Industry Growth Opportunities: A technical report to support the Western Parkland City Economic Development Strategy

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Executive Summary

This report provides technical input to support the Western Parkland City Economic Development Strategy being prepared by the New South Wales Government and the Western Parkland City Authority. It complements the region's broader economic development strategy. The report accounts for the region's comparative economic advantages and examines industry supply-side and demand-side drivers of change which are associated with opportunity and risk. The aim is to grow existing industries and develop new industries which generate sustained growth in jobs, salaries and inclusive wealth within the Western Parkland City. There is a focus on growth opportunities associated with science and technology.

Western Parkland City – Future Industry Growth Drivers

Via the analysis of geopolitical, economic, environmental, social and technological trends we identify several drivers of change creating new industry growth opportunities for the Western Parkland City. These drivers of change are associated with new conditions, new opportunity and new risk. They are occurring at regional, state, national and global scales. The drivers of change include:

- *Demographic change* - The total population of the Western Parkland City is currently 1.1 million people. It is projected to grow 78% by 2041. This is above the New South Wales (NSW) population growth rate of 37% for the same time period. The population will also become more aged and by 2041 the number of residents aged 65 and over will more than double representing growth from 128,500 thousand people to over 333,000. The region is also becoming more culturally diverse and in four out of eight local government areas – including Camden, Liverpool, Penrith and Wollondilly - net migration is expected to exceed natural population growth between 2016 and 2041. Population growth, demographic ageing and cultural diversification will drive demand in the region for construction, health, education, aged care, transport and many other goods and services.
- *Digital transformation* – Telehealth, telework, online retail, online education and online entertainment were all increasing before COVID-19 struck. However, during the pandemic these areas of the digital economy have surged. In February 2021 the NAB online Retail Sales index recorded 40.7% year-on-year growth with Australians spending $46.9 billion online which is 13.2% of all retail [1]. The digital economy has also expanded. For example, since being launched on 24 February 2020 (at the beginning of the pandemic) the S&P ASX All Technology index - which comprises some of Australia's largest digital-sector companies – has increased total market capitalisation from $100 billion to $170 billion and has outperformed the benchmark S&P ASX 200 by 52% [2].
- *Rising freight movements*. The freight and logistics industry supports economic growth and job creation in the Western Parkland City. Freight movements sped-up during COVID-19. A recent study by Deloitte Access economics found that Australia post delivered an additional $2.4 billion worth of e-commerce parcel purchases from March to July 2020. Before COVID-19 freight movements were growing. Between 1997-2017 container freight by sea for advanced-economy countries grew almost 2.5 times and tripled in Australia. Road freight has also been rising. By 2017 the number of tonne-km of goods transported in Australia almost doubled compared to 1997; well above the OECD average [3]. Aerospace company Boeing forecasts that the global dedicated freighter aircraft fleet will increase from 2,010 planes today to 3,260 planes by 2040. The fastest rates of growth are in the Asia-Pacific region which will see the air-freighter fleet increase from 350 to 1,090 planes over the same time period [4]. These trends are indicative of future demand growth for the Western Parklands City freight and logistics industry.
- *Changing human mobility and settlement patterns*. Despite previous setbacks such as SARS and the Global Financial Crisis aviation has proved resilient over the longer term. Global air passenger movements

measured by revenue passenger kilometres (RPKs) have risen from roughly 1 trillion in 1980 to just over 8 trillion in 2020. In the COVID-19 pandemic RPKs dropped to 4 trillion [5]. However, they are forecast by Boeing and the International Air Travel Association to recover to previous levels and trend-growth by around 2025. Over the past 10 years growth in passenger air travel averaged 6.5% per year which is above the long-term average of 5%. Tourism travel is also rising. In 2000 households spent 4.4% of their annual expenditure on travel. By 2017 this share increased to 5.8% [6]. Another dimension to this driver is changed commuter mobility patterns and potential changes in settlement patterns. There has also been a shift in property market demand during the pandemic towards regional areas. CoreLogic property market data released in April 2021 shows sustained stronger price growth in regional NSW over the past 12 months. During this time Sydney property prices grew by 7.5% and regional NSW property prices by 15.6%. This could be relevant to the Western Parkland City as a region with lifestyle/recreation amenity on the fringes of a large capital city with more affordable houses.

> "A preference shift away from higher density housing during a global pandemic is understandable, however a rise in flexible working arrangements also seems to be supporting greater demand for houses around the outer-fringes of capital cities".
>
> - Tim Lawless, Executive, Research Director, Asia-Pacific, CoreLogic, 3 May 2021

- *Emerging systemic risks*. Industries able to create new and innovative products and services that tackle risks such as climate change, waste & pollution, infectious diseases and cybercrime are likely to see rising customer demand. The pandemic happens against a backdrop of rising infectious disease risk. In the last 20 years the world has seen SARS (2003), H5N1 (2005), H1N1 (2009), Ebola (2012) and MERS (2015) and COVID-19. Population growth, human mobility, jet travel, tourism, livestock production, animal handling and urbanisation are likely to see the disease risk intensify into the future. Climate change impacts are rising with increased severity and frequency of flooding, bushfires and extreme heat impacting the Western Parkland City. Waste streams grow at unsustainable rates and cyberattacks also continue to rise if frequency and severity. These challenges will create entirely new industries focused on solutions.

Western Parkland City – Focus Industries

Six focus industries were found to hold importance to the future development of the Western Parkland City economy. Here we briefly comment on the strategic opportunities for these industries:

- *Freight and logistics*: This is the stand-out industry for the region with substantially higher concentration of activity compared to other Australian regions. The industry has been growing well for decades and is well-set for future growth with strong demand drivers in Greater Sydney and beyond. It's a large, job-generating and economically healthy industry. The Western Parkland City industry is also becoming increasingly technologically advanced with warehouse automation (e.g. robotics, sorting, labelling, …), last mile logistics (e.g. address finding technologies, automated drone deliveries…), tracing and tracking technologies (radio frequency identification, global positioning systems…) and data science and optimisation technologies. Strategies for the development of this industry are associated with continuous improvement along the current trajectory of growth.
- *Advanced Manufacturing*: In the post-COVID world Greater Sydney will increasingly opt for local manufacturers with secure supply chains. With initiatives such as the federal $1.5 billion modern manufacturing strategy there's an opportunity for the Western Parkland City to meet this demand.
- *Agriculture and food*: The Western Sydney Airport and the regional freight and logistics industry could solve the longstanding problem of freight costs for farmers and agri-food businesses so they can reach huge and rapid-growth markets in Australia and Asia.

- *Defence and aerospace*: The Australian Government has recently announced an unprecedented increase in defence spending of $270 billion in new funds over the next ten years. Some confidential conversations with the Defence Department could identify opportunities for the region to win and deliver contracts.
- *Health and education:* This is the biggest employer within the region, as per many Australian regions. It will grow in line with population growth. It's an essential industry that will benefit from continued innovation and productivity improvements. Aged and disability care is a rapid-growth sub-sector and there is an opportunity to convert what is currently a service industry within the region into an exporting know-how industry.
- *Visitor economy:* Lots of people visit the region but many are day-trippers from Greater Sydney with relatively low levels of expenditure. The objective for the Western Parkland City visitor economy is to get visitors to stay longer and spend more. The adventure tourism industry can help achieve this.

Western Parkland City – New and Emerging Industries

Our analysis identifies high growth emerging technology industries for the Western Parkland City. These industries don't yet exist and therefore carry risk. However, if they succeed there is high potential pay-off for first movers who gain competitive advantage. These industries are emerging due to shifts in demand and supply. The emerging industries satisfy requirements for path dependence by building upon existing industry within the region. They include:

- *Heat-tech:* This emerging industry provides products and services to mitigate the economic, environmental and social impacts of heatwaves, and unseasonably hot weather, on urban environments. Currently around 30% of the world's population is subject to heat conditions where temperature-humidity combinations exceed a survivable threshold. This will increase to 48% - 74% by 2100 [7]. The demand for solutions will be strong. Recent years have seen an expansion of architectural, healthcare, tree-planting, urban design, construction site, forecasting/advisory and other heat-tech products and services. Business within the Western Parkland City could supply these products and services to the region, Greater Sydney, Australia and worldwide.
- *Building-tech:* This industry involves the manufacture and onsite delivery of prefabricated buildings and the manufacture of high-performance construction materials. In Sweden prefabricated building systems account for approximately 80% of the construction market. However, in Australia just 4% of new buildings are prefabricated. Prefabrication can decrease building duration by 40% with major cost savings [8]. The Western Parkland City will see 45,200 new houses built with 191,050 new houses in greater Sydney over the coming 5 years [9] which will fuel demand for building-tech. Supply-side products and services include manufacturing modular buildings, manufacturing construction materials, software and information technology products and professional services such architectural and engineering advice.
- *Circular-tech:* This industry involves advanced recycling and manufacturing of solar panels, lithium-ion batteries and e-waste. Total worldwide solar panel waste will increase from 250,000 tonnes in 2016 and reach 78 million tonnes by 2050 [10]. There will be strong demand for solar panel recycling. Old solar panels can be used to make new solar panels. Lithium-ion battery waste is growing at 20% per year and 95% of the product can be recycled; mainly to make new lithium-ion batteries. However, only 2% of lithium ion batteries are recycled. In 2018 Chinese factories which convert e-waste into gold bars were economically on par with virgin gold mining [11]. The advanced manufacturing of precious metals, lithium ion batteries and solar panels from recycled materials represents an industry growth opportunity in the region.

Policy Considerations

1. Geographic industry clusters. Identifying a cluster requires choosing specialisations and locations and/or geographic configurations. We have identified emerging specialisations including heat-tech, building-tech

and circular-tech. These can be subject to more detailed appraisal and consultation. A cluster-based approach is suggested because businesses within clusters grow jobs faster, grow revenue faster and innovate more. Cluster approaches need sustained commitment over time. We note that market-forces can create clusters organically.

2. Industry ecosystems. There is strong economic development potential across all the focus and emerging industries requiring different levels of, and types of, government intervention. We identify a set of specific action items in the report for further consideration and assessment to build industry ecosystems and catalyse the growth of the emerging and focus industries. These actions involve the creation of new centres-of-excellence, conducting research and development, developing education and training capabilities and attracting anchor tenant organisations.

3. *Education and training.* Practically every success story of regional industry development from across the globe has a university at its core. Universities generate spill-over benefits for regional economies. The university can provide both education and technical/vocational training in areas relevant to the region's industry specialisations. The standards of excellence in teaching and research at the university are relevant to its regional economic benefit.

4. Research and development. The research and development investment can create new capabilities which can be translated into commercially valuable products and services. If the researchers who develop these new capabilities reside and stay within the Western Parkland City the new knowledge can lead to start-ups which develop into larger companies. This happened spectacularly in the City of Cambridge in the United Kingdom where research and development at the university led to spin-off companies that stayed within Cambridge and some became large > $1 billion companies.

5. Adventure based tourism. Adventure tourism includes hiking, mountain climbing, canyoning, mountain biking and other activities. Visitors engaging in these activities tend to stay at destinations longer and spend more money. This could help the Western Parkland City convert day trippers into longer term, higher spending, visitors.

Conclusion

This report has identified high-level existing and new industry growth options along with policy levers available to government. The next step requires connecting these high-level opportunities with on-the-ground actions. There is also a requirement for prioritisation. Lastly, industry clusters typically develop over decades and require sustained government, industry and community support.

Contents

1 Introduction

This report provides technical input to support the Western Parkland City Economic Development Strategy being prepared by the New South Wales Government and the Western Parkland City Authority. This report is about the growth of existing industries and the creation of new industries within the Western Parkland City of Greater Sydney. The aim is to identify industry development opportunities that maximise job creation, wealth creation and quality of life within the Western Parkland City region. Our analysis concentrates on emerging industry clusters, economic ecosystems and actions which can potentially shift the dial and fast-track growth and development.

The Western Parkland City is one of three cities comprising the future vision for the Greater Sydney region with the Central River City and the Eastern Harbour City being the other two. The Western Parkland City contains eight local government areas including the Blue Mountains, Camden, Campbelltown, Fairfield, Hawkesbury, Liverpool, Penrith and Wollondilly [12]. In March 2018 representatives from these governments signed the 20-year Western Sydney City Deal with the New South Wales State Government and the Australian Federal Government [13]. This agreement supports the management of the entire region to achieve social, economic and environmental objectives and deliver improved quality-of-life for its residents and visitors.

The Western Sydney City Deal will be delivered against a backdrop of unprecedented infrastructure investment and rapid population growth. Within the infrastructure sphere Federal, State and Local Governments have committed to over $20 billion of infrastructure for the Western Parkland City including the Western Sydney Airport ($5.3 billion), new roads ($3.2 billion), new rail ($9.9 billion), new public hospitals ($2.4 billion) and new public schools ($0.7 billion) [13]. There are few precedents within Australia or the world reaching such intensity for infrastructure investment at a regional level. One of the initiatives guiding these investments is the New South Wales Government Place-based Infrastructure Compact. This is a program to plan for, and deliver upon, the infrastructure needs of people and businesses in a 36,000 hectare area of land within the centre of the Western Parkland City [14].

Construction is underway on the Western Sydney Airport with operations planned to commence in 2026. Once up and running it will provide Greater Sydney's first curfew free international and domestic passenger and freight services. The airport will be the centre of the planned Western Sydney Aerotropolis. An aerotropolis is defined as "a community that grows, or is even created, with an airport as its economic engine" (page 149) [15]. The development of the aerotropolis includes five initial precinct plans [16]. Each precinct has a unique social, economic and environmental identity and a distinct, but complementary, industry growth pathway [17]. The Precinct Plans have been on exhibition for community and stakeholder feedback which is now being considered by government.

Another core driver of change relates to demographics. The population of the Western Parkland City is amongst the fastest growing of any advanced economy region worldwide. The current population of 1.1 million people is growing at the rate of 2% per year. The economy is also growing rapidly and there are currently 372,000 workers in the region. The gross regional product is currently $56 billion. Of all the local governments Camden is the fastest growing; it's 2016 population of 80,250 people will grow to 307,750 by 2041 at the rate of 5.5% growth per annum. The need to plan for and accommodate rapid population growth is a foundational issue relevant to economic development, infrastructure planning and a wide range of policies and activities by government in the Western Parkland City [18].

These drivers are creating a rare opportunity for the Western Parkland City to fast track economic growth and development and build a new, and better, way of life for residents and visitors. Part of this will require the growth of existing industries and the creation of new industries. That's the focus of this report. We aim

to apply practical theories and concepts of industry development from the field of economic geography to identify the actions which can catalyse growth. Concepts of industry clusters and economic ecosystems are central to our analysis. These well-established theories of economic development can give governments insights about how to "tweak" the policy environment to take advantage of powerful market forces that organically develop new job generating and new inclusive wealth generating industries.

2 The Western Parkland City Economy

This section presents a baseline analysis of socio-economic indicators relevant to industry growth potential in the Western Parkland City. This includes a brief review of economic development strategies and resources relevant to the region and prepared over the past few years. We describe our source data in Appendix B.

2.1 Focus Industries

The Australian and New Zealand Standard Industry Classification (Level 4) identifies 506 unique industry types. To examine the current and future potential of all these industries in the Western Parklands City would be infeasible. Therefore, to enable a targeted approach Federal, State and Local Governments identified a set of focus industries for the Western Parklands City which are likely to be associated with current strengths and future opportunities. These were first shown in the in the 2018 Western Sydney City Deal by the Australian, New South Wales and eight Local Governments [19]. Subsequent review, analysis and consultation lead to the identification of focus industries to guide the analysis in this report. The focus industries covered in this report include:

1. *Education*. This captures all forms of education and vocational training from early childhood through to universities and technical colleges. It also captures education technology and support services.
2. *Health*. This is defined broadly to cover a wide range of health and wellness services including aged care services.
3. *Freight and logistics*. This includes all forms of road, rail and air-freight services and the warehouses and logistics services needed for the efficient movement of goods.
4. *Visitor economy*. This includes all tourism, business and personal travel and all of the direct and indirect services that supply the needs of the travellers within the Western Parkland City.
5. *Advanced manufacturing*. This involves the use of new and innovative methods and technologies to produce new products, and recycle existing ones, to meet human needs efficiently and effectively.
6. *Agribusiness*. This includes both agricultural production (livestock, horticulture and cropping) and food packaging and processing businesses.
7. *Defence*. This includes all personnel and activities within the armed services and the businesses which support them.
8. *Medical technologies (medtech)*. This includes all technologies and innovations used within the healthcare sector to deliver improved services to patients and customers.
9. *Aerospace*. This industry is involved in the research, development, manufacture, maintenance and support of all forms of aircraft and aviation systems.

2.2 Economic Output and Industry Value Add

The Western Parkland City is estimated to have a Gross Regional Product (GRP) of $56 billion per year [13] which is 12% of Greater Sydney's GRP of $460 billion/year [20] which in turn represents 24.5% of Australia's GDP. Total employment within the Western Parkland City is projected to increase to about 400,000 in 2021. Over the same period, the region's total economic value added – a measure of industry output - is expected to grow from $32 billion to $39 billion (Figure 1). Most of the region's economic activity is in the Penrith, Liverpool, Fairfield and Campbelltown local government areas, which together accounted for 75% of the region's employment and 74% of its value added in 2016.

The focus industries account for about one third of total economic activity in the Western Parkland City (Figure 2). Other significant industries in the region include construction and professional, scientific and technical services. These industries provide opportunities for the development of new and emerging industries. For example, many workers in the large and growing professional, scientific and technical services industry will have skills relevant to the heat-tech, freight-tech, building-tech and circular-tech industries. In addition, the substantial construction activity in the region could provide a local market for the products developed and manufactured by the building-tech and heat-tech industries.

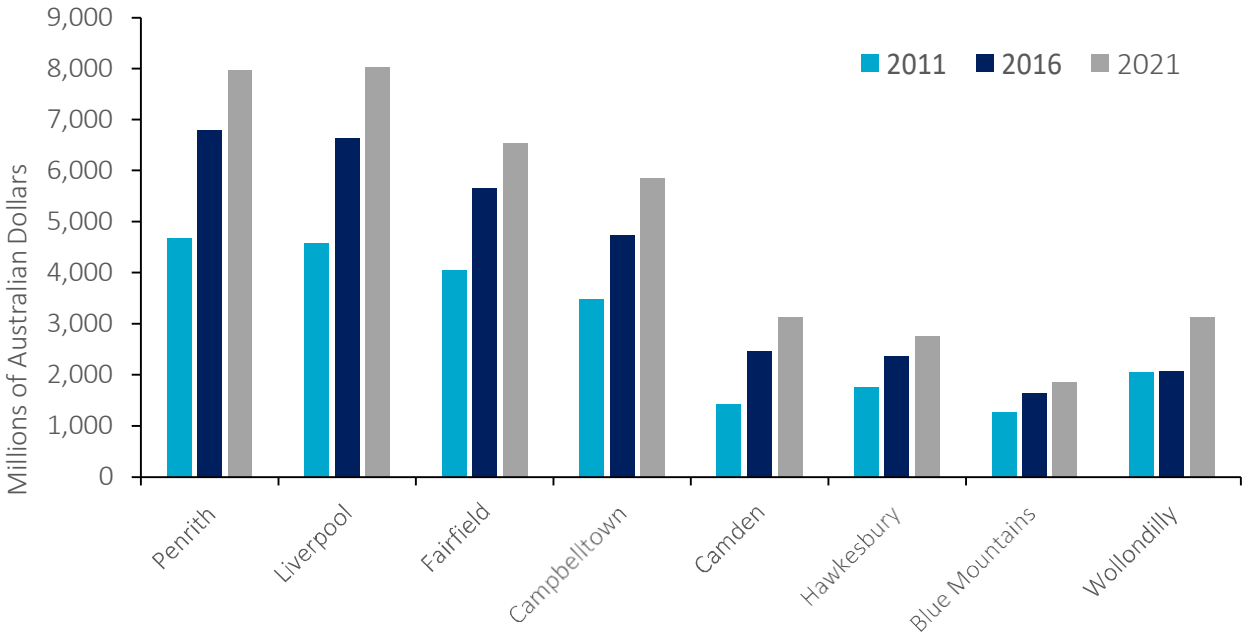

Figure 1 Total industry value added by local government area.

Note: Estimated total value added for the region: $23 billion (2011), $32 billion (2016), and $39 billion (2021).

