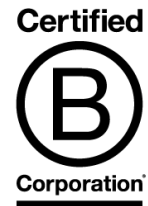


MELBOURNE FUNCTIONAL ECONOMIC REGION REPORT

MARCH 2019

PREPARED FOR:
INFRASTRUCTURE VICTORIA





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EXECUTIVE SUMMARY

Introduction

Melbourne is a diverse and well-connected economy. It covers a large area, from the Central Business District (CBD) to the peri-urban areas where a growing number of Melbourne's workers reside. Some parts of Melbourne are rich with infrastructure, services and jobs, while others provide less access to some or all of these attributes.

This report was prepared to inform Infrastructure Victoria's (IV's) update of their 30-year infrastructure strategy. To provide a deeper understanding of how Melbourne functions as an economic region SGS has defined the Melbourne functional economic region (FER) using a self-containment model that uses labour force catchments, or 'self-contained employment areas', to identify economic subregions.

FERs are well-connected, regional economies where economic interactions are mostly self-contained. They are dynamic and can cross administrative boundaries as urban environments change with population growth, new industries and new technologies. The Melbourne FER spreads beyond the local government boundaries that make up metropolitan Melbourne to include peri-urban areas (see Figure 1).

Going beyond a high-level understanding of metropolitan Melbourne will ensure the infrastructure strategy spatially targets infrastructure investment. This report is an accompaniment to the analysis of regional Victoria completed for IV in the first half of 2018.

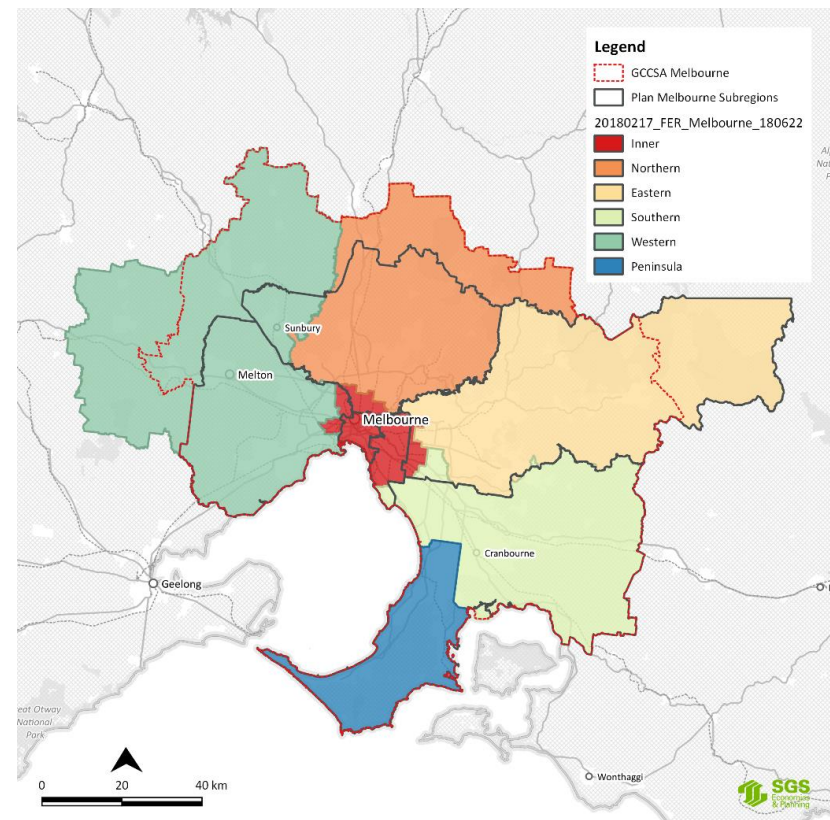
This report presents a profile of the Melbourne FER as an integrated network. Its purpose is to **understand the roles of the many economic locations around Melbourne, the people who contribute their human capital and the flows of**

people, goods and services throughout the economy. Ultimately, the report explains how Melbourne works.

We will explore the Melbourne FER under three themes:

- The **firms** that drive production and services
- The **people** that live and work in the economy
- The **connections** between the people and firms both within the Melbourne FER and economies outside of Melbourne.

FIGURE 1: THE MELBOURNE FER COMPARED WITH ADMINISTRATIVE BOUNDARIES



Source: SGS Economics and Planning 2018

FIRMS

- Melbourne has become increasingly important to Australia's economy, with its contribution to national growth rising from 13 per cent in the 1990s to nearly 30 per cent today.
- Gross product is now \$320 billion and has grown at 3.8 per cent per annum. On a per capita basis, gross product has increased by 25 per cent since 2001.
- Economic growth has been driven by population growth and structural change, with Melbourne now having a more diverse and knowledge services-based economy.
- The many different economic locations spread throughout the FER reflect the diversity of the broader economy.
- There is a high number of knowledge-intensive economic locations in and around the centre of the Melbourne due to its superior accessibility and connectivity.
- Industrial firms have been moving out of the central city to the major industrial precincts in the outer west, north and south.
- Firms in the education, training, health and population-serving sectors are more dispersed across the city because they primarily service the residential population.
- Automation is changing the tasks that workers do and is restructuring the workforce in the process. There is an increasing value placed on higher level cognitive (abstract) tasks, while the relative demand for routine and repetitive tasks that are easily coded has been falling for the last three decades.
- Outer areas tend to be more vulnerable to automation than inner areas of the FER.

PEOPLE

- Melbourne has been the fastest growing capital city in Australia since 2012 and today's population of 4.7 million is forecast to reach 7.5 million in 2046.
- The booming population and investments in education have grown the total human capital stock in the Melbourne FER from \$1.5 trillion in 2006 to \$2.1 trillion in 2016 (in 2016 dollars).
- Human capital is concentrated in the inner subregion, due to the large, high skilled population and job opportunities available, although the skilled population is growing in middle/outer suburbs. Much of the spatial variation in human capital is explained by differences in educational attainment and returns to education, in the form of higher earnings.
- The shifting distribution of population to the city's west highlights the need to maintain the alignment between human and physical capital in order to fully utilise human capital across the FER.
- The Melbourne labour market is performing strongly with an above average participation rate, rising from 64 per cent in 2000 to nearly 66 per cent in 2018.
- Spatial differences in labour market performance are explained by human capital levels, cost of living, personal preferences, access to jobs and the age of local population.
- Access to job opportunities is essential for facilitating labour force participation and better job matching, particularly for women and people living outside of the inner city.
- This will be increasingly important in the coming years when the full impacts of the ageing population are felt in the economy.

CONNECTIONS

- Melbourne is a highly integrated economy, with significant flows between nearly all industries. There are stronger flows between industries of similar types, for example between services such as retail and financial services. Some sectors also have strong inter-industry links, for example wholesale trade. This suggests that the co-location of these industries is important.
- Melbourne's industries operate in a regional and global supply chain and although the manufacturing industry has relatively weaker links to other industries now, it is the biggest importer and largest exporter in the city economy. Other major exporters include the financial and insurance services, and professional, scientific and technical services.
- In 2015, there were over 250,000 freight trips and 360,000 business trips daily. Freight trips are linked to key ports and industrial nodes, while business trips are strongly correlated with major employment nodes and development.
- The inner subregion is the primary destination for work commutes within the Melbourne FER, representing 42 per cent of all trips. Major commuter flows also occur within subregions.
- There is a significant group of long-distance commuters that come to the FER to work from Geelong, Bendigo, Ballarat and Warragul-Drouin. They are rising in number but no faster than the population, which suggests it is not a growing trend.
- Future population and employment growth will place additional strain on Melbourne's transport network, this may be eased somewhat by new technology, particularly driverless cars.

Conclusions

Overall, SGS's analysis has found that the Melbourne economy has transformed from a heavy manufacturing city to a more diverse economy with strong knowledge-intensive sectors. A range of highly varied and specialised economic locations drive productivity across the FER, and growth has been supported by a booming and productive population, with above average participation and increasing levels of human capital.

People living in the outer parts of the FER have reduced economic outcomes when compared to those living in inner areas. This is largely due to lower levels of access to jobs and services. While it is no surprise that inner parts of the city have superior access and opportunities, this highlights the need for infrastructure and jobs in outer areas, particularly with the population boom that is expected in the west and other New Growth Areas.

FERs are dynamic entities and the Melbourne FER will shift and transform in the future. Key drivers of change will be the growing population, new technology, workplace trends and transport infrastructure. It is likely that the FER will expand if commuting from peri-urban areas becomes more popular. The shape of subregions will also change, particularly if outer national employment and innovation clusters (NEICs) develop and take on a more significant role in the broader Victorian economy.

1. INTRODUCTION

Economic functions and future infrastructure

Melbourne is a diverse and well-connected economy. It covers a broad area that includes peri-urban areas where a growing number of Melbourne's workers reside. Some areas are well served by infrastructure, services and jobs, while other areas offer lower access to some or all of these attributes.

To inform IV's recommendations in the 2019 update of the 30-year infrastructure strategy, this report looks beyond administrative boundaries to examine Melbourne as a functional economic region (FER). This informs how subregions, local government areas (LGAs) and suburbs that make up Melbourne are connected and inter-dependent.

FERs describe areas where economic interactions occur in a self-contained way. Trade and commerce, commuting to work, access to goods and services and other activities occur more frequently between firms and residents within an FER than with firms and residents located outside of it. Put simply, FERs are well-connected, regional economies.

"A functional region is characterized by its agglomeration of activities and by its intra-regional transport infrastructure and established economic interaction networks, facilitating a large mobility of people, products and inputs within its borders."

Karlsson and Olsson (2015)

This report uses FERs to analyse the Melbourne economy because they are more meaningful than administrative geographic boundaries. Administrative boundaries can arbitrarily divide otherwise well-connected systems, such as Albury and Wodonga on the Victoria-New South Wales border.

While administrative boundaries tend to be static, FERs change over time. They are shaped by structural transitions in the broader economy, population growth, migration and new ways to connect, both virtually via communications technologies and physically via transport infrastructure.

For example, the opening of the Western Ring Road in the 1990s improved the accessibility of Melbourne's western and northern suburbs and contributed to employment and population increases in those areas.

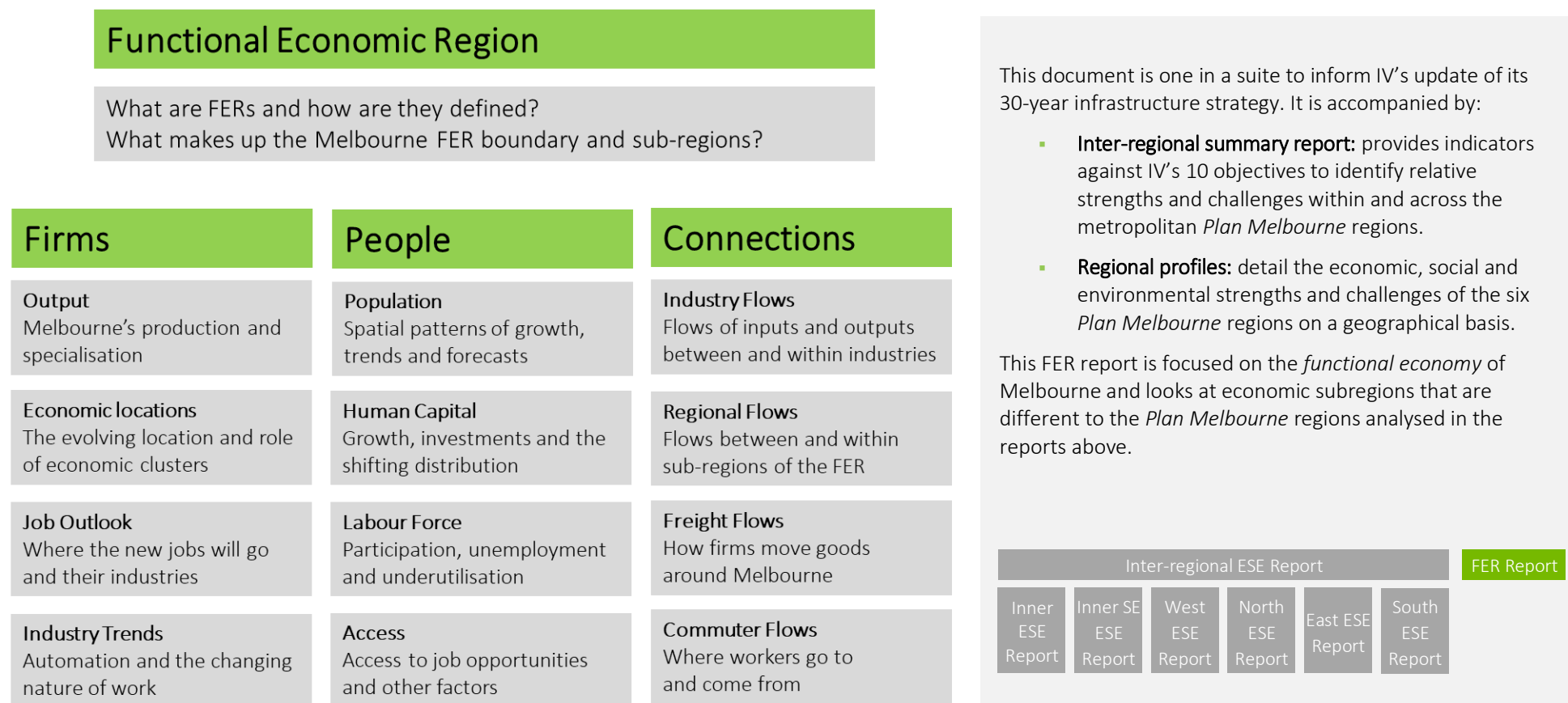
For these reasons, planning based purely on administrative boundaries might not adequately consider the economic systems within them. This can result in poor coordination and inefficient competition for resources (Productivity Commission, 2017).

This report presents a profile of the Melbourne FER as an integrated network. Its purpose is to **understand the roles of the many economic locations around Melbourne, the people who contribute their human capital and the flows of people, goods and services throughout the economy**. Ultimately, the report explains how Melbourne works under three themes:

- The **firms** that drive production and services
- The **people** that live and work in the economy
- The **connections** between the people and firms both within the Melbourne FER and economies outside of Melbourne.

The three themes are shown in Figure 2 along with the information explored under each. To analyse each of these themes, SGS has drawn on inhouse models and methods; these are noted throughout the report and full documentation of the methods can be found in the Appendix.

FIGURE 2: FER REPORT STRUCTURE



2. THE MELBOURNE FUNCTIONAL ECONOMIC REGION

KEY INSIGHTS

- The Melbourne FER constitutes a large geographic area that spreads beyond administrative boundaries into peri-urban areas.
- The functional subregions of the FER are different to the administrative definitions of Greater Melbourne and the *Plan Melbourne* regions.
- The inner FER subregion covers the Inner Metro and Inner South East *Plan Melbourne* regions, and parts of the surrounding regions; this indicates a high level of integration and inter-dependency of firms and workers across a broad area.
- The Southern *Plan Melbourne* region is less integrated and can be split into two functional subregions: the southern subregion in green covering Dandenong to Pakenham and Koo Wee-Rup and the peninsular subregion covering Frankston to Portsea.
- There is a large degree of self-containment in the Melbourne FER (94.9 per cent) and the six subregions are at least 50 per cent self-contained.

Self-contained employment areas

Melbourne contains many economic locations that are formed by highly varied and often specialised employment clusters. Examples include the Melbourne CBD, nodes such as South Melbourne or metropolitan activity centres such as Dandenong and Box Hill. These employment centres tend to have geographic labour force catchments where the majority of their working populations reside.

These economic locations are often closely connected by being accessible to each other through transport, or through local markets of labour, goods and services. A network of connected centres and their local labour market catchment areas may serve as an economic subregion.

Labour force catchments, or self-contained employment areas (SEAs), are a useful tool to identify economic subregions because, in addition to revealing integrated labour markets, they are good approximations of other important economic functions. Households often purchase goods and services close to home, and firms often purchase inputs, sell their products and recruit workers close to their premises (Karlsson and Olsson, 2015).

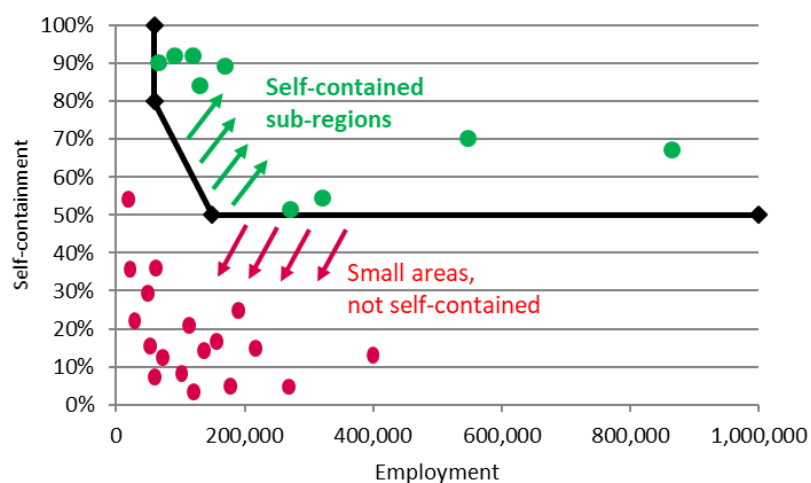
Journey to work data from the 2016 Census informs the identification of SEAs that define function subregions within the Melbourne FER. SGS's self-containment model has identified SEAs that have a large base of working residents, a network of connected employment centres and employment self-containment.

SEAs are defined by having three key characteristics and benchmarks, as follows:

- They are reasonably **self-contained** (minimum 50 per cent)
- They are sufficiently **large in size** (minimum 60,000 workers)
- They are **integrated** (frequent commutes occur between most areas).

As shown in Figure 3, a self-containment algorithm is used to aggregate Statistical Area (SA) Level 2 regions until the minimum self-containment and minimum size constraints are met. The full method is detailed in Appendix O.

FIGURE 3: FER SELF-CONTAINMENT AND WORKER THRESHOLDS



Source: SGS Economics and Planning Self-containment Model 2018

The Melbourne FER

The FER is mapped in Figure 4 which reveals a natural polycentric structure. It is made up of one inner subregion surrounded radially by five subregions. The left panel of the figure shows the variation in urban typology across the FER. The dark blue in the centre of Melbourne indicates built up and well-established areas, with lighter shades of blue for middle and outer ring suburbs. The yellow areas are New Growth Areas where there will be fast population growth.

Beyond this, substantial portions of the FER are regional peri-urban areas (shown in green). They include Bacchus Marsh and Ballan to the west; towns around Gisborne, Macedon and Romsey to the north-west; Wallan to the north; towns around the Yarra Ranges to the east; and Koo Wee Rup and Bunyip to the south-east. These areas were included through the self-containment model because workers in these areas are a growing source of labour for the Melbourne economy.

The right panel of map below compares the FER boundaries with administrative boundaries. The functional subregions are different to the definitions of Greater Melbourne (dotted red line) and the *Plan Melbourne* regions (grey line), which are defined as groups of LGAs.

While there is some similarity in the shape of the FER subregions and the *Plan Melbourne* regions, there are important differences. The inner FER subregion covers the Inner Metro and Inner South East *Plan Melbourne* regions, and parts of the surrounding regions; this indicates a high level of integration and inter-dependency of firms and workers across a broad area from Footscray to Clayton. The Southern *Plan Melbourne* region is less integrated and is split into the southern subregion in green covering Dandenong to Pakenham and Koo Wee-Rup and the peninsula subregion covering Frankston to Portsea.

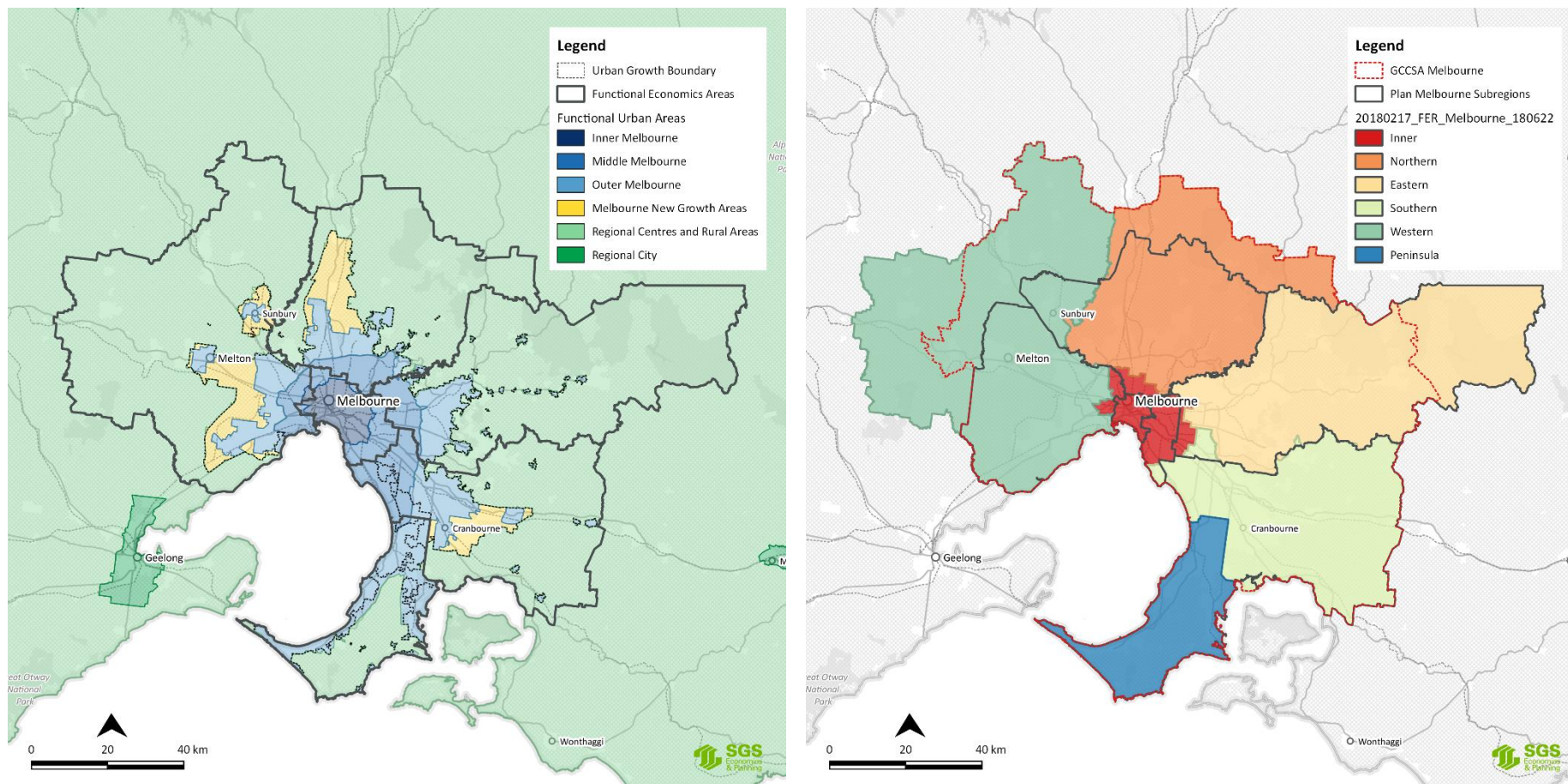
Table 1 shows the resident population, local workforce and degree of self-containment in each subregion and the overall FER. The FER has a high degree of self-containment at 94.9 per cent; the subregions each have a self-containment of approximately 50 to 57 per cent. There are still significant commuter flows between subregions which is analysed in Chapter 5.

TABLE 1: FER POPULATION, WORKERS AND SELF-CONTAINMENT (2016)

Subregion	Population	Local Workers	Self-containment
Inner	1,295,200	904,200	52.2%
West	840,300	232,900	49.6%
North	731,700	225,400	49.7%
East	682,100	228,800	50.5%
South	881,900	339,600	56.9%
Peninsular	300,400	91,000	54.9%
FER Total	4,731,500	2,021,900	94.9%

Source: SGS Economics and Planning; derived from ABS Census 2016

FIGURE 4: THE MELBOURNE FER AND LOCATION TYPOLOGY (LEFT) AND ADMINISTRATIVE BOUNDARIES (RIGHT)



Source: SGS Economics and Planning

The subsequent data analysis in this report uses the FER boundaries above whenever possible. However, the Greater Melbourne boundary defined by the ABS Greater Capital City Statistical Area (GCCSA) is used when more detailed spatial data was not available. This is detailed in the relevant tables and charts wherever 'Greater Melbourne' is used in the title of the chart and/or additional notes are provided.

3. FIRMS

KEY INSIGHTS

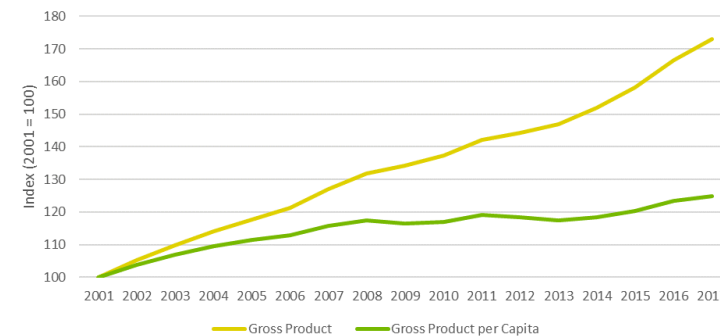
- Melbourne's contribution to national growth rose from 13 per cent in the 1990s to nearly 30 per cent today.
- Gross product is now \$320 billion and has grown at 3.8 per cent per annum. On a per capita basis, gross product has increased by 25 per cent since 2001.
- Economic growth has been driven by population growth and structural change, with Melbourne now having a more diverse and knowledge services-based economy.
- The many different economic locations spread throughout the FER reflect the diversity of the broader economy.
- There is a high number of knowledge-intensive economic locations in and around the centre of the Melbourne due to its superior accessibility and connectivity.
- Industrial firms have been moving out of the central city to the major industrial precincts in the outer west, north and south.
- Firms in the education, training, health and population-serving sectors are more dispersed across the city because they primarily service the residential population.
- Automation is changing the tasks that workers do and restructuring the workforce in the process. There is an increasing value placed on abstract tasks, while the relative demand for routine tasks has been falling for the last three decades.
- Outer areas tend to be more vulnerable to automation than inner areas of the FER.

