to the amount of waste generated as an environmental impact.
Related measures	Dwelling types

Measure guidance	
Measure type & level of skill required	Basic modelling – quantitative data analysis skills required
Measure unit and form	Total waste tonnage generated by industry and households Desired: Lower
Calculation approach	**Industry** Step 1: Align input industries to broad employment categories in Waste Accounts. Step 2: Work out a waste per industry worker rate by dividing total waste produced across industries by the number of workers in the industry. Step 3: Multiply the waste rate with the forecasted employee across each industry to work out total waste produced by industries **Households** Step 1: Work out a per household rate of waste generation across each LGA by dividing total waste produced by residents by the number of households existing in the LGA. Step 2: Align the region with the corresponding LGA. Step 3: Multiply the number of households by the average amount of waste generated per household to work out the total waste produced by households for the region.
Data sources	**Industry** Employment Outputs ABS Australian Industry (RQ1) ABS Waste Account Australia **Households** Sustainability Victoria Local Government Waste Services Workbook 2019-20 Population outputs
Limitations	Method assumes that consumer behaviour is consistent over time and that the behaviour of the future population will have the same tendencies as the existing population. Per industry worker is a high-level approach to understand economic direction across the scenarios, it does not consider industry utilisation and productivity. This will be a large factor across time - efficiencies can be understood by assessing time-series to understand the annual reduction per worker.

Measure	Env10 – Greenhouse gas emissions (GHG)
Description	To measure GHG emissions directly produced.
Justification/ purpose	Greenhouse gas emissions are strongly linked with energy consumption, with the same drivers across transportation, building construction and operation, industry operation, households. As an economic externality, it represents market failure that has not been captured in prices. Especially considering the advancing risk of climate change, GHG has been considered. Scenarios will differ across the level of development required to transform cities and regions to make liveability viable. Levels of GHG generation can vary by a range of factors such as dwelling size, insulation efficiency, consumer behaviour and more.
Related measures	Ties closely with energy consumption and economic performance measures - productivity and GSP. Greenhouse gas emissions has a causation effect with air quality
Measure guidance	
Measure type & level of skill required	Basic modelling – quantitative data analysis skills required
Measure unit and form	Tonnes (CO_2e) of (Direct) greenhouse gas emissions by industry and households Desired: Lower CO_2e
Calculation approach	**Industry** Step 1: Align employment industries Step 2: Work out direct emissions per industry worker in Australia by dividing total greenhouse gas emissions by number of workers Step 3: Multiply greenhouse gas emissions per worker by industry with employment forecasts, to calculate GHG generated by all industry activity **Dwelling** Step 1: Work out GHG produced per Australian household Step 2: Undertake research to understand how GHG differs across household size and apply variations to the water consumption per household rate. As a proxy, energy consumption by household size can be applied here. Step 2: Multiply GHG emissions by household forecasts to calculate direct emissions produced across residential homes.
Data sources	ABS Australian Environmental-Economic Accounts: Direct greenhouse gas emissions

	ABS Australian Industry (RQ1) Employment outputs Population outputs
Limitations	Per industry worker is a high-level approach to understand economic direction across the scenarios, it does not consider industry utilisation and productivity. High level approach but does not consider other GHG reduction from consumer behaviour change, technological advancements and industry efficiencies. This will be a large factor across time - efficiencies can be understood by assessing time-series to understand the annual reduction per worker. Population forecasts will need to be converted to average household sizes by regions. More complex modelling can be completed with environmental specialists.

Measure	Env11 – Noise pollution
Description	To measure noise pollution
Justification/ purpose	Noise pollution not only creates disturbances to amenity of place but also has further environmental impacts. Urbanisation creates noise pollution through increased traffic noise, construction noise, flight paths, major infrastructure noise and noise from commercial and industrial uses. Noise pollution can have significant negative effects on both wildlife and human health.
Related measures	Transport network performance Development of environmentally sensitive land measures, however more vast effects through any level of development. More research needs to be done to understand how these levels will differ across scenarios via population dispersal.
Measure guidance	
Measure type & level of skill required	Complex modelling – environmental specialist is required to determine appropriate unit, form, and approach to measuring impact across scenarios

Measure	Env12 – Water consumption
Description	To measure water usage generated by industry and dwellings

Justification/ purpose	Water is a vital natural resource that is placed under increased stress due to a number of demographic, environmental and economic factors. Population growth increases demand on water, agriculture requires large amounts of water for food production and water consumption for various industries is required to meet demands for energy, and goods and services. Industries all differ across water usage due to their operations requirements, while households consume water for daily needs. Levels can vary by a range of factors such as dwelling size, outlet efficiency, consumer behaviour and more.
Related measures	Agricultural productivity
Measure guidance	
Measure type & level of skill required	Basic modelling – quantitative data analysis skills required
Measure unit and form	GL of water consumed by industry and households Desired: Lower GL
Calculation approach	Industry Step 1: Align employment industries Step 2: Work out water usage per industry worker in Australia by dividing the total water consumption by number of workers Step 2: Multiply water usage per worker by industry with employment forecasts, to calculate total water used across all industry activity Dwelling Step 1: Work out water consumption per Australian household Step 2: Undertake research to understand how water usage differs across household size and apply variations to the water consumption per household rate. Step 2: Multiply water usage by household forecasts to calculate total water consumption used across residential homes.
Data sources	ABS Australian Environmental-Economic Accounts: Water consumption ABS Australian Industry (RQ1) Employment outputs Population outputs
Limitations	Per industry worker is a high-level approach to understand economic direction across the scenarios, it does not consider industry utilisation and productivity.

	High level approach but does not consider for other water reduction from consumer behaviour change, technological advancements and industry efficiencies. Population forecasts will need to be converted to average household sizes by regions.

5.3 Social

Housing diversity and choice

Measure:	S1 – Dwelling types
Description	To measure distribution of dwelling types
Justification/ purpose	Dwelling types are measured to help understand the diversity of housing stock and the densities of populations within areas. The urban development scenarios vary greatly in terms of population densities, and dwelling types are directly linked to this. Understanding dwelling types can help inform many other measures to assess the scenarios.
Related measures	Interlinked with other housing diversity and choice measures
Measure guidance	
Measure type & level of skill required	Basic modelling – quantitative data analysis skills required
Measure unit and form	% of stock for each type Desired: Neutral
Calculation approach	The distribution and mix of dwelling types can be calculated using population densities within land areas to estimate dwelling structure types. Population densities of land areas can be used to assume dwelling types at a high level. For example, higher population densities would assume the presence of apartments, medium population densities would assume the presence of semi-detached housing and low densities equate to detached housing.
Data sources	Population outputs (population densities)
Limitations	Population densities would need to be calculated at the SA1 or a smaller area to calculate the distribution of dwelling types in a meaningful way. Dwelling types can often reflect market demand and opportunity.

Measure	S2 – Housing suitability
Description	To measure the suitability of the housing stock for the population
Justification/ purpose	The measure of housing suitability can be used to determine if dwellings are either over or underutilised based on the number of bedrooms within a dwelling when compared with the number of people occupying a dwelling. Housing suitability compares the number of bedrooms required with the actual number of bedrooms within a dwelling. As different demographics require different forms of housing it is important to measure and align appropriate housing stock with the population.
Related measures	Dwelling types will need to be calculated first to then measure housing suitability
Measure guidance	
Measure Type & Level of Skill required	Basic modelling – quantitative data analysis skills required
Measure unit and form	# or % of households in suitable housing Desired: Higher # or %
Calculation approach	Step 1: Calculate the dwelling types according to population densities Step 2: Compare population demographics against number of bedrooms per dwelling The common measure to assess bedrooms requirements is based on the Canadian National Occupancy Standard for housing appropriateness. The measure assesses housing suitability by specifying that: ▪ there should be no more than two persons per bedroom ▪ children less than five years of age of different sexes may reasonably share a bedroom ▪ children less than 18 years of age and of the same sex may reasonably share a bedroom ▪ single household members 18 years and over should have a separate bedroom, as should parents or couples and ▪ a lone person household may reasonably occupy a bed sitter.
Data sources	Population outputs Dwelling types

Limitations	This analysis can be conducted at a high level only using estimations of dwelling types to calculate housing suitability. Dwelling and population outputs will need to be refined to understand household profile, such as taking into account age distribution and number of bedrooms.