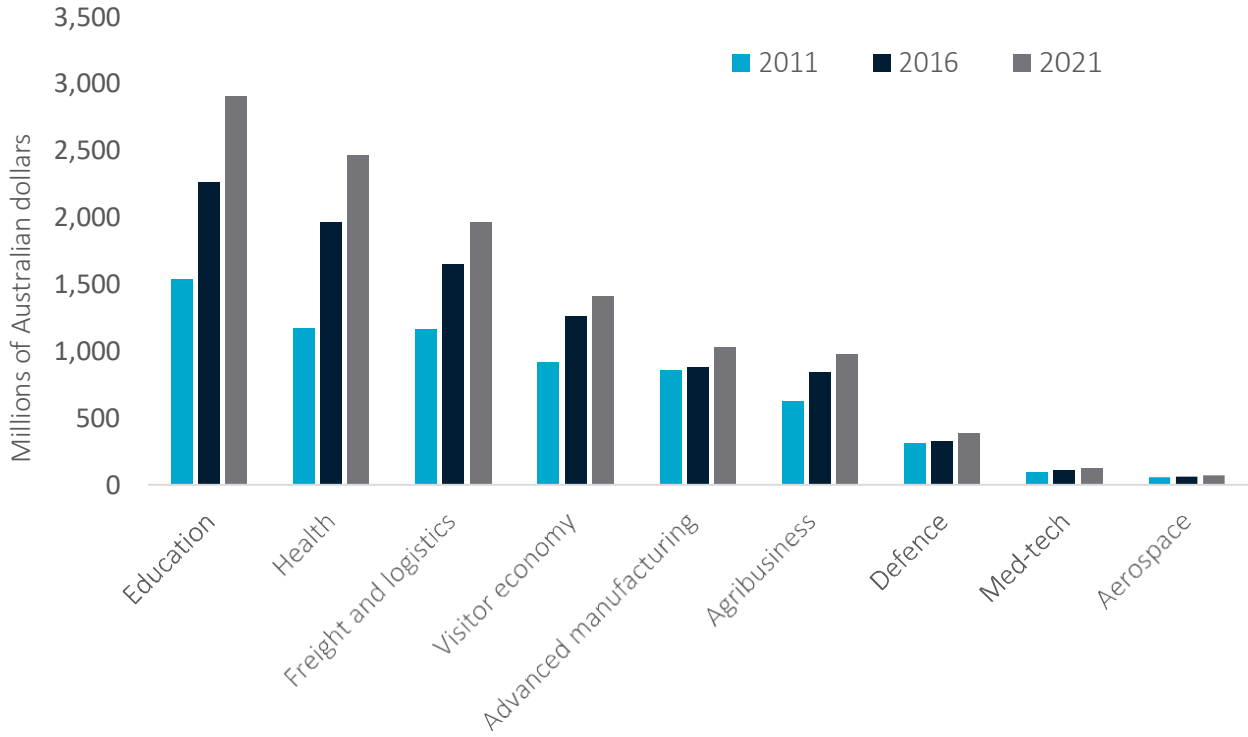

Figure 2 Total gross value added within the Western Parkland City by focus industry.

2.3 Employment by Focus Industry

In each local government area within the Western Parkland City, total employment (Figure 3) increased between the 2011 and 2016 Censuses. It is projected to increase further in the August 2021 Census. Employment and value added tend to be closely aligned across the local government areas. The exceptions are the Blue Mountains, where a relatively large share of the labour force works in low value add industries (such as visitor economy), and Wollondilly, where a relatively large share of the labour force works in high value add industries (such as mining). The sharp projected increase in value added for Wollondilly in 2021 is due to an increase in mining employment.

In terms of total employment within the Western Parkland City, all industries have grown in recent years (Figure 3). Employment growth has been particularly strong in health care and social assistance, construction, professional services, and transport, postal and warehousing with each increasing its share of the Western Parkland City's total workforce. Employment growth has been weakest in manufacturing, retail trade, and public administration and safety, with each accounting for a decreasing share of the total Western Parkland City workforce. However, at State and Federal levels there is a renewed commitment to grow the manufacturing sector [21]. So, the downward trends of the past may change in the future.

The focus industries for our research project (Figure 4) account for 35% of the Western Parkland City's total employment and 29% of its value added. Education, visitor economy and health are the largest employing focus industries; each one increased its employment between 2011 and 2016 and is projected to continue to grow through to 2021. Freight and logistics, advanced manufacturing, agribusiness and defence also employ significant numbers of people within the Western Parkland City. However, only freight and logistics and agribusiness have increased their employment in recent years, with advanced manufacturing and defence flat or in moderate decline. The med-tech and aerospace industries employ very few people in the region. However, we note the greenfields nature of economic development and industry growth in the Western Parkland City. An entirely new city with new industries is being built. Just because it's not showing signs of growth now doesn't mean it won't grow in the future.

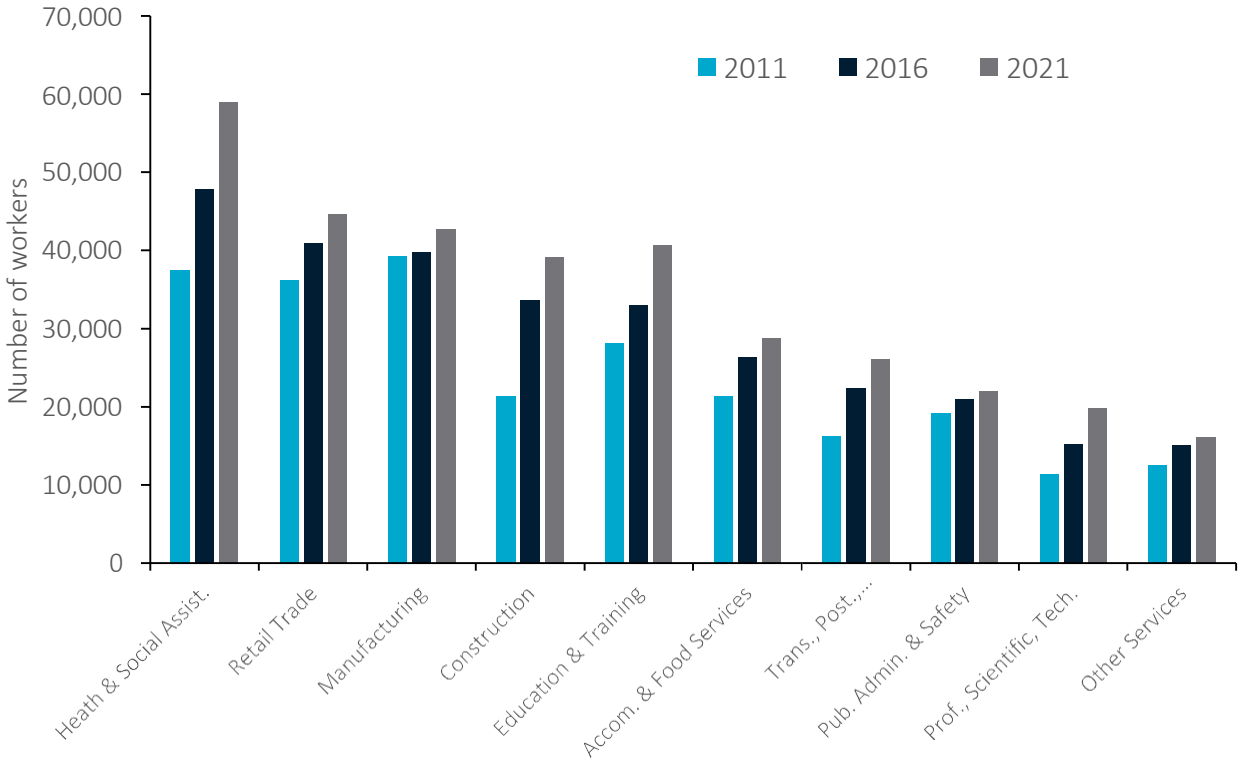

Figure 3 Employment by ten largest employing industries in the Western Parkland City.

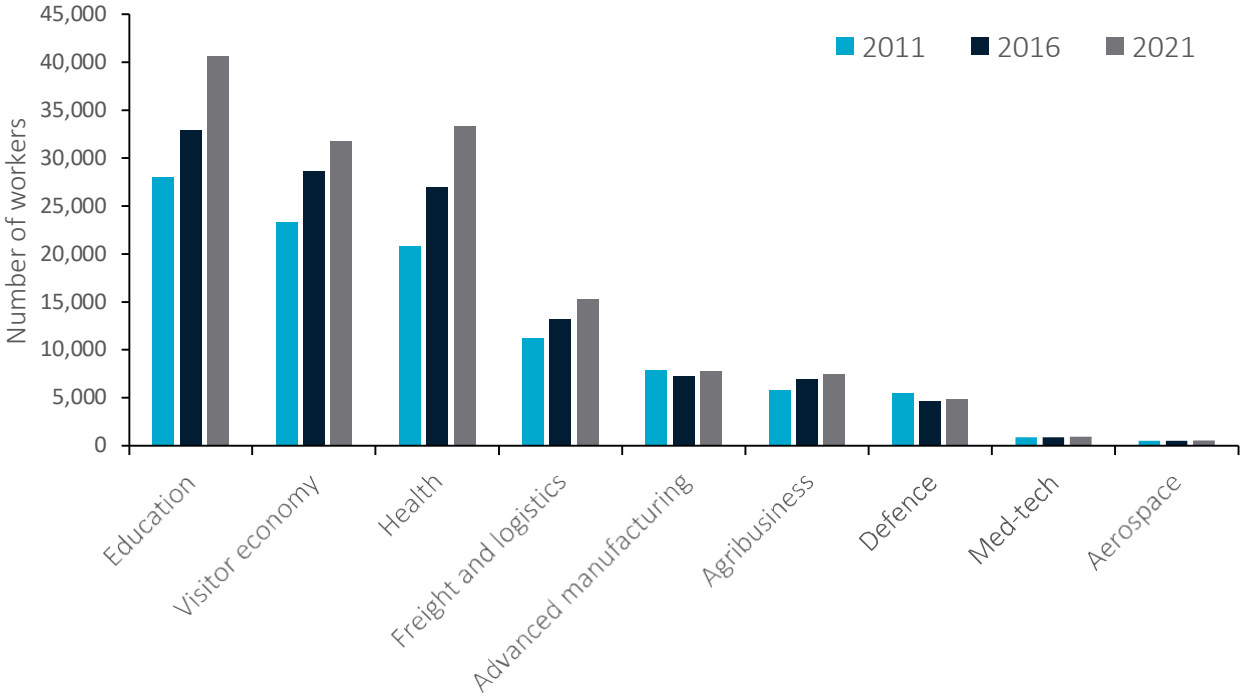

Figure 4 Total employment within the Western Parkland City by focus industry.

2.4 Geographic Distribution of Employment

In comparison to New South Wales and Australia, relatively large shares of the Western Parkland City labour force work in education, freight and logistics, advanced manufacturing and defence (Figure 5). Education's relatively large share of employment in the Western Parkland City is due to large shares of workers in primary and secondary education. Employment in defence is mainly driven by government procurement decisions. In recent years, total focus industry employment has increased in all Local Government Areas within the Western Parkland City (Figure 6). For most of the individual focus industries, employment is unevenly distributed across the region. A summary of the regional distribution of employment is as follows:

- Advanced manufacturing employment is predominantly in Liverpool, Campbelltown, Fairfield and Penrith. These are the built-up and more densely populated regions within the Western Parkland City. These areas are most likely to see continued development of manufacturing and advanced manufacturing.
- Defence employment is mostly in Hawkesbury, where it is a relatively large share of employment, and Liverpool. Hawkesbury is also home to all aerospace employment in the region associated with the Richmond RAAF Air Base.
- Agribusiness employment is spread across all Local Government Areas, and accounts for a particularly large share of employment in Wollondilly.
- Freight and logistics (predominantly road freight transport) accounts for substantial and growing employment in all Local Government Areas in the region, except for the Blue Mountains. The Western Parkland City has a much higher concentration of freight and logistics workers compared to other New South Wales and Australian regions. Freight and logistics is an unambiguous standout industry that characterises the regional economy.

- Employment in the health and education industries is spread across all Local Government Areas. Health employment is particularly large in Liverpool and Penrith. However, health and education tend to be large employers in all Australian regions.
- Aerospace employs a small fraction of the workforce and generates a small fraction of industry revenue. Whilst there are aspirations to grow aerospace it is currently a small industry compared to others in the region.
- Most of the region's med-tech employment is in Campbelltown and relates to pharmaceutical manufacturing.
- Visitor economy accounts for a large share of employment in each Local Government Area, particularly the Blue Mountains.

This distribution of employment has implications for economic development. For example, since defence, aerospace, advanced manufacturing and med-tech activity only occurs in a few of the Local Government Areas, the benefits from the further development of these industries would likely be concentrated on a smaller part of the total region. In contrast, benefits from the development of the spatially dispersed freight and logistics and agribusiness industries are likely to be spread more widely.

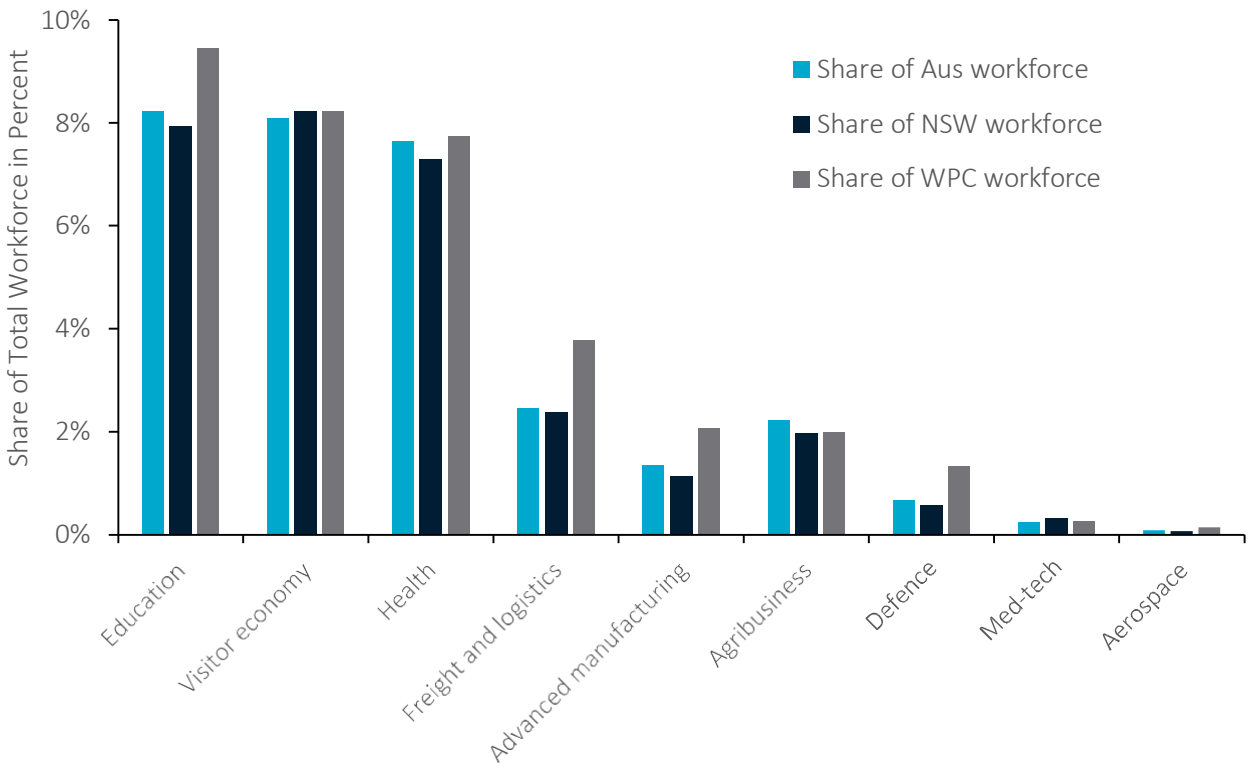

Figure 5 Employment for Australia, New South Wales and Western Parkland City in 2016.

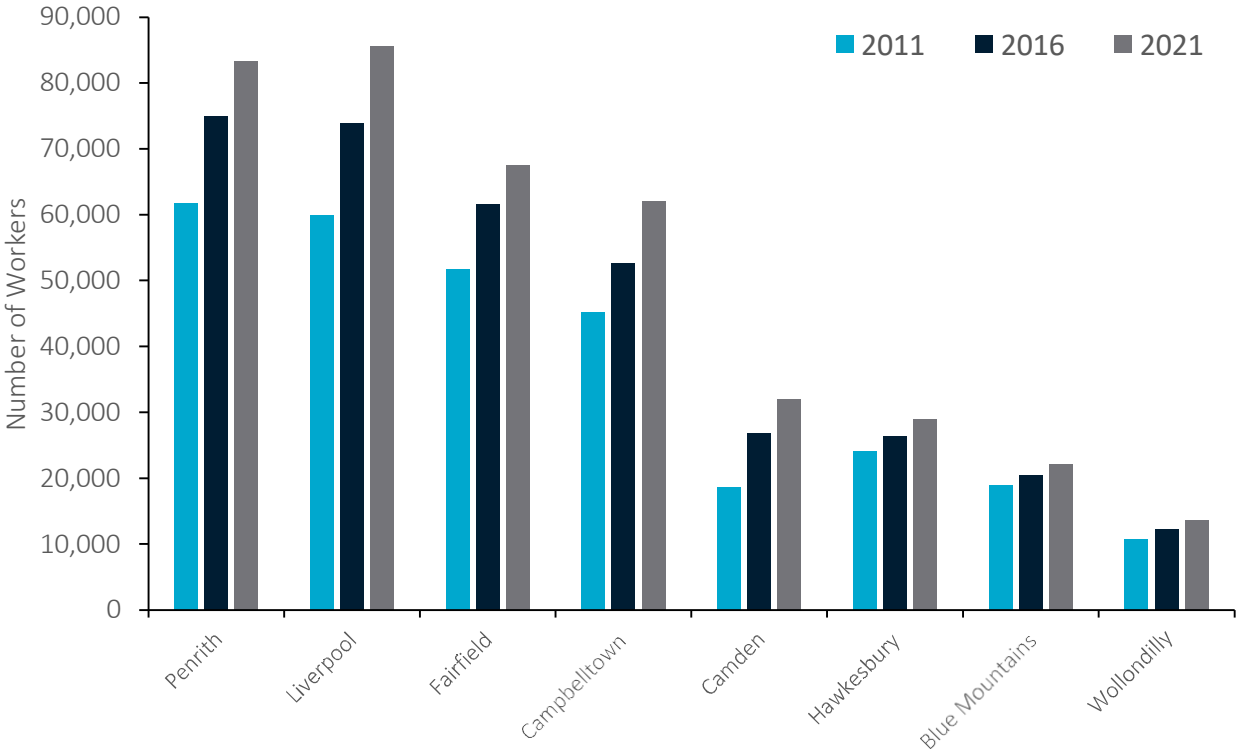

Figure 6 Total employment by local government area within the Western Parkland City.
Note: Estimated total employment for the region: 291,000 (2011), 349,000 (2016), and 395,000 (2021).

2.5 Educational Profile of Workforce

In terms of educational profile, the 2016 Census shows that the Western Parkland City workforce differs from the Greater Sydney workforce in a few ways (Figure 7). First, it has a larger proportion of workers whose highest level of educational attainment is the completion of high school. Second, it has a smaller proportion of degree holders and a larger proportion of certificate 3 and 4 holders. Third, a greater share of its post-school qualifications are in the fields of engineering, architecture and building, health and education, while a smaller share are in management and commerce and information technology (Figure 8).

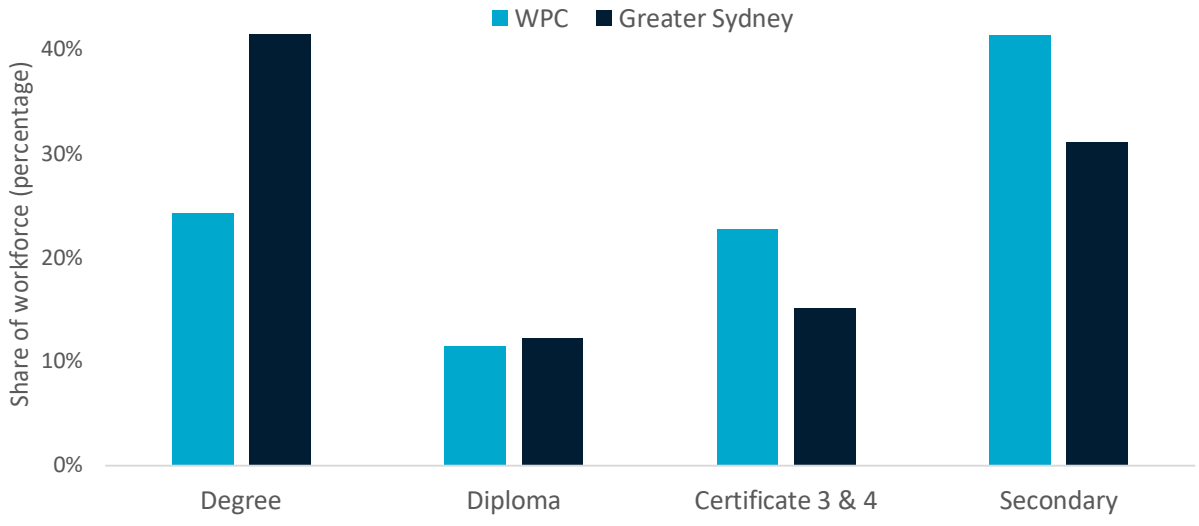

Figure 7 Workforce shares by highest level of educational attainment.