Economic growth amid major structural change

Data from regional accounts produced by the National Institute of Economic and Industry Research (NIEIR) show that the Greater Melbourne economy has risen from \$127 billion in 1992 to nearly \$320 billion in 2017 – with an average annual growth rate of 3.8 per cent, in real terms (in 2015-16 dollar values). Over this period, Greater Melbourne became increasingly important to Australia's economy, its contribution to national growth rising from 13 per cent in the 1990s to nearly 30 per cent today (SGS, 2018b).

Strong population growth in the FER has been a major driver of economic growth, with more people contributing their human capital to the Melbourne economy. However, gross product per capita has also grown more slowly, by 1.4 per cent on average. Figure 5 illustrates these components of growth, where total gross product is 73 per cent higher in 2017 than 2001 while the rise on a per capita basis is still 25 per cent. As the population grows, maintaining a high quality of life for all citizens will depend on whether opportunities to fully participate in the economy are available in all corners of the FER.

FIGURE 5: INDEX OF GROSS PRODUCT AND GROSS PRODUCT PER CAPITA IN GREATER MELBOURNE (2001-2017)



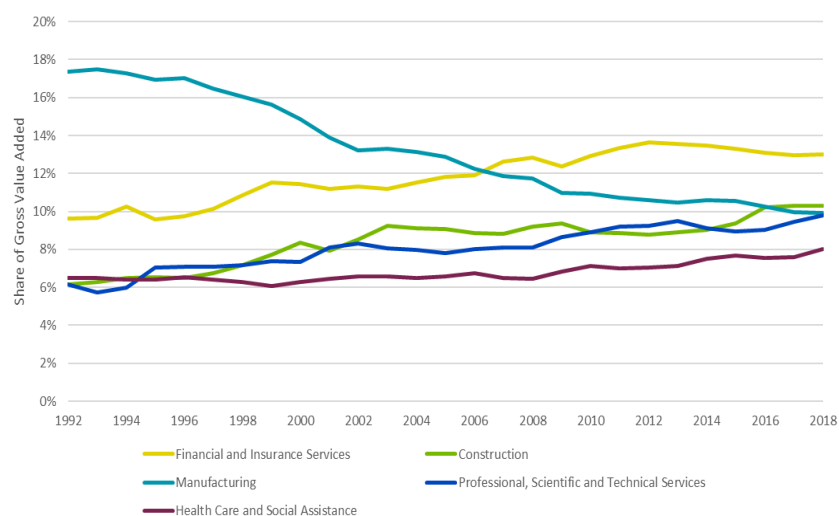
Source: SGS Economics and Planning, derived from NIEIR (2018) and ABS.stat

This period of growth has coincided with the transformation of Melbourne from the rust belt economy of the late 1980s to the diversified economy of today. Figure 6 shows the share of gross value added (GVA) to the Melbourne economy of the top five industries since 1992; these industries generate over half of the value in the Melbourne economy.

Knowledge-intensive industries are now the most valuable in the economy, and the largest of those are financial and insurance services industry and the professional, scientific and technical services industry. Their share of output has risen by about 3.5 percentage points each in the last 25 years.

Manufacturing has dropped from the largest industry with 17 per cent of output in 1992 to 10 per cent in 2018. Despite the decline, it remains a major contributor to the economy as Melbourne's third largest industry and a large generator of exports and jobs. Intermediate manufacturing inputs also generate demand for imported goods, which in turn drive demand for ports, transport and logistics sector services and industrial land.

FIGURE 6: INDUSTRY SHARE OF GROSS VALUE ADDED IN GREATER MELBOURNE, TOP FIVE INDUSTRIES (1992-2018)

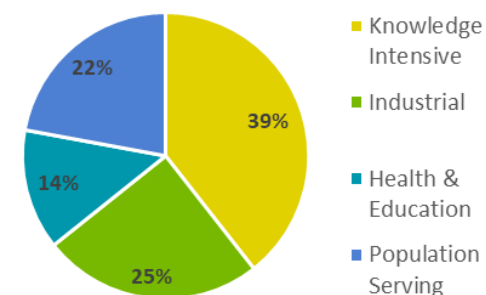


Source: SGS Economics and Planning, derived from NIEIR (2018)

The population and housing boom has driven rising demand for population-serving activity. Construction is now the second largest industry in value-added terms. Health care and social assistance is the fifth largest industry and provides critical social infrastructure for the growing city.

Figure 7 considers the overall industry mix in Melbourne in 2018. Knowledge-intensive firms generate 39 per cent of the value added to the economy, followed by industrial activities (25 per cent), population-serving (22 per cent) and health and education (14 per cent).

FIGURE 7: INDUSTRY SHARE OF GROSS VALUE ADDED IN GREATER MELBOURNE (2018)



Source: SGS Economics and Planning, derived from NIEIR

INDUSTRY CLASSIFICATIONS

The following ANZSIC Divisions make up the classifications used in this report:

Knowledge-intensive: information media & telecommunications; financial & insurance services; rental, hiring & real estate services; professional, scientific & technical services; administrative & support services; public administration & safety

Industrial: agriculture, forestry & fishing; mining; manufacturing; electricity, gas, water & waste; wholesale trade; transport, postal & warehousing

Health and Education: education & training; health care & social assistance

Population-serving: construction; retail trade; accommodation & food

Economic locations and different roles

The location of economic centres across the Melbourne FER and various land uses are determined by land value and commercial viability. While many factors influence commercial viability at a site-level (such as planning controls, development potential or scarcity of alternative sites), accessibility is the most dominant factor at a city level.

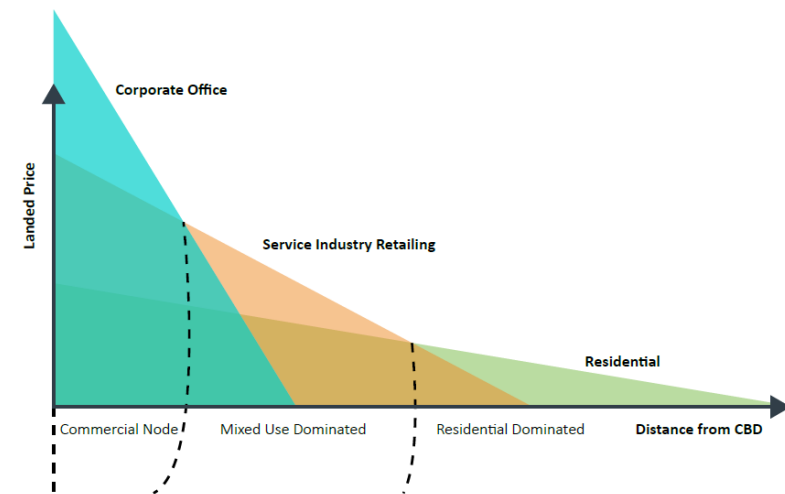
Figure 8 gives a theoretical illustration of how land value increases with the higher accessibility available close to the CBD or other transport hubs. Depending on their needs, different industries will desire different land types and different types of accessibility. This could include access to jobs and services, labour and consumers, natural assets or built assets, such as freight networks or other infrastructure.

These forces shape the land use and clusters of economic activity across the Melbourne FER. A diverse set of economic locations around Melbourne drive production and employment in the city economy. These clusters have unique economic profiles, which reflect the attributes and endowments of their catchment area workforces and historic legacy, and different levels of development maturity. Together, they generate about 60 per cent of all jobs in the FER.

The distribution of these locations is shown in the map below, with some headline statistics for the key locations. The featured locations were selected by identifying which are specialised in one industry type (or mixed) and then selecting the largest clusters from each specialisation in terms of total jobs.

Knowledge-intensive clusters are mainly found in inner Melbourne, such as the central Melbourne CBD, Docklands, East Melbourne and St Kilda Road. The knowledge economy has quite different needs and drivers from traditional industrial or population-serving employment. Higher order knowledge-intensive firms prefer locations with access to a broad and highly skilled labour force and opportunities for business-to-business interactions. This enables economies of scale and scope and facilitates innovation through knowledge spillovers between firms. As a result, they gain strong benefits from highly connected locations, or agglomerations.

FIGURE 8: THEORETICAL DEMAND FOR LAND USES AS A FUNCTION OF ACCESSIBILITY



Source: SGS Economics and Planning

ECONOMIC LOCATIONS

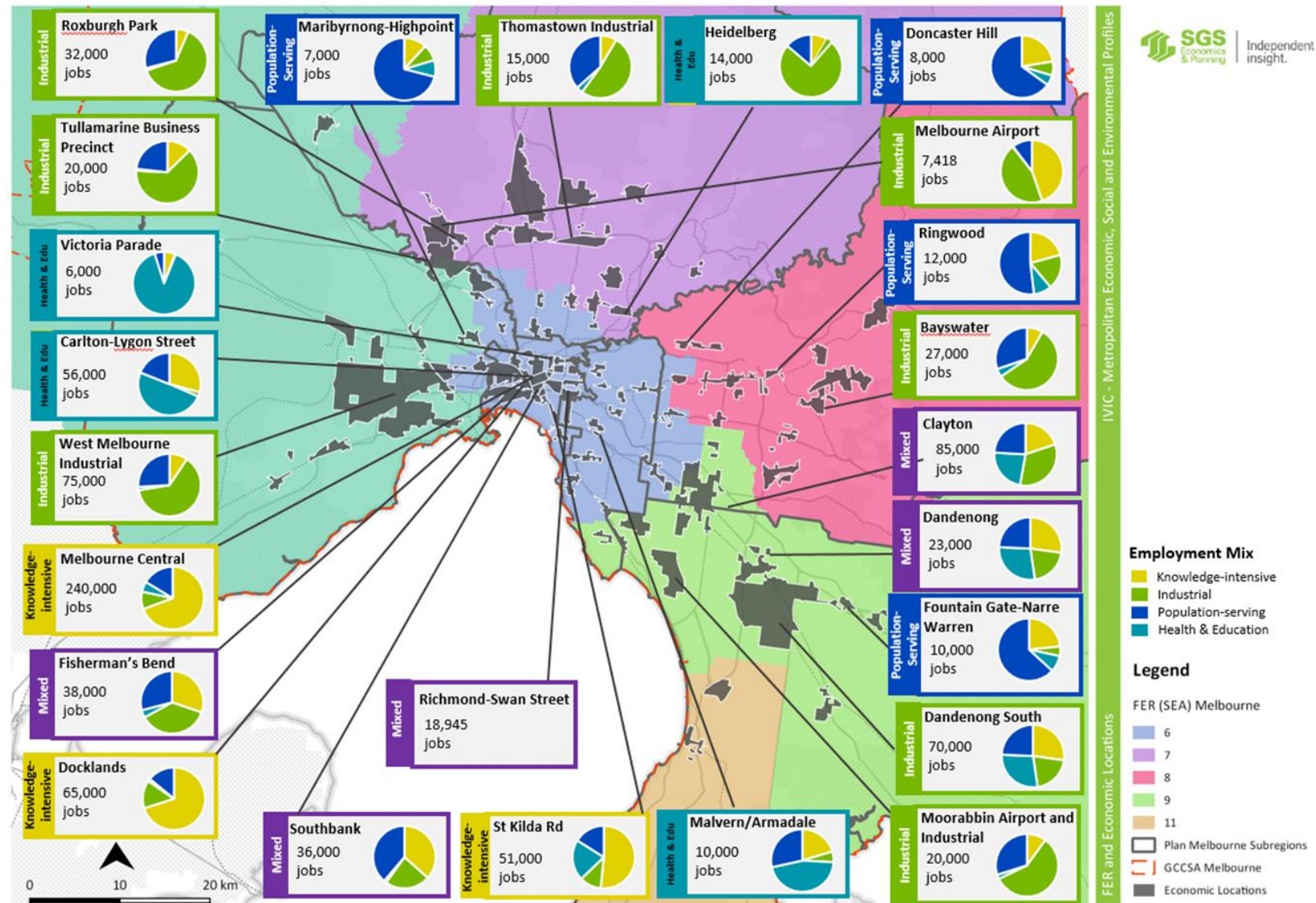
Economic locations are areas with a dense cluster of economic and employment activity, ranging from the Melbourne CBD to smaller localised activity centres.

SGS has identified the key economic locations with a clustering model that forms employment clusters with a minimum of 5,000 jobs within a one-kilometre radius. Full details of the method are provided in the Appendix.

The locations capture many places of state significance identified in *Plan Melbourne*, including NEICs, state significant industrial precincts (SSIPs) and MACs.

While they overlap with the *Plan Melbourne* locations, the boundaries are not identical. They also capture significant clusters that are not in *Plan Melbourne*, such as the Moorabbin Airport and Industrial cluster. See Appendix O. for methodology.

FIGURE 9: FER SUBREGIONS AND ECONOMIC LOCATIONS



Industrial centres are generally located in middle and outer areas such as Dandenong South, Tullamarine and the West Melbourne industrial precinct. Industrial production requires less labour than knowledge-intensive production. Industrial firms need space, and face-to-face interactions are less important, so they generally prefer large premises on more affordable land.

While the benefits of agglomeration economies are not as great for industrial firms as knowledge-intensive firms, there are different benefits to be gained from clustering with similar industrial producers. For example, manufacturers in the west specialise in prefabricated construction materials, building fittings and furniture. Those in the north specialise in the manufacture of steel products, aluminium, packaging, industrial tools and specialised machines. Large manufacturers of transport equipment, automotive and transport components tend to locate in the south. These firms trade as inputs flow through the supply chain and move up the value chain.

Many industrial firms also move physical goods around the city because they need access to production inputs and strategic trade gateways. The industrial land in Dandenong, Werribee and around the Port of Melbourne all serve as major freight hubs for the city, connecting to markets around Australia and the globe. This is explored in Chapter 5.

Firms in the education, training, health and population-serving sectors are more dispersed because they primarily service the residential population. These activities are present across all geographic typologies in Melbourne, with more specialised activities locating at centres and nodes such as Victoria Parade, the Parkville cluster around Carlton-Lygon Street and Heidelberg. Population-serving clusters are smaller than other industry clusters and mainly made up of retail precincts, such as the Maribyrnong Highpoint, Doncaster Hill and Ringwood centres.

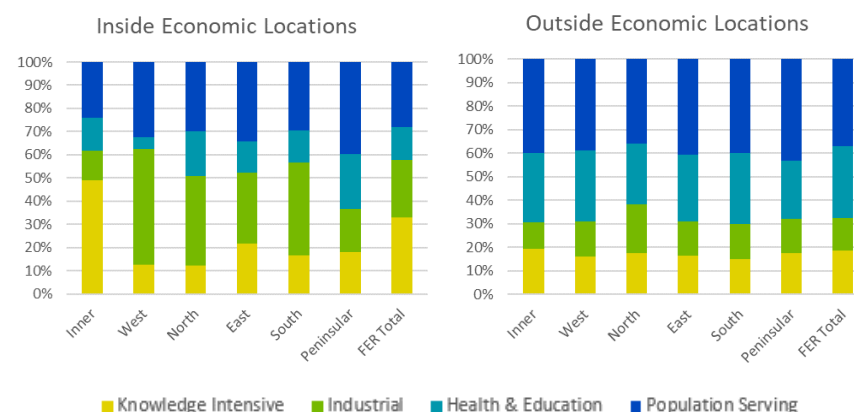
There are also mixed clusters, such as Southbank, Clayton and Fishermans Bend, which do not have any dominant industry type but are state-significant employment clusters with agglomerations of major firms. Many smaller economic locations can be seen across Melbourne and while not all presented, they generate economic activity and provide jobs for the city's residents.

Household-oriented firms

Forty per cent of the city's employment exists outside of economic locations. This is widely distributed around residential areas and includes areas such as subregional shopping centres, schools and smaller hospitals.

Jobs in these areas have a distinctly different character than those in economic locations. Figure 10 compares the industry mix of employment inside and outside economic locations and how this varies across subregions. As already noted, knowledge-intensive jobs are dominant within the economic locations of the inner subregion and industrial jobs are dominant in the outer regions, especially to the west, north and south where SSIPs are situated.

FIGURE 10: INDUSTRY SHARE OF EMPLOYMENT, BY ECONOMIC LOCATION (2016)



Source: SGS Economics and Planning, derived from NIEIR (2018)

Employment outside economic locations is more homogenous across subregions. The dominant jobs are in population-serving industries such as retail and construction and health and education industries, which provide essential services to the residential population. These industries prefer the lower value employment lands that are distributed outside of economic locations because they need to be close to their residential customer base and do not benefit from agglomeration as much as knowledge-intensive firms.

They also need land with lower rents because they have a lower production value than firms in the larger economic locations.

Employment outside economic locations, while not as economically productive, still influence the everyday lives of the city's residents as they provide access to a range of services.

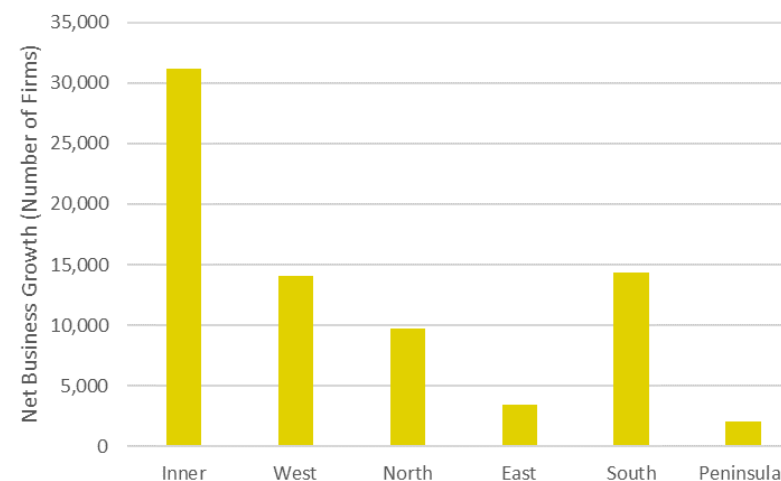
Evolving location patterns

The patterns above evolve over time with the creation and closure of firms across industries and locations. Business creation is considered an important driver of growth, employment, innovation and productivity gains. Historical data from the ABS Business Counts release shows that business creation has been strong in the Melbourne FER – there were over 450,000 active firms in 2017, up from 378,000 firms in 2009 at a growth of 2.5 per cent per annum.

As seen in Figure 11, business creation was strongest in the inner subregion with over 31,000 net new firms over the period. This aligns with the growing importance of knowledge-intensive industries in the economy, which tend to locate in the well-connected inner areas. The next highest level of firm creation was in the western and southern subregions (both 14,000 firms), followed by the northern (10,000 firms), home to major industrial economic locations. Business creation has been slower in the eastern and peninsular subregions where there are fewer economic locations.

The spatial patterns of business creation across industries are shown in Figure 12 and Figure 13. For each SA2 area, a net increase in firms is shown in green dots and a net decrease is shown in purple dots. In line with earlier findings, business creation is strongest in knowledge-intensive industries. While this is most concentrated in the inner subregion, new knowledge-intensive businesses have still been opening across the whole FER. Outer firms in these industries are likely to be locally-focused firms, such as real estate services or accounting services.

FIGURE 11: NET BUSINESS GROWTH, BY FER SUBREGION (2009-2017)



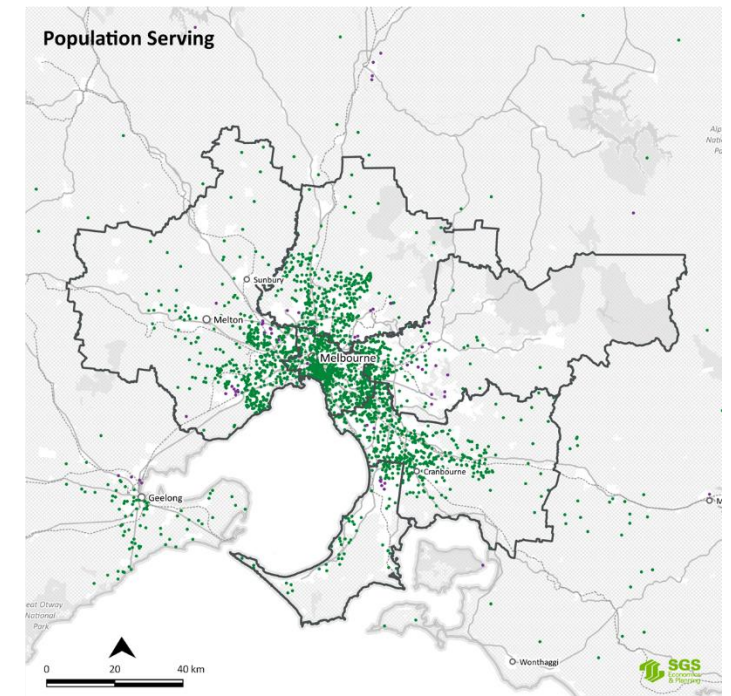
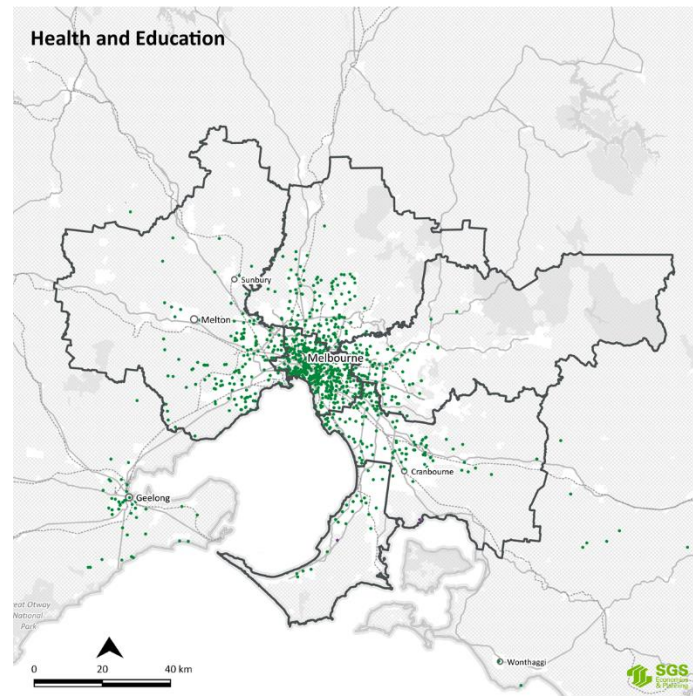
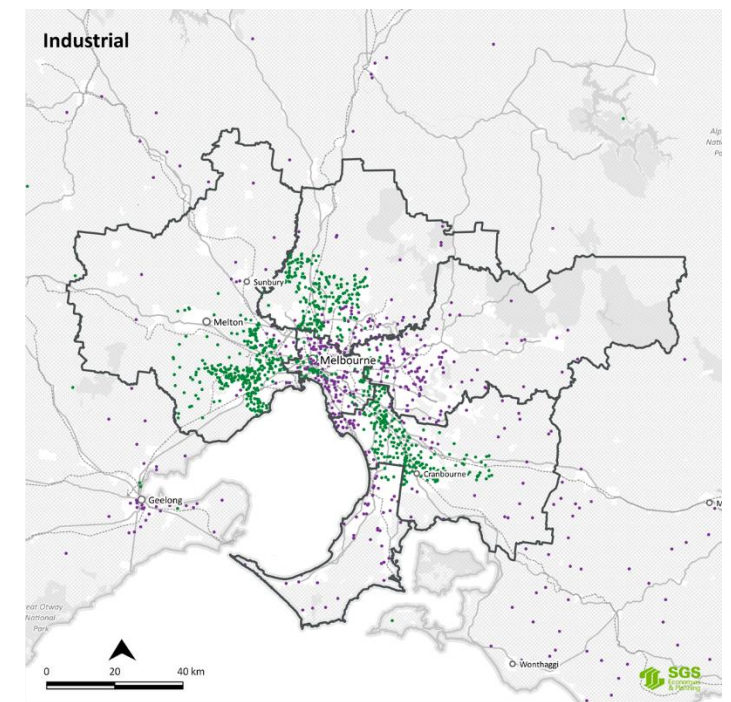
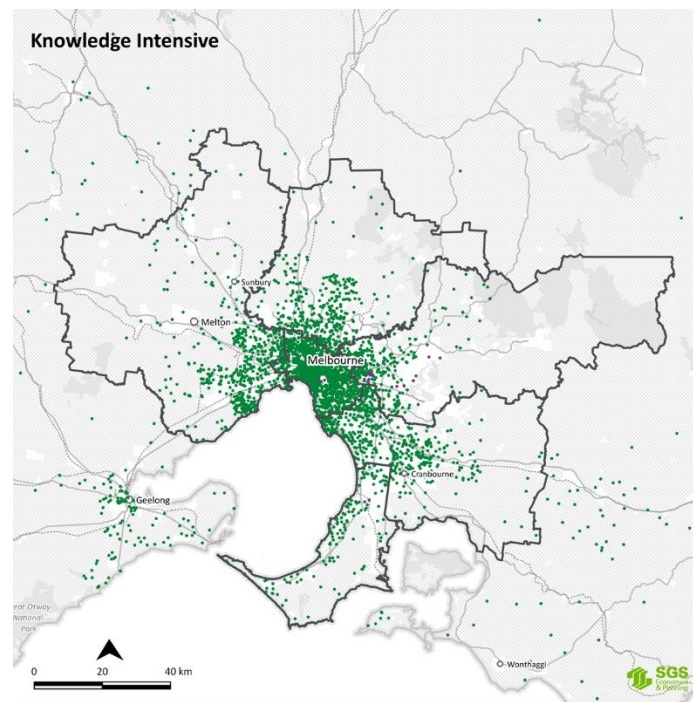
Source: Source: SGS Economics and Planning, derived from ABS (2012,2018) cat. no. 8165.0, Counts of Australian Businesses, including Entries and Exits, Jun 2013 to Jun 2017 and Jun 2007 to Jun 2011

There has been a net reduction in the number of industrial firms across many inner and middle ring suburbs. This reflects the gentrification of some areas as old industrial lands have been transformed to new housing developments and change in land use to accommodate rising demand for commercial space close to the CBD. On the other hand, there was a net increase in firms around key industrial precincts in the west, north and south.