Measure	S3 – Housing stress
Description	To measure the number of households experiencing housing stress
Justification/ purpose	Housing stress is commonly used as a measure for affordability using housing costs as a percentage of household incomes. Access to affordable housing is important to wellbeing, inclusion, mobility and reducing poverty levels among many other issues. Measuring levels of housing stress across development scenarios is important to understand the number of households likely to experience financial hardship in meeting housing costs and where this occurs spatially.
Related measures	Dwelling types Housing suitability
Measure guidance	
Measure Type & Level of Skill required	Basic modelling – quantitative data analysis skills required
Measure unit and form	% or no. of households in housing stress Desired: Lower % or no.
Calculation approach	Step 1: Calculate the dwelling types according to the scenario population density output Step 2: Record patterns of housing stress using current data based on typical urban development patterns existing in Victoria. Step 3: Align the levels of housing stress recorded in existing data with scenario outputs of income levels and housing costs and expand the assumptions across the scenarios. Households considered to be in housing stress are typically described as lower-income households that spend more than 30% of gross income on housing costs.
Data sources	ABS data Population outputs

	Employment/income outputs Dwelling type measures
Limitations	High-level approach has been used to measure housing stress by using existing patterns of household stress in Victoria by comparing population, income and dwelling type metrics. Difficult to measure as market forces are large determiners of house prices, which has not been factored into the method. Uncertainty makes it extremely challenging to assess impacts on house prices across the scenarios.

Access to jobs and services

Measure	S4 – Proximity to transport
Description	To measure residents' access to rail stations, bus and tram stops, and freeway interchanges.
Justification/ purpose	Transportation is the backbone of any economy, and with the necessary infrastructure in place, it is the enabler for trade, commerce and communities. Successful transport provision includes multi-modal options. Road networks are designed to aid low congestion and travel times. Public and active transport are designed to provide people with affordable and/or healthy means to get where they need to go. As such, it serves a broad range of beneficiaries from businesses, people and the environment. While transport connections like this are fundamental to how the economy and society operate, transport investments vary across the State, with sprawl and regional communities typically underserviced. Scenarios will need to consider how people's access to transport may change across development types.
Related measures	Significant relationship with access to jobs and proximity to infrastructure/services, and as such, enabler to all measures under access to jobs and services. Transportation access may improve with better transport network performance through a larger catchment. Transport can also drive housing suitability through households' preferences for close-by connection points. Environmental outcomes such as greenhouse gas emissions, air quality, and noise pollution may also be affected.
Measure guidance	
Measure Type & Level of Skill required	Basic modelling – quantitative data analysis, GIS skills, and transport network assessment skills required

Measure unit and form	% Or no. of the population within the transport catchment Desired: Higher % or no.
Calculation approach	Step 1: Define and create a catchment for rail stations/freeway interchanges/bus and tram stops Step 2: Overlay population figures to work out the %/no. that fall within the catchment
Data sources	Population outputs (would need to refined to more granular geographies) Transport attribute overlays
Limitations	It does not measure how far people will commute on these transport networks. E.g. People right next to a station in regional areas may have great proximity compared to those further out in more central scenarios. Also, applying the same catchment across regions does not consider that different communities will have a varying appetite for travel times. Applying the same radius assumes residents have the same utility. Only considers rail and car access. Population will need to be refined to a more granular level (Travel Zone) in particular to capture more localised information such as tram and bus stop accessibility. Model of active transport, such as cycling corridors would require further detailed modelling and more granular geography considerations. Assumes no change of transport interchanges (capacity and location). This may not affect mass transit modes as much as lower capacity/active modes. Assumptions can be created about changes in transport infrastructure across scenarios, for example, cycling paths, transport stops, etc.

Measure	S5 – Proximity to open space
Description	To measure residents' access to open spaces
Justification/ purpose	Open spaces are an essential feature of liveability for a region – parks, ovals, playgrounds and recreational spaces are community assets that support community connection and health. They can be seen as enablers of wellbeing. The beneficiaries of open space provision are generally the local community with close-by access. The catchment will vary across scenarios, and as such, it's important to capture possible loss or growth in access.
Related measures	May affect wellbeing measures such as youth engagement and cultural/recreational participation
Measure guidance	
Measure Type & Level of Skill required	Basic modelling – quantitative data analysis and GIS skills required
Measure unit and form	% or no. of the population within the open space catchment Desired: Higher % or no.
Calculation approach	Step 1: Define and create a catchment for all open space areas across each SA2 Step 2: Overlay population figures to work out the %/no. that fall within the catchment
Data sources	Population outputs Public Park and Recreational Zone& Public Conservation and Resource Zone State Government GIS databases for open spaces
Limitations	Applying the same radius assumes residents have the same utility across regions Assumes all open spaces are valued the same Population will need to be calculated to a more granular level or be apportioned.

Measure	S6 – Proximity to health/education/other social infrastructure
Description	To measure residents' access to health/education and other forms of social infrastructure
Justification/ purpose	Proximity to other social infrastructure hubs such as health, education, welfare and justice must also be assessed. These are considered population-serving infrastructure essential in servicing communities' wellbeing, viability and economic prosperity. Social capital is vital in bringing people together, supporting a high quality of life and developing skills and resilience for stronger communities. These are important considerations to compare across the scenarios as access will differ, and the likely effects may be significant in some scenarios. It should be noted here, only essential social services should be captured in this measure, as proximity to recreation hubs has been assessed in cultural/recreational participation.
Related measures	May affect wellbeing measures such as youth engagement, cultural/recreational participation. Labour force participation is also highly related, for example, to education, childcare, and health services. Social infrastructure, like open space provision, has a causal relationship that links with spatial equity/concentrated disadvantage; Areas with disadvantage tend to have less provision of social infrastructure.
Measure guidance	
Measure Type & Level of Skill required	Basic modelling – quantitative data analysis and GIS skills required
Measure unit and form	% or no. of the population within the social infrastructure catchment Desired: Higher % or no.
Calculation approach	Step 1: Define and create a catchment for all social infrastructure types across each SA2 Step 2: Overlay population figures to work out the %/no. that fall within the catchment
Data sources	Population outputs Social infrastructure locations (via Google API, Council Plans, VIC data, etc)
Limitations	Applying the same radius assumes residents have the same utility across regions Assumes social infrastructure is valued the same and ignores brand attractiveness.

	Population will need to be calculated to a more granular level or be apportioned. Care must be taken in defining what is considered social infrastructure, and ensuring it does not overlap with other access measures.

Measure	S7 – Effective Job Density
Description	To measure access to jobs
Justification/ purpose	Effective job density (EJD) is a measure of the relative concentration of employment in a particular area given the location and accessibility of all jobs across a region (using Origin Destination matrices), which considers routing and frequency of public transport services and road networks. This is an important metric to assess, with the scenarios differing in employment flow, as it shows the distribution of economic opportunity. Simply assessing workers by their home location is inadequate, as households do not need to be located in a dense location to gain the advantage of jobs. Being near one or multiple is just as beneficial. As such, EJD can capture access to these jobs by looking at travel times to the jobs, in addition to the location of jobs.
Related measures	Proximity to health/education/other social infrastructure Economic measures including GSP and productivity
Measure guidance	
Measure Type & Level of Skill required	Complex Modelling – Specialist skills (transport modelling) are required to measure the change in travel time and understand impact across scenarios
Measure unit and form	# of jobs the population can access (index) Desired: Higher #
Calculation approach	Step 1: Using transport modelling, calculate travel time from location a *(i)* to location b *(j)* using actual public transport (accessible by PT) $$EJD_i = \sum_j \left(\frac{Emp_j}{PV\ Travel\ Time_{ij}} \right)$$ Step 2: Repeat Step 1 for road networks (EJD accessible by private car) Step 3: Define overall catchment area Step 4: Calculate and overlay the number of jobs at location b from employment outputs to work out an EJD index for each region.