These aspects of the workforce's educational profile are largely a reflection of the types of jobs in the region and will change over time with changes in labour demand. In any case, there is clearly the potential for more workers to obtain post-school qualifications to meet the demands of industry development. It is also clear that the current workforce's qualifications are highly concentrated in fields relevant to the focus and emerging industries considered in this report.

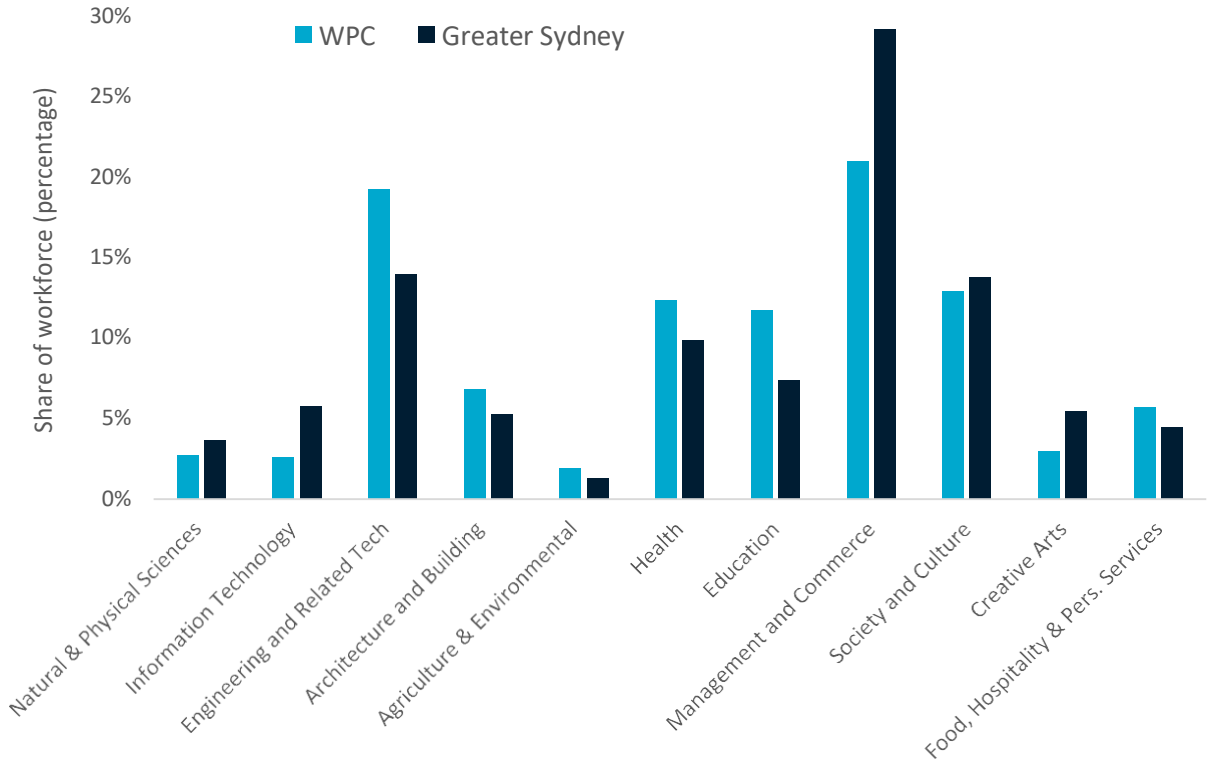

Figure 8 Share of workforce with tertiary qualification by field of study in Western Parkland City.

2.6 Employment Land Development Potential

Since the year 2010 the NSW Government Department of Planning, Industry and Environment has been monitoring the current status and future potential of industrial land and business parks. This is part of the Employment Land Development Monitor project which covers the Sydney, Central Coast, Hunter and Illawarra-Shoalhaven regions. Employment land areas are a significant indicator of industry growth (and jobs growth) potential because they show the available areas that could be developed. The most recent release of the employment lands is for January 2020 and does not capture any potential impacts that may be associated with the COVID-19 pandemic. We also note that the rezoning of land in the aerotropolis will create substantial new employment lands which are not yet captured in these data.

The data reveal that the Western City region contains the bulk of Greater Sydney's undeveloped industrial land stocks (general industry, light industry and heavy industry) equating to 1,341 hectares or 54% of all undeveloped industrial land in Greater Sydney. The Wester City region also contains the largest share of undeveloped "business development" lands at 90 hectares (70% of Greater Sydney) and "business park" lands at 235 hectares (54% of Greater Sydney). This is associated with the "greenfields" nature of the Western Parklands City and is indicative of future development potential. It indicates there is considerable land area to develop employment-generating activity in the Western Parkland City (Figure 10, Figure 9).

All of the eight local governments that comprise the Western Parkland City have considerable undeveloped industrial and business land (Figure 11). Penrith has the largest area of undeveloped industrial land at 466 hectares (45% of the Western Parkland City). Camden has the largest area of undeveloped light industry land at 66 hectares (30% of the Western Parkland City). Wollondilly has the largest identified area of heavy industry land at 58 hectares (60% of the Western Parkland City). Camden has the largest area of "business development" land and Penrith has the largest area of "business park" land.

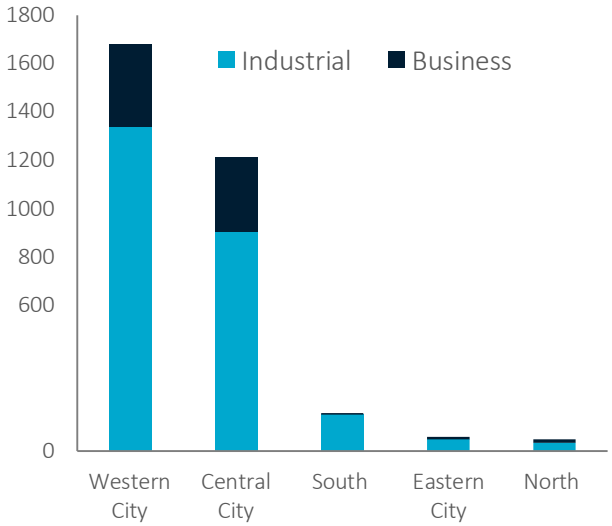

Figure 10. Undeveloped employment lands in Greater Sydney by district.

Data source: NSW Department of Planning, Industry and Environment, Employment Lands Development Monitor 2020 (for January 2020).

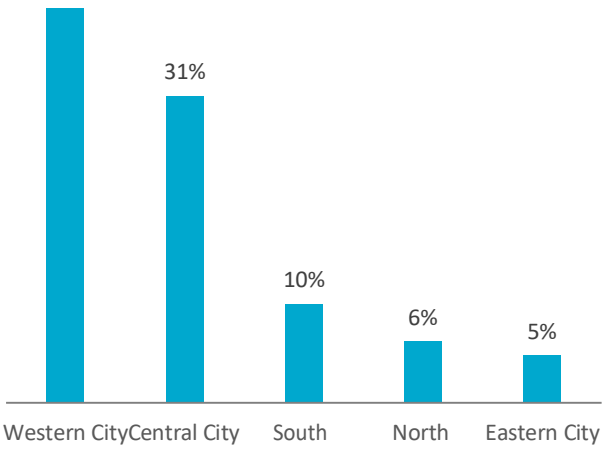

Figure 9. Ratio of undeveloped to developed employment in Greater Sydney by district.

Data source: NSW Department of Planning, Industry and Environment, Employment Lands Development Monitor 2020 (for January 2020).

In summary, the data on developed and undeveloped employment land demonstrate the significant potential for the Western Parkland City to increase land areas devoted to business and industrial purposes with job-creation benefits.

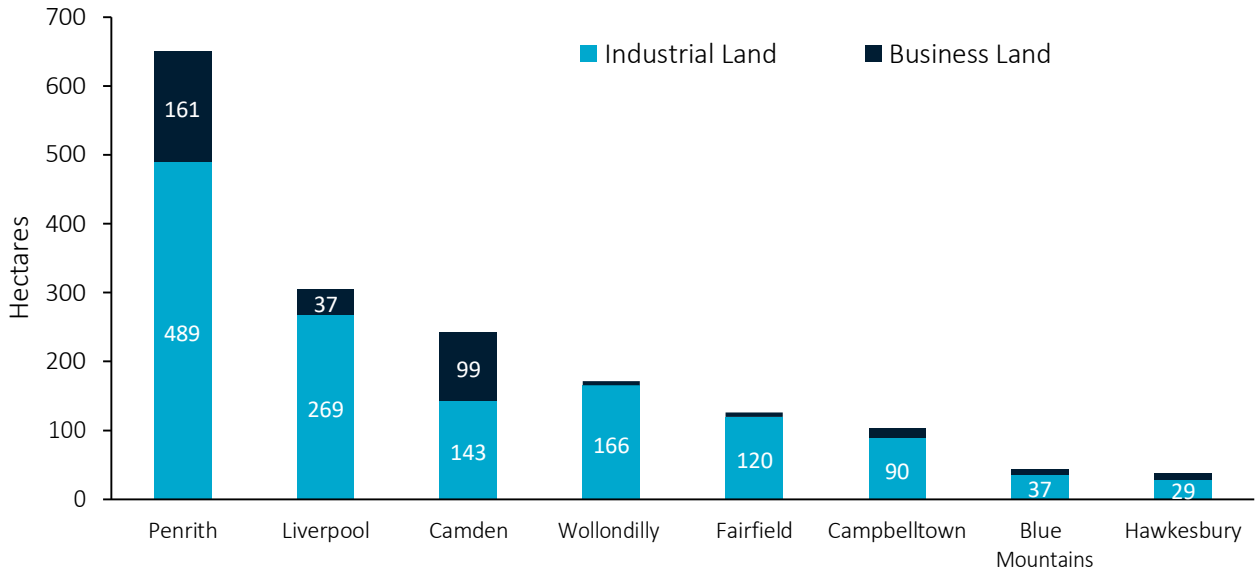

Figure 11. Undeveloped land with employment generation potential within the Western Parkland City.
Data source: NSW Department of Planning, Industry and Environment, Employment Lands Development Monitor 2020 (for January 2020).

2.7 Western Parklands City – Plans and Strategies

In the past few years there have been numerous plans, strategies and information resources developed by the NSW State Government, the Greater Sydney Commission, the Western Parklands City Association and the eight local governments which comprise the region. A comprehensive review of all these documents and related activities lies beyond the scope of this report. Here we identify and summarise a subset of key documents relating to industry development in the Western Parkland City:

- *The Western Sydney Aerotropolis Investor Guide (2018) [22]*. This document identifies opportunities for investment in aerospace and defence; food and agribusiness; health; research; advanced manufacturing; building and construction. It also provides key statistics on the aerotropolis including passenger forecasts of 5 million people by 2026 and 10 million people by 2031 and describes the 20-year investment agreement and infrastructure pipeline by all three levels of government.
- *The Western Sydney City Deal – Vision, Partnership and Delivery (March 2018) [19]*. This sets out six commitments for the deal including (1) connectivity; (2) jobs for the future; (3) skills and education; (4) liveability and environment; (5) planning and housing; and (6) implementation and governance. Quantitative targets are given for some of these including a 30-minute average commute time and 200,000 jobs for the future.
- *The Western Sydney City Deal Implementation Plan (December 2018) [23].* This is an implementation plan for the City Deal that was signed by the Australian and New South Wales governments and the eight local councils on 4 March 2018. The City Deal has 38 commitments including the creation of 200,000 jobs by "supercharging" the Western Parkland City.
- *The Western Sydney City Deal Progress Report (June 2020) [24].* This report is tracks progress against the objectives and outcomes of the city deal. The highlights it reports include the release of a digital twin for the Western Parkland City; the completion of a business case for Stage One Sydney Metro Greater West railway; the opening of an indigenous business hub in Liverpool; the opening of the new opportunity hub at Liverpool; an expanded hub at Campbelltown; the establishment of the Western Sydney Health Alliance and other achievements.
- *Making the Western Parkland City: Initial Place-Based Infrastructure Compact Area (November 2020) [14]*. This presents initial findings of the Place-based Infrastructure Compact (PIC) which identifies two areas for more detailed analysis of infrastructure development. These include the Western Sydney Aerotropolis and the Greater Penrith to Eastern Creek areas.
- *Our Greater Sydney 2056: Western City District Plan – Connecting Communities (March 2018) [12]*. Prepared in accordance with section 3.4 of the Environmental Planning and Assessment Act 1979 this document by the Greater Sydney Commission sets out a plan for the Western City Parklands in the context of the Greater Sydney three-cities metropolis vision.
- *Delivering the Western Parkland City (2019) [25]*. This document describes how the Western City and Aerotropolis Authority will achieve on-ground delivery of all relevant plans and strategies for the Western Parkland City. Employment growth is a focus of this document which opens by stating that "*The Authority has been established under the Western Sydney City Deal to commence delivery of 200,000 jobs, over 20 years, needed for our community*".

3 Industry Growth Drivers

In this section of the report we identify drivers of change relevant to industry growth in the Western Parkland City. These drivers of change will unfold over the coming 20 years signalling opportunity and risk for the growth of existing industries and the formation of new industries within the Western Parkland City. In each case we examine the implications for the Western Parkland City. At the conclusion of this section we also present and discuss a set of generic policy levers which can be applied by governments to catalyse industry growth and illustrate their use through case studies (Appendix A).

3.1 Demographic Change

This first driver of change is about the sheer extent of population growth and demographic change within the Western Parkland City. There are comparatively few regions within the world's advanced economies forecast to have such rapid and sizeable population growth. The Western Parkland City needs to accommodate an additional 679,000 people over the coming 20 years. Demographic change in the region will shape supply and demand drivers for new and existing industries. Population growth will supply a workforce for emerging industry. It will also generate demand for products and services. This driver of change will shape practically every aspect of government policy and industry strategy within the region.

3.1.1 The population is ageing and growing

The total population of the Western Parkland City is currently around 1.2 million people. It is projected to grow 78% by 2041 (Figure 12). This is above the New South Wales population growth rate of 37% for the same time period. Five out of eight local government areas within the Western Parkland City are expected to grow faster than the New South Wales average [26]. The region contains the two fastest population-growth local government areas in New South Wales which are Camden and Liverpool. By 2041 Camden's population is expected to be almost four times its current size and Liverpool's population is expected to double.

In line with the rest of Australia and New South Wales the population of the Western Parkland City is expected to age over the coming decades (Figure 13). However, it will still have a considerably younger population than the national average. By 2041 it is projected that the number of residents aged 65 and over will more than double representing growth from 128,500 thousand people to over 333,000. However, the region is expected to keep attracting young and middle-aged demographics. The share of the aged population in the Western Parkland City (18%) will remain below the average share for New South Wales (21%).

The proportion of older people, and rates of ageing, differ across the local government areas within the Western Parkland City. For example, by 2041 it is expected that almost every third resident of the City of Blue Mountains will be 65 or older making it one of the more aged local governments within the region [26]. By comparison, Camden and Liverpool are expected to retain the same relative shares of young-old population cohorts in the year 2041 as they do currently.

The population of the Greater Sydney Region is expected to increase by 35% by 2041. The largest source of growth is expected to be net overseas migration followed by natural change (number of births exceeding number of deaths). Interstate and intra-state migration is expected to be negative for the Greater Sydney Region between now and 2041 [26]. As well as remaining a significant destination for overseas migration the Greater Sydney Region is expected to see more births than ever before over the coming years [26].

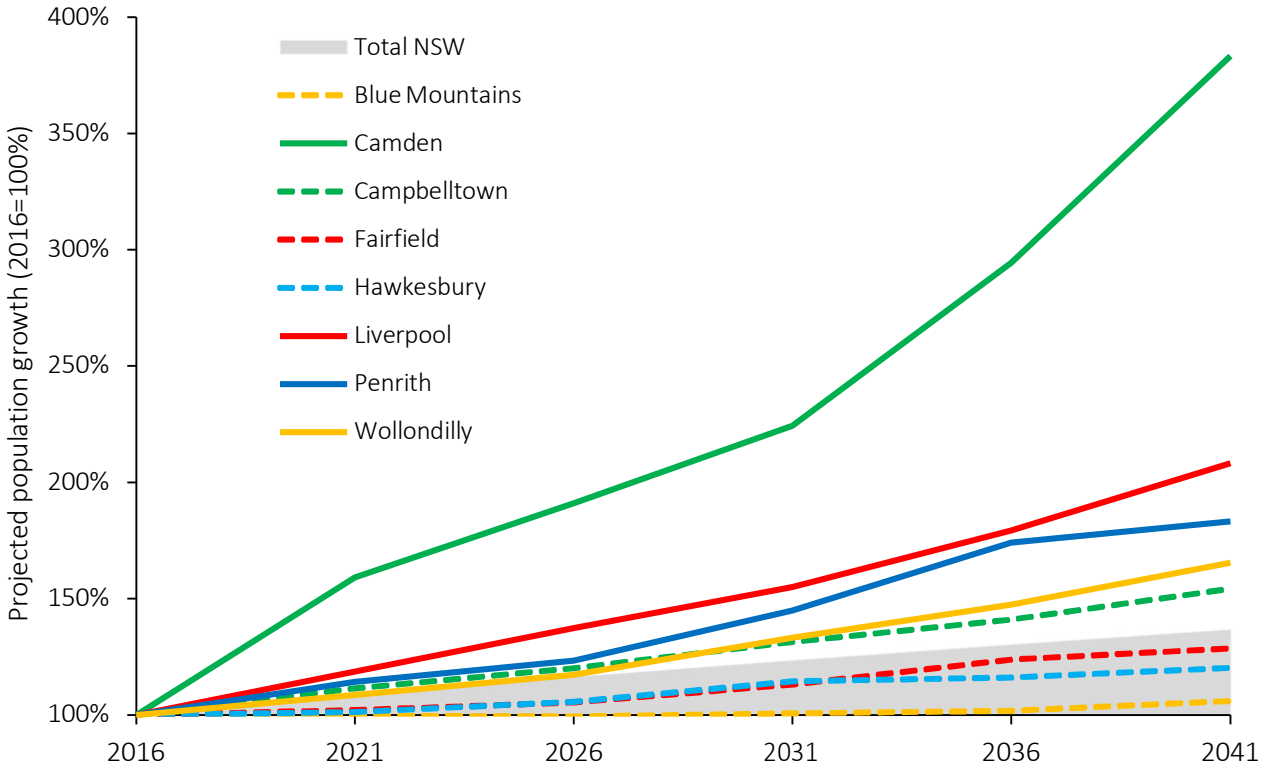

Figure 12 Population growth projections.