Business creation is ubiquitous for population-serving firms and health and education firms. The strongest growth in population-serving firms is seen along growth corridors to the south-east and west of the FER as businesses open to serve the needs of the new residents.

These patterns have resulted in a degree of centralisation of the FER around the inner city while there has been consolidation within economic locations in outer areas, particularly in key industrial precincts. These outer economic locations are important sources of employment for people who live in outer suburbs and peri-urban areas. Commute patterns are explored in Chapter 5.

FIGURE 12: NET BUSINESS GROWTH ACROSS MELBOURNE FER BY INDUSTRY GROUP AND SA2 (2009-2017)



Legend

-  Functional Economics Areas
- Change in Number of Businesses
 -  1 dot = 10 extra businesses
 -  1 dot = 10 fewer businesses

Note: The dots indicate *net* change in the number of firms within an SA2 area after accounting for all new openings and closures, there is a higher number of new businesses created and businesses closed within most SA2s

Source: SGS Economics and Planning, derived from ABS (2012,2018) cat. no. 8165.0, Counts of Australian Businesses, including Entries and Exits, Jun 2013 to Jun 2017 and Jun 2007 to Jun 2011

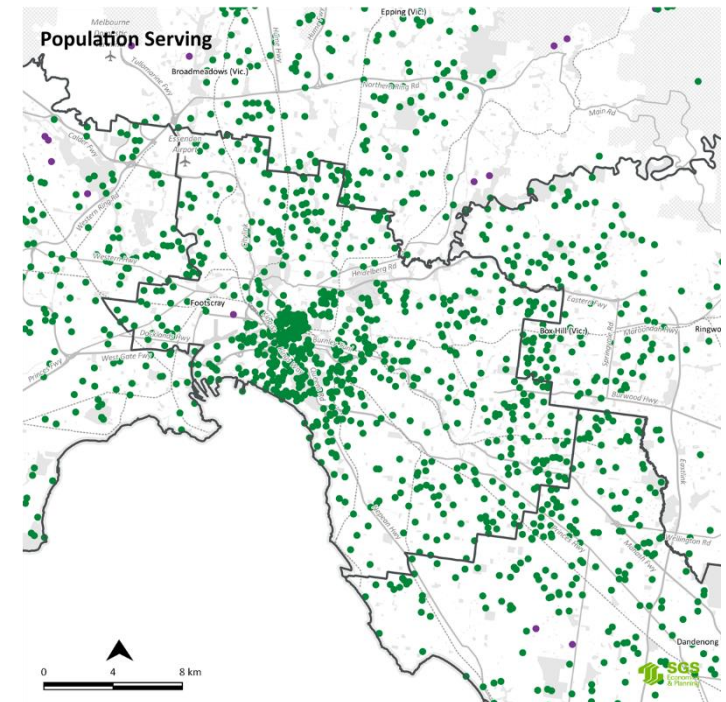
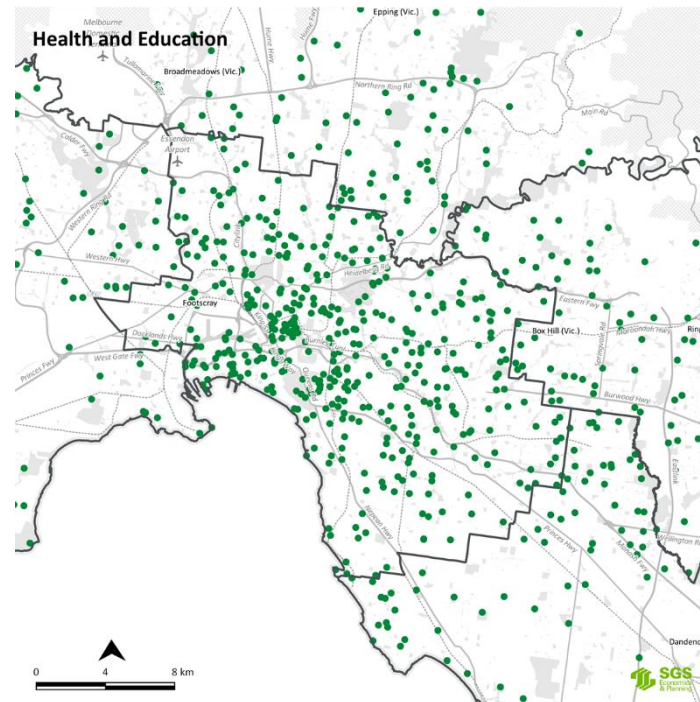
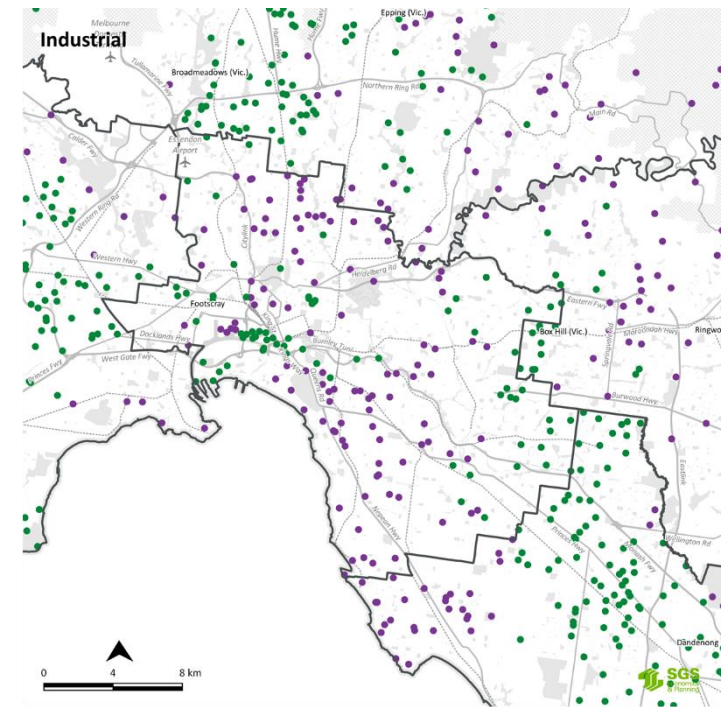
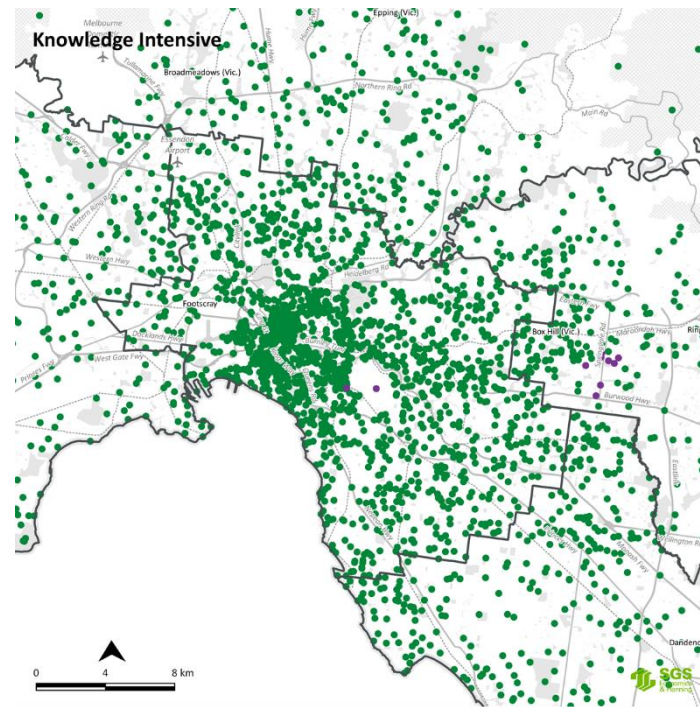
FIGURE 13: NET BUSINESS GROWTH IN INNER MELBOURNE BY INDUSTRY GROUP AND SA2 (2009-2017)

Legend

-  Functional Economics Areas
- Change in Number of Businesses
 -  1 dot = 10 extra businesses
 -  1 dot = 10 fewer businesses

Note: The dots indicate *net* change in the number of firms within an SA2 area after accounting for all new openings and closures, there is a higher number of new businesses created and businesses closed within most SA2s

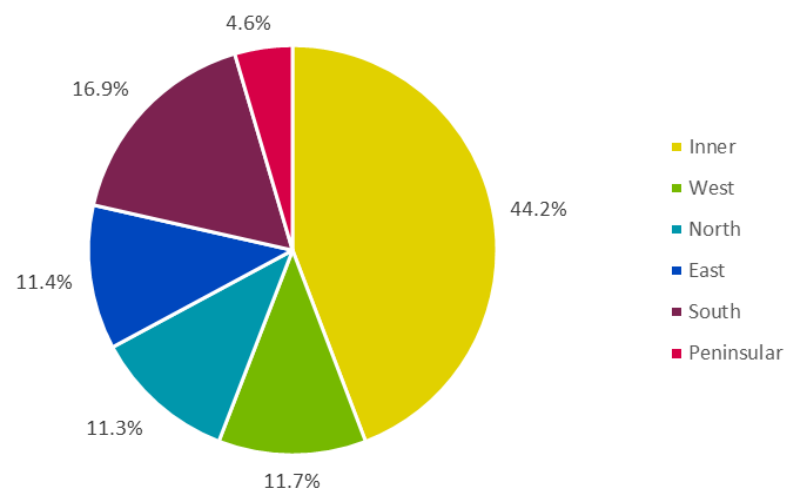
Source: SGS Economics and Planning, derived from ABS (2012,2018) cat. no. 8165.0, Counts of Australian Businesses, including Entries and Exits, Jun 2013 to Jun 2017 and Jun 2007 to Jun 2011



Population growth and employment growth

In line with population growth, employment has risen substantially in the Melbourne FER—from 1.6 million jobs in 1996 to 2.3 million jobs in 2016. In line with the locations of firms, employment is concentrated in central Melbourne, with nearly half of all jobs in the inner subregion (see Figure 14).

FIGURE 14: FER SUBREGION SHARE OF EMPLOYMENT (2016)



Source: SGS Economics and Planning SALUP Model

While not shown here to avoid repetition, shifts in industry composition resemble those of production. Knowledge-intensive jobs take up an increasing share of employment, the share of industrial jobs is shrinking and the share of education and training jobs is rising due to the labour-intensive nature of those industries, and the need to meet the population's education needs.

These trends are forecast to continue. SGS employment forecasts for each subregion and industry group are shown in Table 2 and the locations of new jobs are shown in Figure 15 and Figure 16. Health and education jobs are forecast to have the largest growth with nearly 800,000 jobs, followed by knowledge-intensive jobs (580,000) and population-serving jobs (478,000).

There are only 18,000 additional industrial jobs forecast over the next 30 years, which is a near negligible fraction of the 1.8 million total new jobs expected in Melbourne. This poses risks for workers in these industries and people with skills suited to them as there may be fewer job opportunities. It highlights the education imperative that teaching the skills of the future will be vital to the employment prospects of tomorrow's workforce.

TABLE 2: EMPLOYMENT FORECASTS BY INDUSTRY AND SUBREGION (2016-2031)

	Knowledge-intensive	Industrial	Health and Education	Population-serving	All Industries
Inner	203,000	- 3,000	151,000	80,000	431,000
West	22,000	7,000	48,000	37,000	114,000
North	20,000	3,000	50,000	32,000	105,000
East	14,000	- 4,000	27,000	17,000	54,000
South	29,000	- 2,000	56,000	38,000	121,000
Peninsular	3,000	1,000	11,000	8,000	23,000
FER Total	291,000	2,000	343,000	212,000	848,000

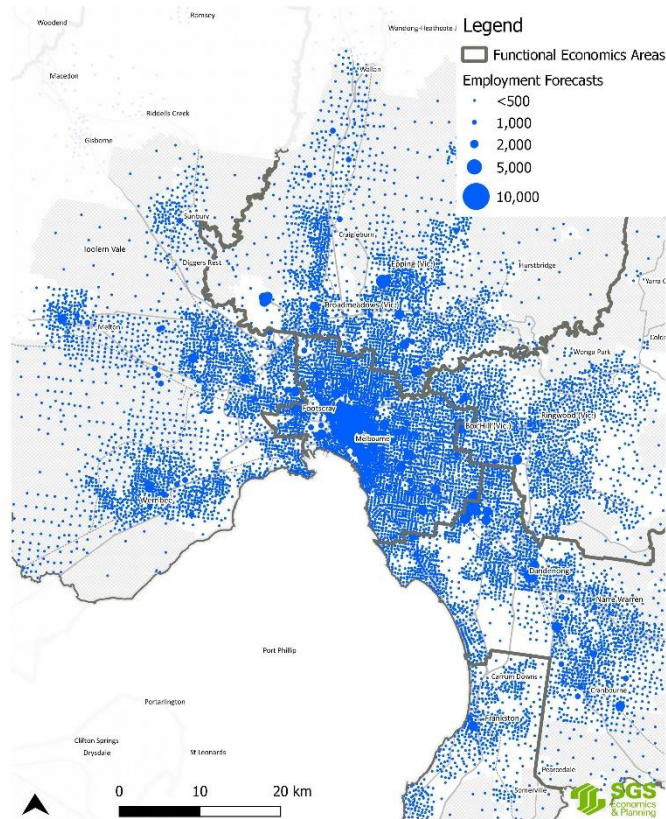
Source: SGS Economics and Planning SALUP Model

In line with the clustering of firms seen earlier, most employment growth is expected to occur in the inner subregion. As seen in Figure 15 and Figure 16, a significant proportion of new jobs will continue to be located in the CBD; however, growth in the CBD will slow as it approaches development and floorspace capacity.

Employment growth will spread across surrounding central city precincts. Docklands, Southbank and City North will capture some of the employment overflow in the short term but these precincts are also reaching development

capacity. For example, it is expected that Docklands will reach full capacity within the next 10 years.¹

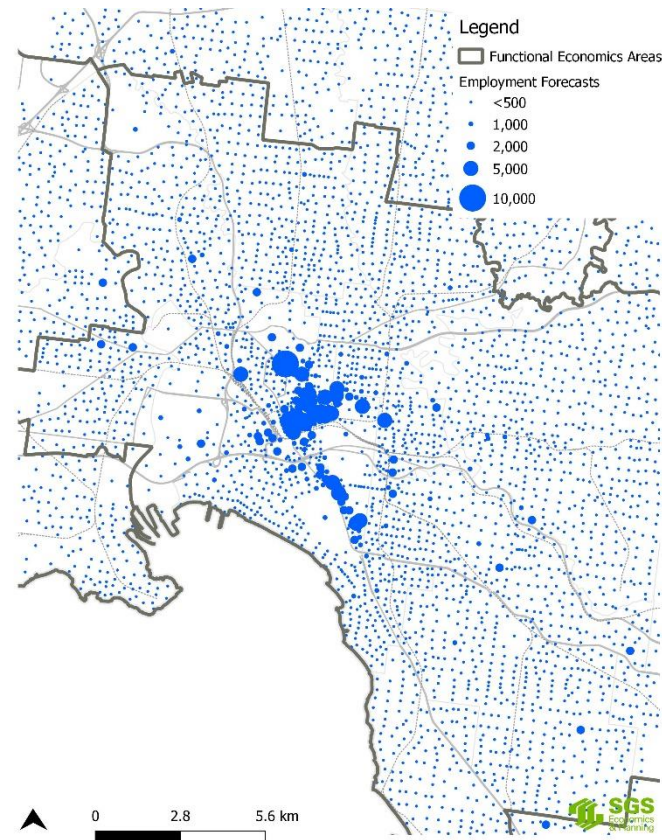
FIGURE 15: FORECAST EMPLOYMENT GROWTH ACROSS MELBOURNE (2016-2031)



Source: SGS Economics and Planning, based on SALUP17, TfV

Surrounding established precincts such as Parkville, East Melbourne, Fitzroy, Collingwood and St Kilda Rd have accommodated increasing amounts of commercial and residential development. Beyond these, new renewal precincts like Arden and Fishermans Bend will become attractive locations for employers and workers.

FIGURE 16: FORECAST EMPLOYMENT GROWTH IN INNER MELBOURNE (2016-2031)



Source: SGS Economics and Planning, based on SALUP17, TfV

¹ Based on 80,000 worker capacity (Development Victoria, 2018) and current employment levels of 58,600 jobs (City of Melbourne, 2017).

Automation and restructuring.

Three key drivers behind the structural transition of the Melbourne labour market in recent decades have been trade liberalisation, labour market deregulation and the automation of jobs. Unlike the first two of those factors, the impact of automation is ongoing with continual technological development and innovation in Australia and around the world. This will shape the firms and jobs of Melbourne's future.

Task-biased technical change is the leading framework for analysing the impact of technology on work.² It is used to measure the intensity of *abstract*, *routine* and *manual* tasks across different occupations.

ABSTRACT, ROUTINE AND MANUAL TASKS

Abstract tasks involve problem solving, creative thinking or complex interpersonal communication. They are intensive in **high skill** managerial, professional and technical occupations such as school principals, ICT trainers and psychologists.

Routine tasks are more common in **middle skill** occupations and can be *routine cognitive* tasks that are intensive in jobs like bookkeepers and accounting clerks, or *routine manual* tasks that are intensive in jobs like machine operators, factory workers and assemblers.

Manual tasks require interpersonal or environmental adaptability, visual or language recognition and in-person interactions. They are common in **low skill** personal care, protective services and food/cleaning occupations.

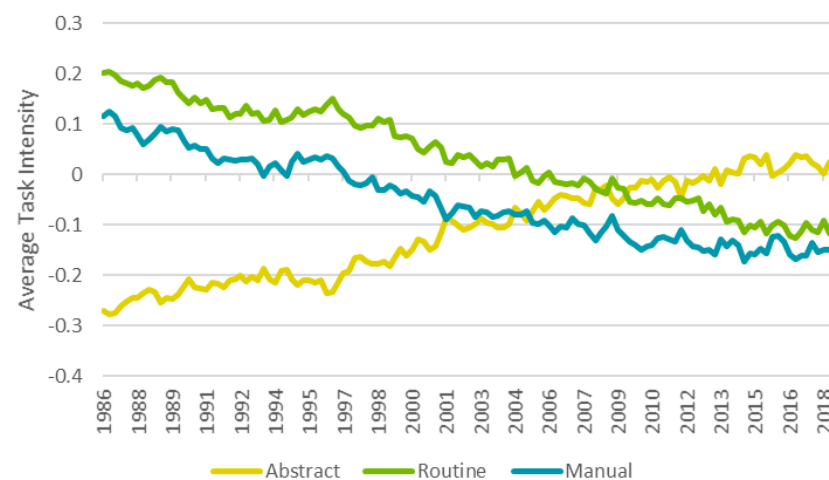
In this report, **task intensity** means the average importance of a task to a particular job. It is measured in United States employer surveys and mapped to Australian occupation data. **Average task intensity** is the average task score for all jobs in the given state, city or SA2.

² TBTC was first proposed by Autor, et al. (2003) and further developed by Goos and Manning (2007), Autor, Katz and Kearney (2006, 2008), and Acemoglu and Autor (2011) amongst others.

While abstract and manual tasks are hard to automate, routine tasks can be easily broken down and codified into a computer program because they follow precise, well-understood procedures. This report models the intensity of these task types to analyse the impact of automation in the Melbourne FER and its likely future implications. A full description of the model can be found in Appendix O.

Many researchers have shown that demand for routine tasks is falling in many advanced economies, including the United States, United Kingdom, European Union and Australia.³ A similar trend can be seen for Victoria in Figure 17, where for the last three decades there has been a consistent trend of rising intensity in abstract tasks across all jobs and falling intensity of routine and manual tasks.

FIGURE 17: AVERAGE TASK INTENSITY IN VICTORIAN LABOUR MARKET (1986-2018)



Note: Time series data was not available for Melbourne so the figure shows data for all of Victoria
Source: SGS Economics and Planning; derived from ABS (2018), Labour Force, Australia, Detailed, Quarterly, cat. no. 6291.0.55.003, May 2018

³ See Acemoglu and Autor (2011) and Autor (2015) for overviews of the literature and evidence.

These trends cannot be neatly aligned to the structural shifts in the industry composition of the Melbourne economy. While certain tasks are required more in some industries than others, all tasks are performed to some degree in occupations across all industries. For example, abstract tasks will be highly sought after in knowledge-intensive and education industries, but they are also important in industrial and population-serving industries, particularly for higher skilled roles like professionals and managers. As all industries innovate and adopt new technologies, abstract tasks are likely to become more important and routine tasks will become less important.

Dramatic claims about the risk of automation to jobs have attracted the attention of governments, academics and the media. However, evidence suggests these claims are overblown and that the aggregate impact of technology on output and employment has been positive.⁴ Despite this, the shifts represent a restructuring that can leave some workers and firms vulnerable, particularly workers who specialise in routine tasks.

One indicator of the potential for technological change is the Routine Task Intensity (RTI) index which measures the routine task content relative to abstract and manual task content. A high RTI score means there is generally a higher dependence on routine tasks and possibly a higher potential for technological disruption.

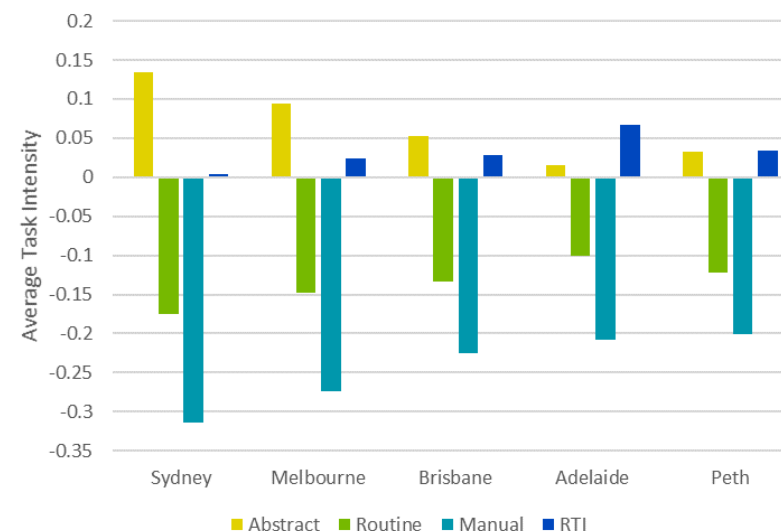
The task scores and RTI scores for Australia's five largest cities is shown in Figure 18. As we might expect, the results show that Sydney has the lowest RTI because it abstract tasks are very important in many Sydney jobs and routine jobs are less important. This is owing to its highly technical financial services industry and other services. Adelaide has the highest RTI because of the relative scale of its manufacturing sector which require lots of routine tasks and fewer high-end services firms which require lots of abstract tasks.

Melbourne has the second lowest RTI which indicates transition to a knowledge-based economy is well progressed. It is in a relatively good position to continue to build on these strengths into the future and take advantage of the productivity benefits that technology has to offer.

⁴ See Arntz et al. (2016) and Autor and Salomons (2017) for evidence in the United States, and Borland and Coelli (2017) for Australian evidence.

Task intensity data has been standardised and should be interpreted as a relative score based around 0. A positive values represents more intensive jobs, a negative value represents more routine jobs.

FIGURE 18: AVERAGE TASK INTENSITY IN AUSTRALIA'S FIVE LAREGST CITIES (2016)



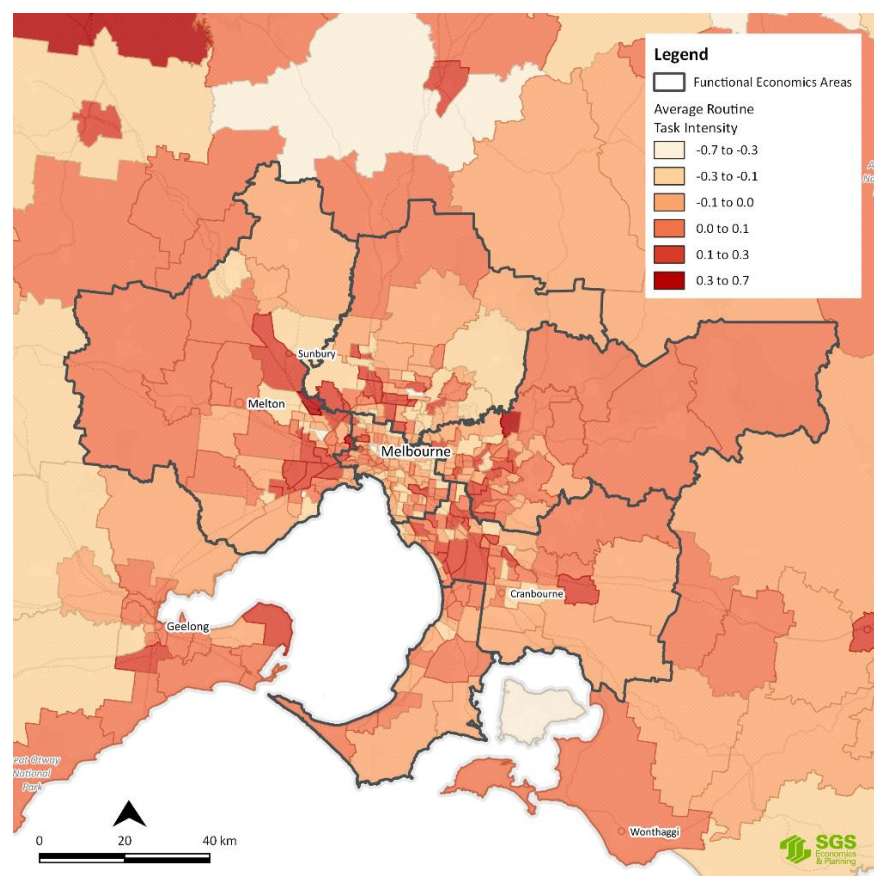
Note: GCCSA boundaries were used to define the greater capital city populations. Note: Occupation task scores are standardized to a mean of zero and standard deviation of 1. The scores above reflect the employment weighted-average task score for all occupations in the relevant area.