Data sources	Transport modelling outputs Employment outputs
Limitations	Difficult to forecast how scenarios will integrate transport networks in the future. Employment will need to be calculated at a more granular level or be apportioned.

Measure	S8 – Labour force participation
Description	To measure the number of people working or actively looking for work.
Justification/ purpose	Labour force participation looks at the total human factor in the economy and can be used in the broader context to understand whether there are enough people for available jobs. It is also often used to measure the economy's active workforce. Unemployment is relatively short-term in nature and often reflects market cycles. And so, forecasts typically achieve a steady rate due to their transient and uncertain behaviour. It's critical to look at labour force participation across the urban development scenarios, which have differing distribution of people and jobs which may impact labour force participation and the future economic structure. While some structural trends may be more stable, e.g. lower participation of young adults in education, other trends like gender and/or regional equality can be better resolved, which can drive participation. Amenity and service provision can lift the participation rate in the long-term in some scenarios, e.g. availability and accessible childcare can incentivise parents to go back to work or work longer hours. It's an important indicator to assess as it links heavily to a region's economy. In the long-term, if structural issues were fixed, labour supply would grow, leading to higher incomes and economic activity.
Related measures	Due to market forces, labour force participation directly affects individual/household income, GSP, and productivity. Correlation with engagement measures – Cultural/recreational participation, youth engagement
Measure guidance	
Measure Type & Level of Skill required	Basic Modelling – Quantitative data analysis skills required
Measure unit and form	Participation Rate

	Desired: Higher %
Calculation approach	Step 1: Make refinements to the employment model to consider adjustments to structural trends Step 2: Work out the participation rate by region, assuming unemployment is held at the constant rate as aimed by Federal Treasury $$\text{Participation Rate} = \frac{Labour\ force}{Working\ age\ population}$$
Data sources	Employment outputs Population outputs Australian Government – Treasury Intergenerational Reports ABS Unemployment (SA4)
Limitations	Population outputs will need to be disaggregated based on the age distribution.

Measure	S9 – Youth engagement
Description	To measure young people's access to educational institutions
Justification/ purpose	Youth engagement takes a similar approach to EJD, with effective job density often used as a proxy for understanding how accessible amenities and services are in a particular area. Instead of accessing how far jobs are, the measure looks at available school and tertiary education places that young people can access through road and public transport networks. Only education access has been measured to understand youth engagement, as research suggests it is one of the most significant factors. Access to high-quality education is understood to be an enabler of vast employment opportunities, potential earnings and future wellbeing. On the flip side, high travel time and low availability to close-by schools/tertiary institutions can lead to disengagement; students may miss out on opportunities to gain qualifications and skills and reduce their ability to provide for themselves. Across scenarios, migration patterns will change around the State, and youth may be particularly vulnerable to accessing educational opportunities.
Related measures	Household income and proximity to transport/open space/social infrastructure are strong drivers of youth engagement.
Measure guidance	

Measure Type & Level of Skill required	Complex Modelling – Specialist skills (transport modellers) are required to measure the change in travel time and understand impact across scenarios
Measure unit and form	# of school and tertiary educational places that young people can access Desired: Higher #
Calculation approach	Step 1: Using transport modelling, calculate travel time from location a *(i)* to location b *(j)* using actual public transport (accessible by PT) $$ED_i = \sum_j \left(\frac{Places\ for\ educational\ institutions_{\ j}}{PV\ Travel\ Time_{ij}} \right)$$ Step 2: Repeat Step 1 for road networks (accessible by private car) Step 3: Define overall catchment area Step 4: Calculate and overlay the schooling/tertiary places at location b
Data sources	Transport modelling outputs Population outputs Education facility locations, including primary, secondary, and tertiary education
Limitations	Difficult to forecast how scenarios will integrate transport networks and educational institutions in the future. Population outputs will need to be disaggregated by age. Schooling and tertiary places by region will need to be calculated

Measure	S10 – Individual/household income
Description	To measure individual and household income across regions
Justification/ purpose	Income is a significant indicator to measure the economic welfare of the community. Holding inflation and tax constant, income relates directly to purchasing power, and whether households can support themselves to buy goods and services. Across scenarios, it can assess the community's potential economic welfare through changes in employment opportunities. As incomes are directly tied to spending, they can also be used to illustrate potential stimulus to the local economy.
Related measures	Contributes to GSP through flow-on effects Wage stagnation can affect productivity by inhibiting output

	Social equity measures will capture variation of income across the region. Individual/household incomes affect housing diversity and choice and people's engagement with cultural/recreation services.
Measure guidance	
Measure Type & Level of Skill required	Basic Modelling – Quantitative data analysis skills required
Measure unit and form	Incomes earned by individuals in the SA2 Desired: Higher income
Calculation approach	Multiply the employment distribution by industry with average weekly earnings to work out total income earned by the region.
Data sources	Employment outputs ABS Employee Earnings and Hours
Limitations	Method does not consider varying levels of employment across the scenarios. Refined adjustments to the employment model can be made to consider this. Only accounts for average incomes paid to employees but does not consider dividends taken out from business equity. As such, more affluent areas may be understated when compared through a spatial lens.

Measure	S11 – Human Capital
Description	To measure the concentration of specialisation, knowledge and skills cumulated by the population
Justification/ purpose	Human capital takes a similar approach to EJD, with effective job density often used as a proxy for understanding how accessible amenities and services are in a particular area. Instead of accessing how far jobs are, the measure looks at the human factor, or rather the concentration of intangible collection of specialisation, knowledge and skills by the population. Access to human capital leads to flow-on benefits as those in proximity gain knowledge and skill spillover opportunities. Access will become varied across each of the scenarios as migration patterns change.
Related measures	Housing diversity and choice may drive the concentration and location of human capital due to housing preferences – e.g. older and educated executives in affluent areas.

	Human capital has a correlation with individual/household income and productivity Spillover effects can affect labour force participation, youth engagement, cultural/recreational participation
Measure guidance	
Measure Type & Level of Skill required	Complex Modelling – Specialist skills (transport modellers) are required to measure the change in travel time and understand impact across scenarios
Measure unit and form	# of high income/knowledge/skilled people that individuals can access Desired: Higher #
Calculation approach	Step 1: Using transport modelling, calculate travel time from location a *(i)* to location b *(j)* using actual public transport (accessible by PT) $$ED_i = \sum_j \left(\frac{Human\ capital_j}{PV\ Travel\ Time_{ij}} \right)$$ Step 2: Repeat Step 1 for road networks (accessible by private car) Step 3: Define overall catchment area Step 4: Calculate and overlay the residential population at location b that match demographic profile (e.g. income)
Data sources	Transport modelling outputs Employment outputs
Limitations	Difficult to forecast how scenarios will integrate transport networks in the future. Static and high-level approach that does not consider demographic changes across time. E.g. Working from home may change the residential profile across regions. The many drivers that influence knowledge and skill accumulation make it challenging to measure over time.