Data source: Department of Planning, Industry and Environment [26]

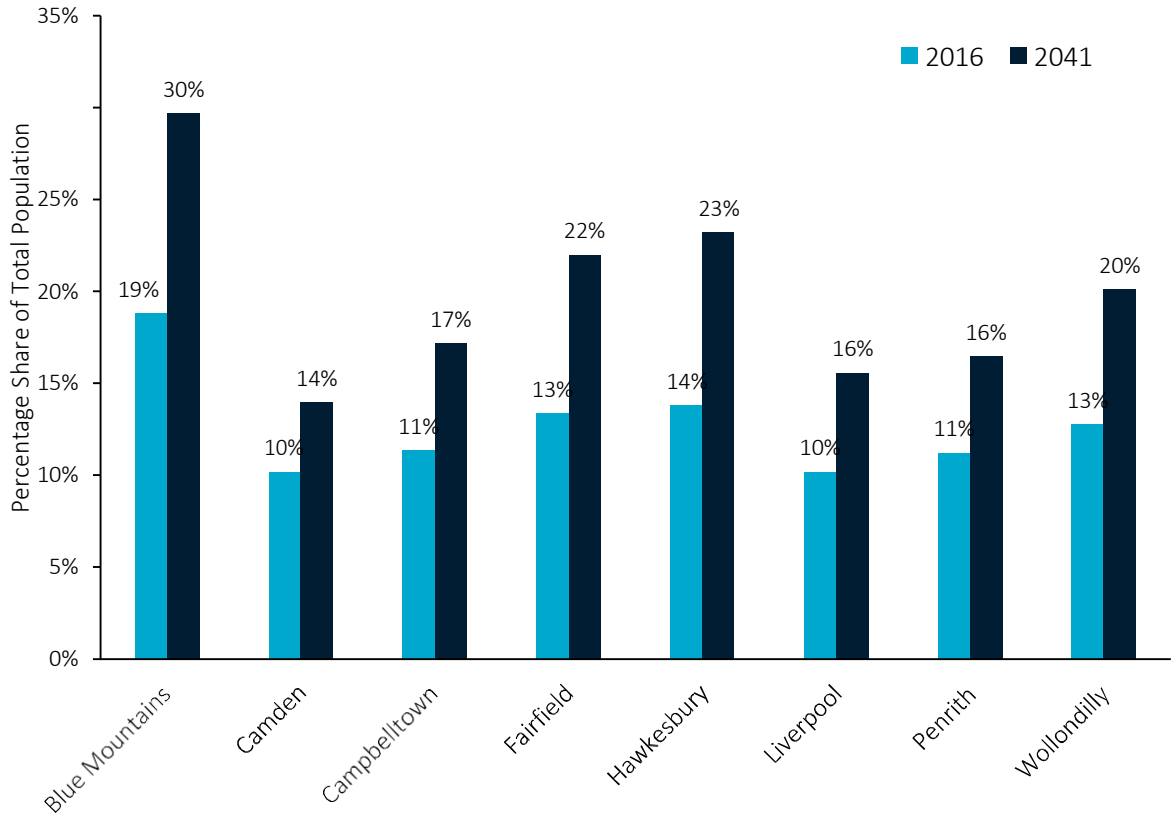

Figure 13 Residents aged 65 years and over as a share of population.

Data source: Department of Planning, Industry and Environment [26]

3.1.2 An increasingly diverse population

The population of the Western Parkland City has historically been diverse and is expected to further grow in diversity. Greater Sydney is one of the nation's largest and fastest growing population hubs for the Aboriginal and Torres Strait Islander community. In 2016, around 4% of the Penrith Local Government Area population identified as indigenous – the largest proportion across the Western Parkland City local government areas and above the New South Wales average of 2.9% [27]. Between 2011 and 2016 the indigenous population has been growing faster (18.4%) than the non-Indigenous population (8.6%) both in New South Wales and nationally [28]. Between 2011 and 2031 the indigenous population in New South Wales is expected to grow by 37.2% [29]. Many community organisations in Western Sydney today dedicate their work to improving lives of the indigenous population [28].

The population is also culturally and linguistically diverse. In 2016 Sydney had the largest overseas-born population of all Australian capital cities (1.77 million people) [30]. The share of the overseas-born population varies across the Western Parkland City regions from around 11% in Wollondilly to almost 40% in Liverpool and over 50% in Fairfield [31].

In the Western Parkland City net inward migration is expected to contribute heavily to population growth. In four out of eight local government areas – including Camden, Liverpool, Penrith and Wollondilly - net migration is expected to exceed natural population growth between 2016 and 2041. In the Camden area, for example, the population is expected to grow by 175,000 people due to net migration and only 53,000 people due to natural growth over 2016-2041 [26].Whilst both the City of Blue Mountains and Hawkesbury City populations will grow, the growth will be less than other local governments within the region. Between 2016 and 2041 the City of Blue Mountains is expected to grow by 6% and the Hawkesbury City by 20%. In both these local government areas net migration is less significant for population growth than natural change [26].

3.1.3 The changing skills and education profile

In 2016, around 28% of the Western Parkland City population had bachelor's degrees or higher. This is below the average for New South Wales of 38.4% and Sydney City Council of 58.8%. Within the Western Parkland City the highest share of population with bachelor (and above) degrees was recorded in Blue Mountains (40.2%) and Liverpool (30.1%) while the lowest was in Wollondilly (21.2%) and Hawkesbury (22.2%) [32]. According to the 2011 population census, 17.6% of people with non-school qualifications in the Western Parkland City were educated in the field of engineering and related technologies. This is above the New South Wales average of 14.7%. Other popular fields of education qualification for Western Parkland City residents are commerce (18.8% of total qualifications); society and culture (9.3%); health (7.2%) and education (7.2%) [33]. As the Western Parkland City develops into the future the skills and education demand profile is likely to continue changing.

3.1.4 Implication for the Western Parkland City

Population growth will drive demand for goods and services within the region which will help fuel the growth of job generating industries. Population growth will also create a large workforce which, if equipped with the right skills and knowledge, will further support industry growth and development. This growth potential can be supported with existing workforce skills in the fields of engineering, commerce, health, education, social sciences. Whilst the Western Parkland City population will become more aged it will age at a slower rate than greater Sydney, it will also become more culturally diverse. The comparatively younger working-age population of the Western Parkland City will help ensure the Greater Sydney's overall labour productivity.

Lastly, the growing population will call for infrastructure and government services to meet the diverse range of people's needs.

3.2 Digital Transformation

The coming decades will see the continued digital transformation of business activity within and beyond the Western Parkland City. This process has sped-up during the COVID-19 crisis which has seen vast swathes of economic activity shift from the physical to virtual world. The extent to which this activity returns to pre-COVID-19 patterns is unknown. However, the widespread adoption of telehealth, teleworking, online retail, online education and online entertainment is likely to have lasting impact on how the Western Parkland City residents live, work and study. These trends have the capacity to reshape industry supply and demand in the region. They may also lead to changed settlement and mobility patterns with changed infrastructure demand profiles.

3.2.1 Online retail is increasing

One of the key digital transformation trends is the growth of online retail (Figure 14). Online retail has been growing in Australia and sped up during the COVID-19 pandemic. The largest rises on record happened in March-April 2020 following the introduction of social distancing measures and in August following store closures in Victoria with Stage 3 and 4 pandemic restrictions [34]. The growth of online retail in Australia in March-April 2020 was driven by domestic online retail sales as international retail sales and traditional retail sales contracted. Although traditional retail has recovered the growth since the April dive, online retail growth remains high as shown by the National Australia Bank Online Retail Sales Index [1, 35-37]. This has been associated with an explosion in demand for e-commerce freight and logistics services.

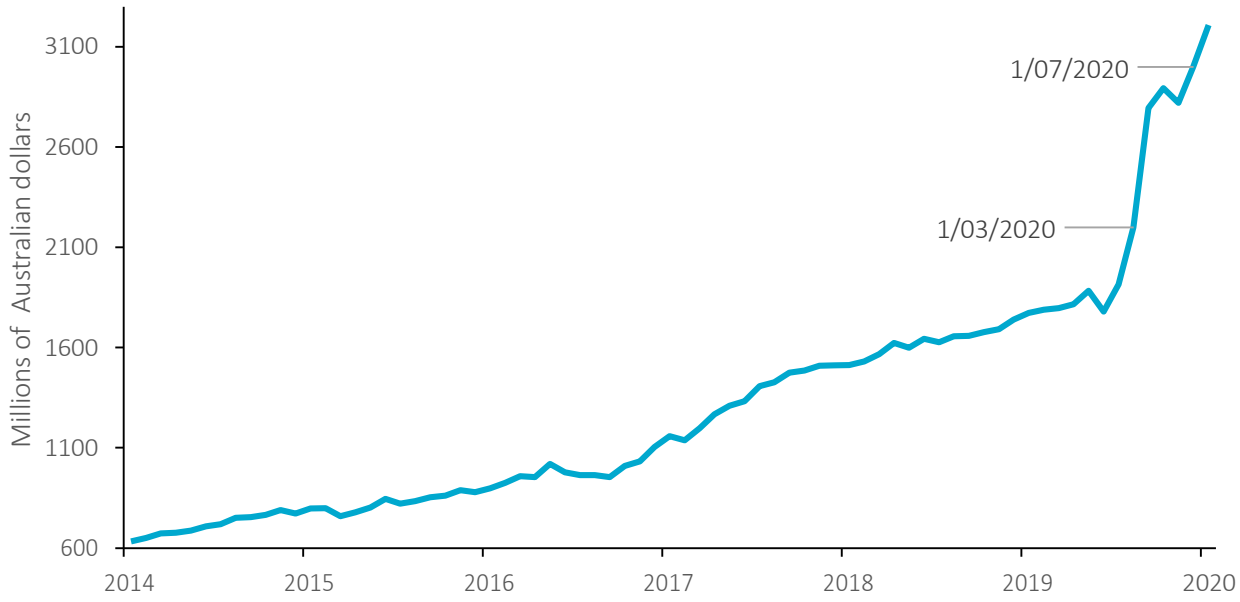

Figure 14 Online retail spending in Australia.
Data source: Australian Bureau of Statistics [34]

There is evidence of structural change within the retail and grocery sectors. In May 2020 it was reported that Coles signed a A$400 million deal with industrial landlord Charter Hall for two high-tech industrial sheds in Sydney and Melbourne [38]. The Sydney facility is located at Horsley Drive in Wetherill Park in Fairfield City

Council within the Western City Parkland and comprises an area of 30,000 square metres [39]. These investments are in response to a 24% jump of online sales in the first half of FY 2019/20 (before COVID-19) and a surge in demand during the COVID-19 crisis which overwhelmed capacity. This highly automated facility would support regional employment as well improve customer service, delivery times, reduce waste and boost safety for staff. [38]. Woolworths has doubled online delivery capacity to capture a forecast A$3 billion growth next financial year. Woolworths has recruited an additional 5,000 third party couriers to complement its current fleet of 800 delivery trucks. Amidst an employment crisis Woolworths announced 20,000 new jobs in late March to boost online delivery capabilities. They are making similar investments in infrastructure, skills and technology [40]. These investments are with a view to longer term structural shifts in the grocery sector.

3.2.2 Telehealth is increasing

In 2019 Australians used on average 9.5 telehealth consultations per 1,000 people [41]. This is below some of the world leaders. For example, in Canadian Ontario the average number of telehealth consultations per 1,000 people was 72.2 in 2018-19 [42]. In March 2020 in response to the COVID-19 outbreak the Australian Government announced an expansion of Medicare-subsidised telehealth services for all Australians [43]. As a result of this decision and the impact of lockdowns, the usage of telehealth sky-rocketed across Australia and New South Wales [41]. Further uptake of telehealth along with other technology facilitated solutions in healthcare will likely transform the health industry in the region.

3.2.3 Teleworking is increasing

Another trend of relevance is the growth in teleworking. Over the past few decades Australians have been gradually moving toward flexible working arrangements and increased teleworking. COVID-19 has accelerated this transition. According to the Australian Bureau of Statistics in 2016 almost every third employed person in Australia regularly worked from home [44]. Although no comprehensive data on the current level of teleworking is available, surveys demonstrate that the number of people shifting to working from home increased substantially during the pandemic and is expected to stay high post pandemic. For example, according to a survey conducted by the University of Sydney Business School 20% of employees in New South Wales worked from home before the pandemic compared to 39% during the pandemic [45].

A research group at the University of Chicago demonstrated that up to 37% of jobs in the United States can be performed at home [46]. A similar study for Australia by researchers at Deakin University; showed that 41% of full-time and 35% of part-time jobs in Australia can be done from home, including 45% of jobs in Australia's eight major cities and 33% elsewhere [47]. The growth of teleworking is also observed through population mobility patterns – specifically by the reduction of visits to workplaces. An analysis of population mobility changes at workplaces reported by Google Community Mobility Reports [48] demonstrates that with the pandemic restrictions visits to workplaces at Western Parkland City regions reduced substantially. This reduction was in line with the overall trend in New South Wales and in Australia.

However, the Google mobility data show the Western Parkland City experienced a lesser reduction of visits to workplaces compared to the New South Wales average. For example, on 6 April 2020 the number of workplace visits in New South Wales on average dropped by 42% while the drop in Wollondilly only reached 25%. This could reflect the types of employment in regions with comparatively fewer office-based jobs. Within the Western Parkland City the City of Blue Mountains had the highest drop in the workplace visits during COVID-19 lockdowns.

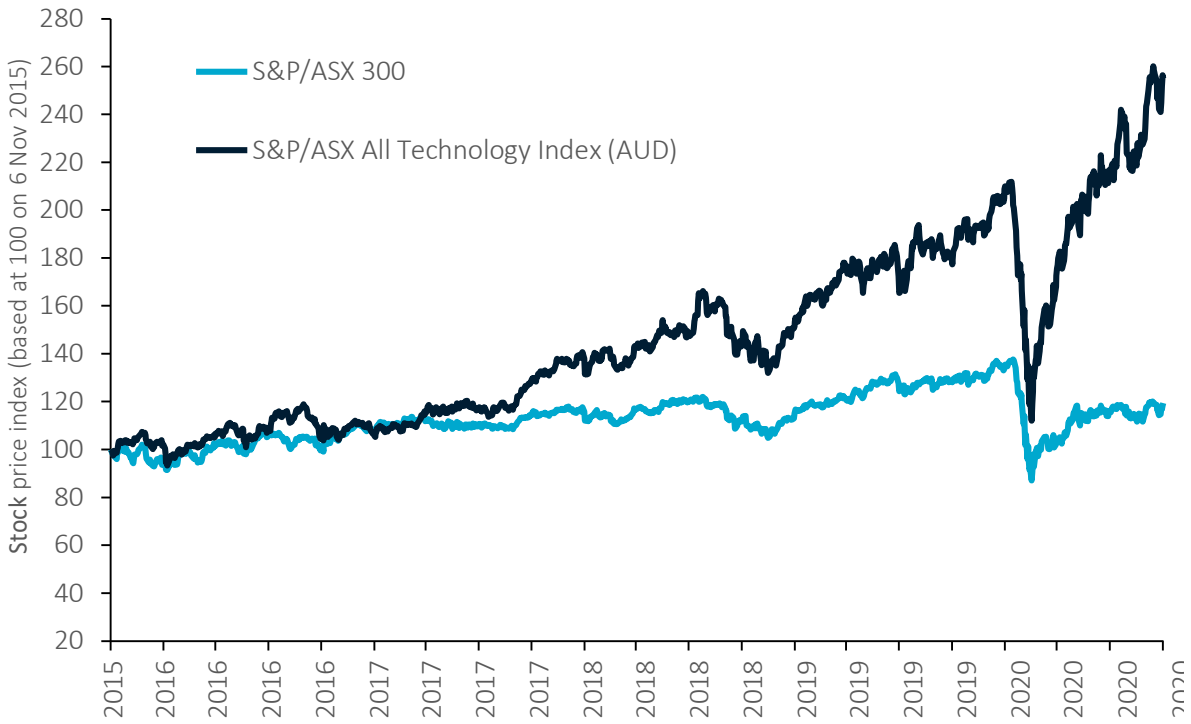

Figure 15 Digital technology sector share market performance versus general market.
Data source: S&P Dow Jones Indices [2]

3.2.4 Digital companies outperform counterparts

During the crisis the digital economy has performed better than other parts of the economy and will be a significant driver of the economic recovery over the coming decade. For example, a comparison of the ASX All Technology Index - which contains a range of digital and software companies - with the general ASX 300 index shows that companies comprising the all-technology index experienced a faster recovery from the February - March 2020 crash (Figure 15).

The ASX All-technology index regained the lost value by July 2020 and has been on a growth trajectory since then, while general market ASX 300 index still hadn't recovered losses by November 2020. Most of the companies comprising the all-technology offer software solutions and digital technologies. Examples include WiseTech (logistics software), REA Group (which includes realestate.com.au), Appen (an artificial intelligence company) and Technology One (an enterprise software company).

3.2.5 Online education is growing

The COVID-19 pandemic has significantly impacted the education sector. Practically all educational levels and institutions had to adjust to a rapidly changing environment. Many relied on digital technology to keep going. According to the United Nations, by June 2020 over 1.1 billion or over 63% of students globally were studying online [49]. The online education sector was growing prior to the pandemic. In 2019 global ed-tech investment almost reached AU$24.76 billion and was projected to grow to AU$456 billion by 2025 [50]. Since early 2020 there has been a surge in the use of online tutoring software along with videoconferencing tools and online learning platforms.

3.2.6 Implication for the Western Parkland City

Whilst digital transformation represents an ongoing trajectory of change, COVID-19 has sped-up the rate of transformation leading to much greater uptake of online retail, online education, telehealth, telework and online entertainment. These shifts are likely to be sustained. The opportunities for the Western Parkland City associated with this driver of change include:

- Attracting Australian and global digital tech-sector corporations into the region likely to invest in research and development and growing their workforces;
- Attracting teleworkers to relocate their places of residence into the Western Parkland City to boost daily expenditure on cafes, shops and businesses at towns and centres within the region;
- Promoting new models of digitally enabled healthcare and catalyse the growth of new telehealth businesses;
- Providing training and education opportunities for workers and residents of the Western Parkland City to develop enhanced digital technology skills and capabilities; and
- Leveraging digital technology to improve the quality, quantity and accessibility of education and training within the region.

3.3 Rising Freight Movements

This driver of change is about the growth of freight and logistics operations associated with the ongoing expansion of e-commerce. Every time someone clicks the “buy” button on a retail website it triggers behind the scenes activity in supply chains. A product needs to be packaged, traced and transported potentially across the entire globe or just a few kilometres. Therefore, as e-commerce expands so too are freight and logistics industries.

3.3.1 Freight and logistic activity are steadily growing

Freight and logistics activity associated with e-commerce sped-up during COVID-19. For example, a recent study by Deloitte Access economics finds that Australia post delivered an additional $2.4 billion worth of e-commerce parcel purchases from March to July 2020. They also found an extra 23,000 small businesses customers used the “MyPost” delivery service to send packages to customers during the same time period. It is likely that many new users of these services keep using them beyond the COVID-19 crisis.

Decades before COVID-19 the volume of global freight has been constantly growing (Figure 16). Between 1997-2017 container freight by sea – involving the transportation of goods in standardized containers - across 21 OECD countries grew almost 2.5 times and tripled in Australia. Container freight saw a temporary drop in growth directly after the 2008-09 global financial crisis but soon returned to the previous growth trajectory [3]. Road freight has also been rising. By 2017 the number of tonne-km of goods transported in Australia almost doubled compared to 1997; well above the OECD average growth [3]. The largest growth of road freight over the past two decades was observed in China with the increase in the number of tonne-km travelled per year by a factor of 12.7. In 2011 China exceeded the road freight of 21 OECD countries combined, including the United States of America [3].

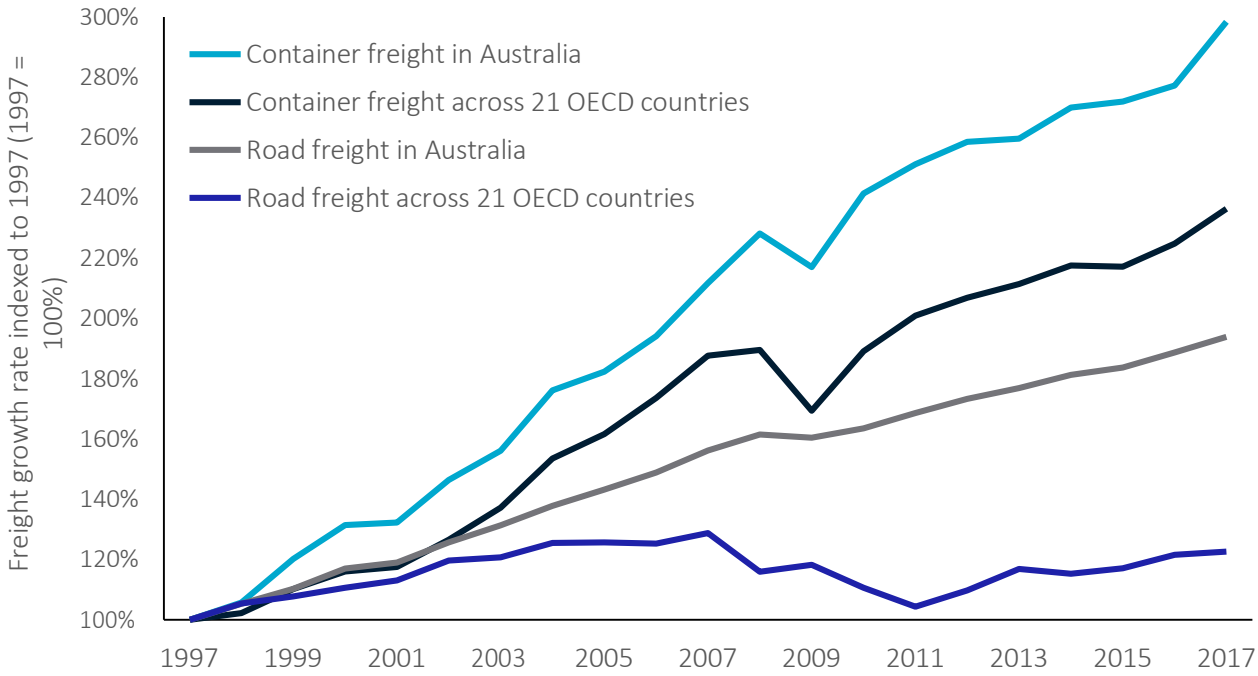

Figure 16 Freight volume growth rates for container transport by sea and road freight.
Data source: Organisation for Economic Cooperation and Development [3]

3.3.2 The expansion of air freight

Freight and logistics are pillars of economic growth in the broader Sydney region. Airfreight represents over 21% of Australia's international trade in terms of dollar value; although under 1% in volume. This means $1 (out of every $5) of goods entering or leaving Australia travels by airfreight [51]. Sydney Kingsford Smith Airport is the most significant freight hub in Australia handling around 45% of all national air freight imports and exports (both in value and volume). Most of the freight (over 80%) is carried in passenger aircraft belly-hold, with the balance carried by dedicated freight carriers [51]. The export volume transported through Sydney Airport has been growing over the past decade while imports have remained relatively stable [52]. The recent growth of exports can be attributed to the booming demand for food from Asia. Specifically, in 2017-18 exports increased by 10% compared to 2016-17 and food products contributed over 50% of this growth. Between 2015 and 2019 exports of infant formula and related products grew from negligible amounts to 18% of airfreight by mass [51].