Source: SGS Economics and Planning; derived from ABS Census 2016

While the results indicate a positive outlook for the Melbourne labour market, they are not evenly distributed across the FER. This is evident in Figure 19 which shows RTI for SA2s across the FER. Economic locations in outer Melbourne tend to have a higher intensity in routine tasks (as seen in the darker shades of red) than locations in inner Melbourne (seen by the lighter shades of yellow).

The 10 SA2s with the highest and lowest average RTI score are given in Table 3. Most areas with high routine task intensity come from outer areas, such as Narre Warren, the Melbourne Airport industrial precinct, Wantirna, Sunshine and Altona. Most areas with low routine task intensity come from the inner subregion, such as Parkville, Caulfield and South Yarra. St Albans-South, the location of Victoria University campus, and Kingsbury, the site of Latrobe Bundoora campus, are also areas with low routine task intensity.

FIGURE 19: AVERAGE ROUTINE TASK INTENSITY ACROSS MELBOURNE SA2S (2016)



Source: SGS Economics and Planning; derived from ABS Census 2016

TABLE 3: TOP AND BOTTOM RANKED AREAS BY AVERAGE ROUTINE TASK INTENSITY (2016)

Most Vulnerable (High RTI)	RTI	Least Vulnerable (Low RTI)	RTI
Maribyrnong	0.26	Parkville	-0.31
Narre Warren - South West	0.23	St Albans - South	-0.28
Melbourne Airport	0.19	Kingsbury	-0.22
Wantirna South	0.19	Caulfield - North	-0.19
Sunshine West	0.19	South Yarra - West	-0.17
Altona North	0.17	Burwood	-0.17
Ringwood	0.16	Heidelberg - Rosanna	-0.15
Doncaster	0.16	Caulfield - South	-0.15
Cheltenham - Highett (East)	0.16	Kew	-0.15
Preston - East	0.15	Fitzroy	-0.13

Note: SA2s with fewer than 5000 jobs were excluded from the table above

Source: SGS Economics and Planning, derived from ABS Census 2016

The employment areas in Table 3 can be considered at risk of technological disruption in future years. Planning for the economic transition will improve the productivity of those areas of the FER and job opportunities for people living in outer Melbourne.

These observations are based on historical trends and may not extend to future changes. Automation of some non-routine tasks are foreseeable, such as with machine learning and driverless vehicle technologies. Regardless, policy settings must be in place for business creation and growth and appropriate supports must be available for displaced workers to realise the full benefits of future innovations while mitigating the risks.

The changing nature of work

The rise of part-time work has been the biggest change in the nature of work in Melbourne and Australia. Driven primarily by the rising female participation, part-time work has grown from 22 per cent of all jobs in Melbourne in 1991 to 32 per cent in 2018.⁵

While this is a choice for many, it is not for all; the proportion of the Victorian labour force who want to work more hours than they currently do (i.e. the underemployment rate) has risen from 5.7 per cent to eight per cent over the same period.⁶ The rate is substantially higher for women and young people. Clearly, there are opportunities to better utilise this capacity in the Melbourne labour force.

There are also concerns about precarious work, particularly with casual work and gig economy positions. The gig economy is a relatively new phenomenon where workers are independent contractors to companies like Uber and Deliveroo. Like most independent contractors, gig economy workers do not enjoy the same conditions and protections as standard employees but unlike other contractors, they cannot negotiate the terms of their employment.

Despite this concern, there is no evidence in representative surveys that the prevalence of these types of work is rising. The rate of casual workers has been steady since the early 2000s⁷ and the rate of independent contractors has been falling⁸. This does not mean conclusively that poor working conditions have not been rising. Gig economy work is difficult to define, which makes it hard to detect in surveys. It may be that gig economy work is substituted for more traditional forms of independent contracting that have better conditions. Likewise, casual work may not be on the rise but general conditions for casual workers could be deteriorating. These trends have certainly been reported anecdotally and in smaller sample surveys.

At the other end of the scale, Australians who are employed full-time work some of the longest hours in the OECD. This may reduce quality of life for

those workers through limited work-life balance and reduce labour productivity as people are overworked through excessive hours.

It is beyond the scope of this report to fully analyse this matching problem where there are some people with too many hours and others with too few. However, one important factor is locational disadvantage across cities. Workers who live in less accessible areas are more likely to be underutilised in the labour market. Improving their access to a wider pool of jobs, and conversely improving employer access to a wider pool of workers, would help to achieve better labour market matching across the FER.

More optimistic views of the nature of work tend to focus on innovative ways of working, especially in knowledge-intensive fields. Some notable trends⁹ and driving forces include:

- the unbundling of traditional job functions
- the rise of technology that enables work to be done anywhere
- the open and collaborative nature of the innovation process
- the revaluing of face-to-face contact
- the growth of the sharing economy
- the use of alternative labour to provide flexibility to scale up or down resources (consultants and freelancers, crowdsourced labour, contract-based workers and transactional remote-workers)
- workers seeking more flexible work and lifestyles.

While some of these trends only impact a small portion of the workforce today, they could influence how and where people work in the future. New types of workspaces have emerged as a result of these trends, including flexible offices that foster social, collaborative and informal work environments, lifestyle-oriented workspaces, artisan manufacturing and design spaces, and co-working spaces.

Co-working spaces are currently the most prevalent of these new types of workspaces, albeit still a very nascent portion of the total office floorspace in

⁵ Derived from ABS (2018) cat. no. 6291.0.55.001, Labour Force, Australia, Detailed - Electronic Delivery, June 2018

⁶ ABS (2018) cat. no. 6202.0 Labour Force, Australia, Jul 2018, Table 23

⁷ Measured as the proportion of workers who have no paid leave entitlements in ABS (2018) cat. no. 6291.0.55.003, Labour Force, Australia, Detailed, Quarterly, May 2018

⁸ Measured as self-employed persons with no employees, in ABS (2018) cat. no. 6291.0.55.003, Labour Force, Australia, Detailed, Quarterly, May 2018

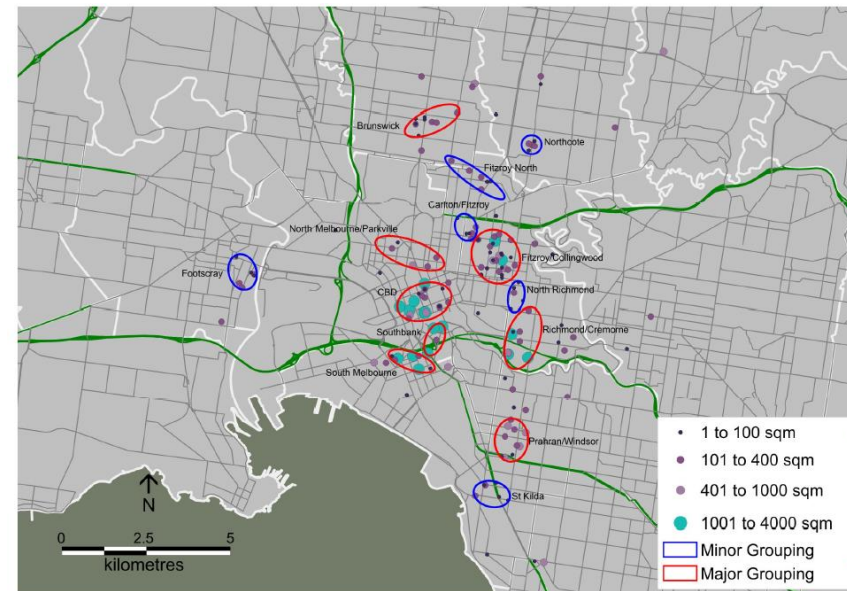
⁹ Deloitte (2018) and Sodexo (2017, 2018) provide some evidence for these trends, however, it is worth noting that there is limited academic literature on new workplace trends and the available evidence is often qualitative and anecdotal.

Melbourne. In scoping work on the range of co-working spaces in Melbourne, Elliott (2017) defines them as “a working arrangement where a variety of businesses, which range from individual freelancers to larger businesses, co-locate to share a workspace and facilities”. They range from small and highly informal, such as cafes and libraries, to large and formal, such as industry-specific spaces, incubators and co-working communities.

These spaces have been growing rapidly in Melbourne, although from a very low base. Elliott (2018) estimates that in 2017 there was approximately 61,000m² of co-working floor space in Melbourne, with 85 per cent of that located in the CBD and surrounding suburbs (see Figure 20).

Co-working spaces can benefit the economy by reducing barriers to new business formation and generating agglomeration economies by facilitating knowledge spillovers between early stage enterprises. Since these spaces represent less than one per cent of office floor space in inner Melbourne, they are likely to remain a very small part of the overall workspace for some time. However, they have the potential to generate impacts beyond their scale by supporting start-up businesses which are an importance source of innovation, economic growth and future jobs.

FIGURE 20: CO-WORKING SPACES IN INNER MELBOURNE (2017)



Source: Elliott, P. 2018, *Geography of coworking in Melbourne*, DELWP, Melbourne.

4. PEOPLE

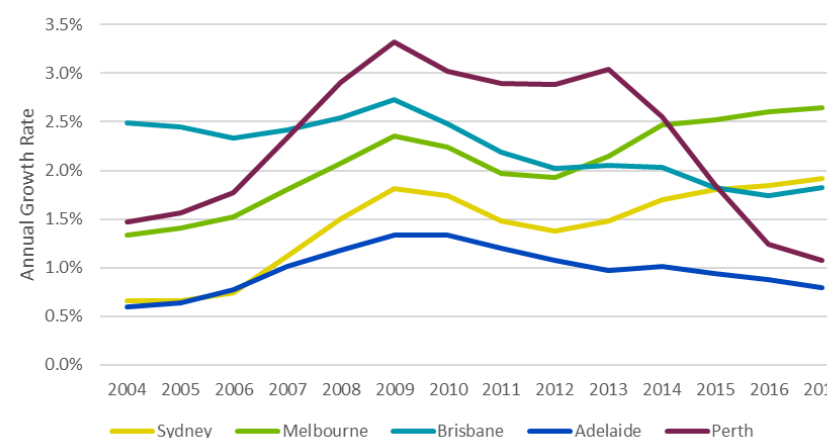
KEY INSIGHTS

- Melbourne has been the fastest growing capital city in Australia since 2012 and today's population of 4.7 million is forecast to reach 7.5 million in 2046.
- The booming population and investments in education have grown the total human capital stock in the Melbourne FER from \$1.5 trillion in 2006 to \$2.1 trillion in 2016 (in 2016 dollars).
- Human capital is concentrated in the inner subregion, due to the large, high skilled population and job opportunities available. Much of the spatial variation in human capital is explained by differences in educational attainment and returns to education, in the form of higher wages.
- The shifting distribution of population to the city's west highlights the need to maintain the alignment between human and physical capital in order to fully utilise human capital across the FER.
- The Melbourne labour market is performing strongly with an above average participation rate, rising from 64 per cent in 2000 to nearly 66 per cent in 2018.
- Spatial differences in labour market performance are explained by human capital levels, cost of living, personal preferences, access to jobs and the age of local population.
- Access to job opportunities is essential for facilitating labour force participation and better job matching, particularly for women and people living outside of the inner city.
- This will be increasingly important in the coming years when the full impacts of the ageing population are felt in the economy.

Continued growth

The Melbourne FER population was 4.7 million in 2016, which has grown from 3.5 million at the start of the millennium. This is an average annual growth rate of 2.3 per cent, with growth in recent years as high as 2.7 per cent. As seen in Figure 21, Melbourne has grown faster than any capital city in Australia since 2012 and it has been one of the fastest in the developed world.

FIGURE 21: POPULATION GROWTH IN AUSTRALIA'S FIVE LARGEST CITIES (2004-2017)



Note: GCCSA boundaries were used to define the greater capital city populations; data was smoothed with a rolling 3-year average

Source: SGS Economics and Planning, derived from ABS statistics

Most of the population growth has occurred in the inner, western, northern and southern subregions (see Figure 22). Growth in the inner subregion has occurred through urban infill and higher density developments. This adds to an already large population base, which is why there is strong growth in absolute terms but an average growth *rate* in proportional terms. Growth to the west and south has largely been through the development of new land with a relatively lower population base (and hence, higher growth rates).

FIGURE 22: SUBREGION POPULATION GROWTH (2001-2016)



Source: SGS Economics and Planning SALUP model

This rapid growth seen above is set to continue. Population forecasts from SGS's Small Area Land Use Projections (SALUP) Model are shown in Figure 23 and Table 4. SALUP is produced for the Victorian Government's Victorian Integrated Transport Model (VITM) team and aligns with Victoria in Future 2016 forecasts (see Appendix for more details).

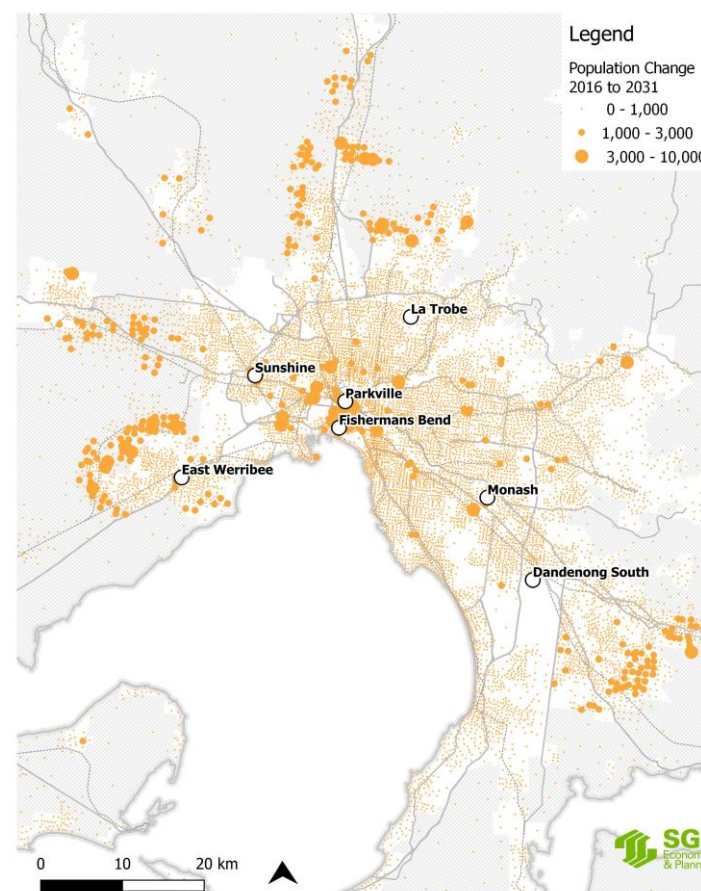
TABLE 4: POPULATION FORECASTS BY FER SUBREGION (2016-2031)

FER Subregion	2016 Population	2031 Population	Growth	Growth Rate (p.a.)
Inner	1,295,000	1,617,000	322,000	1.5%
West	840,000	768,000	86,000	0.8%
North	732,000	1,145,000	263,000	1.8%
East	682,000	1,194,000	354,000	2.4%
South	882,000	1,004,000	272,000	2.1%
Peninsular	300,000	337,000	37,000	0.8%
FER Total	4,732,000	6,065,000	1,334,000	1.7%

Source: SGS Economics and Planning SALUP Model

The Melbourne FER is forecast to grow to 7.5 million people in 2046, most likely surpassing Sydney as Australia's largest city sometime in the 2030s. The patterns of growth in the next 30 years are likely to mirror those from the past 15 years. The western and inner subregions will be the primary growth locations, followed by the north and southern subregions. Significant investment in infrastructure is required to meet the needs of this population.

FIGURE 23: FORECAST POPULATION GROWTH ACROSS MELBOURNE (2016-2031)



Source: SGS Economics and Planning SALUP model

Human capital as a major contributor to growth

Human capital is the set of knowledge, skills and characteristics that make someone valuable to their workplace and the broader economy.¹⁰ Important sources of human capital include innate ability, schooling, quality of education, training, work experience and sociological factors. While individuals can accumulate human capital through these factors, particularly by investing in education, other factors can lead to the depreciation of human capital, primarily ageing and technological development.¹¹

At a macro level, the stock of human capital is influenced by the level of education, age distribution of the population and the size of the population (in turn, influenced by the rate of births, deaths and migration). Since the 1980s, education has been an important driver of growth in Australia's human capital stock, while the ageing population has reduced the stock (Wei, 2008).

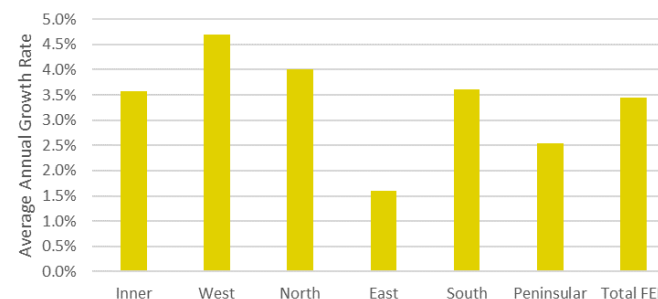
This section draws on the lifetime earnings approach of measuring human capital. Since human capital is considered the most important determinant of wages, earnings can also be used to measure the level of human capital. Hourly wages for people of different age, gender, qualification and FER subregion were derived from the 2016 ABS Census and modelled to estimate the human capital of all workers in the Melbourne FER (full details are given in Appendix O). Human capital is expressed as the net present value of expected lifetime earnings.

The total human capital stock in the Melbourne FER is estimated to be \$2.1 trillion, up from \$1.5 trillion in 2006. This represents an average annual growth rate of 3.5 per cent per annum in real terms and has outpaced growth of the broader economy over the same period.¹² This strong growth in human capital has come primarily through two avenues: population growth and individual investments in human capital through education.

Figure 26 shows the average annual growth in human capital since 2006. The patterns across subregions closely resemble those of population growth seen

in Figure 22, which indicates that population growth is the primary driving factor behind the human capital growth across the FER. This is the net effect of births, deaths and migration into and out of the FER.

FIGURE 24: GROWTH IN HUMAN CAPITAL, BY FER SUBREGION (2006-2016)



Source: SGS Economics and Planning Human Capital Model

The different rates of growth between subregions has resulted in a shift in the distribution of human capital across the FER, particularly from east to west. This is shown in Figure 25; the population growth in the west contrasted with the relatively slow growing and ageing population of the east means that the share of human capital has risen in the west by 1.7 percentage points and fallen in the east by 2.5 percentage points.

In line with its share of the population, the inner subregion also holds the largest share of human capital (37 per cent). The other subregions each have between 13 and 16 per cent, except for the peninsular subregion (five per cent). This distribution mirrors the distribution of physical capital across the FER, with the most significant physical capital being infrastructure and business capital, which is skewed to inner Melbourne. However, the shift from east to west in human capital highlights a potential mismatch as more established eastern suburbs are relatively rich in infrastructure compared to

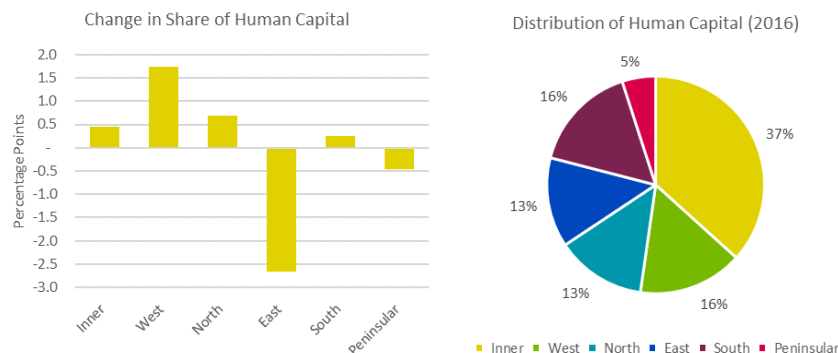
¹⁰ This focus on knowledge and skills aligns with the traditional notion of human capital developed by Becker (1964) and others, however, broader definitions of human capital can take into account other factors such as health, behavioural compliance and the signaling effects of education.

¹¹ New technology can be a substitute for some skills (via automation), leading to depreciation of that human capital, but also complement other skills, leading to the appreciation of human capital. The impact of automation on employment is explored later in this report.

¹² Both figures are in 2016 dollars

the developing western suburbs. Aligning physical and human capital must fully utilise human capital is across the FER.

FIGURE 25: CHANGE IN FER SUBREGION SHARE OF HUMAN CAPITAL (2006-2016)

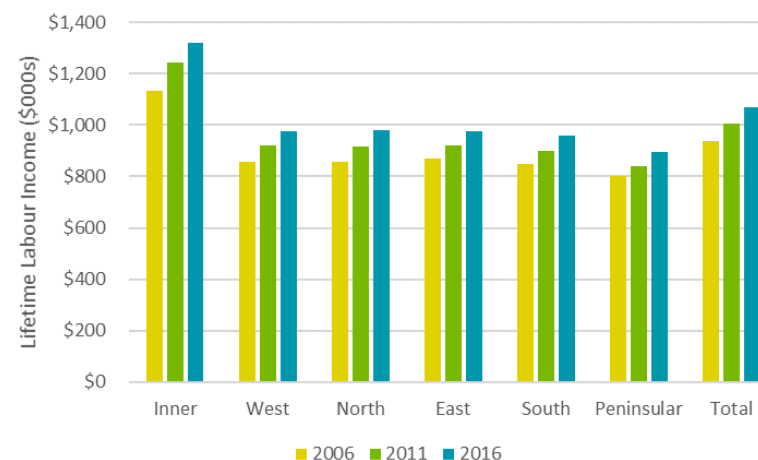


Source: SGS Economics and Planning Human Capital Model

Figure 26 shows human capital per capita across the FER. Individual human capital is consistently highest in the inner subregion. This is understandable from a social point of view because the high wages earned by people with high levels of human capital (by definition) mean that they can afford to live in high amenity inner suburbs where housing costs are greater. It is also desirable from an economic point of view because most high skill jobs are located in the inner city so the human capital can more easily be put to its highest value (most efficient) use.

Much of the variation in individual human capital between the FER subregions is reflected in educational attainment. The breakdown of the education levels of the 20 to 64 year old population is shown in Figure 27. Half of the inner subregion population has at least a bachelor's degree; this level is 32 per cent in the eastern subregion, the next highest proportion.

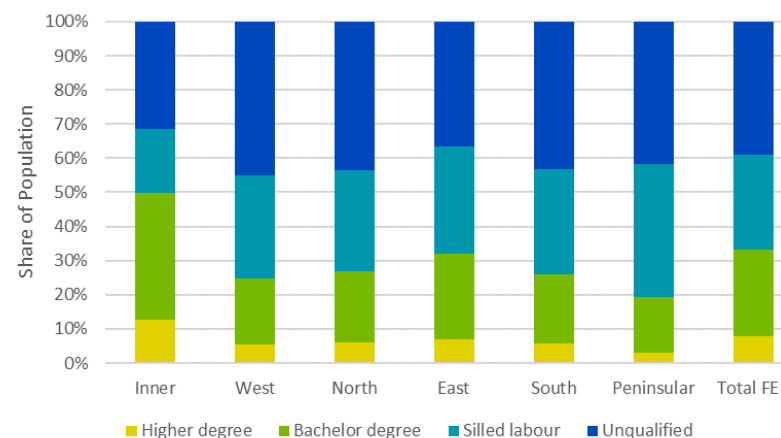
FIGURE 26: EXPECTED LIFETIME LABOUR INCOME PER CAPITA, BY SUBREGION (2006-2016)



Notes: Subregions represent place of residence; lifetime labour income is measured in 2016 dollars

Source: SGS Economics and Planning Human Capital Model

FIGURE 27: DISTRIBUTION OF WORKING AGE POPULATION (20-64 YEARS) BY EDUCATIONAL ATTAINMENT AND FER SUBREGION (2016)



Source: SGS Economics and Planning, derived from ABS Census 2016

CLASSIFYING EDUCATIONAL ATTAINMENT

Higher degree:	Postgraduate degree, such as a masters or PhD
Bachelor's degree:	Bachelor's degree, graduate diploma or graduate certificate
Skilled labour:	Advanced diploma or certificate level
Unqualified:	Higher school education or below

Human capital is not only rising because there are more people in the FER, it is also growing on a per capita basis. Figure 26 showed that human capital per capita rose across all subregions between 2006 and 2016, due mainly to investments in skills and education over the same period.