Measure	S12 – Transport network performance
Description	To measure the performance of the transport network
Justification/ purpose	Measuring transport network performance is an important indicator to understand the efficiency of transport provision. This is due to the large differences in transport networks that may be required in each urban development scenario. Transport network performance can be measured using strategic transport models. Strategic transport models (such as the Victorian Integrated Transport Model or

	VITM) are tools for assessing the impact of transport infrastructure options and for identifying how the transport system is likely to perform. Scenarios may vary across performance due to differences across a wide range of factors. These include: ▪ Utilisation and usage of the transport network ▪ Disruption resilience (i.e. from natural hazards and heat) ▪ Travel times for passengers ▪ Working from home assumptions ▪ Impact on autonomous vehicles ▪ Changes to road capacity
Related measures	Outputs of the transport model can be used to inform EJD calculations, youth engagement (access to education), and human capital, and contribute to emissions measures.
Measure guidance	
Measure Type & Level of Skill required	Complex Modelling – Specialist skills (transport modellers) are required to adjust transport model inputs to understand the impact across scenarios.
Measure unit and form	Transport model outputs (VKT, trip numbers and/or travel times) Desired: reduced travel times, reduced vehicle VKT
Calculation approach	Land use outputs, including distribution of population and jobs, can be used as inputs into a transport model, however, these need to be disaggregated down to a Travel Zone level. Scenarios can be tested across numerous inputs highlighted previously. The transport model can also be extended to include freight due to its separate trip classification.
Data sources	Land use outputs Population outputs Employment outputs Likely infrastructure provision based on scenario narrative/assumptions as well as particularly transport behaviour/technology changes assumed by the scenario i.e. WFH/Autonomous vehicles etc.
Limitations	Assumptions will need to be made about future transportation trends, e.g. active transportation, autonomous vehicles, future of land use, etc. The modelling discussed above is intended to focus on strategic level transport performance and therefore would not consider more granular transport analysis

	such as individual intersections or the strategic impact of active transport networks. As noted, the SA2 level land use outputs will need to be disaggregated to more granular geographies such as travel zones to run the transport models and allow for more detailed analysis at a local level for specific areas in Victoria. As a strategic dataset, the outputs from the land use scenarios should be treated with caution when undertaking more granular modelling and be supplemented with bottom-up analysis of local conditions such as transport network capacity and local land uses.

Measure	S13 – Cultural/recreational participation
Description	To measure resident's participation in cultural/recreational activities
Justification/ purpose	Participation in culture/recreation is directly tied to the provision and access to these services/amenities, as such the catchment approach has been used as proxy. This takes a similar approach to the other social infrastructure measure, utilising the EJD method. However, this measure captures the proximity to leisure services, which are also essential to communities. Population-serving cultural institutions, including art galleries, museums, sports centres, and performance spaces, enable communities to achieve greater wellbeing, viability and economic prosperity. Social capital is vital in bringing people together, supporting a high quality of life and developing skills and resilience for stronger communities. These are important considerations to compare across the scenarios as access will differ, and the likely effects may be significant in some scenarios. Note that essential social infrastructure, such as justice, health, education, welfare, should be captured in the proximity to health/education/other social infrastructure measure.
Related measures	May affect engagement measures such as youth engagement and labour force participation. Also related to social infrastructure and open space provision which has a causal relationship that links with spatial equity/concentrated disadvantage; areas with disadvantage tend to have less provision of social infrastructure.
Measure guidance	
Measure Type & Level of Skill required	Basic Modelling – Quantitative data analysis skills required

Measure unit and form	% of likely participation in different activity types by SA2 Desired: Higher %
Calculation approach	Step 1: Define and create functional catchments for different types of social infrastructure across each SA2, identifying the cultural/recreational activity types that each infrastructure item supports Step 2: Overlay population figures to work out the %/no. that fall within the catchment Step 3: Assess the household and individual characteristics within each catchment area to determine likely participation levels according to each activity type
Data sources	Population outputs GIS data for social infrastructure
Limitations	Applying the same radius assumes residents have the same utility across regions Assumes social infrastructure is valued the same and ignores brand attractiveness. Population will need to be calculated to a more granular level or be apportioned.

5.4 Economic

Economic performance

Measure	Eco1 – Labour productivity
Description	To measure the region's level of economic efficiency
Justification/ purpose	Labour productivity is considered a key source to assess economic growth and competitiveness, measuring the productive capacity of a region's economy. Agglomeration via knowledge spillovers, R&D investments and/or brand attractiveness are all drivers of a business' capacity utilisation. Scenarios may vary in productivity depending on the level of centralised industry activity. For example, a decentralised scenario may see a fall in effective job density, leading to reduced agglomeration benefits. This can adversely affect: ▪ The ability for firms to achieve economies of scale and scope through specialisation given reduced numbers of potential customers that are readily accessible ▪ The availability of numerous supply sources and potentially specialised infrastructure, and the competitive environment that stems from this ▪ The access to a deep and diverse pool of skilled labour, which often complements technological/knowledge transfer between firms, bolstering innovation ▪ Further opportunities for knowledge spill-overs due to local supply linkages, face-to-face contact and trust-based commercial relationships.
Related measures	Linkages with GSP, Labour force participation, Individual/household income via business confidence
Measure guidance	
Measure Type & Level of Skill required	Basic Modelling – Quantitative data analysis skills required
Measure unit and form	Change in labour productivity Desired: Increased GSP per hour worked
Calculation approach	Step 1: Calculate the total hours worked by multiplying the number of employees and the hours worked per employee (industry-specific). Step 2: Divide GSP by the total hours worked to get a ratio of GSP per worked hour The same method can be used to understand labour productivity at a regional or local area level by utilising Gross Regional Product.

Data sources	Gross State Product measure outputs ABS Labour force data: Table 11 ABS Australian Industry (RQ1)
Limitations	Each scenario assumes the same levels of current/future employment across Victoria, and the same ratio of hours worked per employee. Also, does not consider the link between productivity and non-labour resources, such as capital and entrepreneurship.

Measure	Eco2 – Gross State Product (GSP)
Description	To measure the region's economic output
Justification/ purpose	Economic output will vary across scenarios due to a wide array of outcomes: labour force, investments and wellbeing, etc. It's essential to capture GSP, both at a macro level and across regions, to understand whether the economy may be worse off with the development outcomes. While model refinements may be required to measure how GSP might be affected under varied employment levels, GSP can be estimated based on the spilt of jobs now. Based on industry efficiency, each sector will have varied GVA per job. E.g. Mining has a higher GSP per employee than Retail.
Related measures	Linkage to all factors, in particular access to jobs and services (social), productivity outcomes (economic).
Measure guidance	
Measure Type & Level of Skill required	Basic Modelling – Quantitative data analysis skills required
Measure unit and form	$ of Gross State Product Desired: Increased $
Calculation approach	Step 1: Using Industry Gross Value Added* (Table 3) and Employment by Industry RQ1, work out GVA/job across each Industry for Victoria. Step 2: Multiply the ratios with employment outputs to work out GVA produced at the SA2 level, based on the industry mix of the region.
Data sources	Employment outputs

	ABS State Accounts dataset (Table 3) ABS Australian Industry (RQ1)
Limitations	Using constant GVA per employee ratios, labour is assumed to be highly mobile across industries. It does not consider that industries may be operating at high or optimal utility. Each scenario assumes the same levels of current/future employment. The same method can be used to understand production at a more granular region (Gross Regional Product).

*Note: GVA has been used to measure GSP/GRP. For simplicity, subsidies on products and taxes on products hold across scenarios.