One indicator of future freight and logistics expansion comes from long-range 20-year forecasts of dedicated air freight planes [4]. Aerospace company Boeing forecast that the global dedicated freighter aircraft fleet will increase from 2,010 planes today to 3,260 planes by 2040 (Figure 17). The fastest rates of growth are in the Asia-Pacific region which will see the air-freighter fleet increase from 350 to 1,090 planes over the same time period. At the current time 930 new dedicated freighter planes are in production and scheduled for delivery to global customers. The expansion of the global dedicated freight aircraft fleet is indicative of expectations for increased air freight demand.

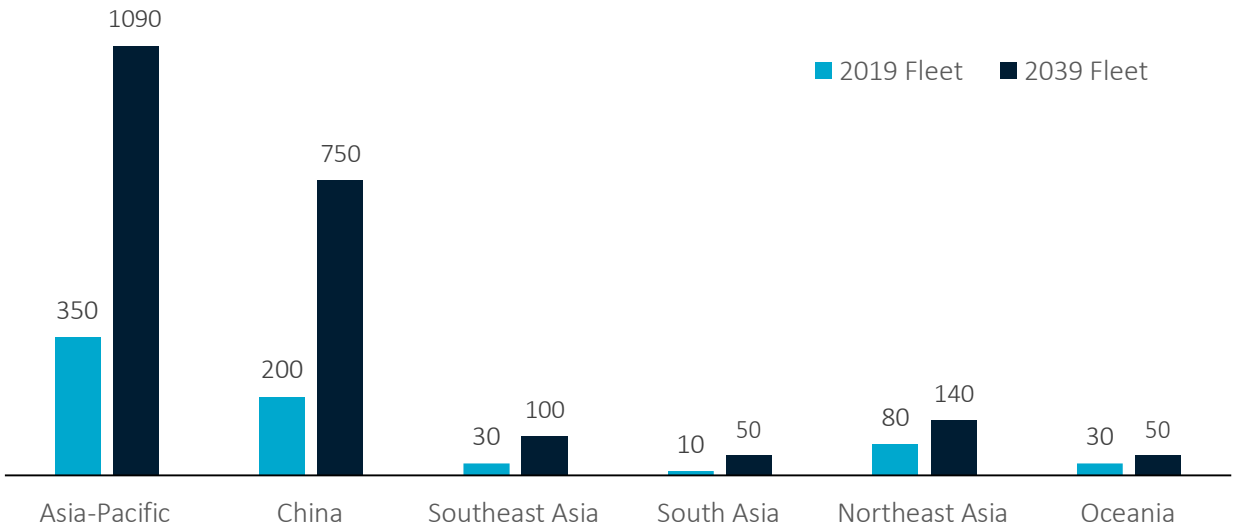

Figure 17 Dedicated air freighter plane fleet in world regions.
Data source: Boeing Commercial Outlook [4]

3.3.3 Automation in the logistics sector is increasing

The rise of freight and logistics within the region is likely to be associated with the growth of automated storing and sorting warehouses often located near shipping ports and airports. Online retailer Amazon, for example, has rapidly expanded its network of customer fulfillment centres across the globe in recent years. These facilities are used for temporarily storing online orders whilst they await "last mile" delivery to the customer. They also allow Amazon to build up local stock and provide rapid deliveries. According to media reports [53] Amazon has over the last decade or so built 110 customer fulfillment warehouses in the United States and another 185 facilities globally with 33 new facilities planned for construction. Amazon has recently purchased 70 freight planes and is reported to have ordered 20,000 new delivery vans last year [53]. These moves are making Amazon a global freight and logistics company as much as an online retail company. This is creating competitive pressure for companies such as FedEx and UPS.

3.3.4 Implication for the Western Parkland City

Freight and logistics is a defining industry for the Western Parkland City. With the Greater Sydney economy on its doorstep the region supplies much of the freight and logistics services to a large and growing economy and population. As freight and logistics activity grows across Australia and the globe the Western Parkland City can develop and export technology and know-how. Like most industries freight and logistics are subject to technology-enabled disruption. The emergence of Amazon as a freight and logistics company, with sophisticated warehouses and supply chains, is an example of how the industry is being reshaped.

3.4 Changing Mobility and Settlement Patterns

This driver of change is about the longer-term increase in practically all forms of human mobility. The COVID-19 period has undoubtedly been associated with a substantial drop in air travel along with a drop in average distances flown. However, the longer term (decadal) pattern is towards a much more mobile world. In addition to increased movement the modes of transportation are also becoming much diversified. Recent times have seen a surge of interest in e-scooters and bicycles for transportation. It's possible that the post COVID-19 world may see some extent of changed settlement patterns, evident through changes in real-estate markets, which have flow on implications for mobility patterns.

3.4.1 Air travel demand could grow after COVID

One of the most widely used indicators of future global human mobility comes from the Boeing Commercial Market Outlook [4]. This gives historic and future forecasts estimates of revenue passenger kilometres (RPKs) for 41 air traffic flow routes worldwide (Figure 18). It also contains estimates of the current and future jet aircraft fleet. RPKs represent the sum total of all passenger movements on commercial aircraft. RPKs can be thought of as the world's cumulative total frequent flyer miles (kilometres).

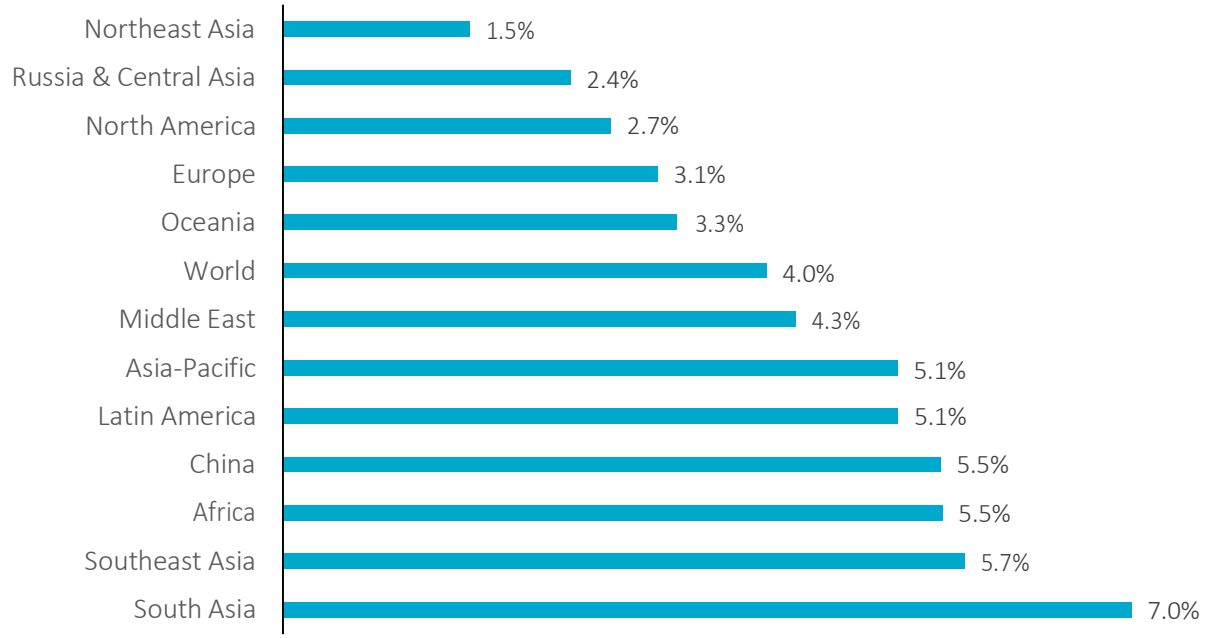

Figure 18 Forecast annual growth rates for aviation revenue passenger kilometres for 2020-2040.
Data source: Boeing Commercial Market Outlook [4]

Despite previous setbacks such as SARS and the Global Financial Crisis aviation has proved resilient over the longer term. The world's RPKs have risen from roughly 1 trillion in 1980 to just over 8 trillion in 2020. In the COVID-19 pandemic RPKs dropped to 4 trillion. However, they are forecast by Boeing and the International Air Travel Association to recover to previous levels and trend-growth by around 2025. Over the past 10 years growth in passenger air travel averaged 6.5% per year which is above the long-term average of 5% [5].

Projections for future air travel demand are positive. For example, Boeing recently raised its 20-year forecasts for China aircraft demand expecting the fundamental drivers of economic growth to be robust and resilient and boost the industry post-pandemic [5]. The International Air Transport Association (IATA) expects that air travel demand will return to 2019 levels by 2024. Analysis of long-term data series on the passenger movements through Australian airports also demonstrates strong increasing trends in the number of passengers arriving and departing [6].

3.4.2 Rising domestic tourism market opportunities

Along with challenges, the crisis is opening new opportunities for domestic tourism operators and regional travel destinations. Australian households' spending on travel has been growing steadily for decades. In 2000 households spent 4.4% of their annual expenditure on travel. By 2017 this share increased to 5.8%. This is more than spent on cars or furniture [54]. Australia is one of the top ten nations by expenditure on overseas trips [54]. As restrictions prevented overseas travel regional hotels experienced a "staycation" boom [55, 56]. Although the health crisis is constraining travel opportunities, domestic tourism is anticipated to

recover quickly once the health crisis is resolved [57]. Nevertheless, Australian remote destinations such as Uluru, the Whitsundays, Kangaroo Island, Kakadu and the Kimberley and luxury resorts are more reliant on international visitors [58].

3.4.3 Commuter patterns are changing

According to the population census, more than two out of three Australians were driving to work in 2017 equating to 69% of the working population. This share increased slightly from 68% in 2011. Greater Sydney residents were among the most active users of public transport in Australia with almost 21% of trips done by train, bus, tram or ferry [59] . Commuting duration and stress is also higher. According to the Household, Income and Labour Dynamics in Australia (HILDA) survey in 2017 Australians spent 4.5 hours a week - just under one hour per workday - commuting to and from work. This commute time has increased from 3.7 hours weekly in 2002 [60]. Longer commute times are associated with lower job satisfaction, less work-life balance satisfaction and worsened job stability [60]. Workers in mainland capital cities (Sydney, Melbourne, Brisbane, Adelaide, Perth) in 2017 had longer commute hours compared to those living elsewhere. On average mainland capital cities residents spent 66 minutes commuting daily – up from 55 minutes in 2002. While Sydney residents had the longest average daily commute of 71 minutes [60, 61].

3.4.4 Expanding list of mobility options

The list of mobility options for Australians has been continually expanding over the past decades, catalysed by the rapidly developing digital solutions such as ride-sharing platforms (*e.g.* Uber, Didi), car-sharing platforms (*e.g.* GoGet, Car Next Door, Flexicar, DriveMyCar), electric and conventional bike and scooter hire apps (*e.g.* Lime, Neuron). Research estimates suggest that every shared vehicle operated through peer-to-peer car-sharing platforms, such as GoGet and Car Next Door, could potentially replace 9 to 13 private vehicles on the roads [62]. The City of Sydney car sharing initiative with 20,000 users and 805 vehicles, was reported to have removed 10,000 vehicles from the area [63]. The use of ride-sharing has been growing in Sydney. Despite the downturn in 2020, further growth is expected post-pandemic. According to the IBISWorld projections, the revenue of ridesharing services in Australia will almost double by 2027 compared to the level of 2020 and reach almost $1.5 billion [64].

Active modes of transport including walking and cycling are on the rise. The driving forces for the uptake of active transport are rising health consciousness, increasingly difficult traffic and parking in the city centre, and improved infrastructure including pedestrian paths and bikeways. Europe has been the cycling centre of the world pre-pandemic with some outstanding leaders like the Dutch capital where 40% of journeys are made by bike [65].

The use of bikes for transport has accelerated around the world during the pandemic as people started avoiding public transport [66]. For example, in the United Kingdom sales of VanMoof's sleek electric bikes increased by 184% between February and April 2020 [67, 68]. To meet the growing needs of city residents, city authorities in Europe, United Kingdom, United States and New Zealand used temporary pop-up bike lanes to turn the road space into footpaths and bike lanes or widen bike paths to allow for social distancing [69, 70].

Since the start of the year several large city governments announced programs to boost cycling culture and active travel infrastructure [65]. Whilst we note they are illegal for use on New South Wales roads and footpaths electric scooters have also become a significant transport option. An industry survey by RACV in Victoria in 2019 revealed that about 80% out of 1400 respondents would ride an e-scooter for commuting to/from public transport services, shopping and entertainment with 40% preferring rented scooters [71].

3.4.5 Changing property markets

Potentially as a result of COVID-19 real estate property markets in Australia and New South Wales saw stronger price growth and demand in regional areas. According to CoreLogic analysis, in the June quarter 2020 regional centres experienced higher capital growth than the city regions [72]. Whether it's a temporary shift or a trend is yet to be seen [73]. However, there is a possibility that COVID-19 combined with other drivers has caused a shift in settlement patterns which will have flow-on consequences for mobility patterns.

3.4.6 Implication for the Western Parkland City

Transport connectivity is an important component of industry cluster development. Clusters that work well typically have efficient and high quality intra-regional and inter-regional transportation systems. This includes pedestrian, cycling and e-scooter connectivity along with road, rail and aviation systems that allow people to travel in speed and comfort.

The longer-term trajectory towards increased human mobility and more diversified modes of transport will have flow on consequences for settlement patterns and infrastructure requirements. It can be expected that post-COVID there will be a higher work-from-home population making fewer trips to the city centre and increased within-neighbourhood trips. Overall, the Western Parkland City can take advantage of the new modes of transport and increased mobility to catalyse industry growth within the region.

3.5 Emerging Systemic Risks

The COVID-19 crisis in Australia happened directly after the worst bushfire season on record. Both events have confronted people with unfamiliar, systemic shocks. We are also coming to terms with geopolitical shifts and complex cybersecurity risks. At the same time we are seeing a much higher level of technological capability. Overall, governments, companies and communities are becoming accustomed to a world of new normals which require new levels of resilience and preparedness.

3.5.1 Bushfire shocks and changing climate

Perhaps the first of the major shocks in recent times was the 2019-2020 bushfire season which was the most devastating in recent history. In New South Wales bushfire damaged 7% of land or 5.4 million hectares [74]. According to New South Wales Government estimates bushfires damaged or destroyed 37% of the national park estate, over 81% of the World Heritage listed Greater Blue Mountains Area, 54% of the New South Wales components of the Gondwana Rainforests and locations containing over 293 threatened animals and 680 threatened plants [74].

The bushfires have occurred against a backdrop of climate change. Since 1910 Australia's climate has warmed by over 1°C [75]. Global concentration of major greenhouse emissions have continued to increase and reached record highs in 2019. In 2020 a decline in fossil fuel emissions due to the pandemic and economic downturn saw a decline in greenhouse gas emissions. However, this is not expected to be a long-lasting effect before emissions as greenhouse gas concentrations are rising again [75]. Since 1880 the global mean sea level has risen by 25 cm and continues to rise at accelerating pace [75]. According to the Bureau of Meteorology and CSIRO in the coming decades Australian is likely to see a continuing increase in air and ocean temperatures, more extreme heat, more dangerous fire weather days, increased marine heat-waves and further sea level rise [75].

3.5.2 The rise of infectious disease and antibiotic resistant bacteria

The bushfires were followed by the global COVID-19 pandemic which created a situation beyond experience for much of the world's population. The COVID-19 pandemic happens against a backdrop of rising infectious disease risk. In the last two decades the world has seen SARS (2003), H5N1 (2005), H1N1 (2009), Ebola (2012) and MERS (2015) [76-79] and now COVID-19 [80]. Population growth, human mobility, jet travel, tourism, livestock production, animal handling and urbanisation are likely to see the zoonotic disease risk intensify into the future [81-84]. On the upside the world has learned about how to manage pandemics along with substantial advances in vaccine production and epidemiological strategy. Whilst the risk may be rising our ability to mitigate the risk is also rising.

Another challenging infectious disease dilemma relates to the rise of antibiotic resistant bacteria. Certain species of bacteria have developed resistance to antibiotics partly due to the overuse and/or incorrect use of antibiotics in human healthcare and livestock production. According to the estimates by the International Federation of Pharmaceutical Manufacturers and Associations (IFPMA) the deaths of around 700,000 people annually are caused by antimicrobial drug resistant bacteria [85, 86]. The problem is worsening.

Furthermore, the development of new antibiotics by pharmaceutical companies has slowed down since the age of discovery in the 1960s, 1970s and 1980s. To address this problem three United Nations organisations - the Food and Agriculture Organization , the World Organisation for Animal Health and the World Health Organization - launched the Anti-Microbial Resistance Multi-Partner Trust Fund to accelerate global action [87]. In 2020 over 20 leading biopharmaceutical companies launched a US$1 billion action fund to boost investment and bring 2-4 new antibiotics to patents by 2030 [88].

3.5.3 Cybersecurity challenges

The last of the emerging systemic risks we identify relates to an elevated and pervasive cybersecurity threat hitherto not experienced. By mid-2020 cyberattacks in Australia increased 3.3 times from the start of the year - including the most significant co-ordinated cyber targeted attack yet experienced [89, 90]. Australian governments have responded to this threat with a range of actions and strategies including the International Cyber Engagement Strategy [91] and the establishment of the Australian Cyber Security Centre. Number and sophistication of cyberattacks grows annually, and so do the knowledge and skills to manage cyber risks. Western Sydney University is among the Australian universities offering degrees in cybersecurity, and the only university combining technical and behaviour sides of the cybersecurity field of knowledge[92].

3.5.4 Implication for the Western Parkland City

There has been significant social and economic upheaval associated with bushfires and the COVID-19 pandemic. These events were critical for the Western Parkland City, one of Australia's fastest growing regions by population and a home to Blue Mountains region – a natural tourist attraction and a point of potential growth for the visitor economy of the state. Given that the infectious disease risk, climate change and other risks such as cybersecurity are likely to remain there is a requirement for heightened levels of resilience and disaster mitigation capability. Whilst meeting these requirements is a challenge it is also an opportunity for new companies and industries which provide solutions to emerge in the Western Parkland City and address regionally specific to global challenges of the new norm.

3.6 Policy Levels to Catalyse Industry Growth

There is a large and expanding body of knowledge largely within the fields of economic geography and management science about the processes of, and policy levers for, industry growth and development. This body of knowledge has been established from thousands of successful and failed industry development initiatives and is a powerful ally for current-day economic development strategists. In Appendix A for this report we describe a set of worldwide case studies of industry growth/development strategy relevant to the Western Parklands City.

In this section we identify and describe the main approaches taken by governments when aiming to increase new business activity and develop new industries. We also explore some important strategic considerations relating to specialisation strategy, path dependency and economic ecosystems. We examine the relevance of the case studies for industry strategy in the Western Parkland City.