Figure 28 shows growth rates of working age people with different levels of qualification. The proportion of people with at least a bachelor's degree is growing faster than any other group, particularly in the western, northern and southern subregions. In contrast, the number of unqualified workers has shrunk in some subregions as older workers reach retirement age and other workers obtain higher qualifications.

Assuming these trends continue, they will further grow the human capital stock in the Melbourne FER. Importantly, the stronger rates of growth in outer areas should improve the equality of the distribution of human capital across the FER. However, these outcomes are limited by geographical differences in the returns on investments in human capital (as measured by expected lifetime labour income).

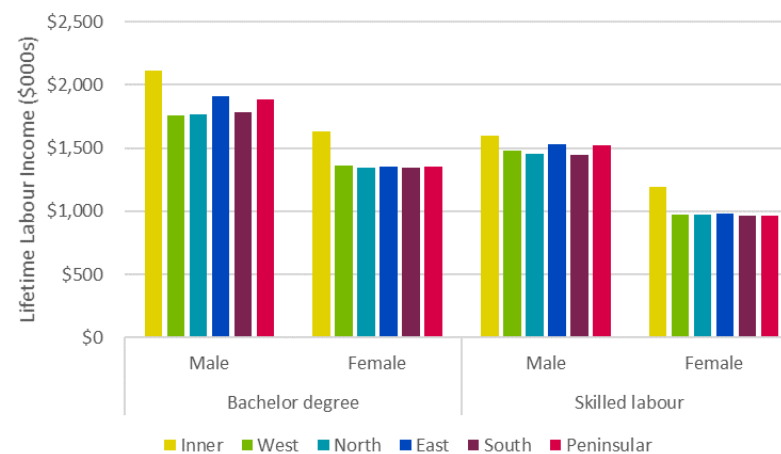
Figure 29 shows the expected lifetime labour income of 25 year old bachelor's degree workers and skilled labour workers. Lifetime earnings are substantially higher in the inner subregion than in other subregions, irrespective of education level, due to the reduced worker to job matching in areas where there are fewer job opportunities. These patterns only compound the differences in higher educational attainment across subregions to result in the human capital per capital differences shown in Figure 26.

FIGURE 28: GROWTH IN WORKING AGE POPULATION (20-64 YEARS) BY EDUCATIONAL ATTAINMENT AND FER SUBREGION (2006-2016)



Source: SGS Economics and Planning, derived from ABS Census 2016

FIGURE 29: EXPECTED LIFETIME LABOUR INCOME PER CAPITA FOR 25-YEAR OLDS, BACHELOR'S DEGREE HOLDERS AND SKILLED LABOUR (2016)



Note: FER subregions represent place of residence; lifetime labour incomes figures are in 2016 dollars

Source: SGS Economics and Planning Human Capital Model

Labour market participation and labour force utilisation

Utilising human capital through strong labour market participation is important for the growth of the economy and higher living standards for individuals and households. Drawing on the monthly ABS Labour Force Survey, Figure 30 compares the labour force participation rate and unemployment rate in Australia's five largest cities and the overall Australian average.

Across all cities there has been a trend of rising participation and falling unemployment since 2000. These trends halted following the 2009 financial crisis but over the last three years labour markets have once again both expanded (through rising participation) and tightened (through falling unemployment).

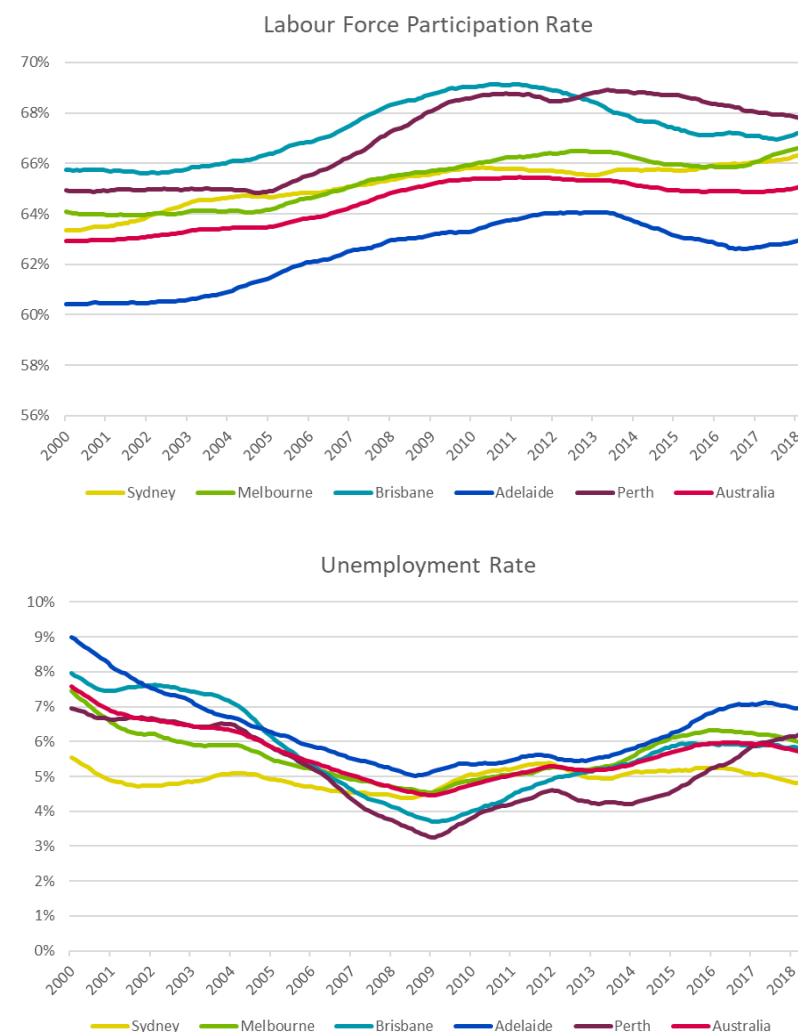
Melbourne has an above average participation rate, which has risen from 64 per cent in 2000 to nearly 66 per cent in 2018. Melbourne has a near average unemployment rate, which has fallen from 7.5 per cent in 2000 and 6.5 per cent in 2015 to less than six per cent in 2018.

This indicates that the Melbourne labour market is performing strongly and has benefited from both a larger pool of labour and greater utilisation of the labour supply (as indicated by lower unemployment). These benefits have been compounded by rapid population growth.

Still, research indicates that the labour market has spare capacity, with unemployment above the five per cent that is considered the “natural rate of unemployment” (see Cusbert, 2017). Further, the performance of the labour market is uneven across the Melbourne FER, which can be seen in the breakdown across subregions below in Figure 31.

Participation is highest in the inner subregion, at 73 per cent for men and 65 per cent for women. The western subregion has the next highest rate of male participation with 72 per cent, followed by the northern, eastern and southern subregions which all have participation rates of approximately 70 per cent. Men in the peninsular subregion are the least likely to participate in the labour market participation, with a rate of 68 per cent.

FIGURE 30: PARTICIPATION AND UNEMPLOYMENT IN AUSTRALIA'S FIVE LARGEST CITIES



Notes: GCCSA boundaries were used to define the greater capital city labour markets; data is for persons 15 years and over; figures are smoothed with a rolling 3-year average
Source: SGS Economics and Planning, derived from ABS (2018) cat. no. 6291.0.55.001, Labour Force, Australia, Detailed - Electronic Delivery, June 2018, Table LM9

FIGURE 31: PARTICIPATION AND EMPLOYMENT ACROSS THE MELBOURNE FER (2016)



Note: FER subregions represent place of residence; data is for persons 15 years and over
Source: SGS Economics and Planning, derived from ABS Census 2016

Female participation is more variable. A much lower proportion of women participate in the labour force in the outer subregions than the inner subregions, particularly in the northern, southern and peninsular subregions. This results in a significant gender participation gap across all subregions, ranging from nine percentage points in the inner subregion to 13 percentage points in the western and southern subregions. These gender gaps are closely related to the additional burden that women often bear, juggling work in the labour market with unpaid work in the home.

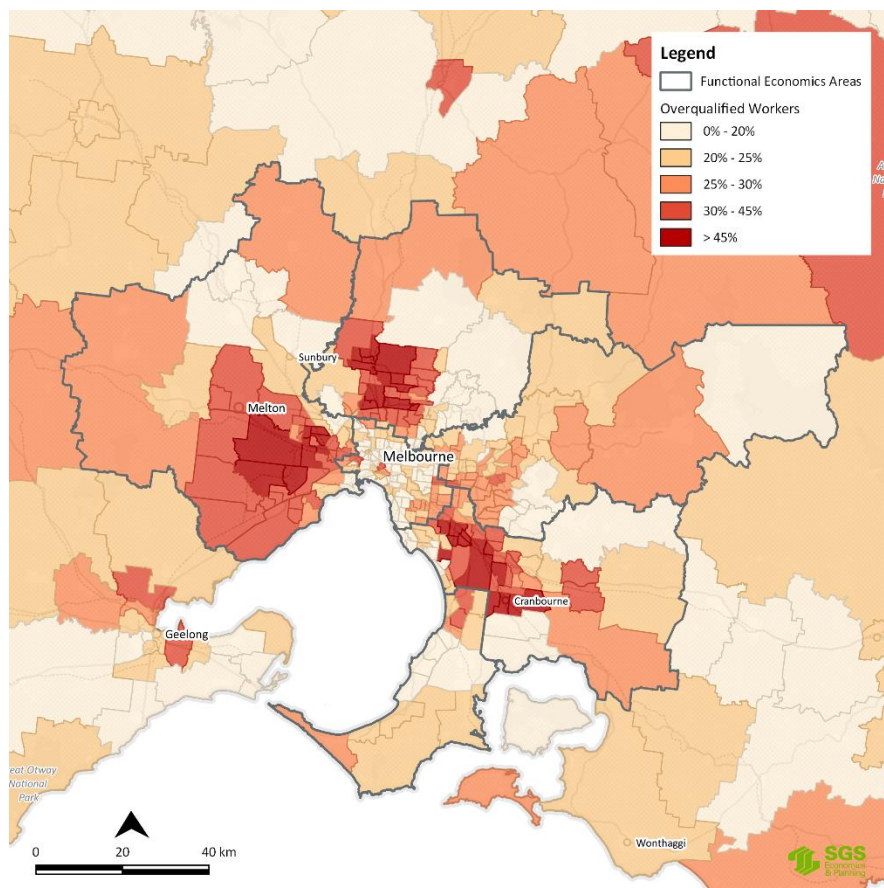
The rate of unemployment also varies substantially across regions. There are lower unemployment rates in the inner and eastern subregion and higher unemployment rates in the western, northern and southern subregions, particularly for women.

A way of further exploring these differences is looking at the quality of worker to job matching across the FER. People who are overqualified for their job are likely to have lower earnings than people whose job requires their level of education and training. The map in Figure 32 shows the proportion of workers who live in each SA2 that are overqualified for their job; that is, a person with at least a bachelor's degree who work in jobs that do not require that level of education (see Appendix O for the full method).

The further out from the centre of Melbourne that someone lives, the more likely they are to be overqualified. Especially high rates of overqualified workers can be found in the highly disadvantaged areas of Doveton and Dandenong in the south, Epping and Craigieburn in the north and Rockbank and St Albans in the west. These patterns indicate that the increasing levels of higher education in these subregions may not necessarily result in well utilised human capital across the Melbourne FER.

Being underutilised and over-skilled can lead to a range of adverse outcomes when compared to being in a job that is well-matched to a worker's skills. Overqualified people tend to have reduced future employment prospects (via higher rates of future unemployment), and incur a significant wage penalty and reduced overall job satisfaction (Mavromaras et al. 2007, 2010, 2015). This only serves to further entrench disadvantage in those areas.

FIGURE 32: OVERQUALIFIED WORKERS WITH A BACHELOR DEGREE OR HIGHER (2016)



Note: Data is broken down to SA2 areas by place of residence. Overqualified workers are those with a bachelor degree or higher working in an occupation with a skill requirement less than 1.

Source: SGS Economics and Planning, derived from ABS Census 2016

Access to jobs and spatial variations

Many inter-related factors explain the different patterns of participation, unemployment and overqualification shown above. Among these factors, the most influential include human capital, cost of living, personal preferences, access to jobs, and the age of local population.

People with higher levels of human capital work more than people with lower levels of human capital because they attract higher wages in the labour market. This is confirmed in the data above which showed that people in the inner FER subregion had higher human capital per capita and higher rates of participation than other subregions.

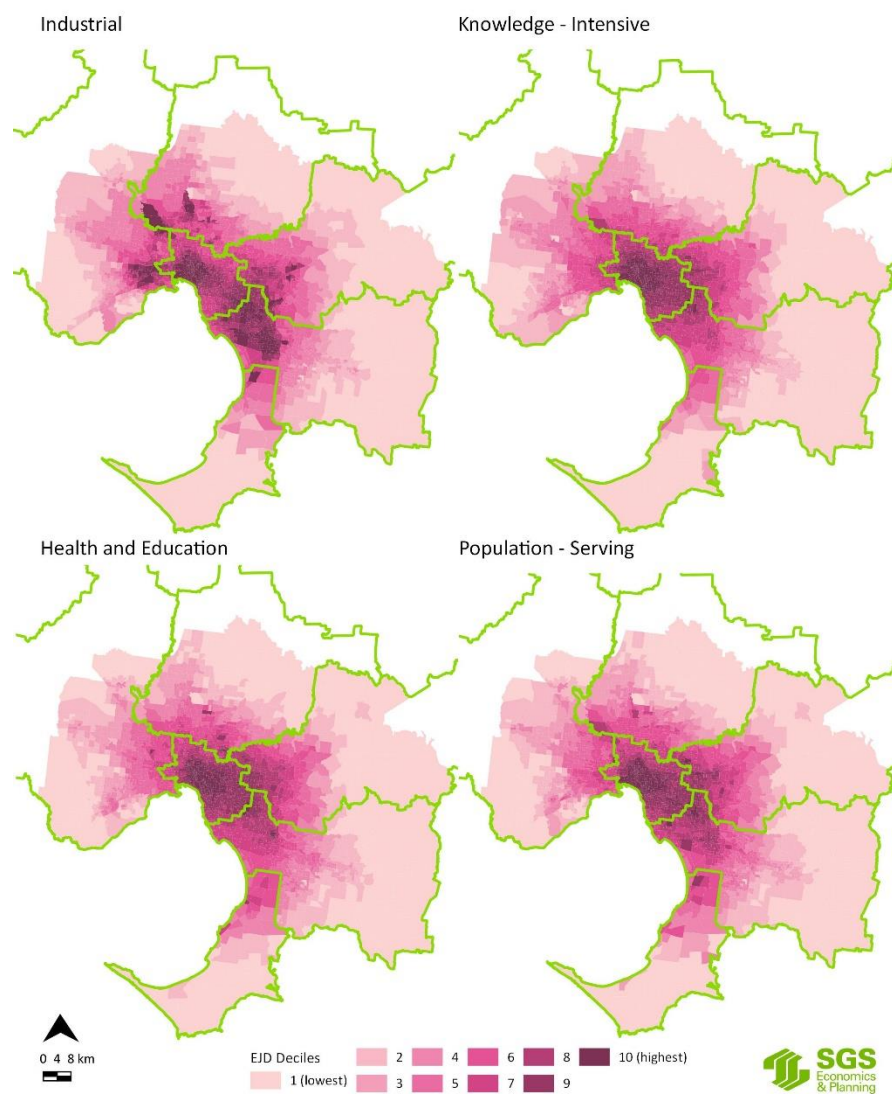
High living costs also incentivise participation because people need to work more to pay for their day to day expenses. Given housing costs make up the largest portion of living costs in Melbourne¹³, people who live in areas with higher property prices are more likely to work. This contributes to the higher participation in the inner subregion where property prices are the most expensive in the city and, to a lesser extent, the eastern subregion. Living costs are also a likely factor behind the above average participation in the western subregion where there are many young families and new migrant households. These households tend to have higher debts from recent mortgages and/or lower savings.

The influence of living costs is moderated by personal preferences. Many people reduce their level of participation or work in lower skilled jobs to trade off wages and working hours for lifestyle factors, such as work-life balance, or to live in areas with lower real estate prices and (potentially) lower levels of amenity.¹⁴ However, many others work fewer hours than they'd like, work in lower level jobs than they'd like, or are unemployed altogether. As noted earlier, this comes at a great personal cost for those workers and a great economic cost as human capital in the FER goes underutilised.

¹³ See Dosen, Aroozoo and Graham (2018)

¹⁴ In fact, evidence from the United States indicates that high real estate prices in areas with good access to high skill jobs can reduce the returns to higher education by 25 per cent (Morretti, 2013).

FIGURE 33: EFFECTIVE JOB DENSITY, BY REGION (2016)



Source: SGS Economics and Planning

EFFECTIVE JOB DENSITY

Effective job density (EJD) indicates the accessibility to jobs in a given area based on the location of jobs both in the area and how long it takes to get to other jobs nearby.

Closely linked to transport networks and infrastructure, a high EJD can be a result of having a large pool of employment nearby or being well connected to more distant employment.

Access to job opportunities is a critical employment factor for those searching for work and obtaining the best possible worker-to-job match in the labour market. Figure 33 shows accessibility across the Melbourne FER for the four industry groups using effective job density (EJD), SGS's measure of the spatial concentration of jobs. More details can be found in the Appendix 0.

EJD is highest in the inner city for most industry groups, with the greatest inner concentration for the higher skill, higher wage knowledge-intensive jobs. Industrial jobs have high EJD in the inner city but also around the industrial economic locations to the north, west and south east. The EJD for population-serving and health and education jobs is more dispersed around the city, especially for population-serving jobs that serve residential households in all parts of the city.

For all industries, the EJD is highest in inner Melbourne and skewed somewhat to the inner east. People who live in these areas can access more jobs locally and from afar through superior public and private transport networks. The low unemployment rates for these workers reflects their greater access to jobs than other subregions. Conversely, there are lower levels of EJD in the western, northern and southern subregions which also have higher unemployment rates.

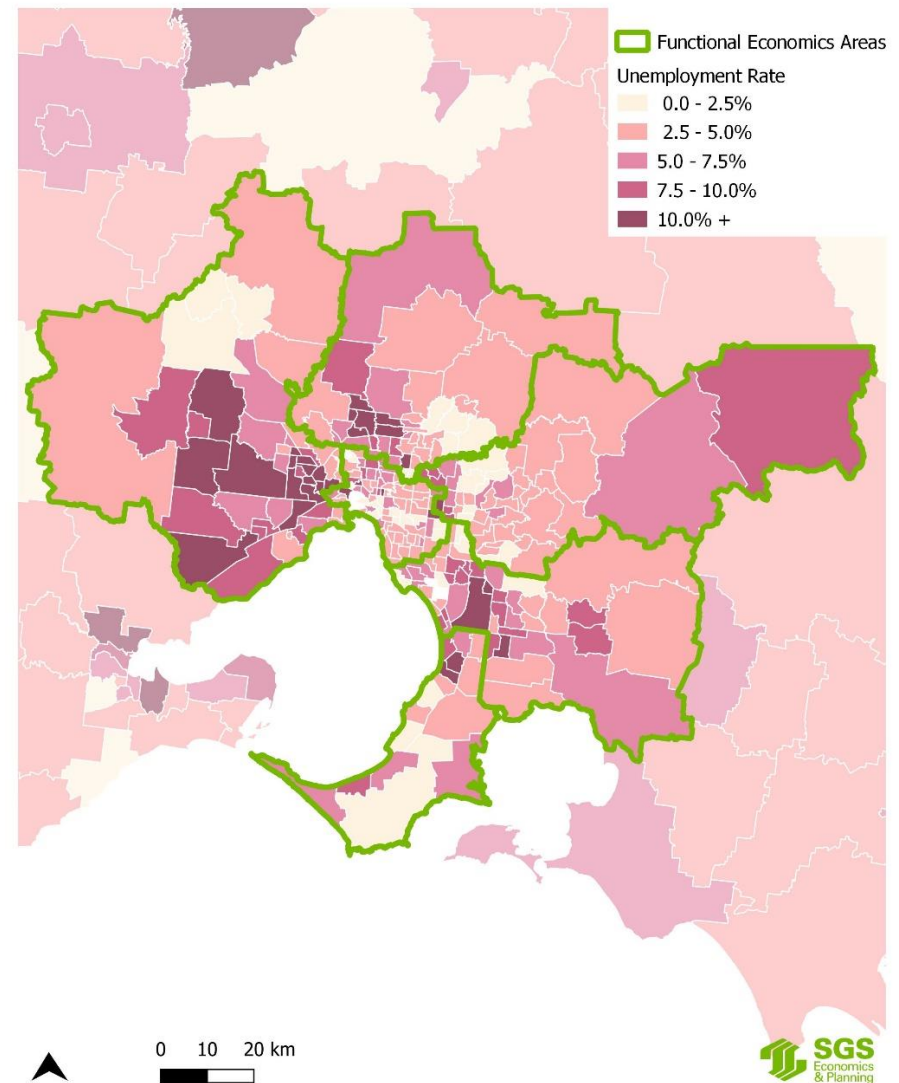
Accessibility is important for many female workers who balance child care responsibilities with paid work more often than their male counterparts. Good access to flexible working opportunities and affordable child care can be necessitating factors for employment, and these are difficult to find further

out from the central city. Households' ability to pay for child care is also reduced by the lower wages that workers earn in these areas.

The impact of accessibility is seen in the distinctly larger drop in female participation when comparing the inner subregion with other subregions. For males, participation drops by three percentage points on average but for women it drops by seven percentage points. This is partly due to the types of jobs available; the major economic locations in outer areas tend to have a high proportion of male-dominated industrial firms whereas the more gender-balanced knowledge-intensive firms are located in inner area. Women also had substantially higher unemployment rates than men in the western and southern subregions where the two largest industrial precincts are located.

Figure 34 illustrates the unemployment rate across the metropolitan area. When compared to Figure 33, it shows that areas of high unemployment generally correlate with areas that have lower levels of effective job density. This is particularly the case for areas in the west of Melbourne.

FIGURE 34: UNEMPLOYMENT RATE 2018



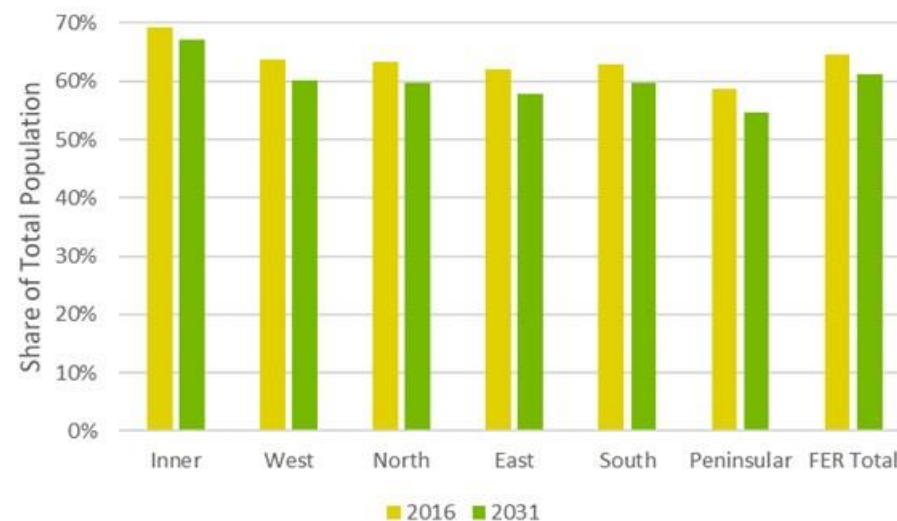
Source: Australian Government, Department of Jobs and Small Business 2018

A final influential factor on labour market participation is the age of the local population. An ageing population works less because more people have retired. This was seen above where the peninsular subregion had substantially lower participation and unemployment rates than other subregions, largely due to the older age profile of the local population.

The ageing population will place increasing pressure on the economy because the pool of labour will shrink and reliance on welfare payments will increase. This can be seen in the forecasts in Figure 35, where the share of the population that is working age is forecast to shrink by between three and five percentage points across all FER subregions.

Therefore, sufficient opportunities should be available across the whole FER to fully participate in the labour market. To that end, investment and development in those subregions with spare labour force capacity can be a potential target through better connectivity with growing economic locations or through investment in economic locations in those subregions themselves.

FIGURE 35: FORECAST WORKING AGE (18-64 YEARS) POPULATION SHARE (2016-2031)



Note: FER subregions represent place of residence

Source: SGS Economics and Planning SALUP Model

5. CONNECTIONS

KEY INSIGHTS

- Melbourne is a highly integrated economy, with significant flows between nearly all industries. The strongest flows are between industries of similar types, for example between services such as rental and financial services. Some sectors also have strong inter-industry links, for example wholesale trade. This suggests that the co-location of these industries is important.
- Melbourne's industries operate in a regional and global supply chain and although the manufacturing industry has relatively weaker links to other industries now, it is the biggest importer and largest exporter in the city economy. Other major exporters include the financial and insurance services, and professional, scientific and technical services.
- In 2015, there were over 250,000 freight trips and 360,000 business trips on average each day. Freight trips are linked to key ports and industrial nodes, while business trips correlate with major employment nodes and development.
- The inner subregion is the primary destination for work commutes, representing 42 per cent of all trips. Major commuter flows also occur within subregions.
- Long-distance commuters to the FER for work from Geelong, Bendigo, Ballarat and Warragul-Drouin are rising but no faster than the population, which suggests it is not a growing trend.
- Future population and employment growth will place strain on Melbourne's transport network, this may be eased by new technology, particularly driverless cars.