Measure	Eco3 – Agricultural productivity
Description	To measure the productivity of agricultural land
Justification/ purpose	Productivity is an important measure of agricultural performance. Agricultural productivity shows how efficiently inputs (labour, capital, land, materials and services) are used to produce outputs over time. Growth in the ratio of outputs to inputs translates to improved productivity. One of the main inputs of concern is the amount of land required to produce outputs. Productivity in the agricultural sector is often improved by technological advancements and enhanced methods.
Related measures	Development of environmentally sensitive land measures have a link to agricultural productivity, through agricultural land consumption, soil degradation, water quality, water consumption. This can affect how much is produced, as well as impact those measures.
Measure guidance	
Measure Type & Level of Skill required	Complex modelling – agricultural specialists are required to understand impact across scenarios with further research required around appropriate measures and methodology

Socioeconomic equity

Measure	Eco4 – Spatial equity/concentrated disadvantage
Description	To measure equity and concentrated disadvantage spatially across the population

Justification/ purpose	Concentrated disadvantage refers to spatial clustering of the population who are economically or socially disadvantaged. Concentrated disadvantage is a disproportionate share of disadvantaged people in a geographic area. Measuring concentrated disadvantage is important to understand equity, poverty and disadvantage spatially across a population. The urban development scenarios include different distributions of urban populations with varying incomes.
Related measures	Individual/household income, proximity to health/education and other social infrastructure, household stress.
Measure guidance	
Measure Type & Level of Skill required	Basic Modelling – quantitative data analysis skills required
Measure unit and form	Composite score Desired: Higher score
Calculation approach	Step 1: Design a composite score to assess the level of spatial disadvantage across previous measures that could include (but not limited to): ▪ Proximity to infrastructure and services ▪ Effective job density ▪ Human capital/educational attainment ▪ Individual/household income ▪ Unemployment Further refinements of the approach including the use of any weightings to selected measures could be considered in further analysis.
Data sources	Outputs from other measures
Limitations	Difficult to accurately project into the future Measure is limited in measuring spatial disadvantage, as it may be largely dependent on other factors, e.g. quality of infrastructure, and operational effectiveness.

5.5 Infrastructure Provision Costs

Measure	Costs
Description	To measure the cost to deliver infrastructure/services
Justification/ purpose	Infrastructure and services will be required to build communities, however in some scenarios, provision may be less efficient and more costly. Variation with costs may be due to what is currently existing, geographical limitations, future population and more. Estimations can account for the utilisation and potential capacity in utilising existing networks or infrastructure/service provision. As such, this will be a heavy input and consideration to the likely impacts of the development scenarios. Cost should be considered across these categories with key considerations noted: ▪ Energy generation/ transmission requirements ▪ Water ▪ Gas ▪ Transport ▪ Health/education/social services ▪ Digital communication (ICT, broadband, telecommunications etc.) ▪ Justice ▪ Emergency services ▪ Waste ▪ Cultural and recreational ▪ Drainage and sewerage ▪ Civil works and street scape ▪ Blue and green infrastructure (including open space) ▪ Freight (ports, rail, and airports)
Related measures	All benefit measures
Measure guidance	
Measure Type & Level of Skill required	Complex Modelling – will likely require quantity surveyors to estimate cost and consultants to undertake need assessments, to be based on benchmarks or comparable case studies for provision requirements per resident or per worker. These benchmarks would need to consider spatial requirements and catchments for different infrastructure types and be cognisant of infrastructure delivery cost differences in urban and regional areas.

	For example, how many Primary Schools are required per 10,000 people and what is the normal catchment area multiplied by the cost to provide a primary school in an urban/regional area.
Measure unit and form	Costs per job/capita Desired: Lower cost per job/capita
Calculation approach	Step 1: Assess typical benchmarks for infrastructure provision, i.e. number of facilities per capita sourced through consultation with asset and infrastructure providers/operators. Step 2: Multiply the per capita costs by population or jobs to understand the infrastructure required to support the scenarios.
Limitations	Modelling should include spatial differences in costs to provide the services, i.e. urban vs. regional. It is difficult to forecast infrastructure costs in the future, noting that changes in policy and design and building practices (e.g. delivering more sustainable communities) would alter the cost/benefit profile over time. This type of analysis doesn't provide assessment of programming or other responses to infrastructure demand. In established areas, it is difficult to quantify existing available capacity and the added cost of building in an "active" environment. "Active environment" additional costs include traffic management and scheduling works to avoid significant disruption to existing users of services.

6. Additional Research, Modelling and Next Steps

This section summarises the limitations of assessing urban development scenarios and proposes additional modelling and next steps for scenario assessment.

6.1 Limitations

The framework outlined in this report establishes a comprehensive approach to assessing the urban development scenarios built in Part A. However, it is again worth noting that urban development has complex, far-reaching, and often interdependent impacts to people, the environment, the economy, and other governance systems, many of which cannot be modelled based on the outputs from scenarios as well as other available data and information.

Accordingly, measures identified in the framework are limited to what can be reasonably modelled using population and employment forecasts. The flow-on effects identified in the framework capture those impacts that are more qualitative in nature, may be influenced by a number of factors, and feed back into mega-trends. These can be explored qualitatively further in future phases of work. Further quantification would require the development of additional tools.

6.2 Additional modelling required to evaluate scenarios

Based on the approach to measuring impacts detailed at section 5, there are likely six key modelling exercises that would need to be undertaken to measure the impacts of urban development scenarios. Each is classified as simple or complex.

- Land consumption model (basic): to measure the proportion of developed land considered environmentally sensitive
- Network analysis model (basic): to measure access to jobs and services
- Economic model (basic): to measure performance as well as socioeconomic equity
- Transport model (complex): to measure transport network performance and enable modelling of effective job density
- Emissions/environmental outcomes model (complex): to measure consumption, pollution, waste, and impacts to natural resources
- Infrastructure costs model (complex): to estimate investment required to deliver scenarios

In addition, agricultural productivity could likely be modelled based on findings of the land consumption and environmental outcomes modelling.

6.3 Next steps for phase 3

Building on the modelling and framework of Phase 2 (A and B), Phase 3 of the project will comprise detailed scenario modelling and assessment of impacts. The following are recommended as next steps:

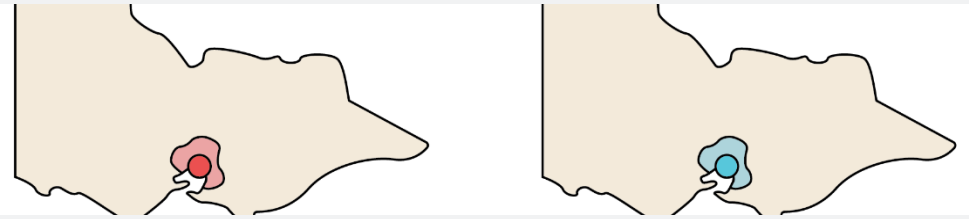
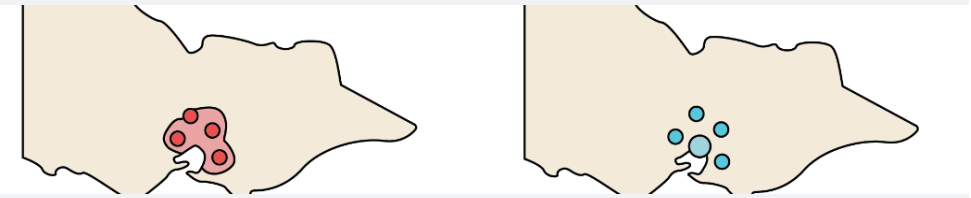
- Gather data and undertake simple modelling based on the methodologies outlined at section 5
- Undertake more granular modelling of land consumption, transport systems, and network analysis at the SA1 level to better understand impacts and enable complex modelling
- Engage specialists to undertake complex modelling
- Supplement the findings of the modelling with additional qualitative research to better understand flow-on effects of scenarios
- Assess the distributional effects of the modelled measures to better understand how impacts are experienced differently across population groups

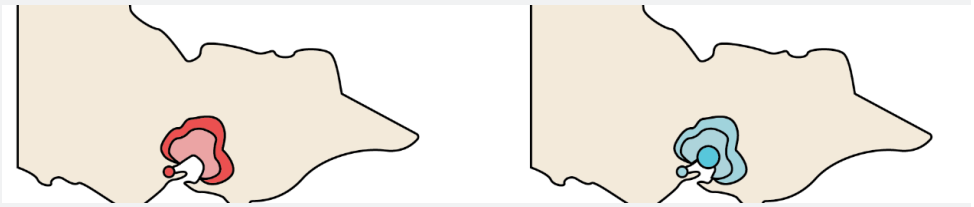
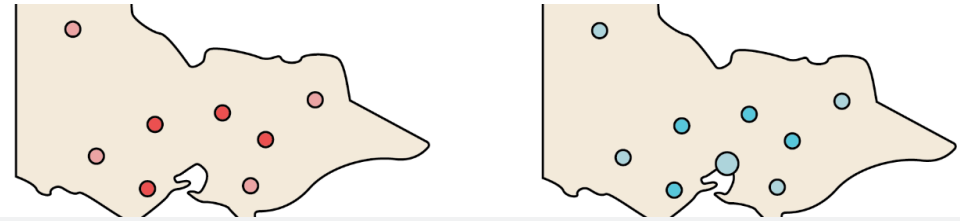
Appendix A: Indicative Scenario Assessment