3.6.1 Place-Based Approaches

Geography is known to play a significant role in the creation of industry clusters and economic development. An industry cluster is a spatially concentrated and interconnected set of companies, universities, research institutes and other organisations engaged in the production and development of related goods and services. Typically, the entities within a cluster will form an economic ecosystem involving high levels of collaboration and knowledge sharing. Clusters can have widely varying scales and geographic expression. As a rough guide the Western Parkland City could accommodate around a dozen existing and/or new industry clusters. However, the actual number would depend upon how a cluster is defined. One definition of industry clusters suggests they should meet four criteria [93, 94]:

1. Clusters should contain economically related and geographically concentrated industry activity.
2. There should be localised collaboration and competition within the cluster.
3. The firms, organisations and workers within the cluster should recognise they are part of the cluster and have some type of shared understanding of its purpose and a commitment to its development.
4. There should be evidence of increased innovation activity and competitiveness for firms within the cluster.

Empirical research has demonstrated that companies within a geographic cluster grow their revenues and workforces faster than those outside a cluster [95-97]. Regions with clusters have also been shown to attract and retain more start-up companies [95, 98] with higher levels of innovation [99, 100]. This is partly because industry clusters are naturally aligned with market forces. As a cluster grows it attracts more activity which then builds the cluster and attracts more again. In this way clusters can have a "snowball" effect. Clusters can also achieve economies of scale and knowledge-sharing allowing industries to become more competitive by achieving lower costs of production and higher quality products. Professor Ron Johnstone from the University of Sydney studied industry clusters in the Australian context and identifies 62 clusters in Australia and 24 clusters in New South Wales [101].

Government policies to create industry clusters accelerated in the 1980s after Harvard University economist Michael Porter wrote a convincing case for the economic competitiveness of a nation being dependent on the presence of world-leading industry clusters. Porter's bestselling book "Competitive Advantage of Nations" published in 1980 examined cluster formation and growth in ten nations [102]. After the publication of this book and subsequent updates he became the most cited theorist in economic development, and social science, worldwide. Today Michael Porter has 571,000 citations (Google Scholar) mostly relating to his work on industry clusters. Industry clustering has been widely researched and applied in Australia over the past few decades [101, 103, 104]. Today industry cluster growth strategies are the

dominant approach for regional economic development. There are multiple approaches used by governments to develop geographic industry clusters:

- Building new infrastructure such as science, business and technology precincts [105] and/or sporting and recreation facilities [106];
- Improving digital infrastructure and network connectivity to enable remote work and growth in the digital economy [107];
- Developing new freight and transport facilities including airports, cruise terminals and shipping ports [108] ;
- Urban renewal (place-making) investments such as developing parklands, bikeways and cycleways and the application of planning instruments such as zoning controls, land use planning and various forms of strategic planning [109];
- Developing mass transit systems which permit efficient and comfortable movement of people from nearby populations centres to and within the cluster [110]; and
- Other strategies such as financial incentives to attract businesses, assistance with developing business networks for new market entrants and regional marketing of the cluster.

Overall, place-based approaches involving geographic clusters for industry formation and growth are the most widely applied strategies for regional economic development. There are countless examples of industry clusters which have grown quickly boosting the economy at local, regional and national scales.

However, success is not assured. There are cases where cluster development ambitions were not realised. The demise and disappearance of the government supported boat building cluster in Norway provides an example as documented in a research paper by an academic at the University of Agder, Grimstad, Norway [93]. The growth of Norwegian boat-building was linked to one large firm called Fjord in the district of Arendel. The firm received considerable public support to expand and develop activity with the objective of creating a sustainable job-generating industry. At the start it worked well. By 2000 Arendel accounted for 75% of Norwegian boat construction with 30 yards and 800 direct jobs. Due to a slow-down in demand for leisure boats combined with cost-competitive production elsewhere the industry experienced sharp decline during the Global Financial Crisis from 2008-2010. The failure of the cluster is attributed to excessive lock-in. The Arendel industry cluster was set up to only make boats, mostly of a certain type, and little else. When market demand collapsed there was no pivot strategy and the boat building infrastructure was stranded. Another explanation was the “irrelevant regional innovation system and policy”; the boat producing companies did not do the research and development needed to develop new designs and cost cutting techniques. They were unable to keep pace with innovation in other boat building industries.

Successful industry cluster growth strategies require careful geographic and economic analysis to choose the best locations for future infrastructure and development. Successful clusters also respond to the human need for liveability by providing recreational, natural and cultural opportunities for visitors and residents. Successful clusters also have high levels of flexibility, innovation, competitiveness and new product development that can handle changes in the broader marketplace. Lastly, successful clusters will deliver excellent physical, virtual and socio-economic connectivity for residents, workers and businesses.

The substantial infrastructure investments and planning tools being applied in the Western Parkland City could potentially be associated with the formation of new industry clusters. For example, the development of the aerotropolis includes five initial precinct plans including [17]:

1. The Aerotropolis Core Precinct – This precinct is a dense urban neighbourhood focused on the new metro rail station and the Wianamatta-South Creek system. It includes Thomson’s creek which forms the regional park complemented by a network of corridors associated with retained creeks [16].

2. Badgerys Creek Precinct – This precinct is entirely focused on employment and will comprise logistics, commercial industry, high technology industry and associated employment uses [16].
3. Wianamatta-South Creek Precinct – This precinct is defined by the Environment and Recreation zone established by the Western Sydney Aerotropolis Plan [16].
4. Northern Gateway Precinct – This Precinct is north of the major entry to the airport and is planned to support economic activity at the airport with jobs in warehousing, distributing and manufacturing [111].
5. Agribusiness Precinct – This precinct will support the production and value-adding of food and fibre products from the agricultural and horticultural industries within the region [112].

Whilst a spatial-economic analysis of cluster locations and expression within the region lies beyond the scope of this document there is evidence of existing clusters within the Western Parkland City. We analysed spatial concentration of workers by 447 destination zones across the region to identify where industry may be clustered. Through this analysis we found concentration of freight and logistics industry in the Penrith, Fairfield, Liverpool and Campbelltown local government areas. We also identified a concentration of defence and aerospace activity in the City of Hawkesbury associated with the Royal Australian Air Force Richmond Air Base. In the Blue Mountains there was a concentration of "visitor economy" workers located in a small area surrounding the Katoomba township. Whether these concentrations are "industry clusters" requires further analysis.

A next step in the application of place-based approaches within the Western Parkland City would involve identifying existing, and forecast future, geographic industry clusters. A key consideration for the region is that, unlike many other regions, the Western Parklands City is highly "greenfield" in nature. Furthermore, the region is about to be reshaped by huge infrastructure investment and development. The airport has the potential to reshape patterns of economic geography within the region and beyond. A final consideration is that an industry cluster in the Western Parkland City needn't necessarily be a single spot on the map. It could be represented by a set of physically separate, but economically related, geographic locations across the entire region.

3.6.2 Skills, Education and Training Approaches

One of the most important determinants for investment attraction for a country or region is human capital; which includes the skills and education of the workforce [113, 114]. This is because companies can't grow, and won't invest, where they can't readily attain workers with the right types of skills, aptitudes and knowledge. Companies are much more likely to invest where these conditions are met. This is known to many of the world's leading trade and investment attraction agencies. For example, Austrade frequently attracts large companies to invest in Australia via benchmarking our world-leading workforce skills and educational attainment standards [115]. This information would be valuable for the Western Parkland City in the context of investment attraction.

Universities, technical colleges, schools and early childhood education organisations all play a role and can themselves be significant investment attractors. These institutes meet the short and long-term needs of companies considering relocation into the region. For example, new firm creation has been shown to be greater in proximity to universities that specialise in basic sciences, applied sciences and engineering [116]. There is also substantial evidence that investment in skills and education will increase the value of other investments in infrastructure particularly information, communications and technology infrastructure [117]. Digital infrastructure upgrades tend to create greater economic benefits in regions with highly educated and skilled workers. This is because they have the skills to utilise improved digital connectivity in their jobs and businesses. Whilst cause and effect can be debated internet speed and reliability are consistently positively

correlated with economic growth. For example, a study of OECD countries during 1996-2007 found that a 10% increase in broadband penetration increased annual GDP per capita growth by 0.9 - 1.5% [118].

In addition to formal education and training institutions large firms with specialised equipment can play a significant role in creating skills needed for new industry. Also important is the overall environment for entrepreneurialism. Famously Apple and Microsoft founders Steve Jobs and Bill Gates gave up on their formal education to start their now global businesses in the top 10 of all global companies after learning basic computer skills at their high schools and in local computer clubs. The fact they could turn these skills into new businesses and gain substantial investment was partly possible due to the investment environment and cultures of entrepreneurialism around them. There's a considerable body of research relating to government policies to promote entrepreneurialism. Some of the main approaches include [119-121]:

- Taxation and regulation approaches – These involve simplifying and/or removing unnecessary regulatory burdens for start-ups and incentivising new entrepreneurial activity via tax incentives;
- Providing mentorship and training for potential entrepreneurs by connecting them with well-established and experienced entrepreneurs in related fields and offering cost-effective training;
- Improving access to venture capital by organising conferences and meeting events where entrepreneurs can pitch their ideas to investors;
- Creating physical spaces for start-up firms to operate with low cost and high levels of connectivity and interaction with other firms and investors; and
- Creating physical urban environments that appeal to entrepreneurs in terms of lifestyle and liveability with excellent digital connectivity.

Developing a skilled population with the right types of knowledge and aptitudes for emerging industries is a critical component for practically all economic development strategies. One of the key challenges in achieving this is forecasting and anticipating the future skills demand which is constantly evolving. For example, the engineering and electronic skills that played a crucial role in building Silicon Valley in the first half of last century are not the same skills that will sustain Silicon Valley as a centre of digital technology development going forward. Therefore, skills and education approaches need to keep pace with the evolving requirements of industry.

An alternative to education and training is to attract skilled workers from other areas. Skilled immigrant visas, targeted recruitment campaigns, and regional marketing approaches based on selling lifestyle and opportunity are all strategies used by fast-growing industries in need of highly skilled workers. The marketplace for highly skilled global talent is fiercely competitive, however, and may be becoming less dependent on location due to the increased availability of broadband digital communication networks [122].

Developing human talent in the Western Parkland City will be a vital component of the industry growth strategy. Across the globe science parks, similar to those being constructed as part of the Western Sydney Aerotropolis precincts, depend on talent attraction. It is widely recognised that talent is the best attractor of more talent. Regardless of the quality of architecture and design building a science park without talented researchers, scientists, engineers and experts is likely to fail. Economic activity, industry growth, investment and job creation are closely tied to talent availability.

A study of 120 science parks from across the globe found that "talent characteristics have a positive effect on the number of successful tenant firms and also on the total number of employees in tenant firms, both factors that make up the success of a Science Park" [123]. Another study by the United States National Bureau of Economic Research [124] of 5,401 "star scientists" within the field of nanotechnology found that individual researchers with particularly strong citation/publication metrics consistently and significantly increased new high-tech firm creation in places where they worked. They state that "the number of stars in a United States region or in one of the top-25 science and technology countries generally has a consistently

significant and quantitatively large positive effect on the probability of firm entry in the same area of science and technology" (page 1). The research also found that star scientists tend to congregate over time; the main thing that attracts star scientists is star scientists.

Therefore, to achieve success in the science and technology precincts within the aerotropolis, and within other existing and emerging clusters within the Western Parkland City, government will need to look beyond physical structures to developing, attracting and retaining world-class scientists and researchers. This involves identifying the types of skills of highest value. Training and developing skills already residing within/near the region and the recruitment of interstate of overseas talent are viable strategies. If the softer (human) side of the science and technology parks being constructed in the Western Parkland City are overlooked or side-stepped the economic activity (and jobs) may not follow. The physical infrastructure of the science parks should be accompanied by a human talent development, acquisition and retention strategy. Otherwise there's a risk of well-designed buildings empty of science and technology expertise with limited chance of seeding new firms or developing new industries.

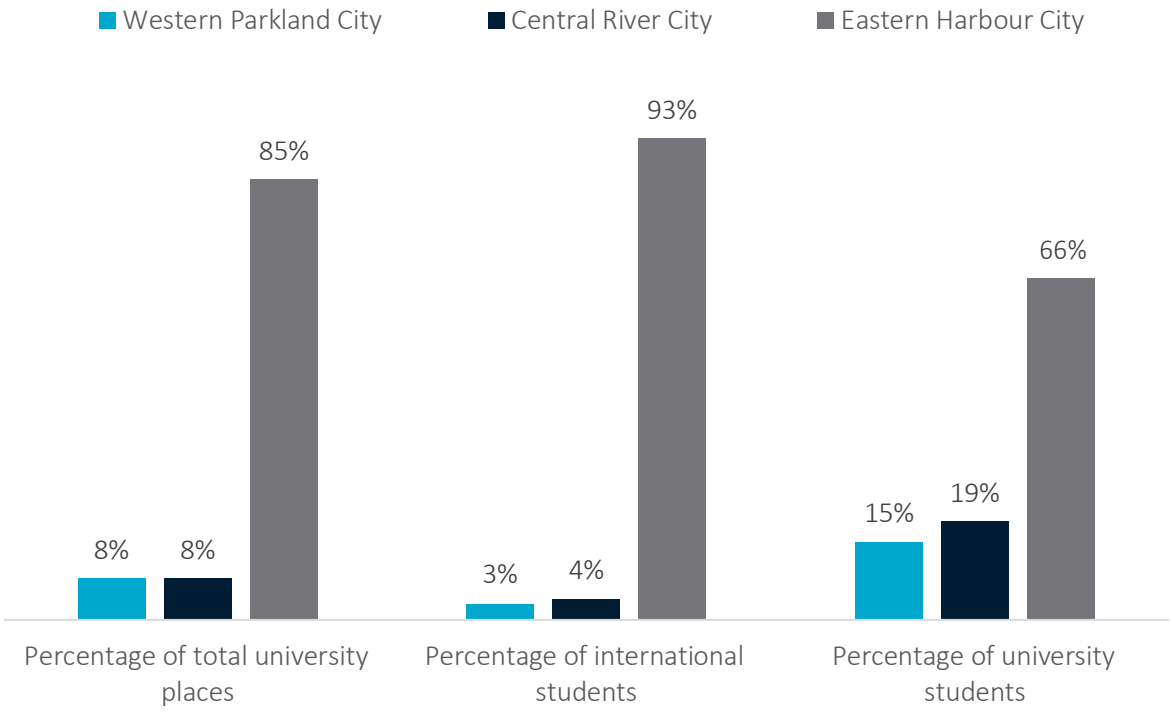

Figure 19 The distribution of university places and students within Greater Sydney.
Data source: Greater Sydney Commission [125]

At the current time tertiary education and vocational training institutes are relatively sparse in the Western Parkland City compared to the Central River City and, to a much greater extent, the Eastern Harbour City (Figure 19). On 13 September 2018 by the Greater Sydney Chief Commissioner Lucy Turnbull announced plans to address this issue and develop a multi-university campus within the Western Parkland City with a focus on science, technology and mathematics. The Greater Sydney Commission estimates that only 16% of Greater Sydney's university places currently exist outside of the Eastern City whilst 34% of university students live in the Central and Western Cities [125]. The "multiversity" may be an important part of the region's industry growth strategy. Siting the campus(es) will also be an important process requiring transparent criteria and consultation. In addition to the planned multiversity The University of Western Sydney has significant existing presence in the region with campuses within the Western Parkland City in Penrith, Bankstown, Liverpool, Campbelltown and Hawkesbury cities.

3.6.3 Science, Research, Technology and Development Approaches

It is well established that research and development is an excellent way of developing industry, creating jobs and growing the economy at national and regional scales [126-131]. Investments in research and development create spill-over benefits which are associated with the formation and growth of new companies. This is because research and development are associated with the creation of new capabilities which can be translated into new commercially valuable products and services. The companies and regions which make discoveries typically enjoy a strong competitive first-mover advantage [132]. Other industries take considerable time to catch-up to the original inventor. And in the process of catch-up other industries will rely upon using and/or purchasing the original inventor's technology and intellectual property.

The power of regional research and development investment to grow new industry is perhaps best illustrated via the "Cambridge Phenomenon". Cambridge University is a research and teaching institution which has long pursued excellence, but with negligible centralised control. Following explosive growth in the 1980s and 1990s, by year 2000 there were over 1,200 high tech firms employing 36,000 people or 10% of the entire Cambridgeshire workforce. The ecosystem continued to grow over the global financial crisis years of 2008-2009 and by the year 2013 had 1,500 firms, five of which had valuations over $1 billion [133]. The success of the tech start-ups attracted larger companies with larger investments. Microsoft, Google and Toshiba are a few of the companies setting up major research and development labs in Cambridge. Whilst governments and industry invested in research and development and teaching at Cambridge University much of what happened in the Cambridge Phenomenon was serendipitous. However, it wasn't without government involvement. Over decades the United Kingdom government invested in pure research and teaching activity at the university. This helped develop a world-class university with high standards of teaching and research excellence.

Much of the investment into research and development which has built some of the world's most successful industry clusters comes from defence. For example, most researchers attribute the emergence of Silicon Valley in California to investments by the United States Navy into radio communications and radar research and development [134, 135]. The scientific and technological capabilities developed in the Bay Area and Palo Alto fuelled the growth of Stanford University and thousands of start-ups, some of which quickly grew into larger companies. The area remains a hotspot of technological innovation which has diversified into a wide range of civilian applications. However, defence investments in Silicon Valley remain an important driver of growth.

A recent trend in research and development investment strategy is mission-oriented policy. Professor Mariana Mazzucato has published seminal works on the topic [136] and defines a research mission as "systemic public policies that draw on frontier knowledge to attain specific goals or big science deployed to meet big problems" (page 804). Research and development missions tend to identify a substantial problem relevant to the region and call for innovative scientific and technological solutions. When things go well with a mission it delivers multiple benefits. The mission can solve the problem at home and then export the solutions to other problem holders worldwide. This delivers societal benefit via improved quality of life along with spin-off benefits such as the creation and growth of new job-generating companies. Missions also focus a diverse research and development community on problems that matter. A missions approach could be used by governments in the Western Parkland City. This would involve identifying mission outcomes in relevant areas of science and technology and then providing funding to capable organisations, or consortia of organisations, to deliver the missions.

Research and development investments are a well-established way of growing new industries and developing a regional economy. This approach is at the core of many of the world's most significant industry growth strategies. As with educational and training, science and research institutes are relatively sparse within the Western Parkland City. Within Greater Sydney most are in the Eastern Harbour City. Nevertheless,

CSIRO has recently announced [137] it will relocate 450 employees and researchers into a new state-of-the-art facility within the Western Sydney Aerotropolis from 2026. The 18,000 square metre carbon-neutral facility will be focused on advanced manufacturing, quantum technologies, defence, aerospace and agribusiness. In addition to this CSIRO has entered into a 10-year lease agreement within the $350 million "Innovation Quarter" precinct for health and nutrition researchers in nearby Westmead.

3.6.4 Procurement, Regulatory and Taxation Strategies

Procurement strategies are an important tool used by governments worldwide to develop regional economies. They are effective because government is an influential and oftentimes monopsonistic (sole) purchaser of goods and services within regional economies. Procurement activities by government, especially defence sector departments, can boost regional GDP and grow new industries. Governments routinely use procurement strategies to favour local businesses and grow jobs and salaries within a region. Sometimes governments will also use procurement to favour socially and/or environmentally beneficial businesses.

A challenge with procurement approaches is ensuring the best performing products and services are purchased by government, on behalf of society, whilst supporting local suppliers. The Australian Government Department of Finance [138] provides guidance to public sector procurement staff about how to handle these issues and consider local economic benefits in procurement decisions. Issues of public sector procurement for innovation have also been examined by the Organisation for Economic Cooperation and Development along with guidance on "good practices and strategies" [139].

Another set of approaches relate to changes in regulatory systems and taxation systems that reduce the friction of certain types of business activities and create incentives for investment and business activity in certain sectors of the economy. Whilst these can be effective policy levers for industry growth careful consideration needs to be given to possible distortions to the market via changes in taxation policy, the costs of these schemes, the feasibility of administering these scheme and social and environmental risks associated with changes to regulatory requirements.

Whilst these approaches have been used extensively in Australia there are limited publicly available case studies or publications about their efficacy. The Regional Australia Institute and Charles Darwin University [140] studied procurement approaches in the context of regional development in Australia and found that "unhelpfully, there is little systematic and robust analysis of the scale and range of regional development impact that public procurement can have" and that "this is largely due to a history of poor program and policy assessment, where policy effort is weighted towards announcements and implementation at the expense of ongoing review and evaluation" (page 3). However, a lack of data is not evidence of a lack of effectiveness. They are widely and routinely applied policy tools for stimulating regional economic development.