Economic integration

The economy is comprised of transactions between producers and consumers of goods and services. Industries require inputs from other industries to operate and form a large interconnected network. Supply chains exist through product development, sourcing and transportation of raw materials, manufacturing and retailing, and the information flows necessary to support these activities (Figure 36). At each step of the supply chain, value is added, and the final product is the combined effort of multiple organisations. A well operating supply chain is vital to a strong economy.

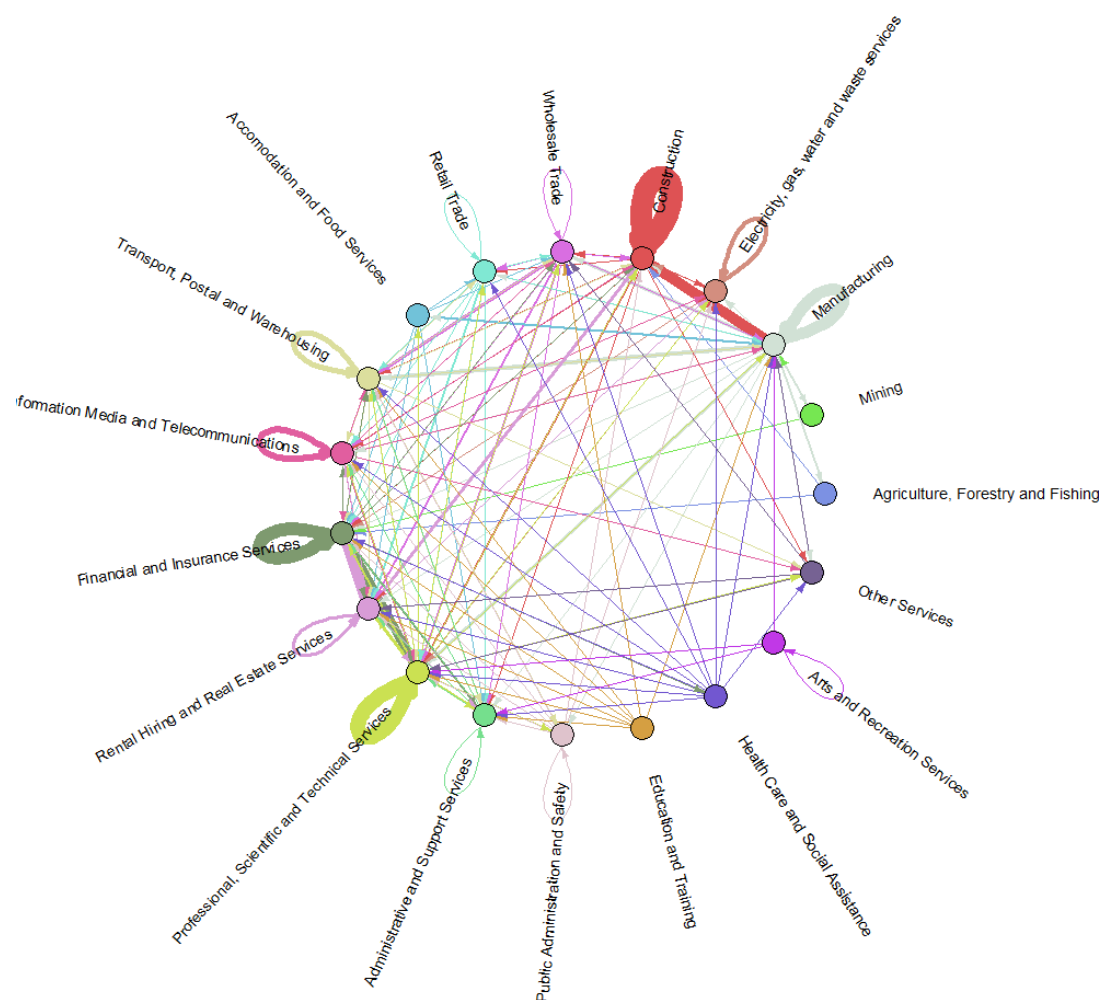
FIGURE 36: FLAT SUPPLY CHAIN EXAMPLE



Analysis of trade flows and supply chains often considers industry relationships but not where they locate. This report attempts to consider the spatial implications of these trade flows to ascertain the economic benefits to industry-target locations. This does not quantify supply chain linkages but instead explores how industries spatially relate to one another in the supply chain.

Trade flows within Melbourne have been derived from ABS Australian National Accounts Input-Output Tables using SGS's Input-Output Model (the full method is outlined in Appendix 0). The model identifies the inter-dependencies of industries by measuring the value of the transactions between them. Figure 37 below shows the flows between and within industries in the Melbourne economy. The arrows indicate the direction of the supply flow and their thickness represents the dollar value of the traded goods and services, some of which are tangible (wholesale trade) and others intangible (financial services). The thicker the line, the stronger the supply chain relationship.

FIGURE 37: MAJOR TRADE FLOWS BETWEEN INDUSTRIES, GREATER MELBOURNE (2015-16)



Source: SGS Economics and Planning 2018; ABS (2018) cat. no. 5209.0.55.001, Australian National Accounts: Input-Output Tables, 2015-16

The internal loops within industries indicate where there is a supply chain relationship between businesses or industries within the same 1-digit ANZSIC Division. A more detailed analysis of 2-digit ANZSIC Subdivision is contained in Appendix O.

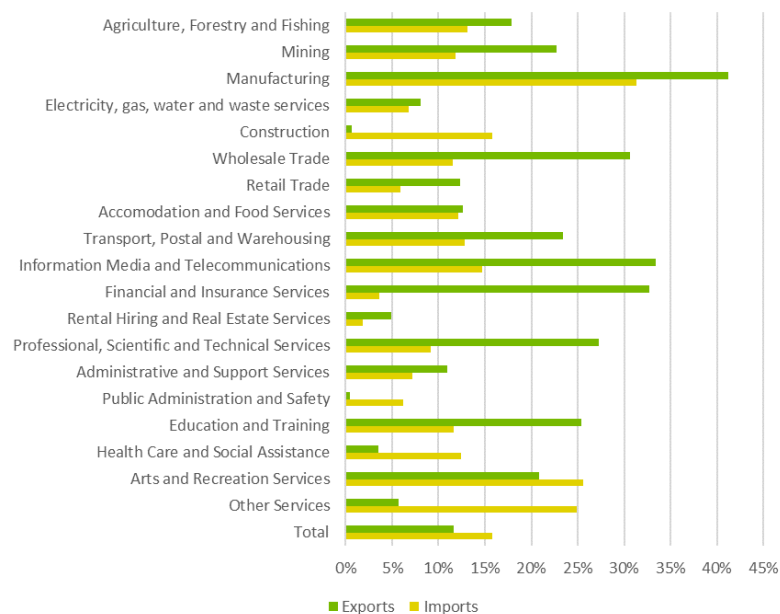
Overall the diagram shows that Melbourne is a highly integrated economy, with significant flows between nearly all industries. There are stronger flows between industries of similar types, for example between services such as rental and financial services, and between heavier industrial activities, such as wholesale trade and transport, postal and warehousing. This echoes the earlier analysis of that showed geographic clustering of similar activities, with concentrations of knowledge-intensive industries in inner city economic locations and industrial activities in outer precincts.

Many industries also have strong internal flows, for example within construction, professional services and financial services. The manufacturing industry has a strong internal link as products move through several stages of manufacturing, moving up the value chain. This suggests that the co-location of these industries is important and that the economic ecosystems created by these precincts are important for the development of goods and services at various points along the value chain.

As well as links within the city economy, Melbourne's industries operate in a regional and global supply chain, importing and exporting goods to and from the city. For example, although the manufacturing industry has relatively weaker links to other industries, it is the biggest importer and largest exporter in the city economy (Figure 38 and Figure 39). It is particularly important therefore for this industry to have good access to interstate and global freight networks.

Other major exporters include the financial and insurance services, and professional, scientific and technical services. Access to freight networks is likely to be less important for these industries, given the knowledge-intensive nature of their production. These industries typically export services via the information economy rather than physical products.

FIGURE 38: IMPORT SHARE OF TOTAL INPUTS V. EXPORT SHARE OF TOTAL PRODUCTION BY INDUSTRY, GREATER MELBOURNE (2014-15)

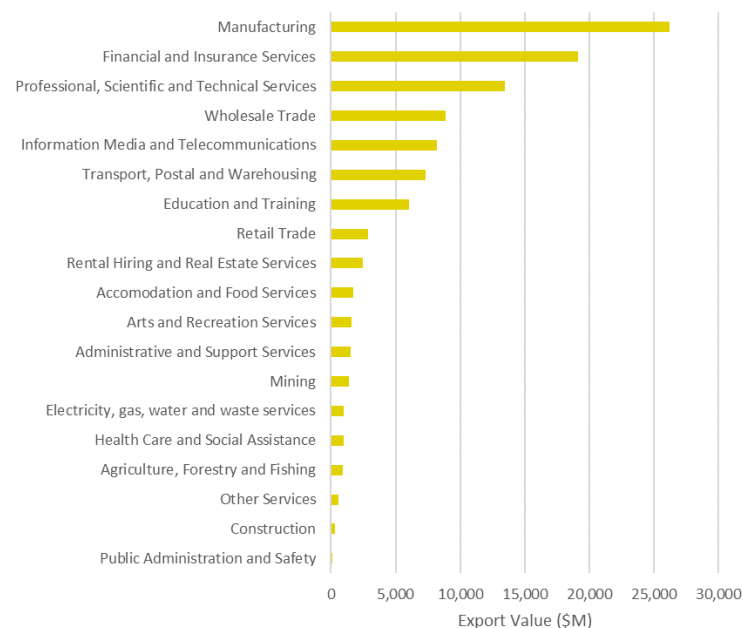


Note: This data reflects the Greater Melbourne GCCSA, rather than the Melbourne FER geography; Imports and exports are trade with any area outside of Melbourne (both in Australia and overseas).
Source: SGS Economics and Planning Input Output Model

Trade flows

Based on employment in different industries, this report allocates the aggregate flows from the modelling above to the FER subregions. The following diagrams, Figure 40, show the net flows between regions: the green circles represent the source of inputs and input destinations are represented by the grey circles. Each subregion also has an internal loop that represents internal trade flows. The inner region is a major customer of inputs from the other regions as well as a major supplier. This captures the importance of the inner economic locations to the entire Melbourne FER.

FIGURE 39: EXPORT VALUE BY INDUSTRY, GREATER MELBOURNE (2014-15)

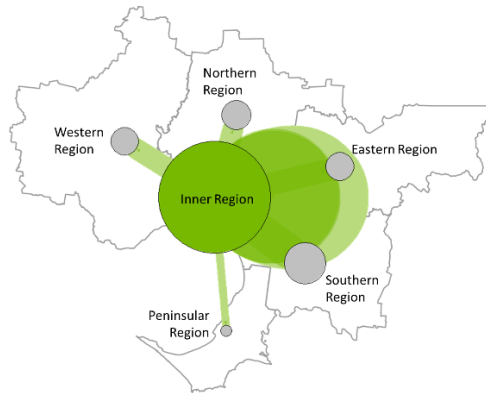


Note: This data reflects the Greater Melbourne GCCSA, rather than the Melbourne FER geography; Imports and exports are trade with any area outside of Melbourne (both in Australia and overseas).
Source: SGS Economics and Planning Input Output Model

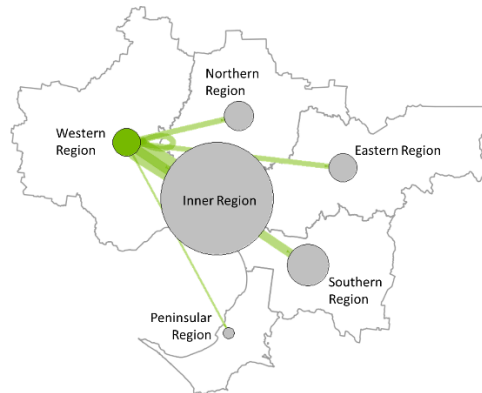
There are also major internal flows as services are exchanged within the city. This highlights the importance of proximity between firms within economic locations. The northern, western and southern regions all have relatively strong links. This reflects the movement of intermediate goods through the supply chain between the major industrial precincts.

FIGURE 40: INTER-REGION SUPPLY CHAIN INTERACTIONS

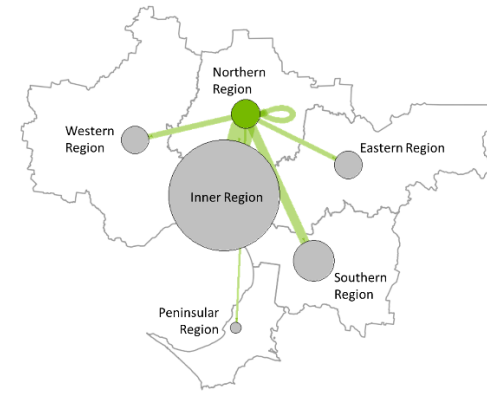
Flows from Inner Subregion



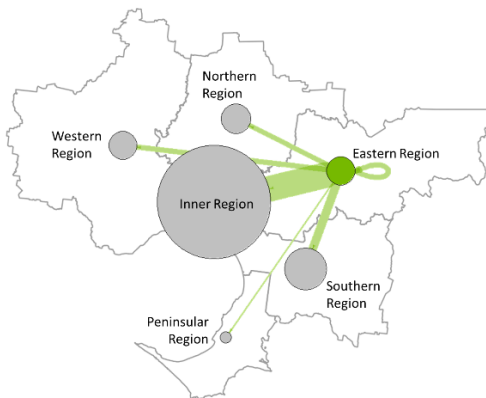
Flows from Western Subregion



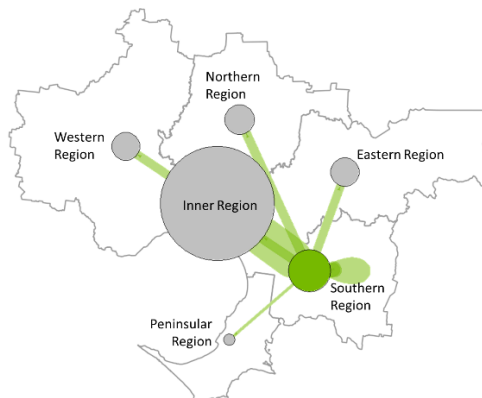
Flows from Northern Subregion



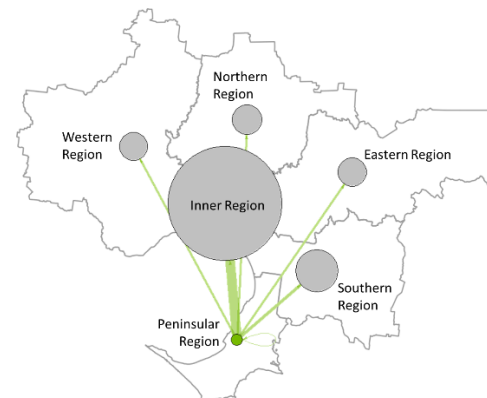
Flows from Eastern Subregion



Flows from Southern Subregion



Flows from Peninsular Subregion



Note: Net trade flows are shown by the weight of the lines between subregions and the small loops represent trade within a subregion. Green circles show the source of inputs and grey circles are destinations.

Source: SGS Economics and Planning Input-Output Model

Physical movement of goods and people

Outputs from KPMG's Melbourne Activity and Agent Based Model (MABM) provide origin and destination information for different trip purposes, including work commutes, school trips, shopping, business and freight.

Freight trips represent large truck movements while business trips represent smaller vehicles, such as vans, as well as any other business-related trips. Freight trips are strictly about the movement of goods, but business trips can be about the movement of services as well as smaller goods. Estimates of both trip types include some share of empty trips, which inform understanding of road use but do not necessarily represent an economic transaction. The share of empty trips is not identified in the MABM data.

In 2015, there were over 250,000 freight trips and 360,000 business trips on an average day. The spread of these trips across economic locations throughout the FER is shown in the origin and destination locations in Figure 41. Overall, trips were dispersed around the FER, with no dominant link between any two specific locations. Table 5 identifies several hubs that have around a quarter of all freight trips and a third of all business trips to all parts of the FER.

The Port of Melbourne is a central gateway that links the FER to international markets. Dandenong in the south, Wyndham in the west and Whittlesea-Wallan in the north are major hubs for both moving goods around the FER and as container destinations where cargo from the Port of Melbourne is unpacked and shipped to its intended destination.

Business trips show a slightly different and more dispersed pattern around the FER. There are more trips in outer ring suburbs, likely due to workers in population-serving industries like construction and labouring work.

Projected origins and destinations of business trips in 2046 reinforce the ongoing role of the CBD with Melbourne City to remain the top origin and destination for business trips. The projections also highlight the dominance of Melbourne's east and south east for business trips. Freight trip projections suggest each of the top 10 in 2015 will continue to have an important role in 2046 with strong overlap with key industrial areas such as Dandenong

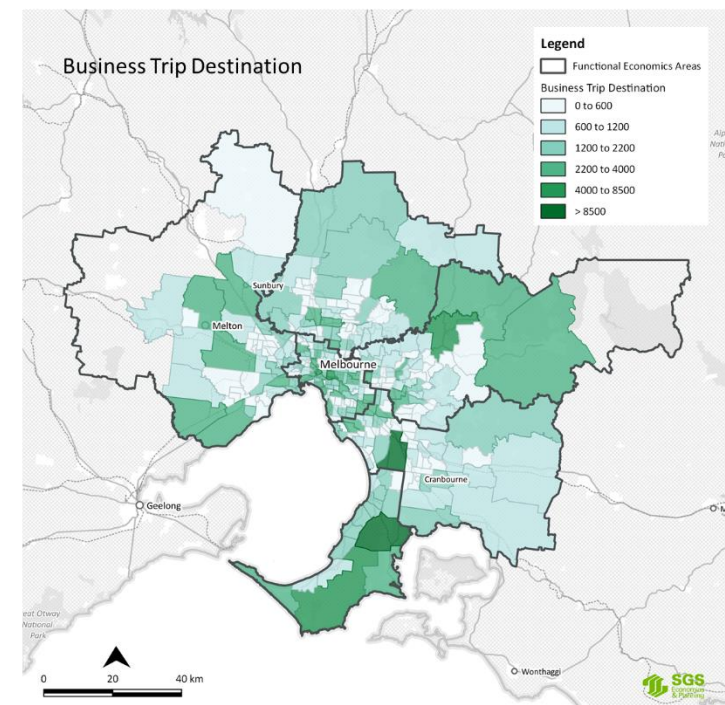
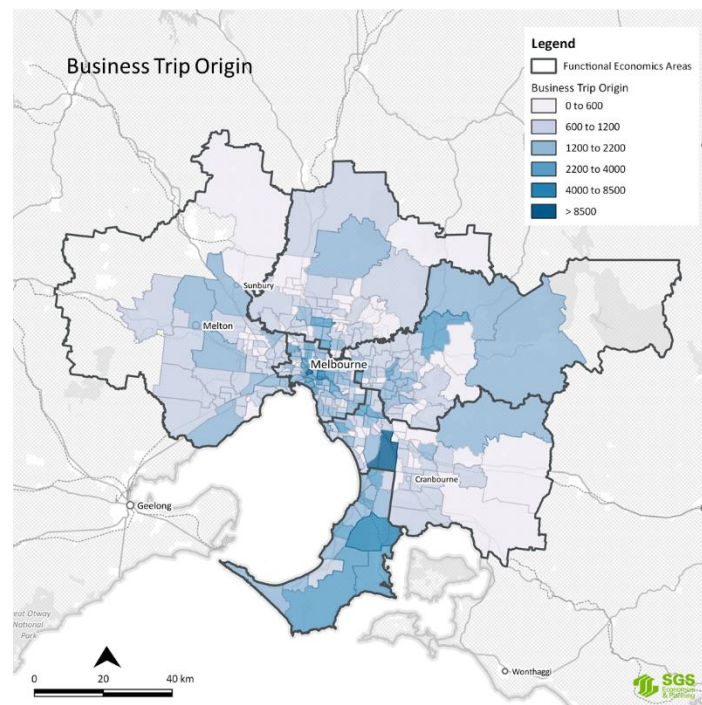
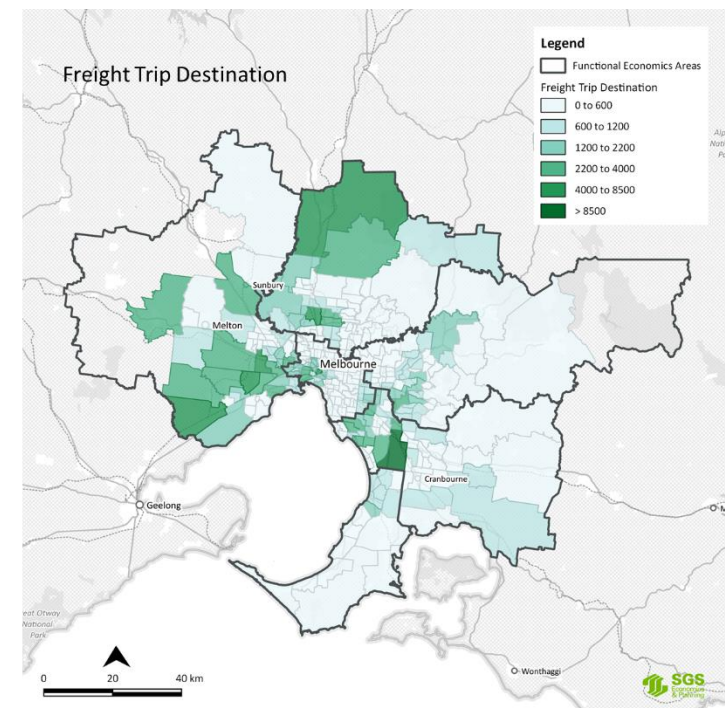
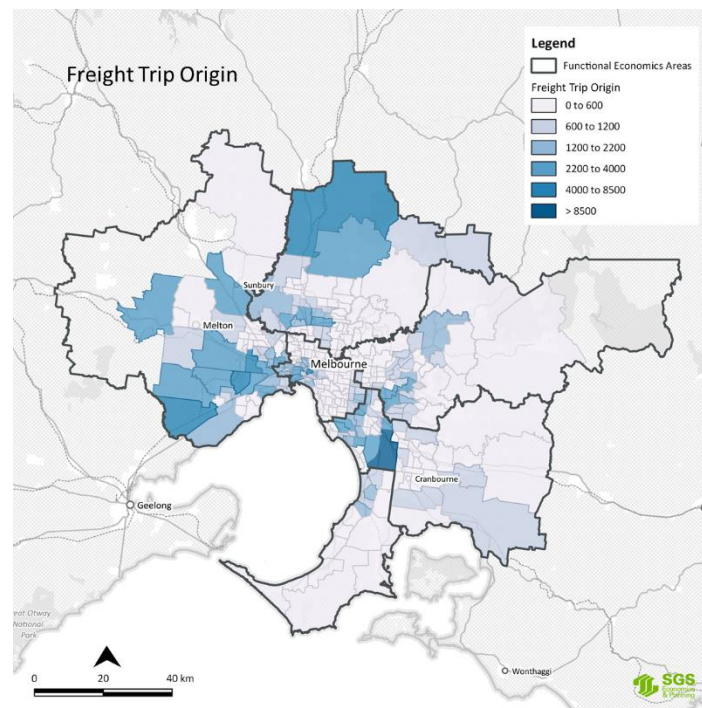
(Dandenong south), Wyndham (Western State Significant Industrial Precinct) and the Tullamarine-Broadmeadows industrial areas.

TABLE 5: TOP FREIGHT AND BUSINESS TRIP LOCATIONS (2015 AND 2046)

SA3	2015 Origin	2015 Destination	2046 Origin	2046 Destination
Freight Trips				
Dandenong	33,600	34,000	67,600	65,900
Wyndham	21,600	21,800	30,500	31,400
Melbourne City	18,200	18,000	24,500	24,700
Whittlesea - Wallan	17,600	17,600	23,400	23,300
Tullamarine - Broadmeadows	15,400	15,500	28,900	28,100
Brimbank	15,000	15,000	31,200	30,400
Knox	15,100	14,600	23,800	24,200
Kingston	13,600	13,600	24,200	25,000
Monash	11,600	11,500	22,600	22,900
Business Trips				
Melbourne City	29,800	23,800	61,100	38,100
Mornington Peninsula	21,000	24,400	27,400	32,000
Dandenong	19,400	24,800	25,700	31,400
Yarra Ranges	13,300	18,500	15,500	23,000
Monash	14,600	16,100	20,000	22,000
Whittlesea - Wallan	13,300	14,000	24,800	23,400
Knox	13,600	13,600	15,900	16,700
Boroondara	13,300	13,900	17,000	18,700
Port Phillip	13,800	12,700	20,000	18,900

Source: SGS Economics and Planning; derived from MABM (KPMG, 2018)

FIGURE 41: BUSINESS AND FREIGHT DAILY TRIPS, ORIGINS AND DESTINATIONS, BY SA2 (2016)



Source: Source: SGS Economics and Planning; derived from MABM (KPMG, 2018)

The MABM forecasts for 2046 show that the Melbourne FER will have to accommodate an increase in freight and business trip in the next 30 years. The number of trips in many locations is forecast to double and the estimated total trips in 2046 is 556,000 freight trips and 526,000 business trips – a total of 1.08 million trips on an average day.

This rise in activity will increase pressure on the road network and demand for industrial lands to facilitate the movement of bulky goods. Easing congestion will allow the unimpeded flow of goods and services and there may be a need for new transit hubs to be developed to accommodate growth around Melbourne.