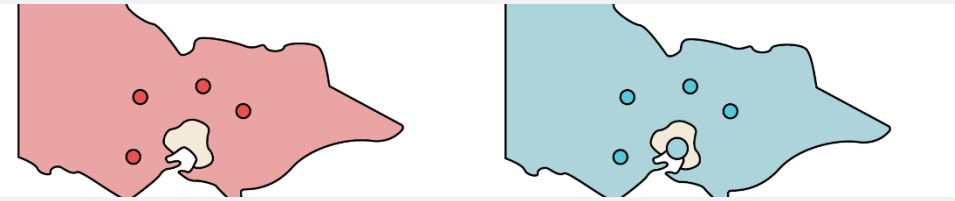
This appendix provides an overview of the scenarios from Part A and an indicative assessment of each one against the headline impacts in order to understand how they might perform using the evaluation framework developed in this report.

The assessment is indicative only to illustrate how, once the additional analysis detailed in Section 4 - 6 is completed, the proposed evaluation framework might highlight differences between scenarios. As such, the assessment is only based on a review of scenario narratives, initial land use results (from Part A) and professional judgement. Outcomes may change once additional analysis is completed.

SCENARIO OVERVIEW

	Scenario	Description
1	Compact City	 The Compact City scenario reflects more concentrated urban development in the inner city of Melbourne and housing development in places of high transport accessibility. This structure supports sustainable city outcomes adapting to climate change impacts through policy and behavioural change. This leads to reduced car dependency and a focus on government investment in accessible affordable housing. Consolidation of both residential and employment growth, primarily in inner Melbourne and middle Melbourne along train corridors. This trend will accelerate from 2031 and result in lower growth across outer Melbourne and regional Victoria, particularly areas at risk of adverse climate change impacts. The central city and inner urban renewal precincts experience the largest population and employment growth, reaching their aspirational residential densities while also continuing to attract a large net inflow of workers. **Key Focus Areas:** ▪ focuses most heavily on Inner Melbourne, with much higher employment and population growth levels than other scenarios. Outer Melbourne, Melbourne New Growth Areas and Regional Victoria receive the lowest shares of growth under this scenario.
2	Consolidated City	 The Consolidated City scenario reflects a response to climate change through the development of key centres across Melbourne providing local living and working through changing preferences to create a polycentric city that balances the distribution of people and jobs across a number of high density precincts. Population and jobs growth focuses on a select number of suburban centres outside the central city within metropolitan Melbourne. Both households and firms/workers maintain a preference for accessible and agglomerated locations, but find these needs met within key suburban precincts – Monash, Heidelberg, and Sunshine - which have benefitted from successful government investment. Much of the growth in population and population-serving jobs is drawn from growth that would have otherwise located in outer Melbourne. However, these precincts also compete with central Melbourne for employment in knowledge intensive services and the health and education sectors.

Scenario		Description
		Key Focus Areas: ▪ has a growth focus on Middle Melbourne. Population growth for Outer Melbourne, the New Growth Areas and Regional Victoria would relatively low, but higher than Scenario 1, with the result that Scenario 1 still forecasts slightly higher population growth overall for Middle Melbourne. However, the distribution of population growth within Middle Melbourne differs between the scenarios, as discussed in more detail in the following chapters. Scenario 2 also features the highest employment growth rates for Middle Melbourne of any scenario..
3	Dispersed City	 The Dispersed City forecasts a more dispersed urban structure with increased population in outer Melbourne. Melbourne's urban footprint expands as population growth spreads across outer Melbourne, peri-urban areas, and the new greenfield development areas at Melbourne's fringe Residential development slows across inner and middle Melbourne, with households choosing to live in outer Melbourne (including new growth areas, with the UGB needing to expand along growth corridors) and in peri-urban towns stretching along transport corridors from Melbourne to Torquay, Seymour, and Traralgon. While population-serving employment moves proximate to residents, there will be less movement of knowledge sectors, which continue to be attracted to central Melbourne. More people work from home part-time, but many still need to live within a reasonable distance of Melbourne, limiting migration into further away regional areas. **Key Focus Areas:** ▪ places substantial levels of growth in Outer Melbourne and the New Growth areas, drawing growth from Inner Melbourne and Middle Melbourne. There is also a shift towards Regional Centres and Rural Areas focused around Peri-Urban Melbourne compared to Scenario 1 and 2.
4	Network of Cities	 The Network of Cities scenario projects a future where housing affordability in metropolitan Melbourne combined with continuing remote working leads to the development of regional cities as people choose to live regionally. Policy leads the development of these cities as higher density areas and they become consolidated centres for living regionally with mass transit connections between these regional cities and Melbourne maintaining the physical connections.

Scenario		Description
		These regional cities grow and densify attracting both population-serving and higher-order employment. Increased agricultural employment across the regions is also served by workers from regional cities. At the expense of metropolitan Melbourne, a large portion of Victoria's growth is accommodated in Geelong, Ballarat, and Bendigo. Traralgon also experiences additional population growth to a moderate extent and smaller regional cities attract additional residents and associated population-serving employment. **Key Focus Areas:** ▪ allocates more growth to Regional Cities, which under this scenario would receive several times more growth than under some other scenarios. Regional Centres and Rural Areas also receive moderately high growth rates, but less than under Scenario 3 or Scenario 4.
5	Distributed State	 In the Distributed State scenario population growth decentralises from existing settlements with housing affordability in established areas leading people to settle regionally. This growth in regional areas is unmanaged and results in sprawling low density development across the state. Residential growth slows within metropolitan Melbourne as development becomes more dispersed from existing metropolitan and regional centres across the state, initially in major regional cities and then in low density corridors which stretch from Melbourne to regional centres, and between regional centres. Agricultural production falls as export demand is lower and farmland is used for urban sprawl. At the same time, companies return manufacturing and fabrication to Australia with industrial employment slowing the decline of manufacturing at the expense of business and government services. **Key Focus Areas:** ▪ places very high levels of growth in the Rural Centres and Regional Areas FUA, reflecting employment and population growth spread broadly across Regional Victoria. Regional Cities also have very high growth rates, although lower than under Scenario 4.

Scenario 1: Compact City

SCENARIO IMPACT ASSESSMENT

Headline Impact	Scenario Results	Spatial Considerations	Likely Net Outcome for Victoria
Development of environmentally sensitive land	Significantly reduced land consumption in environmentally sensitive areas in comparison with other scenarios due to high-intensity development in the existing metropolitan area as population and employment growth are consolidated in inner and middle Melbourne.	This relates to land located mostly outside metropolitan areas, however the intensification of development in inner and middle Melbourne may mean that any natural landscapes within these areas are converted to development to divert growth from the city fringe. Intensification in existing high-risk areas, including the low-lying areas of Docklands, Southbank and Fishermans Bend, may still result in large populations of people residing and working in areas vulnerable to climate change impacts.	Positive outcome – lower % of environmentally sensitive land developed.
Environmental outcomes	Car dependency is reduced and road space is reallocated to public and active transport infrastructure. Government leads in sustainable policy and investment, supporting a reduction in the consumption of non-renewable resources and pollution as well as delivery of more efficient medium- and high-density housing.	Intense development in inner and middle Melbourne may generate higher noise pollution and some impacts to soil, air, and water quality in these areas. However, these may be mitigated through policy and design measures, and would not occur in an environmentally sensitive setting.	Positive outcome – lower energy consumption and greenhouse gas emissions.
Housing diversity and choice	Increase in medium- and high-density dwellings in inner and middle Melbourne, with provision of family-friendly affordable housing by government.	Diversity and choice likely greatest in inner Melbourne, where the most significant population growth is to occur.	Mixed outcome – mix of dwelling types and provision of affordable housing. However, potential for reduced choice for those who prefer suburban or regional low-density living.
Access to jobs and services	Employment growth is consolidated in inner and middle Melbourne, supported by an injection of investment in the CBD and inner suburbs of Melbourne through	Inner Melbourne continues to attract a large net inflow of workers, particularly those in knowledge-intensive industries. Residents locating closer to the city centre also drives up population-serving employment within	Mixed outcome – access to jobs and services is strong in inner Melbourne, however those in outer Melbourne and the