3.6.5 Other Strategic Considerations

Specialisation Strategy

There is much evidence that technological specialisation boosts regional and national economic growth [141-145]. The benefits of specialisation are pronounced in advanced economies like that of Australia and Greater Sydney. For example, a comprehensive economic study [142] of all countries comprising the European Union over the years 1969 to 1998 by researchers from the University of Wuppertal in Germany found that "the level of relative technological specialisation in the area of research and development-intensive industries and especially in the area of leading-edge industries contributes significantly to economic growth" (page 271). An

earlier study of technological specialisation [141] amongst 20 OECD countries during 1975-1990 came to a similar conclusion stating that "a general positive relationship is found between the degree of specialisation in technology and higher rates of growth" (page 157).

These empirical studies support longstanding Ricardian theories in economics about economies-of-scale, comparative advantage and trade. Specialisation allows a regional economy to decrease the costs of production and produce a higher quality product. This creates competitive advantage. However, there are also some risks with specialisation. The most significant risk is a failure to specialise in the correct area of science and technology due to future changes in consumer demand or the emergence of competition from other industries worldwide. This can be managed via a targeted, adaptive and balanced specialisation strategies.

Another challenge relating to specialisation strategy is achieving economic resilience. Regional economies dependent on an industry producing a single, or small number, of goods and services are at risks of sudden shocks in the marketplace for those goods and services. For example, a study [146] of Ohio counties between 1977 and 2011 found that counties with more concentrated industries performed better when times were good whilst counties with more diversified industries performed better when times were bad. The researchers argue that highly specialised regional economies require contingency plans for economic downturns.

Overall, a sound specialisation strategy within the context of a resilient and robust regional economy is likely to be associated with higher rates of industry creation and economic growth. Specialisations can evolve organically. However, industry specialisation is often the results of clear government objectives for sustained investment and commitment to identified areas of specialisation. This can be seen in the case studies presented in the following section.

Path Dependency

Economic geographers from Rotterdam University, Utrecht University and Lund University studied processes of industry growth and economic development in 70 Swedish regions from 1969 to 2002 drawing upon detailed company level data [147]. They found that "the long-term evolution of the economic landscape in Sweden is subject to strong path dependencies" and that "industries that were technologically related to the pre-existing industries in a region had a higher probability of entering that region" (page 237). Companies not related to the pre-existing industry of the region had a higher likelihood of failure or exiting the region and re-establishing elsewhere.

This finding from Sweden complements a significant body of work in the field of economic geography about the importance of path dependency. Path dependency indicates that new and emerging industries are associated with, and evolve from, existing industries. One of the best examples is Australia's highly successful mining, engineering, technology and services (METS) industry which has developed from Australia's mining industry. In another example from the United Kingdom researchers demonstrated that within the automobile industry early-stage companies had higher survival rates when their founders worked in closely related industries [147, 148]. Geography is an important component of path dependency. For example, the importance of spatial proximity to related industries has also been shown in an empirical analysis of firms in 110 newly developed industrial parks across eight Chinese cities [149]. In Brazil it appears to be particularly important for "pioneer firms" developing an industry which is new to a region [150]. Based on these observations the geographic proximity of the Western Parkland City to Greater Sydney could help fulfil the conditions of path dependence. For example, whilst Westmead Hospital and the associated med-tech companies are not within the Western Parkland City they are nearby and could provide a foundation for path-dependent industries to grow within the parklands.

Furthermore, whilst the Western Parkland City has considerable "greenfield" characteristics there are still significant existing industries from which path dependent future industries can be developed. For example, the region has unambiguous strengths in manufacturing, construction, agribusinesses and freight and logistics. The number of facilities and concentration of the workforce is much higher within the region for these industries compared to elsewhere in Australia. Building new industries upon these, and other such, existing industries is more likely to be a successful strategy.

Overall, there is consensus that regional economic development strategy needs to account for path dependence and target the development of new industries, especially new technology industries, that are related to – and build upon – existing industries.

Leveraging Economic Ecosystems

Ecosystem strategies aim to leverage an entire network of institutions, companies, resources and/or individuals relevant to business activity. They look beyond organisational and/or jurisdictional boundaries to the flow of ideas and assets. Ecosystems are known to develop, and flourish, within geographic industry clusters [151]. Professor Christos Pitellis from the University of Cambridge Business School has examined the role of ecosystems in the formation of clusters. He argues that "the co-location and embeddedness of firms and other institutions and organizations in a cluster helps create a supporting ecosystem … thereby increasing the overall pie of created appropriable value"[151] (page 1372).

In a study of the French Omega-3 agrifood industry cluster researchers [152] from the Institute for Entrepreneurship and Competitiveness at the Università Cattaneo in Italy find that an industry cluster ecosystem will have the following attributes:

- Increased opportunities for participants in the ecosystem to access markets and technologies;
- Collaborative research and development activities;
- Improved development of skills, education, knowledge and overall human capital;
- Improved access to scarce/specialised resources and skills;
- Improvements to operational flexibility and production capacity;
- Improved atmosphere of mutual trust making business deals easier; and
- Increased speed in response to market opportunities.

Whilst entrepreneurial ecosystems create positive feedback loops they need to be developed purposefully to realise their full economic growth potential. Hard infrastructure such as transport systems are important but ecosystems depend on softer, cultural and interpersonal connectivity within the business community. This calls for solutions beyond infrastructure involving analysis and nurturing of human/business connectivity.

3.6.6 Industry Development Strategy – Ingredients for Success

Our analysis of case studies of successful industry development across the globe concentrating on North America, the United Kingdom, Europe and Australia (Appendix A and Table 1) combine with the theories and concepts described above identifies ingredients for success:

- *Path dependence (play to your strengths)* – New industries are more likely to succeed if they build upon existing industries. Australia's successful mining technology industry was built upon its successful mining industry. The Western Parkland City can build upon freight and logistics and other existing industries.

- *Specialisation* – Especially within the context of advanced economies such as the Western Parkland City, technological specialisation is associated with higher rates of regional economic growth. Specialisation strategy needs to be flexible, dynamic and resilient to handle changes in the marketplace.
- *Clusters* – Clusters are geographic locations containing concentrated and interconnected business activity. Businesses in clusters grow revenue and jobs faster plus innovate more. Practically all the successful case studies have evidence of planned and serendipitous industry clustering.
- *Universities and technical colleges are critical* – Practically all the case studies of success have a high-quality university and/or technical college at their core which does teaching and research. Universities create spill-over benefits in the form of tech-enabled and skilled start-up companies.
- *Research and development* – Practically all the successful case studies contain research and development activity associated with the development of new products and services – known as original equipment manufacturers (OEMs) – which provide the region with long lasting competitive advantage.
- *Government investment* – Practically all the case studies we reviewed involved strategic government investment and/or seed funding in the early stages. Probably the most significant category of government investment was defence-sector spending.
- *Urban amenity and liveability* – All the successful case studies saw investment in urban renewal to create connected and liveable cities which attracted skilled workers which attracted industry.

Table 1. Summary of implications of the case studies for the Western Parkland City (Appendix A).

Case Study	*What does it mean for the Western Parkland City?*
Toulouse, Seattle and North West England	• Attract and retain a few anchor organisations. Boeing, Airbus, BAE Systems and Rolls Royce are some of the longstanding companies that helped build these clusters. • Win defence contracts – companies within all three of these clusters won large and ongoing government defence contracts which helped sustain revenue through the business cycle. • Training and education in relevant technical areas are vital – a skilled workforce attracted companies which attracted skilled workers and yet more companies. • Don't expect instant results and ensure long term commitment; these clusters are decades (arguably up to a century) in the making and have been through high/low business cycles.
Manchester and Graphene	• Betting industry development on a single breakthrough is a viable but risky strategy – the jury is out on whether (or not) graphene will work for Manchester. However, it could be high pay-off if it succeeds. • Invest in research and development at universities and in research organisations to improve the chances of a breakthrough – this came about because two scientists at the University of Manchester won a Nobel Prize for their curiosity-driven research in physics on graphene. • Have a Plan B – if the strategy does hinge on a single invention or technology make sure there's a pivot option where the skilled workers, facilities and infrastructure can be used for another commercial industry. • Monitor and evaluate industry growth progress so there's good signals on whether, when and how to change strategy.

Zaragoza (Spain) Freight and Logistics Cluster	• Embed a university, technical college and training facility within precincts and/or technology parks offering world-class qualifications at all levels relevant to the industry specialisation. • This can be created via partnership with existing universities rather than building a new university or college from scratch. • Invest in research and development to create localised and new capabilities and/or products relevant to the industry specialisation. • Conduct careful site selection for industry/technology parks and precincts to ensure the needs of the proposed industry are well met with beneficial impacts on surrounding areas. • Achieve ongoing multi-jurisdictional support (Federal, State, Local) for the proposed industry cluster.
The Fort Collins, Colorado technology industry cluster	• Invest in enhanced lifestyles for workers and residents via parklands, cycle/walking trails, high quality urban design, recreational opportunities and a vibrant community. Attracting and retaining skilled workers was key to Fort Collins success. • Ensure well developed and accessible nature based and outdoor recreation activities which attract workers and tourists – Fort Collins has effectively capitalised on skiing, mountain biking, golf, hiking and other outdoor activities afforded by the Rocky Mountains. • Place a university and associated research organisations at the centre of the industry development strategy; Colorado State University receives considerable financial and other forms of support from Federal, Local and State Governments. • Win defence contracts – The defence lands management research and development activities at Colorado State University are a significant source of revenue for the university and region with spill over benefits.
Glasgow Cluster Strategy	• Identify and commit to clusters - Scottish Enterprise approved four priority industry clusters for the Glasgow region with an additional four clusters announced in 1999; these can be seen today. • Lower socio-economic and/or abandoned areas can be transformed into wealthy, vibrant and highly liveable places affording high quality of life via effective industry growth strategy. • Geography and physical connectivity matter – choose the right locations for clusters and infrastructure to create a connected industry ecosystems.
Maryland health sciences cluster	• Tax incentives can be used to attract investment but the instruments need to be targeted and designed to attract and retain the right type of investor (likely to stay and invest in research and development and jobs). • Invest in research and development – The main industry growth strategy here has been huge government investment in biotech research and development via research grants to universities and other organisations. • Have an anchor institution – Maryland John Hopkins University which is famous worldwide for excellence in health and medical research. This has been supported by government via research and development investment and standards of research excellence.
Brisbane West Wellcamp Airport	• Opportunity to leverage demand for food and fibre from Asia – Wellcamp airport is in its early stages but is responding to market demand from Asia.

	• Opportunity to co-locate freight and logistics facilities near airport – there are plans for a major food freight and logistics hub with support from the Queensland Government.
Memphis Aerotropolis	• Attract an anchor tenant – The growth of the airport, and creation of the aerotropolis, was significantly catalysed by FedEx basing its operations for North America at that location. • An airport with freight and logistics activity can have substantial spill-over benefit for the regional economy. • Monitor and measure the economic benefits of the airport to the broader economy – the Memphis International Airport commissions the University of Memphis to do this.
London's East End	• Demonstrates that a lower socio-economic and non-visited area near a major city centre can be revitalised economically and socially. • Build high quality transport connectivity – The Docklands could not have succeeded without the Docklands Light Rail connecting the area to the heart of London. London City Airport also played an important role.

4 Focus Industry Development

4.1 Advanced Manufacturing Industry

Due to advances in technology and a renewed focus on reshoring and/or nearshoring to improve supply chain stability there has been much attention given to advanced manufacturing in recent times. Early signals of the reshoring trend can be observed in the United States [153] where the manufacturing sector reshoring index by the Coalition for a Prosperous America saw growth in 2019 after several years of contraction [154]. However, where the reshoring trend has been studied in the United Kingdom, Germany [155] and Australia [156] the results have thus far been less compelling. It's possible that Australia may follow a similar pathway however we do not yet have compelling data showing that technology and supply chain security will drive change. But we note in the popular discourse there is a widely held belief and/or aspiration that technological advances and supply chain security objectives will lead to a resurgence in demand for Australian-made and local-made products that boosts the manufacturing sector and especially the advanced manufacturing sector.

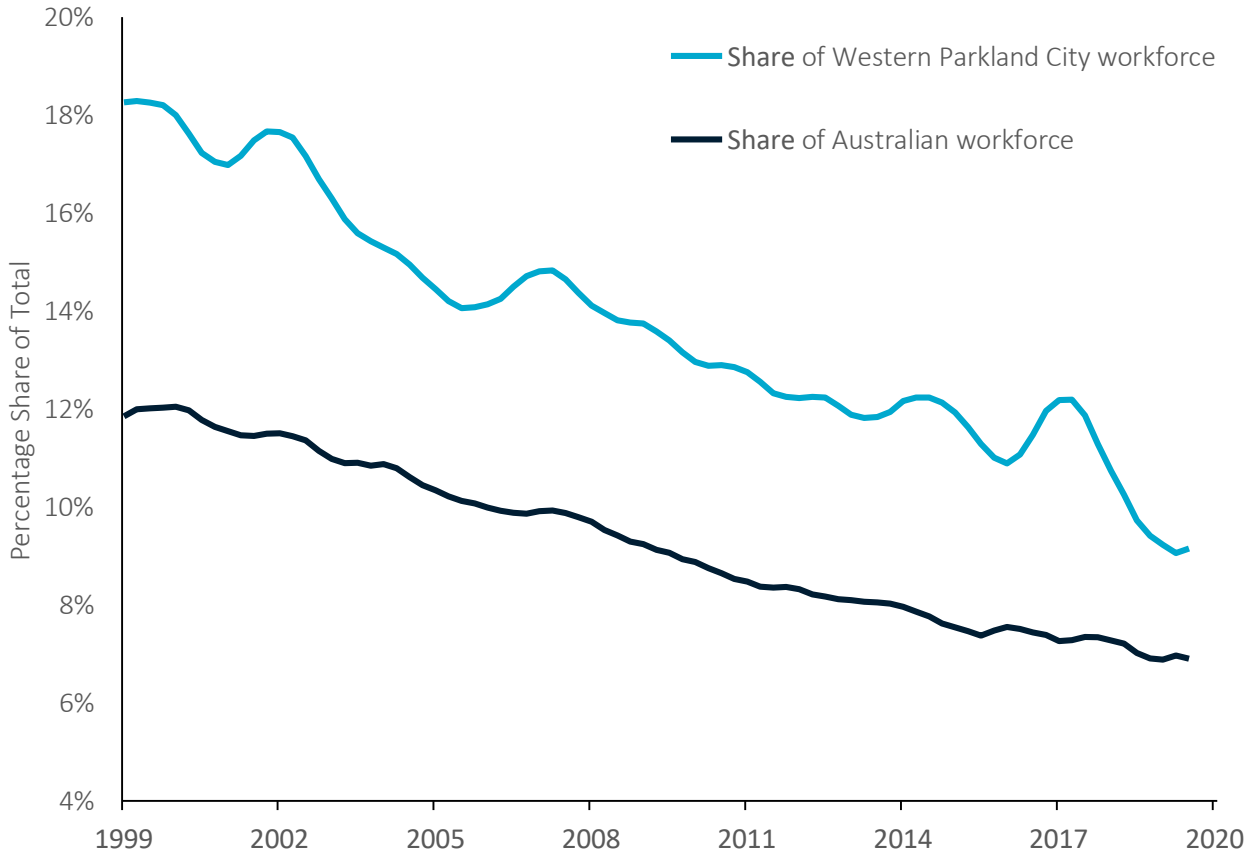

Figure 20 Share of employment in the manufacturing sector.
Data Source: Australian Bureau of Statistics Labour Force Survey (five quarter moving average).

However, for some time Australia's manufacturing industry has been in decline, both in terms of the absolute number of workers and its share of the workforce (Figure 20). The Western Parkland City, where the manufacturing industry has been a relatively large employer, followed the same trend. The manufacturing industry is currently spread across all local government areas in the Western Parkland City, with most employment located in the Fairfield, Liverpool, Campbelltown and Penrith local government areas (Figure 21). Furthermore, advanced manufacturing as defined by the Australian Bureau of Statistics (which includes transport equipment, machinery and chemical manufacturing) has also been in decline at the

national level. For the purposes of this report we do not limit our definition of advanced manufacturing to those subsectors covered by the Australian Bureau of Statistics; rather we consider it to cover any manufacturing activity which makes extensive use of new technology.

Much of the decline in Australia's manufacturing sector relates to globalisation, with increased competition from emerging economies, notably China. As a high wage country Australia struggles to compete in labour intensive processes for which production need not be in the same place as consumption, and so is prone to offshoring. This trend was exacerbated during the mining boom by the strength of the Australian dollar which makes imports relatively cheaper. This is not unique to Australia and has happened across the developed world; notably in the United States where it has contributed to higher unemployment, lower workforce participation and reduced wages in exposed regions [157].

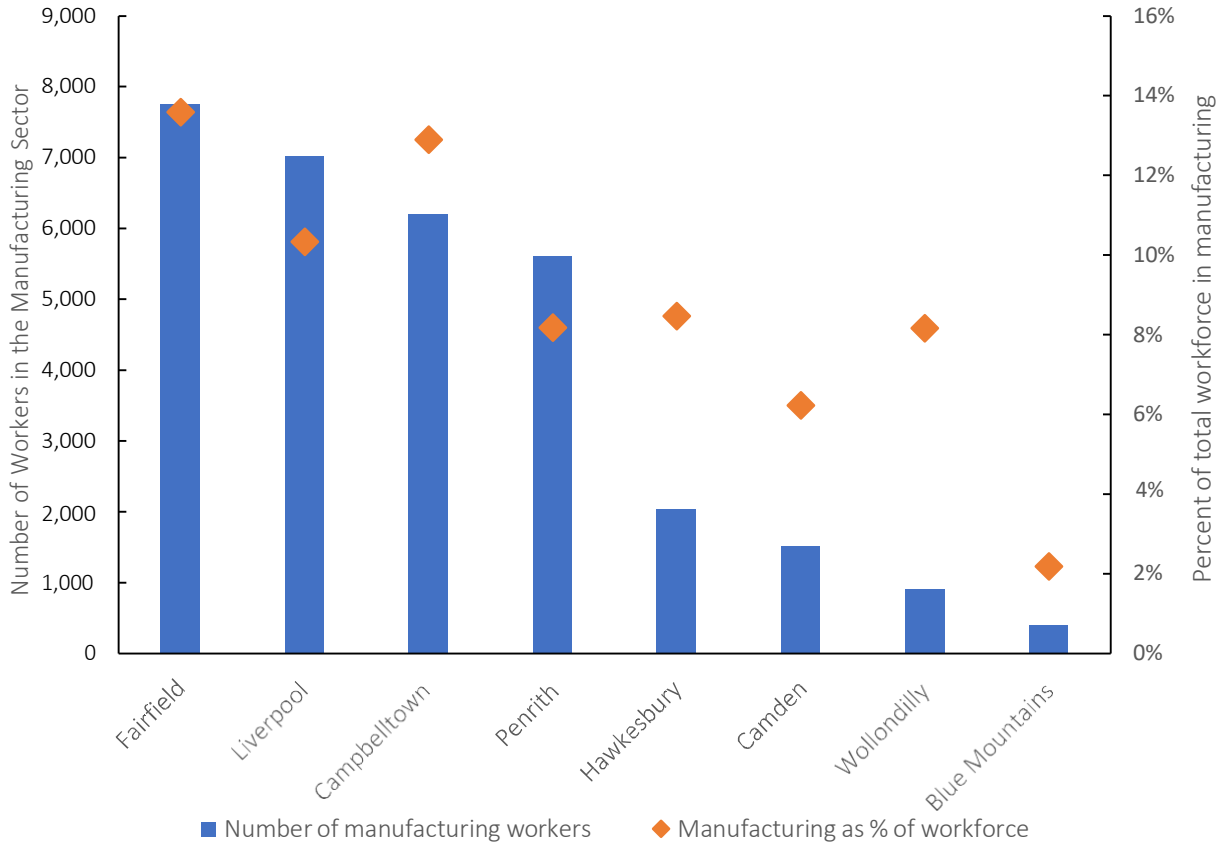

Figure 21 Concentration of manufacturing sector workers in the Western Parkland City.
Data source: Australian Bureau of Statistics 2016 Census

The trend towards globalised manufacturing looks set to continue, given ongoing cost differences and decreasing transport costs. Australia is unlikely to see a major resurgence in manufacturing employment in the near term. However, several countervailing forces may see a pick-up in local manufacturing. Firstly, technology has greatly reduced the amount of labour required in many factory processes, reducing the benefits from offshoring. Advanced manufacturing has higher productivity, employing fewer, but more highly skilled, workers for a given volume of output. Technology can be applied across all sectors of the industry, and is not confined to the sub-sectors used in the Australian Bureau of Statistics definition of advanced manufacturing [158]. All things being equal, technology would further reduce local employment, but in practice it can increase local production due to elastic demand, and comparative advantage in global markets leading to more jobs overall, and an increased proportion of more highly skilled and hence better paid jobs.