Port of Melbourne

The Port of Melbourne is the largest container port in Australasia, handling over 2.64 million containers annually (measured in 20-foot equivalent units, or TEUs).¹⁵ With a total trade value over \$100 billion, the port is an essential part of Melbourne's infrastructure. It serves the economy by supplying goods and as an export gateway giving local producers access to international markets.

Victoria University's port import commodity estimates for 2015-16 are shown in Table 6. These are either finished goods for local consumption, such as household goods and textile, clothing and footwear products, or intermediate inputs for further local production, such as machinery and vehicle parts.

The freight hubs identified above help to distribute the goods imported through the Port of Melbourne to the broader FER, as shown in Figure 42, which shows the first move destinations of TEUs from the Port of Melbourne. The patterns are similar to those for freight trips, with major hubs near the industrial precincts of the west, north and south. This is confirmed in data in Table 7 and Table 8 from a 2017 Victoria University study which estimates container volumes by region and primary container destination.¹⁶ Around three quarters of all TEUs from the Port of Melbourne were unpacked at these container destinations.

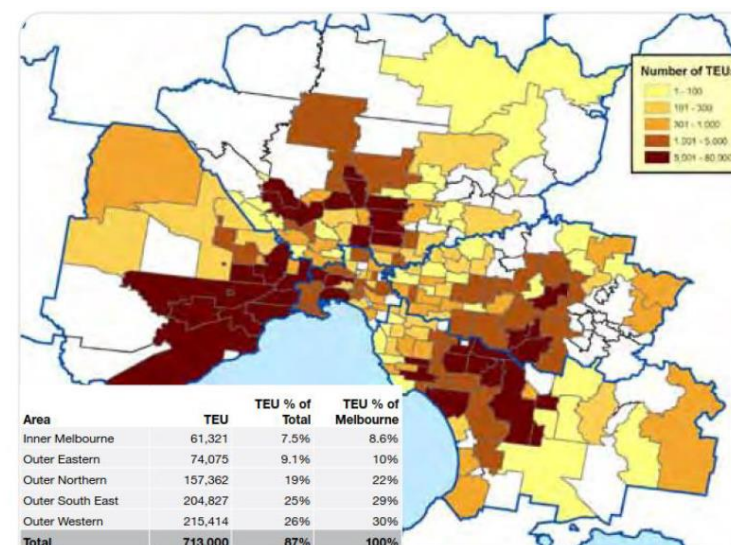
¹⁵ Historical Trade Data, available at: <www.portofmelbourne.com/about-us/trade-statistics/>

TABLE 6: PRIMARY COMMODITY CLASSES IN IMPORT CONTAINERS (2015-16)

Commodities in Import Containers (TEUs) in 2009	Share
Household goods	15%
Machinery and vehicle parts	12%
Metal, non-metal and rubber products	10%
Plastic and chemical products	3%
Pulp and paper products	6%
Textile, clothing and footwear products	7%
Other products	48%

Source: Victoria University (2017), Indicative Estimates of Commodities and Truck Volumes from Container Destinations in Melbourne, p12

FIGURE 42: FIRST MOVE DESTINATIONS FROM PORT MELBOURNE (2009)



Source: Port of Melbourne (2009) Container and Logistics Study, cited in Deloitte (2017) Infrastructure Victoria Second Container Port Advice, p14

¹⁶ Primary container destinations are suburbs that contain distribution centres and freight stations where 10,000 to 20,000 TEUs were unpacked in 2015-16.

TABLE 7: ANNUAL VOLUME OF IMPORT CONTAINER DESTINATIONS FROM THE PORT OF MELBOURNE, BY REGION (2009 AND 2015-16)

Region of Melbourne	2009 TEUs	2015-16 TEUs	Share
Inner Melbourne	61,224	77,706	9%
Outer West	215,413	273,405	30%
Outer North	156,950	199,203	22%
Outer East	74,076	94,018	10%
Outer South East	204,828	259,970	29%
Total	712,491	904,303	100%

Notes: Victoria University held regional shares constant across years to generate 2015-16 estimates; regions in this table are those used by Victoria University; they are broadly similar to FER subregions
Source: Victoria University (2017), Indicative Estimates of Commodities and Truck Volumes from Container Destinations in Melbourne, p10

TABLE 8: ANNUAL VOLUME OF IMPORT CONTAINERS AT THE TOP 10 PRIMARY CONTAINER DESTINATIONS ACROSS MELBOURNE (2015-16)

Primary Container Destination	Region of Melbourne	2015-16 TEUs
Dandenong	Outer South East	90,524
Laverton North	Outer Western	74,201
Somerton	Outer Northern	46,197
Altona	Outer Western	40,413
Tullamarine	Outer Northern	37,924
West Footscray	Outer Western	34,655
Campbellfield	Outer Northern	33,663
West Melbourne	Inner Melbourne	32,846
Derrimut	Outer Western	32,276
Altona North	Outer Western	26,058

Note: Regions in this table are from Victoria University; they are broadly similar to FER subregions
Source: Victoria University (2017), Indicative Estimates of Commodities and Truck Volumes from Container Destinations in Melbourne, p27

Commuter flows

MABM outputs informed data on journeys to work across the Melbourne FER. Figure 43 shows the major intra-FER commuter flows across Melbourne, defined as more than 20,000 commutes between any two subregions. A detailed matrix is provided in Table 9, including for 2015 and forecasts for 2046.

Given it hosts nearly half of the jobs in the Melbourne FER, the inner subregion is the most important commuter destination. The map illustrates this importance, with large volumes of flows from all subregions except peninsular. This does not represent travel to the CBD only, it also includes economic locations in the surrounding areas of the inner-western suburbs (such as Footscray) and inner-southern suburbs (such as Caulfield). The highest number of inbound daily commutes came from the western subregion (101,000 trips) and the northern subregion (85,000 trips).

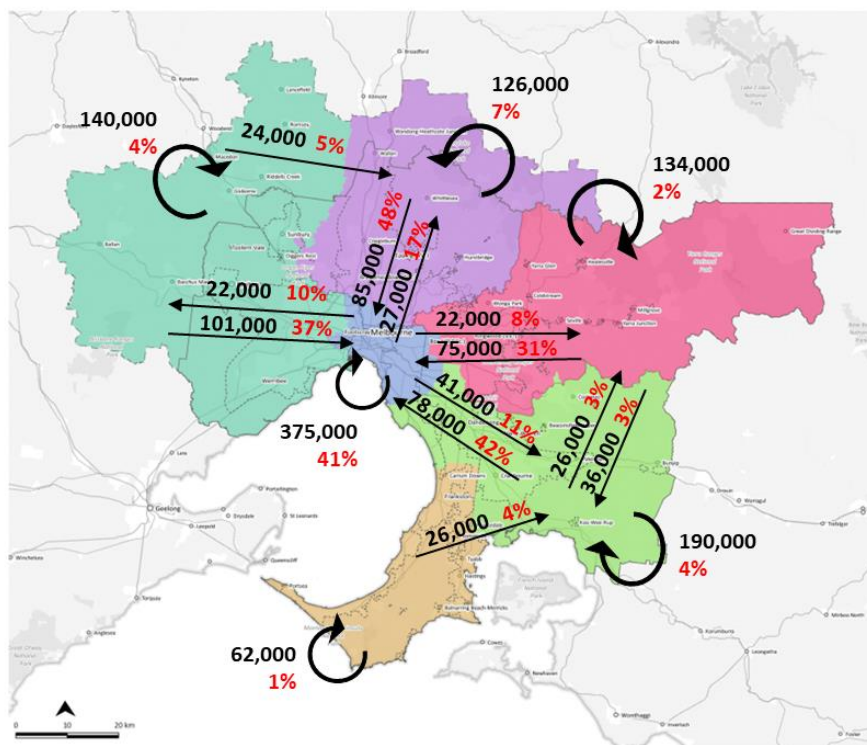
Many residents of the densely populated areas inner subregion also travel to the western, northern, eastern and southern subregions. Other important lateral flows include those from the western to northern subregions and between the eastern and southern subregion. Very few people travel into the peninsular subregion, as expected given the relatively small number of economic locations in the area. The southern subregion is a good source of work for residents living on the peninsular.

The figures in red indicate the mode share for each route. Given the higher quality public transport infrastructure available in inner Melbourne, commutes into the central city are characterised by a high public transport mode share. It is highest for the northern and southern subregions and slightly lower in the western and eastern subregions. Trips out of the inner subregion and lateral flows have a much lower public transport mode share. This reflects Melbourne's radial train line system, which offers good services into the city but poorer services to outer economic locations, particularly for cross-regional journeys to work.

There are also major internal commuter flows within the subregions. Given the subregions are defined by the self-contained employment area model, these commutes make up at least half of all commutes across the FER. This

highlights that many workers who live in the outer suburbs travel to more local employment than the CBD and other inner economic locations. As with the cross-regional flows, these trips are predominantly made by car (at least 93 per cent of trips).

FIGURE 43: MAJOR WORKER COMMUTER FLOWS AND PUBLIC TRANSPORT MODE-SHARE BETWEEN SUBREGIONS (2015)



Note: Numbers represent the total daily trips from home to work between FER subregions, and the proportions represent the share of those trips that are made by public transport

Source: SGS Economics and Planning; derived from MABM (KPMG, 2018)

This growth will place substantial pressure on the transport network, with congestion on the roads and public transport infrastructure. MABM forecasts indicate that road congestion will push commuters to public transport, with the mode share nearly rising from 21 per cent in 2015 to 39 per cent in 2046.

As noted earlier, the FER contains many peri-urban areas outside of the urban growth boundary. Workers in these areas are a growing source of labour the Melbourne economy. The analysis above captures incoming trips from many of the peri-urban areas inside the FER, including Bacchus Marsh and Ballan to the west; towns around Gisborne, Macedon and Romsey to the north-west; Wallan to the north; towns around the Yarra Ranges to the east; and Koo Wee Rup and Bunyip to the south-east.

TABLE 9: SUBREGION WORKER COMMUTE TRIP MATRIX (2015 AND 2046)

2015	Destination							
Origin	Inner	West	North	East	South	Peninsular	Outside FER	FER Total
Inner	375,000	22,000	41,000	22,000	27,000	2,000	4,000	494,000
West	101,000	140,000	4,000	2,000	24,000	-	3,000	274,000
North	78,000	3,000	190,000	26,000	3,000	14,000	3,000	316,000
East	75,000	3,000	36,000	134,000	11,000	1,000	3,000	264,000
South	85,000	18,000	5,000	12,000	126,000	-	3,000	249,000
Peninsular	12,000	1,000	27,000	3,000	1,000	62,000	1,000	106,000
Outside FER	7,000	1,000	3,000	1,000	2,000	1,000	-	15,000
FER Total	734,000	186,000	307,000	201,000	192,000	80,000	18,000	1,718,000

2046	Destination							
Origin	Inner	West	North	East	South	Peninsula	Outside FER	FER Total
Inner	655,000	33,000	66,000	35,000	42,000	3,000	4,000	838,000
West	240,000	260,000	11,000	4,000	49,000	-	3,000	568,000
North	135,000	4,000	337,000	47,000	5,000	31,000	4,000	561,000
East	120,000	3,000	55,000	195,000	16,000	2,000	3,000	395,000
South	172,000	34,000	10,000	22,000	242,000	-	5,000	485,000
Peninsular	20,000	1,000	43,000	5,000	1,000	89,000	1,000	159,000
Outside FER	10,000	2,000	3,000	2,000	3,000	-	-	22,000
FER Total	1,353,000	337,000	525,000	310,000	357,000	127,000	20,000	3,028,000

Source: SGS Economics and Planning; derived from MABM (KPMG, 2018)

Commuters from peri-urban areas

The following maps, overleaf, show long-distance commutes into the FER from Bendigo, Ballarat, Geelong and Warragul-Drouin. The first map, Figure 44, shows all trips and the second set of maps, Figure 45, show the major destinations of the trips in detail. The analysis uses SA2-level journey to work data from the ABS Census 2016. The thickness of the lines and shade of the SA2 area both represent the volume of the trips from the different cities.

By far the largest volume of trips into Greater Melbourne come from Geelong with 15,300 daily trips. Bendigo, Ballarat and Warragul-Drouin each had between 1,000 and 3,500 trips. The number of trips from each location are increasing; however, in most cases the increase is in line with population growth. For example, daily commutes from Geelong have risen by 1,400 trips since 2011 but the share of all work trips was just under 14 per cent in both years.

This suggests that rising commutes into Melbourne from regional cities are not necessarily a growing trend. The exception is Warragul-Drouin where trips into Greater Melbourne grew from 18.5 per cent of all work commutes in 2011 to 22.5 per cent in 2016.

While commuters from Ballarat and Bendigo mostly went to central Melbourne, many commuters from Geelong and Warragul-Drouin travelled to more industrial economic locations in outer south-western parts of the Melbourne FER (see Figure 45). These commutes to industrial areas tend to be shorter trips that are often made by car. The dispersed set of destinations indicates that Geelong and Warragul-Drouin will increasingly become integrated into the Melbourne FER as economic activities grow in these outer areas.

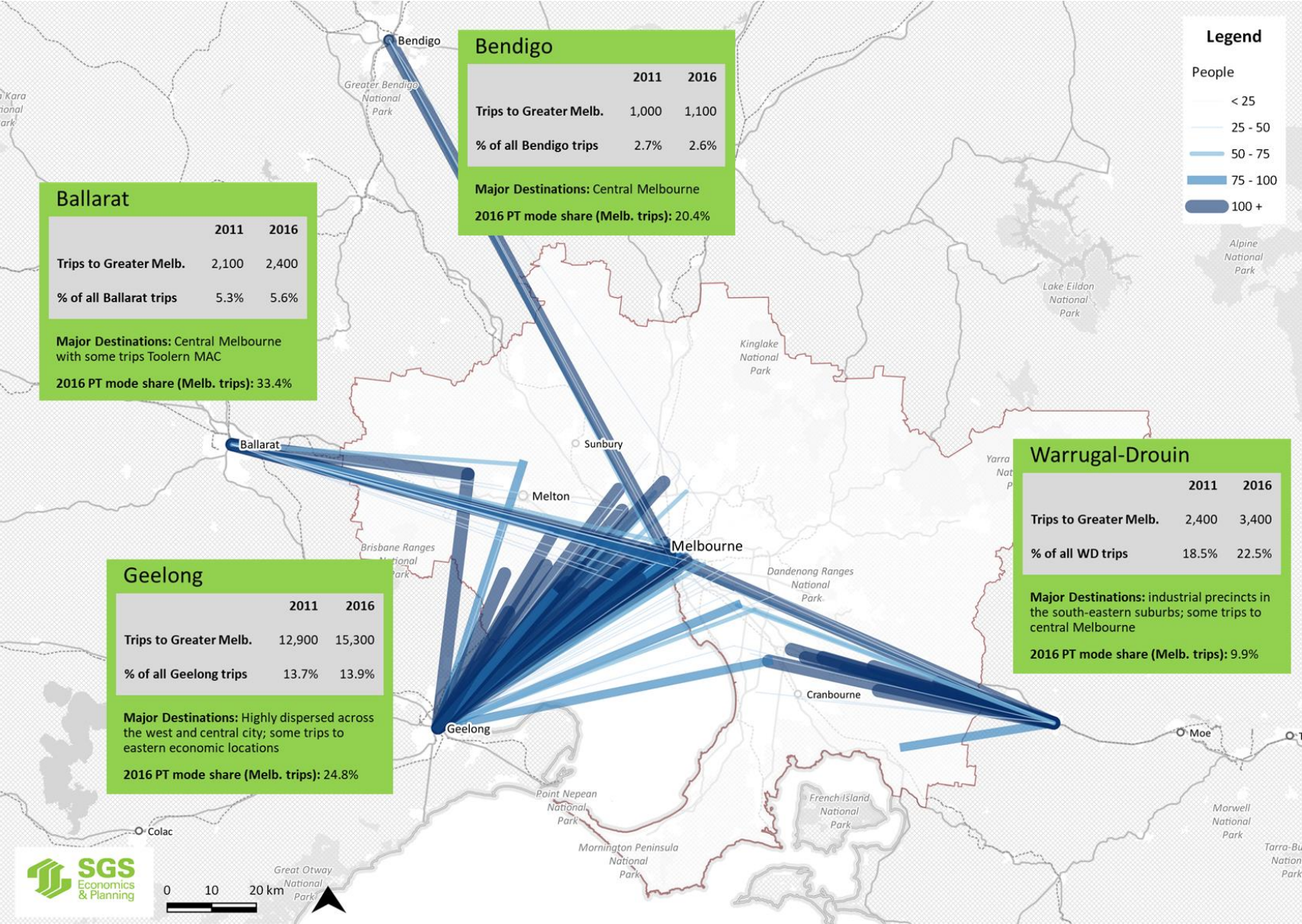
For further details on work commutes into the FER from peri-urban areas, Table 10 shows the top 10 SA2 areas in terms of number of work trips to the FER. Many of these areas are just outside the SA2, for example Kilmore, Broadford, Woodend and Kyneton. These trips tend to make up a very large portion of all commutes in the area, which indicates that those SA2s are also very closely connected to the FER labour market.

TABLE 10: PERI-URBAN LOCATIONS WITH HIGHEST NUMBER OF DAILY WORK COMMUTES INTO THE MELBOURNE FER (2016)

SA2	Work Trips to FER	Share of all Work Trips
Kilmore - Broadford	2,800	46.3%
Woodend	1,600	52.0%
Torquay	1,300	14.5%
Kyneton	1,200	28.1%
Wonthaggi - Inverloch	900	11.3%
Korumburra	700	17.4%
Daylesford	600	16.2%
Gordon (Vic.)	500	18.8%
Phillip Island	500	11.4%
Castlemaine	400	10.8%

Source: SGS Economics and Planning, derived from Census 2016

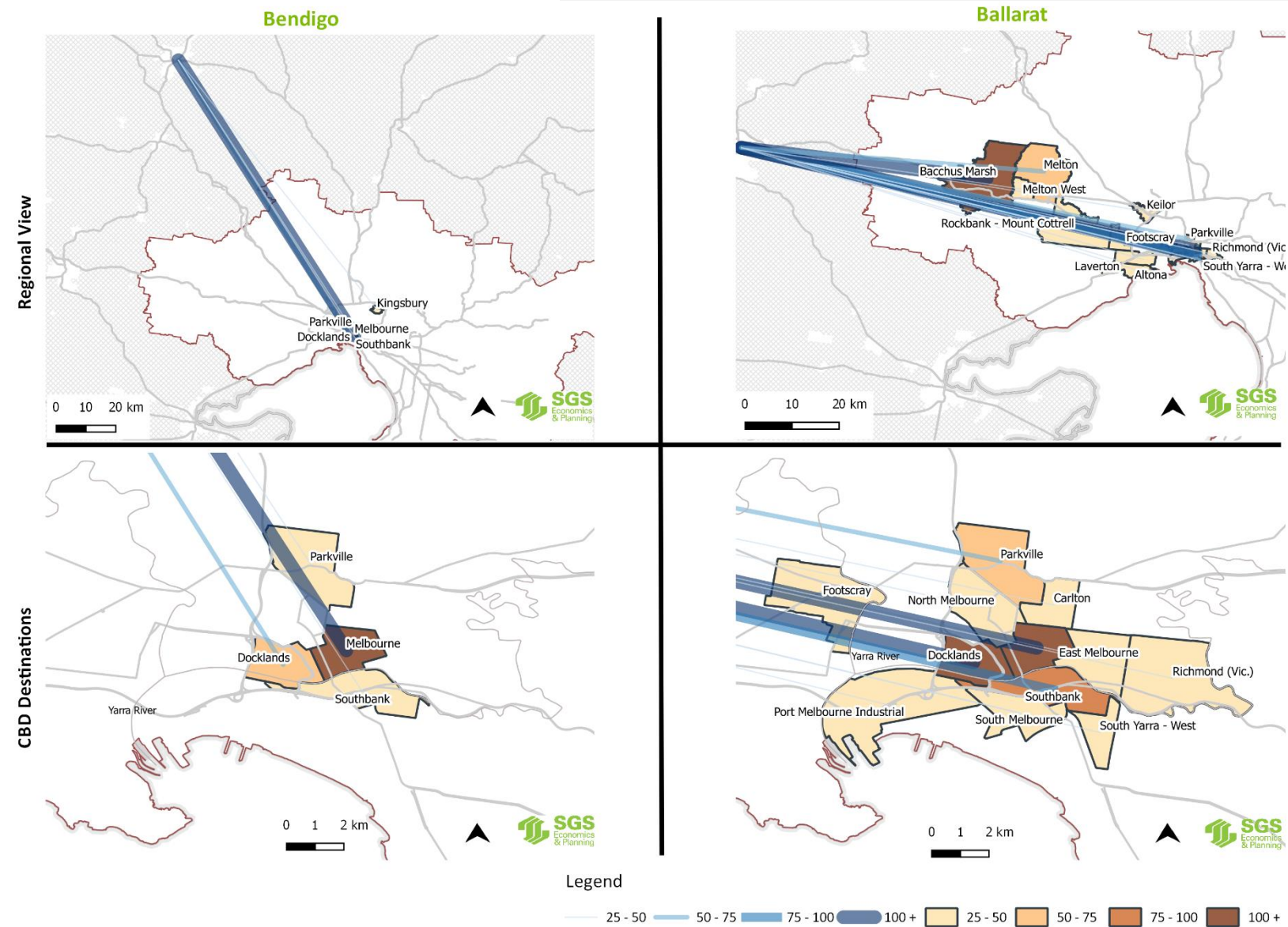
FIGURE 44: LONG-DISTANCE COMMUTES TO GREATER MELBOURNE

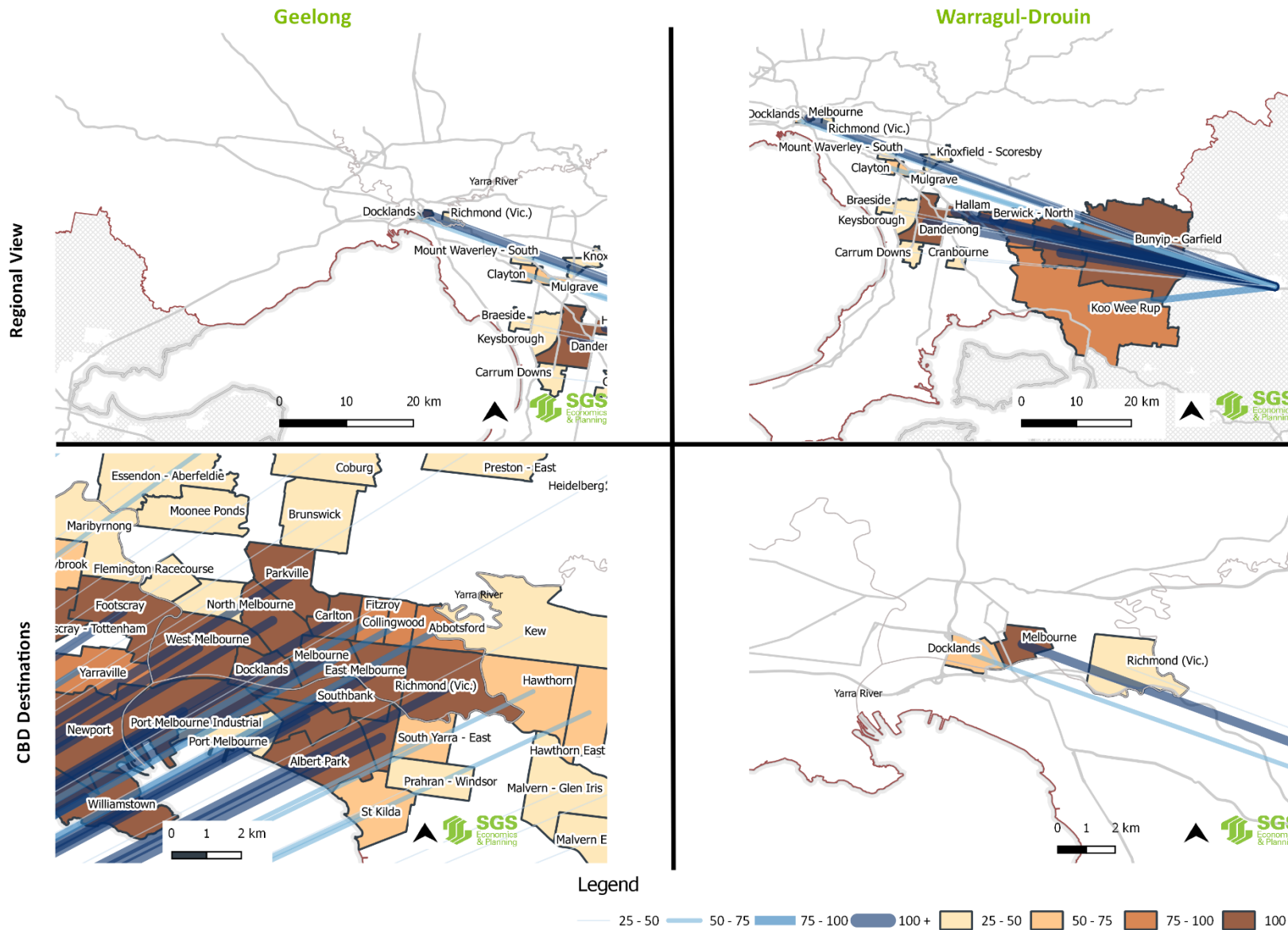


Source: SGS Economics and Planning; ABS Census 2016

The maps below show long-distance commutes from key regional cities. The top row shows the destinations across the FER. The second row provides a close-up of the CBD destinations. These maps indicate the reach of commutes from key regional cities and the degree to which they are dispersed across the wider Melbourne area or limited to the Melbourne CBD.