Headline Impact	Scenario Results	Spatial Considerations	Likely Net Outcome for Victoria
	government-led infrastructure and policy incentives, including public transport.	inner and middle Melbourne, such as retail and hospitality. The highest level of infrastructure access is concentrated in the central City, with outer areas and the regions experiencing lower levels of service and limited local employment opportunities. This may place significant pressures on infrastructure in inner Melbourne as people travel to the area to access employment and services.	regions likely experience longer travel times and centralised infrastructure is under significant pressure.
Economic performance	Inner Melbourne attracts a large net inflow of workers, but Regional Victoria sees a decline in population growth. Greater accessibility to the city centre fuels further economic agglomeration, particularly for knowledge-intensive industries such as Business & Government Services.	Economic performance is largely driven by the knowledge economy and service-based industries, concentrated in inner Melbourne.	Positive outcome – productivity and GSP likely to increase due to inner Melbourne employment and population growth
Socioeconomic equity	N/A – this is a function of the distribution of other headline impacts rather than scenario results directly.	Most of the benefits of this scenario go to those living in inner Melbourne, where population and employment growth would be concentrated. Outside of this area, there are likely to be more areas of disadvantage.	Mixed outcome – positive outcome for those in inner Melbourne, potential negative or neutral outcomes for others.
Required investment	Efficient infrastructure delivery focused on greater urban densities in Inner Melbourne, reduced transport and services costs as well as potential co-location of facilities.	Potential additional costs for regional areas with businesses/infrastructure focused on Melbourne. Where infrastructure is already over capacity in established areas and expansion is costly due to limited availability of land there is potential for greater costs of provision in Inner Melbourne.	Likely Positive (i.e. lower costs)

Scenario 2: Consolidated City

SCENARIO IMPACT ASSESSMENT

Headline Impact	Scenario Results	Spatial Considerations	Likely Net Outcome for Victoria
Development of environmentally sensitive land	Reduced land consumption in environmentally sensitives areas in comparison with other scenarios due to consolidation of population and employment growth in major precincts.	Potential for some take up of environmentally sensitive lands around Outer Melbourne, but primarily located within existing growth corridors. Environmentally sensitive green wedge land located around the precincts in Outer Melbourne would be the most likely to be developed to divert growth from the city fringe.	Positive outcome – lower % of environmentally sensitive land developed.
Environmental outcomes	Car dependency is reduced and government leads in sustainable policy and investment, supporting a reduction in the consumption of non-renewable resources and pollution as well as delivery of more efficient medium- and high-density housing.	Similar to Scenario 1, intensification of Melbourne and suburban precincts may generate higher noise pollution and some impacts to soil, air, and water quality in these areas. However, these may be mitigated through climate-conscious policy and design measures, and would largely not occur in an environmentally sensitive setting.	Positive outcome – lower energy consumption and greenhouse gas emissions.
Housing diversity and choice	Increase in medium- and high-density dwellings in middle Melbourne, with provision of family-friendly affordable housing by government.	Diversity and choice likely greatest in middle Melbourne around the major precincts where the most significant population growth is to occur.	Mixed outcome – mix of dwelling types and provision of affordable housing. However, potential for reduced choice for those who prefer regional low-density living.
Access to jobs and services	Employment growth is concentrated in the suburban growth precincts in middle Melbourne, each with sectoral specialities.	Healthcare and education jobs are prominent in all primary growth precincts. These primary precincts function as small-scale CBDs, providing accessible jobs, healthcare, and education. Those in outer Melbourne and regional areas travel to their nearest precinct for services.	Mixed outcome – access to jobs and services is strong in inner and middle Melbourne, but those in the regions may experience longer travel times.

Headline Impact	Scenario Results	Spatial Considerations	Likely Net Outcome for Victoria
Economic performance	Economic performance is largely driven by knowledge-intensive industries and advanced manufacturing, including production of clean energy technology.	Much of the job growth in major suburban precincts would have otherwise located in outer Melbourne. Manufacturing moves into middle Melbourne as streamlined factories can afford to take up a more central location.	Positive outcome – likely increase in productivity and GSP.
Socioeconomic equity	N/A – this is a function of the distribution of other headline impacts rather than scenario results directly.	Most of the benefits of this scenario go to those in the major suburban precincts and inner Melbourne, where population and employment growth would be concentrated. Outside of this area, there are likely to be more areas of disadvantage in areas where access to services is lower.	Mixed outcome – positive outcome for those in inner Melbourne and the major suburban precincts, potential negative or neutral outcomes for others.
Required investment	Efficient infrastructure delivery in key centres reduced transport and services costs as well as potential co-location of facilities.	Precincts may benefit from better use of existing infrastructure. Potential additional costs for regional areas with businesses/infrastructure focused on Melbourne.	Likely Positive (i.e. lower costs)

Scenario 3: Dispersed City

SCENARIO IMPACT ASSESSMENT

Headline Impact	Scenario Results	Spatial Considerations	Likely Net Outcome for Victoria
Development of environmentally sensitive land	Greater land consumption in environmentally sensitive areas as the metropolitan area expands and new greenfield areas are developed.	Both green wedge and agricultural lands likely to be developed under this scenario. Development in high-risk areas along Victoria's coast also likely, associated with market-driven adaptation measures.	Negative outcome – higher % of environmentally sensitive land developed.
Environmental outcomes	Urban expansion results in high levels of traffic congestion and a proliferation of lower-density dwellings in outer Melbourne and new growth areas, with private sector investment in climate technologies driving adoption of renewable energy technology and electric vehicles.	Likely degradation of air, soil, and water quality as well as noise pollution in some environmentally sensitive areas on the urban fringe. Energy and water consumption likely higher in lower density areas in outer Melbourne.	Mixed outcome – potential for higher energy consumption and greenhouse gas emissions than Scenarios 1, 2, 4, with ultimate levels dependent on technological advancements and market forces.
Housing diversity and choice	Increase in lower-density dwellings in outer Melbourne as households seek affordability outside the central city.	Some outer Melbourne areas may be more affordable than inner and middle metro areas, however choice will be limited to these lower-density greenfield areas and households may be forced to consume housing that does not align with their preferences. However, for households who do prefer detached housing, their preferences are more likely to be met in outer areas. Choice and suitability may also be limited in inner and middle Melbourne areas as households resort to overcrowding or housing stress to live in a dwelling that aligns with their preferences.	Negative outcome – diversity and choice are reduced.