FIGURE 45: LONG-DISTANCE COMMUTES FROM KEY REGIONAL CITIES





Source: SGS Economics and Planning, derived from ABS Census 2011

Automated vehicles

The introduction of automated vehicles could increase road capacity, improve safety, provide greater mobility for older people and those with disability, and raise productivity during travel time.¹⁷

Perhaps most importantly, automated vehicles have the potential to improve accessibility across Melbourne. They are likely to alleviate congestion because they require smaller headways (the stopping distance between cars) and will be able to make quicker road manoeuvres. This platooning will increase the network capacity because cars are able to travel closer together than traditional cars at the same speed.

Estimates for Melbourne are that up to 91 per cent of congestion could be reduced.¹⁸ This improved accessibility would provide better access to job opportunities for workers, better access to labour for firms and allow the physical movements of goods and services to flow more freely around the city. In particular, it could help the FER to support the expected extra road use that was identified earlier in this theme: 3 million daily work commutes and 1 million daily freight and business trips are anticipated in 2046.

Improved accessibility is also likely to have major impacts on land use patterns across the FER. It has long been observed that the economic geography and land use patterns adjust over time in response to changes in relative transport accessibility. Substantial shifts in transport accessibility have changed the location choices of firms and households alike. Moving operations to areas of superior accessibility reduces transaction costs in dealing with suppliers and distributors, as well as improving access to workers. These same dynamics apply to households. They adjust location to maximise opportunities for employment, education, recreation and other services.

SGS has modelled the potential land use impacts of automated vehicles across a range of scenarios for the 30 years to 2046 (SGS, 2018a), finding that automated vehicles are likely to create a redistribution of dwellings and jobs to the middle and outer suburbs. This happens because middle and outer ring suburbs with good arterial roads and access to the freeway network become more attractive in comparison to a non-driverless car scenario.

These impacts bear many similarities to the development patterns observed when car ownership became commonplace during the 1950s, 1960s and 1970s. While several factors are at play, the shift can primarily be attributed to the effect that automated vehicles have on car use and congestion. Under all the scenarios, the cost of car travel was reduced such that the overall amount of car transport increased.

The changes in relative accessibility with the adoption of automated vehicles could cause between 10.8 and 14.5 per cent of dwellings, and between 12.3 and 16.6 per cent of jobs to shift location in Greater Melbourne. This is a significant impact on the urban structure of the city. In comparison, major transport projects such as CityLink, EastLink and rail projects have only shifted one to four per cent of additional dwellings.

The middle ring suburbs that will see additional growth should be able to absorb additional housing without the need for significant additional infrastructure. However, additional growth in greenfield areas would only add to the infrastructure challenge on Melbourne's urban fringe. This will place additional demand on infrastructure provision in areas that will already see the fastest and largest scale growth in Melbourne.

Ultimately, the improved accessibility from automated vehicles has the potential to ease strain on Melbourne's transport network from future population and employment growth. However, it could pose other infrastructure challenges in outer areas by changing the dynamics of land use across the city.

¹⁷ See Infrastructure Victoria's 2018 evidence base report on automated and zero emissions vehicle infrastructure for a summary of the evidence in the Melbourne context (Infrastructure Victoria, 2018). SGS contributed major portions of the evidence related to land use impacts.

¹⁸ Ibid.

6. SUMMARY AND CONCLUSIONS

This report aims to understand the roles of the many economic locations around Melbourne, how people contribute their human capital and the flows of people, goods and services throughout the economy. It will inform IV's recommendations in the 2019 update of the 30-year infrastructure strategy.

The Melbourne FER is a diverse and well-connected economy. It covers a broad area that includes the peri-urban areas where a growing number of Melbourne's workforce resides. This report explores three key themes:

- the firms that drive production and services
- the people that live and work in the economy
- the connections between the people and firms, both within the Melbourne FER and economies outside of Melbourne.

The Melbourne economy has transformed from heavy manufacturing to a more diverse economy with strong knowledge-intensive sectors. Growth has been supported by a booming and productive population, with above average participation and increasing levels of human capital.

A range of highly varied and specialised economic locations drive productivity across the FER. Economic locations in inner areas are more often specialised in knowledge-intensive industries or specialist health and education services. Industrial economic locations are found in major precincts to the west, north and south, while firms in the education, training, health and population-serving sectors are more dispersed across the city because they primarily service the residential population.

Melbourne is a highly integrated economy across these locations, with significant flows between nearly all industries. There are particularly strong

within-industry links, which suggests that the co-location of these industries is important.

The flow of inputs and outputs is facilitated by the physical movement of goods and people around the Melbourne FER. Freight trips are linked to key ports and industrial nodes, while business trips are strongly correlated with major employment nodes and development.

The inner subregion is the primary destination for commuter flows within the Melbourne FER, representing 42 per cent of all work trips. Major commuter flows also occur within subregions. Future population and employment growth will place additional strain on Melbourne's transport network; this may be eased somewhat by new technology, particularly driverless cars.

People living in the outer parts of the FER have reduced economic outcomes when compared to those living in inner areas. This is largely due to lower levels of access to jobs and services. While it is no surprise that inner parts of the city have superior access and opportunities, this highlights the need for infrastructure and jobs in outer areas, particularly with the population boom expected in the west and other New Growth Areas.

FERs are dynamic entities and the Melbourne FER will shift and transform into the future. Key drivers of change will be the rising population, new technology, workplace trends and transport infrastructure. It is likely that the FER will expand if commuting from peri-urban areas becomes more popular. The shape of subregions will also change, particularly if outer NEICs develop and take on a more significant role in the broader Victorian economy.

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8. METHOD APPENDIX

Self-contained Employment Area Model

Background

As noted earlier, worker commutes can provide a sound basis for the estimation of FERs. In addition to revealing integrated labour markets, they are good approximations of other important economic functions. Households often purchase goods and services close to home, and firms often purchase inputs, sell their products and recruit workers close to their premises (Karlsson and Olsson, 2015).

In Australia, journey to work data has been used to estimate FER boundaries with varying methodologies by the Productivity Commission (2017), University of Newcastle's Centre of Full Employment and Equity (CofFEE) (CofFEE nd; Mitchell and Stimson, 2010; Mitchell and Watts, 2010; Stimson et al. 2016), the NSW Government and others.

The approach in this study is based on work first conducted by the UK Office for National Statistics and Coombes (1998) and later refined by Bond and Coombes (2007). The method uses a self-containment algorithm to define self-contained employment areas (SEAs) where the majority of workers also reside in the same region. While using a different methodology, the resulting boundaries are comparable to those identified by the Productivity Commission and CofFEE.

Self-containment model

The self-containment model defines SEAs using origin-destination data for 433 SA2s across Victoria. The data was obtained from ABS journey to work information in the 2016 Census.

The three broad aims for the self-contained employment areas developed are that they be self-contained, contain relatively connected areas, and have a significant base of working residents. These are captured by two parameters in the algorithm used to develop SEA's, which are:

- Self-containment; and
- Number of working residents.

Here 'self-containment' refers to both ensuring that most workers living in an area also work in the same area and most people who work in an area also live there. Self-containment is calculated using Formula 1 below:

FORMULA 1

$$\text{Self containment} = \min(SCT_{\text{supply}}, SCT_{\text{demand}})$$

Where:

$$SCT_{\text{supply}} = \frac{\text{number of people living and working in an area}}{\text{total number of workers living in an area}}$$

$$SCT_{\text{demand}} = \frac{\text{number of people living and working in an area}}{\text{total number of people working in an area}}$$

The algorithm allows the specification of minimum values for these two parameters which all SA2s are assessed against. The subregions are created by starting with the area that is furthest from meeting this minimum requirement and joining it with the area that it is most 'connected' to (in terms of commuting links) using Formula 2 below to measure connectedness.

Note that connectedness, as shown in this formula, considers commuting work trips in both directions between the areas. Furthermore, it is based on proportions, which measures the "importance" of trips each way. If simply total number of trips was used it would merge areas into larger areas and will not separate distinct areas.

FORMULA 2

$$\frac{JTW(a,b)}{Wkrs(a)} \times \frac{JTW(a,b)}{Jobs(b)} + \frac{JTW(b,a)}{Wkrs(b)} \times \frac{JTW(b,a)}{Jobs(a)}$$

Where:

JTW(a,b) = number of workers that live in area a and work in area b

Wkrs(a) = number of total workers residing in area a

Jobs(a) = number of total jobs in area a

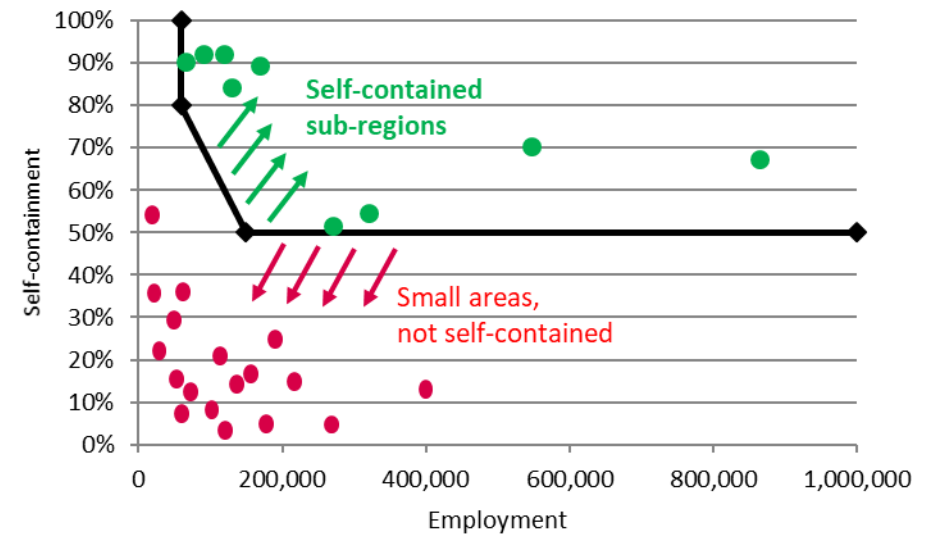
The following chart illustrates how areas are considered to be SEAs. The x-axis measures number of workers and y-axis measures the self-containment. Areas which lie above the line can be considered to be a viable SEA. For areas below the line, they will be combined with other areas based on their distance from the closest point on the line. Once two areas are combined these distances from the line are recalculated and the same process is repeated. If a previously combined group of SA2s is considered as having the highest distance from the line the group is split and each SA2 is combined with the area with which it is most connected. This is done until all groups are valid SEAs according to the parameters set.

Assumptions

Three primary assumptions are made to run the model:

- A minimum self-containment rate: 50 per cent
- A minimum number of workers: 60,000 persons for each region
- A worker rescaling factor that sets the relative importance of the self-containment- and worker variables: the self-containment requirement falls between 80 per cent 50 per cent on a linear scale for areas with workers between 60,000 and 150,000 persons (this is visible in the diagonal portion of the threshold line in Figure 46).

FIGURE 46: FER SELF-CONTAINMENT AND WORKER THRESHOLDS



Source: SGS Economics and Planning

SGS Small Area Land Use Projections

Model Overview

SGS has worked with the Victorian State Government and Victorian Integrated Transport Model (VITM) team to develop Small Area Land Use Projections (SALUP) since 2008. Over that period several minor, area specific, and major updates have been completed.

This report relates to the 2017 release, SALUP17. It exactly aligns with:

- 2016 Victoria-in-Future (VIF16) population and housing projections created by the Department of Environment, Land, Water and Planning (DELWP) at a Statistical Area 2 (SA2) level.
- January 2017 release of employment by industry forecasts created by Deloitte for the Department of Economic Development, Jobs, Transport and Resources (DEDJTR) at the state-wide level.

Many other datasets were also utilised; however, it should be noted SALUP17 does not include ABS Census 2016 data as this was not released at the time.

At a high level, the data covers three dimensions and over 25 million data points:

- **Time Period:** Five-yearly time periods from 2011 to 2051, plus 2014 and 2015.
- **Geographic:** 20,390 travel zones across Victoria
- **Variables:** 105 variables covering people, employment and students.

When modelling the possible land use, it should be understood there is no one single future. Therefore, SALUP17 seeks to represent the most likely urban future based on current data, trends and an understanding of policy/structural changes. It does not reflect a do nothing, policy aspiration or project specific scenario which would need to be further developed as separate scenarios.

SALUP17 Method

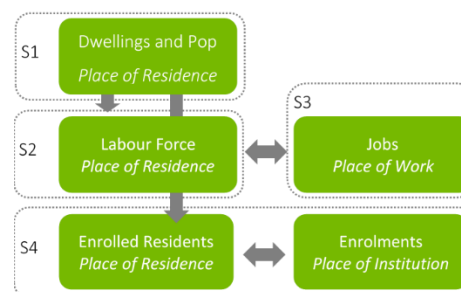
The following diagram highlights the four key stages to the SALUP method. Each stage draws on a number of external datasets along with previous model outputs to create the final SALUP17 dataset which includes over 20 million data points.

At a high level, VIF16 dwelling projections by SA2 are disaggregated to travel zones using small area input sources on current and future development trends.

Dwellings are then translated into population which is also aligned with VIF16 population projections by SA2. From this point, population is further segmented by age, education and workforce status. Resident education status (i.e. enrolled residents) are then used to forecasts enrolments at institutions.

Official DEDJTR state wide employment by industry forecasts are also disaggregated to travel zones. Employment by industry is systematically disaggregated to regions and then travel zones using a number of macro and small area input sources on current and future employment distribution and trends.

FIGURE 47: MODELING OVERVIEW



Source: SGS Economics and Planning

Economic Location Cluster Model

SGS uses a DBSCAN model to identify economic locations. DBSCAN, or 'Density-based spatial clustering of applications with noise', is a commonly used clustering algorithm with many different forms of spatial data.

The key steps and assumptions of the clustering method are:

- Take input data from 2016 employment levels in SALUP small zones
- Covert input data to 'dot points', each point is equivalent to 500 jobs
- Set cluster parameters for a minimum of 5,000 jobs (10 points) within a 1km radius
- Initial clusters are formed of core points, which meet the cluster definition are identified; a core point has a minimum of 9 other points within a distance of 1km from it which makes 5,000 total jobs
- Larger clusters are then created by combining neighbouring core points (within 1km of each other).

Two manual checks were made to finalise the clusters:

- Some logical inclusions were made that were not detected in the model. For example, some low density areas, such as industrial warehouses, still constitute part of a cluster from a functional and morphological perspective.
- The Melbourne CBD was manually subdivided into smaller clusters, based on their morphology, densities and functional characteristics.

Automation Task Model – routine tasks

Autor et al. (2003) developed measures of the task content of occupations with five categories of tasks; non-routine cognitive interpersonal, non-routine cognitive analytic, routine cognitive, non-routine manual and routine manual. The measures were derived from the occupational requirements detailed in the US Dictionary of Occupational Titles (DOT) that indicate the importance of various task types. For example, the importance of eye-hand-foot coordination is taken to approximate the intensity of non-routine manual tasks in occupations.

The original method has been enhanced in subsequent studies by Goos and Manning (2007), Autor et al. (2006, 2008), and Acemoglu and Autor (2011) and others, with more recent studies using activity measures from O*NET, the successor to the DOT. In the Australian context, Coelli and Borland (2016) used the original DOT measures to show declining demand for routine tasks over 45 years from 1966 to 2011.

Following Acemoglu and Autor (2011), this report selects a set of representative O*NET scales of *Work Activities* and *Work Context* to measure the five task types. Acemoglu and Autor note that the benefit of O*NET is that it uses a more current data set than the DOT but the drawback is that it contains a large set of scales that can be difficult to differentiate from one another (there are more scales in O*NET than occupations in the US Census).

Acemoglu and Autor's O*NET scales are detailed in Table 11; the multiple scales for each task type allows for a more sophisticated measure than the DOT method, yet they are also sparse enough to avoid the risk of overlap across task types. Regardless, Autor and Acemoglu (2011) find there is broad agreement between the two sets of task measures when applied to the same data.

The application of US data to Australia is done in four steps that follow a similar process to Coelli and Borland (2016), except that O*NET task measures and HILDA employment data are used instead of DOT task measures and Australian Census data. First, task scores for O*NET occupations are obtained by taking the average of the component scales. The task scores are then translated from O*NET to ANZSCO occupations with a method used by the

Australian Government Department of Industry (Edmonds and Bradley, 2015). The Department of Industry used a series of employment-weighted concordances to convert O*NET classifications to the US Standard of Occupations, which is in turn converted to the International Standard Classification of Occupations and finally to ANZSCO.

TABLE 11: O*NET SCALES FOR CONSTRUCTION OF TASK MEASURES

Task	O*NET scales
Non-routine cognitive analytic (Abstract)	*Analyzing data/information *Thinking creatively *Interpreting information for others
Non-routine cognitive interpersonal (Abstract)	*Establishing and maintaining personal relationships *Guiding, directing and motivating subordinates *Coaching/developing others
Routine cognitive (Routine)	*Importance of repeating the same tasks *Importance of being exact or accurate *Structured v. Unstructured work
Routine manual (Routine)	*Pace determined by speed of equipment *Controlling machines and processes *Spend time making repetitive motions
Non-routine manual (Manual)	*Operating vehicles, mechanized devices, or equipment *Spend time using hands to handle, control or feel objects, tools or controls *Manual dexterity *Spatial orientation

Source: Acemoglu and Autor (2011)

Second, the five measures of cognitive/manual and routine/non-routine tasks are converted into three broad task types set out by Autor et al. (2006, 2008). *Abstract* tasks are the average of non-routine cognitive analytical and interpersonal tasks. *Routine* tasks are the average score of routine cognitive and routine manual tasks. *Manual* tasks are equivalent to non-routine manual tasks.

The abstract, routine and manual scores are then converted into percentile scores that correspond to the rank of each occupation and the level of employment in each occupation in 2001, broken down by gender. Percentile scores are used because the multiple scales that make up the raw task scores mean that they cannot be treated confidently in a cardinal way (Autor et al., 2003).

Third, an additional measure called the Routine Task Intensity (RTI) index is constructed from the abstract, routine and manual score, such that:

$$RTI = \ln(routine) - \ln(abstract) - \ln(manual)$$

Taken from Autor and Dorn (2013), the RTI index builds on the routine task measure by providing an index of the routine task content *relative to* abstract and manual task content, such that a high RTI score means there is generally a higher dependence on routine tasks and possibly a higher potential for technological disruption.

Human Capital Model

Higher lifetime labour earnings have been found to be related to increases in life satisfaction, overall happiness, and lower anxiety levels. Unfortunately, there is limited information on human capital stock in Australia. The work of Hui Wei in the early 2000s is the most valuable resource for Australia, but it is now dated and does not disaggregate data below the Australian level.

This report uses the ‘lifetime labour income approach’ used by Wei to estimate human capital stock. It is based on the Jorgenson and Fraumeni (1989, 1992) income-based approach which estimates the stock of human capital as the discounted present value of expected lifetime labour income.

Future expected income streams were derived by using cross-sectional information on labour hours and income in 2006, 2011 2016 using ABS Census data. Expected earnings are produced for:

- women and men (2 groups);
- five-year age groups from 20 to 64 years of age (7 groups);
- qualifications as unskilled, skilled, bachelor degree or higher degree (4 groups);
- FER subregions (6 groups).

The combination of these breakdowns generates 336 cohorts for which expected lifetime earnings are estimated using a discount rate of 4.58 per cent and expected income growth rate of 1.32 per cent. These assumptions are in line with Wei (2008) and Jorgenson and Fraumeni (1989, 1992).

Limitations of the lifetime labour approach are that it assumes that all differences in wages are explained by skills and education. There are other sources of wage variation however, including compensating differentials, labour market imperfections and wage discrimination amongst other factors.

Effective Job Density

SGS has developed a measure of EJD to analyse access to jobs, agglomeration and its related benefits.

The measure is derived from the density and accessibility of all jobs across a region and is calculated using three variables: the travel times between locations, the transport mode of those trips and the employment levels those locations.

EJD is estimated as follows:

$$EJD_i = \sum_j \left(\frac{PT \text{ Mode Share}_j \times Emp_j}{PT \text{ Travel Time}_{ij}} + \frac{(1 - PT \text{ Mode Share}_j) \times Emp_j}{PV \text{ Travel Time}_{ij}} \right)$$

Where:

EJD_i is the Effective Job Density for zone i;

$PT \text{ Mode Share}_j$ is the percent of work trips which involve public transport for zone j;

Emp_j is the number of jobs/employment within zone j;

$PT \text{ Travel Time}_{ij}$ is the time it takes to travel on public transport from zone i to zone j; and

$PV \text{ Travel Time}_{ij}$ is the time it takes to travel by private vehicle from zone i to zone j.

Skill level analysis - over qualified workers

The ABS uses a multi-factor method to measure skill level that accounts for level of education, previous experience and on-the-job training required in an occupation. Skills are ranked from 1 (high) to 5 (low) and assignments are based on advice from employers, professional organisations and other groups (ABS, 2013).

The ABS has assigned a skill level to each four-digit ANZSCO occupation. Occupations with the top skill requirement generally require a bachelor degree or at least five years of relevant experience, these include most managers occupations and all professionals occupations.

Occupations with the bottom skill requirement generally require a Certificate 1 or secondary school education level. These include various labourer, sales and operator occupations.

For the analysis in this report we used ABS Census 2016 to obtain data on the highest educational attainment, occupation and relevant skill requirement for persons between 25 and 64 years. Those with a bachelor degree or higher who worked in occupations with a skill requirement less than 1 were considered overqualified for their position.

Input-Output Model – trade flows

Conversion of national tables

Using the Australian Input-Output tables published by the ABS as a base (ABS cat. no. 5209.0.55.001), the SGS model disaggregates national flows to regional geographies. The model estimates trade flows within the Greater Melbourne GCCSA boundary (rather than the Melbourne FER) and flows between FER subregions within the Greater Melbourne GCCSA have been derived with the following method.

Two rules apply within each modelled subregion:

1. Total supply must equal total demand
2. Total supply by an industry

The following factors are scaled using regional industry employment:

- Industry supply
- Private gross capital formation
- Consumption due to change in inventories
- Employee compensation
- Gross operating surplus and mixed income
- Taxes less subsidies on production

The following factors are scaled using regional government employment:

- Public gross fixed capital formation

The following factors are scaled using regional population:

- Household consumption
- Government consumption

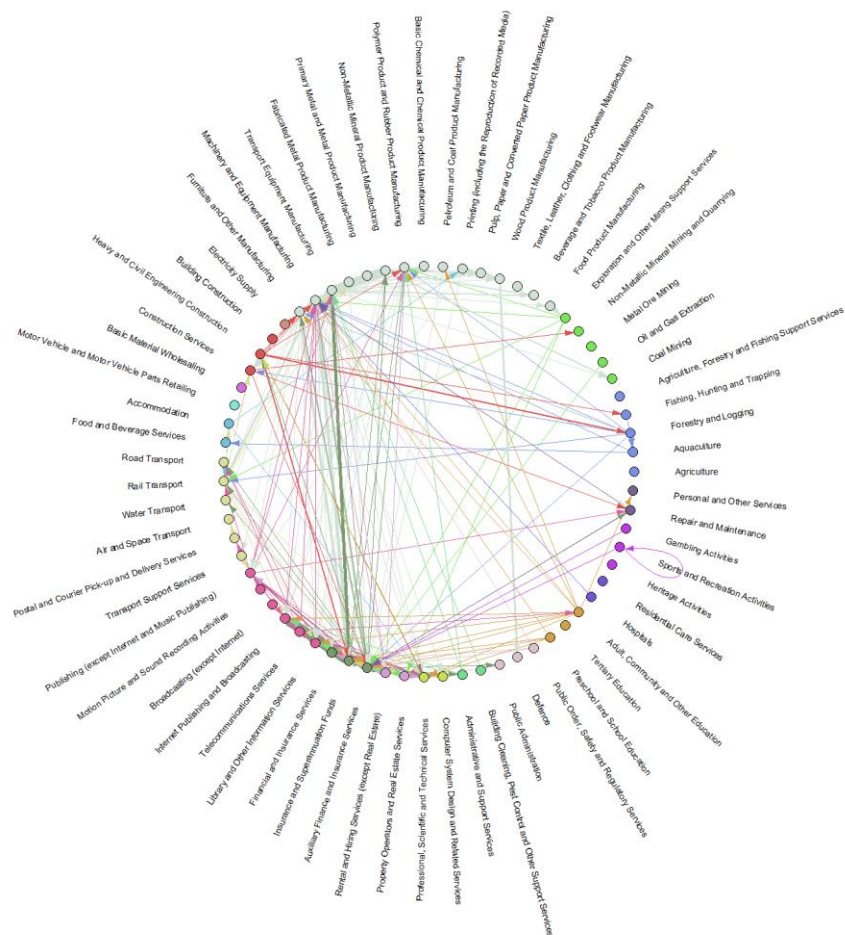
Imports are set so regional supply equates to regional production. Regional exports are calculated using location quotients for each industry. Note that imports and exports reflect both regional and international imports and exports.

Allocation of subregional flows.

Subregional flows for each are scaled by industry employment. Inputs for each industry and district are distributed according to the proportion of the region's employees within that district and industry. The regional output flows are then dispersed according to the proportion of the city's employees in each industry and district being supplied.

While the flows between the major Industry Divisions (ANZSIC 1 digit) were shown in the body of the report, more detailed flows between Industry Subdivision (ANZSIC 2 digit) are given in Figure 48 below.

FIGURE 48: TWO DIGIT ANZSIC SUPPLY CHAIN FOR MELBOURNE FER, SELECTED INDUSTRIES (2015-16)



Source: SGS Economics and Planning 2018; ABS (2018) cat. no. 5209.0.55.001, Australian National Accounts: Input-Output Tables, 2015-16



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