Headline Impact	Scenario Results	Spatial Considerations	Likely Net Outcome for Victoria
Access to jobs and services	Jobs are dispersed across the metropolitan area in growth areas and at co-working spaces; remote service delivery rises.	Slower employment growth within inner and middle Melbourne. Central Melbourne experiences a small loss in employment but continues to attract knowledge jobs. Services are still accessible in outer Melbourne areas and to a lesser degree in the regions through remote service delivery.	Mixed outcome – access to jobs and services is strong in inner, middle, and outer Melbourne, but those in the regions likely experience longer travel times and the level of service and access across Victoria may be lower with limited government investment.
Economic performance	There is a rise in postal and warehousing and an aggregate decline in retail as population and employment are more dispersed; significant technological advancements, but automation does not replace workers. Decrease in agricultural productivity likely as peri-urban areas are developed.	Dispersed distribution of jobs provides benefits to local areas, however lack of agglomeration in key centres reduces overall productivity.	Negative outcome – may not necessarily result in higher GSP or productivity; agricultural productivity likely to decrease.
Socioeconomic equity	N/A – this is a function of the distribution of other headline impacts rather than scenario results directly.	Residents of inner and outer Melbourne may experience some benefits of growth in employment and access to jobs and services, while residents of regional areas may experience more disadvantage as agricultural opportunities decrease and access to jobs and services overall does not improve.	Mixed outcome – likely some disadvantage spread across middle Melbourne and regional Victoria.
Required investment	Additional costs to provide infrastructure across a wider urban footprint, higher costs to cater for longer distances such as transport, waste, civil infrastructure and energy.	Challenges with efficient infrastructure delivery in outer Melbourne and regional areas.	Mixed (i.e. potential for higher costs)

Scenario 4: Network of Cities

SCENARIO IMPACT ASSESSMENT

Headline Impact	Scenario Results	Spatial Considerations	Likely Net Outcome for Victoria
Development of environmentally sensitive land	Some land consumption in environmentally sensitive areas associated with the scaling up of regional centres.	Potential for development of environmentally sensitive land, particularly agricultural land, likely around regional centres, if growth boundaries are not implemented in regional cities. Some of these areas may be high-risk for bushfires.	Mixed outcome – some environmentally sensitive land developed around regional centres.
Environmental outcomes	While urban development increases in regional centres, government leads in sustainable policy and investment. This supports consolidation in these areas and a reduction in the consumption of non-renewable resources and pollution as well as delivery of a strong public transport network across Victoria.	Intensification of regional centres may generate higher noise pollution and some impacts to soil, air, and water quality in these areas. However, these may be mitigated through climate-conscious policy and design measures, and would largely not occur in an environmentally sensitive setting.	Positive outcome – lower energy consumption and greenhouse gas emissions.
Housing diversity and choice	Increase in dwellings in regional centres as households seek affordability outside metropolitan Melbourne.	Some regional areas may be more affordable than metro areas, however households may be forced to make choices that do not align with their dwelling type, density, and location preferences. Choice and suitability will also be constrained in the metropolitan area as households may resort to overcrowding or housing stress to live in a dwelling that aligns with their preferences.	Mixed outcome – diversity and choice may be impacted, depending on housing preferences.
Access to jobs and services	Victorians migrate to the regions, enabled by remote working trends; the regional centres become self-contained economic hubs and public transport connections are strong between the regions and metropolitan Melbourne.	Regional cities act as hubs for agricultural employees as well as civic, health, and community infrastructure, in addition to central Melbourne. Outer Melbourne residents can travel to inner Melbourne or a regional centre for work or services.	Positive outcome – access to jobs and services improved across Victoria.

Headline Impact	Scenario Results	Spatial Considerations	Likely Net Outcome for Victoria
		Access is more spatially distributed between metropolitan Melbourne and the regions, with strong public transport infrastructure connections.	
Economic performance	Economic performance is driven by the agricultural sector, which experiences increased export demand and technological improvements which drive an increase in productivity.	Increased agricultural employment across the regions is also served by workers from regional cities. Performance is strong in regional areas, supplemented by knowledge and service-based industries in the regions as well as inner Melbourne.	Positive outcome – likely increase in productivity and GSP.
Socioeconomic equity	N/A – this is a function of the distribution of other headline impacts rather than scenario results directly.	Those in inner Melbourne as well as the regions benefit from this scenario. Potential for lower-income regional households to be disadvantaged by higher housing prices in regional cities resulting from greater demand.	Positive outcome – concentrated disadvantage likely to be reduced across Victoria as the distribution of jobs and services improves.
Required investment	Additional infrastructure costs to service regional areas and higher costs to cater for longer distances such as transport, waste, civil infrastructure and energy	Challenges with efficient infrastructure delivery in outer Melbourne and regional areas. Centres development in Regional Victoria may provide for higher densities and reduced regional costs.	Mixed (i.e. potential for higher or lower costs depending on the use of existing infrastructure)

Scenario 5: Distributed State

SCENARIO IMPACT ASSESSMENT

Headline Impact	Scenario Results	Spatial Considerations	Likely Net Outcome for Victoria
Development of environmentally sensitive land	Significantly greater land consumption in environmentally sensitive areas as low-density growth extends into peri-urban and rural/regional areas across Victoria.	Natural landscape/conservation land and agricultural land both likely to be developed under this scenario. Also poses risk of infringement on Native Title lands. Development in high-risk areas for bushfire in central Victoria as well as high-risk coastal areas is likely.	Negative outcome – higher % of environmentally sensitive land developed.
Environmental outcomes	Decentralisation results in a proliferation of lower-density dwellings in outer Melbourne, growth areas and the regions, with little climate change action.	Population growth dispersed across Victoria likely to result in poor environmental outcomes state-wide.	Negative outcome – higher energy consumption and greenhouse gas emissions.
Housing diversity and choice	Increase in lower-density dwellings in growth areas and across regional Victoria as households seek affordability outside metropolitan Melbourne.	Some growth and regional areas may be more affordable than metro areas, however households may be forced to make choices that do not align with their dwelling type, density, and location preferences.	Mixed outcome – diversity and choice are impacted.
Access to jobs and services	Employment grows in regional centres, which become more self-sustaining, with services distributed across the state.	Regional centres accommodate anchor health and education institutions. A larger decline in jobs is experienced in Melbourne's New Growth Areas. Inner Melbourne remains an economic concentration of activity as it retains jobs in the knowledge economy, but experiences less development and unrealised infrastructure improvements. Importantly, the spatial distribution of jobs does not align with population - employment becomes concentrated primarily in Middle Melbourne between 2036 and 2056	Negative outcome – employment and services are more spatially distributed across Victoria, but do not align with the distribution of population growth, resulting in poorer access.

Headline Impact	Scenario Results	Spatial Considerations	Likely Net Outcome for Victoria
		despite the population residing primarily in regional areas during this same period.	
Economic performance	Agricultural production falls as export demand is lower and farmland is developed for urban expansion. On-shore industrial employment slows the decline of manufacturing at the expense of business and government services.	Employment slows alongside population growth in inner Melbourne. Growth in hospital and tertiary education in middle Melbourne sees this area benefit from agglomeration.	Mixed outcome – will not necessarily result in higher GSP or productivity; agricultural productivity likely to decrease.
Socioeconomic equity	N/A – this is a function of the distribution of other headline impacts rather than scenario results directly.	Potential for disadvantage across different areas due to the misalignment between jobs and population growth and other negative outcomes. Moreover, residents of regional areas may experience more disadvantage as agricultural opportunities decrease.	Negative outcome – potential for widespread disadvantage as access to infrastructure and employment does not align with population distribution.
Required investment	Additional costs to provide infrastructure across a wider urban footprint and higher costs to cater for longer distances such as transport, waste, civil infrastructure and energy	Challenges with efficient infrastructure delivery in outer Melbourne, growth areas and regional areas.	Negative (i.e. higher costs)

MELBOURNE
Level 14, 222 Exhibition Street
Melbourne VIC 3000
+61 3 8616 0331
sgsvic@sgsep.com.au

CANBERRA
Level 2, 28-36 Ainslie Avenue
Canberra ACT 2601
+61 2 6257 4525
sgsact@sgsep.com.au

HOBART
PO Box 123
Franklin TAS 7113
+61 421 372 940
sgstas@sgsep.com.au

SYDNEY
Suite 2.01/50 Holt Street
Surry Hills NSW 2010
+61 2 8307 0121
sgsnsw@sgsep.com.au

SGS Economics & Planning

Certified B Corporation