Skills demand for manufacturing jobs in the Western Parkland City has increased in recent years, suggesting a move towards more advanced manufacturing. To identify this trend we analysed job advertisement data supplied to us by Adzuna; an online job search platform with offices in Sydney Australia (see Appendix C for details). The Adzuna job advertisement data we used holds detailed categories of skills and occupations for all job advertisements in the eight local governments comprising the Western Parkland City during 2015 – 2020. Adzuna job postings data show that between 2015 and 2020 the mean number of skills listed per manufacturing job posting in the Western Parkland City increased for all major manufacturing occupational groups (Figure 22).

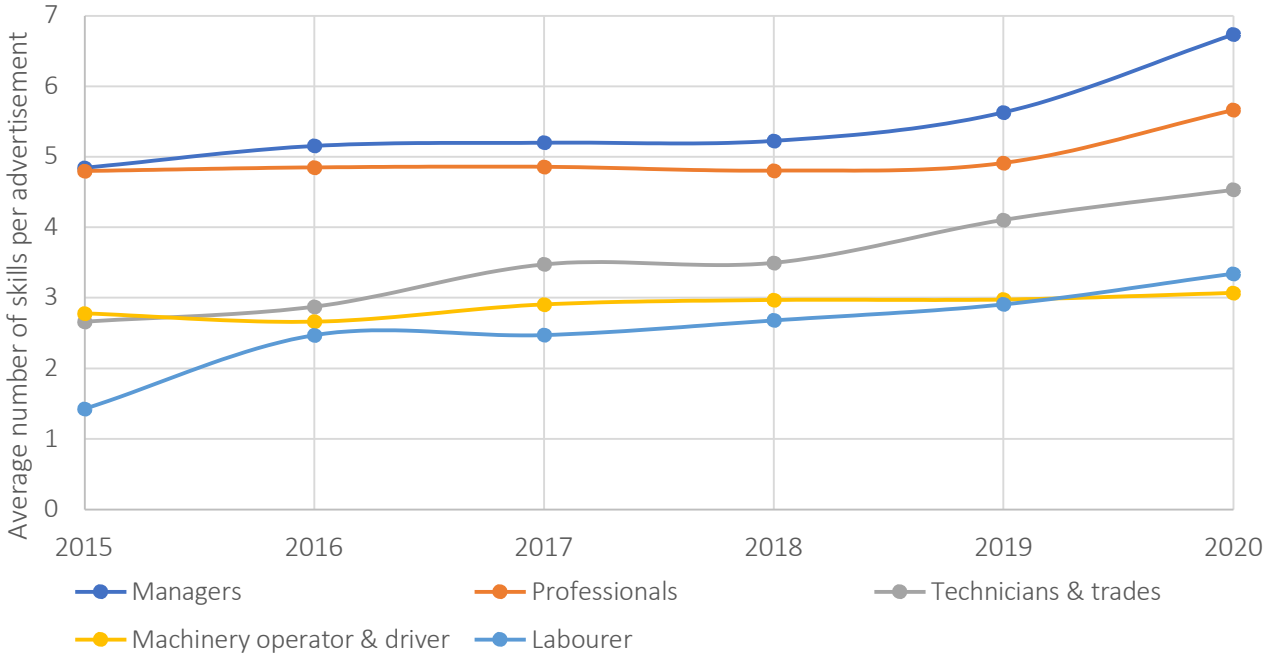

Figure 22 Average (mean) number of skills for manufacturing jobs in the Western Parkland City.
Source: Adzuna job postings and advertisements data (Appendix C).

The overall increase in skills demand has been driven by increased demand for certain types of 'higher tech' skills: engineering and related trades; ICT; monitoring, inspecting and testing; and physical sciences (Figure 23). In contrast, demand has been relatively flat for more traditional skills such as manufacturing and processing and moving and lifting.

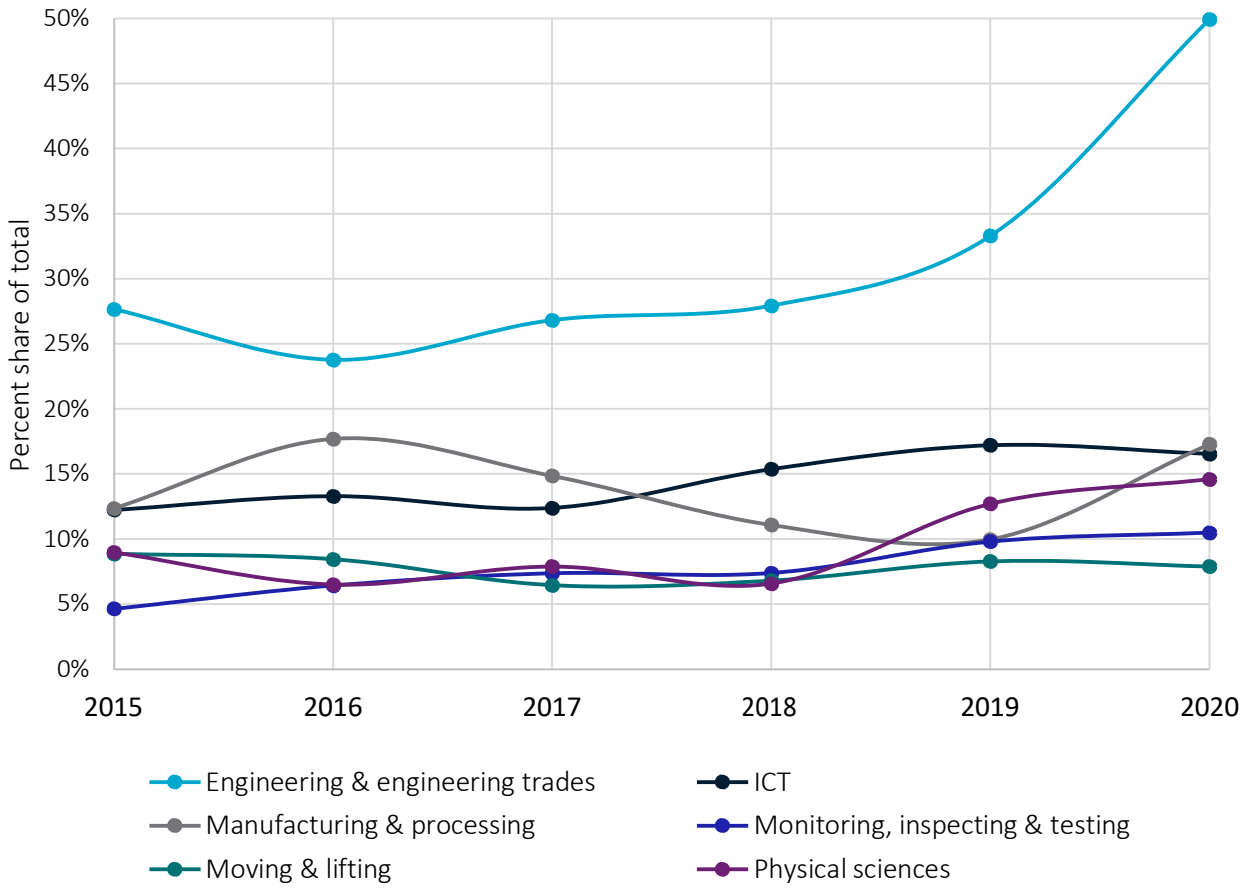

Figure 23 Western Parkland City manufacturing job advertisements by skills & competencies.
Source: Adzuna job postings and advertisements data (Appendix C).

In terms of skills supply, census data reveal a relatively small proportion of the Western Parkland City workforce has a post-school qualification (58% compared to 69% for Greater Sydney). Around half of the manufacturing workforce has a post-school qualification, though the Western Parkland City does have a lower representation of manufacturing workers with university degrees than the rest of New South Wales (Figure 24). The increasing skills demands of manufacturing jobs may drive more members of the region's workforce to obtain relevant post-school qualifications. In terms of field of qualification, a large proportion of the Western Parkland City workforce's post-school qualifications are relevant to advanced manufacturing: 19% are in engineering and 7% are in architecture and building (compared to 14% and 5% respectively for Greater Sydney). These levels would likely need to be maintained to support the development of advanced manufacturing in the region. A potential skills gap may arise in information technology, which is increasingly demanded in manufacturing but accounts for just 3% of the region's post-school qualifications (compared to 6% for Greater Sydney).

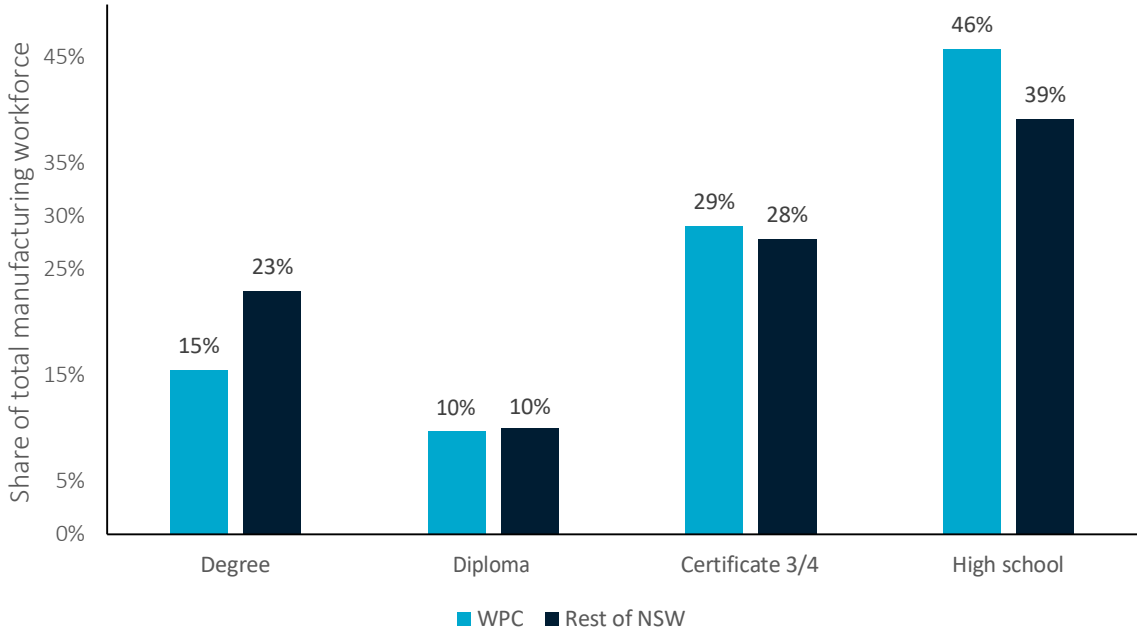

Figure 24 Manufacturing workers by highest level of educational attainment.
Data source: Australian Bureau of Statistics 2016 Census

Our jobs advertisements dataset does show evidence of increasing demand for advanced manufacturing skills in the Western Parkland City (defining an advanced manufacturing job ad as any ad for the manufacturing industry that mentions skills in engineering, data analysis, ICT, or mathematics/statistics). The share of such ads in Western Parkland City has grown strongly in recent years relative to the rest of New South Wales (Figure 25).

Advanced manufacturing techniques (*e.g.* 3D printing) can also reduce the economies of scale which concentrate global production in a small number of mega-factories. As a high cost location with a relatively small local market Australia is unlikely to host mega-factories, but smaller advanced manufacturing facilities can be viable and service the local market with reduced transport costs. Furthermore, there is increasing recognition, by both business and governments, of the risks inherent in globalised supply chains. When all goes well such supply chains are highly efficient, but they lack resilience. Recently many supply chains have been significantly disrupted by international trade disputes and the pandemic. These will not be the last such disruptions, so the benefits of locating production closer to consumption are becoming clear.

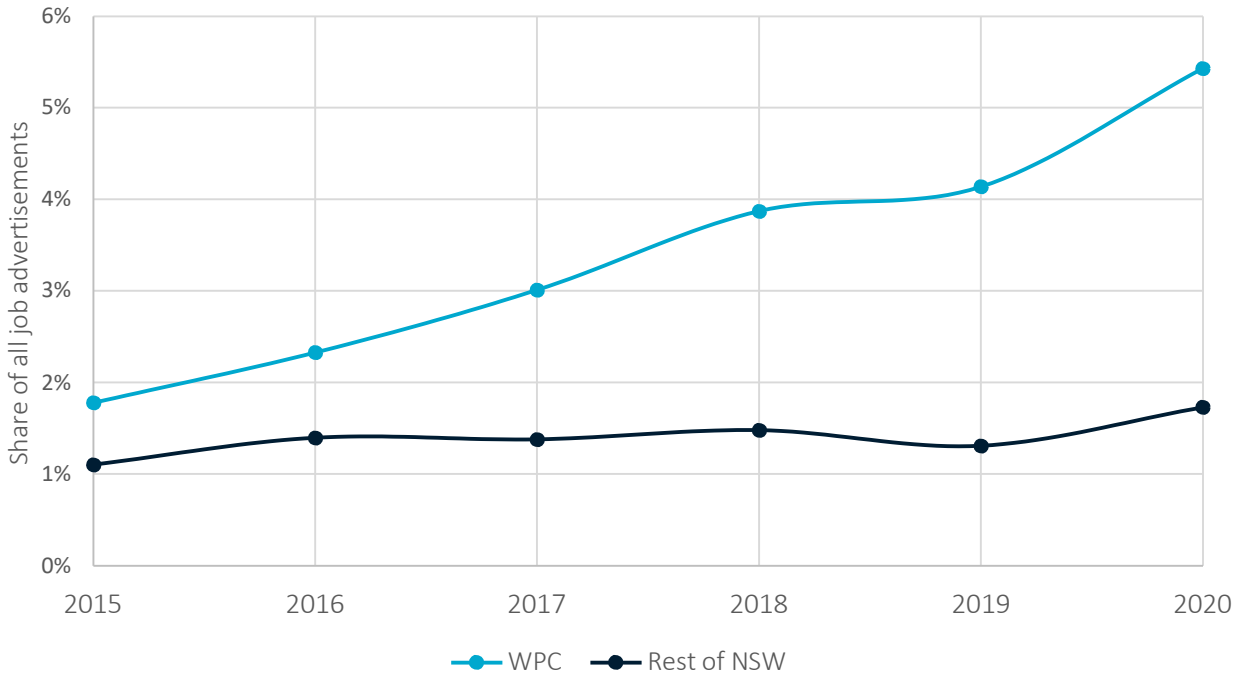

Figure 25 Advanced manufacturing job postings as shares of total postings.
Source: Adzuna job postings and advertisements data (Appendix C).

The Western Parkland City is uniquely well placed in terms of having land available with excellent infrastructure and close to Australia's largest domestic market. The new airport in Western Parkland City promises cheaper access to export markets which could increase demand for locally manufactured products. The strong demand for the Australian Government's International Freight Assistance Mechanism [159], an initiative to support exports disrupted during the pandemic, suggests many Australian firms see untapped export opportunities. However, increased freight capacity through the new airport goes both ways; it will also reduce import costs, which could further increase competition for some products which is good for local consumers but not so much producers.

There is clearly still strong demand for manufactured products. For example, the Australian Bureau of Statistics Australian Industry survey shows sales income for the concrete product manufacturing industry (which includes the manufacture of prefabricated concrete buildings and components) increased by 27% between 2011 and 2019 ($2.3 billion to $3 billion). Construction is among the largest employers in the Western Parkland City and nationally, so demand for construction products will likely remain strong. Localised manufacturing can reduce transport costs for what are typically relatively bulky products; transport costs will make up a relatively large share of the cost of imported products, providing room for local production to compete.

Local manufacturing can also support more bespoke products which are better suited to local conditions and can be more rapidly shipped to customers. Employment in the manufacture of prefabricated building products is increasing rapidly [160], but is clearly not keeping up with demand as imports are also growing strongly [161]. Western Parkland City accounts for a relatively large share (about 5%) of Australia's total employment in this industry. The proposed transport and logistics hub in the Western Parkland City may decrease the cost of distributing these products throughout the domestic market, providing firms in the industry with opportunities to expand. This opportunity is broader than just prefabricated buildings as similar economic fundamentals will apply to many building products from bathtubs to windows. If the application of advanced production techniques can reduce costs and/or provide a better or more bespoke products there will clearly be sufficient local demand to support industry growth. As with agribusiness, provenance is a further advantage of local production, with far better assurance that products are up to standard.

4.1.1 Insights for Further Analysis

The Australian manufacturing sector has been in steady decline for many years but remains an important source of employment and economic activity. Nearly one million Australians are employed in the sector. Applying new technologies to increase productivity is necessary to help the local industry survive and grow. The Western Parkland City is already home to considerable manufacturing activity, and this has the potential to increase given its endowments of land, infrastructure, workers and market access. Hi-tech manufacturing can increase productivity and allow local production to better compete with imports. This does not necessarily also require high-tech outputs.

Manufacturing high-tech devices, whether medical implants or smartphones, is a highly competitive industry. Such devices are typically small and so transport cost is less of a barrier to imports. Many of these markets are very small domestically. By contrast bulkier goods such as prefabricated building materials are relatively more costly to import, and also subject to shipping and wharf delays. If specific sectors are to be targeted then it is important to focus on those in which the Western Parkland City is likely to have a defensible comparative advantage. Building on existing strengths is one such option, and/or focussing on products for which technology can increase manufacturing productivity, for which there is strong local demand and which are costly (relative to the value of the product) to import is another.

Traditional manufacturing activity is attracted to particular locations by the availability of workers with the required skills and its proximity to the supply chains and markets in which they operate; knowledge spill-overs are less important [162]. Skills supply is likely to be even more important to more advanced manufacturing. This indicates that a key role for government is ensuring the supply of skilled workers (*e.g.* with technical qualifications in areas such as engineering, logistics and information technology) to support an advanced manufacturing industry. Since the availability of skilled workers is a key issue in firms' decisions about where to locate, there may be a case for collecting and publishing such information to help firms identify opportunities. Government procurement might also target sectors which appear to be growing in order to help them achieve and maintain scale. For example, government could be a major purchaser of prefabricated and bespoke construction products providing firms with sufficient certainty to invest.

There is potential for novel thinking and policy around supply chain integration which could represent an untapped new source of agglomeration economies. Co-locating with customers and suppliers drives much clustering and can be expected to happen without specific intervention provided land availability and zoning constraints are not limiting. However, many factories produce more than just their product – they also have waste and by-product streams which could potentially be used by other firms. A key barrier to this is the availability and dissemination of relevant information. There are many different firms, with many different types, and grades, of by-products and inputs. As most of these firms are SMEs they have neither the time nor resources to realise all the potential re-use opportunities.

There is therefore a role for a "matchmaker" platform to link those that have useful waste with those that could use it. This must be done in a way which is easy for firms to engage with, while also protecting commercially sensitive information (so it is not simply a case of posting such information publicly). There could be a role for the Western Parkland City to support this, potentially building on existing initiatives such as the ASPIRE network originally developed by CSIRO [163] and the New South Wales Circular Economy Network. Much of this information is required by various levels of government anyway (*e.g.* waste streams for environmental regulators) so putting it to work for the industry is both feasible and desirable.

4.2 Defence and Aerospace Industry

The aerospace manufacturing industry represents a small and shrinking proportion of the Australian workforce, currently accounting for 11,500 workers and less than 0.1% of national employment. It is also

relatively small in the Western Parkland City represented mainly by a few hundred workers in the Hawkesbury Local Government Area. The aerospace industry includes the manufacture and maintenance of aircraft. Whilst the national and international aircraft fleet has grown steadily over recent decades, there is a trend for the more labour-intensive heavy maintenance to be offshored to where labour costs are lower. This is because planes are mobile and can be serviced practically anywhere in the globe.

For example, most Qantas heavy maintenance is now done offshore. In 2015 the Australian Capital Territory Government brokered a deal to move Qantas 717 heavy maintenance to Canberra, but less than four years later it was relocated to Hong Kong. The new airport in the Western Parkland City will clearly increase local demand for aircraft maintenance and engineering, along with other support work such as baggage handling and catering. Such direct employment is likely to be relatively modest; a 2013 Australian study reported that smaller airports such as Cairns, Canberra and Darwin each supported several hundred aerospace jobs [164]. And while passenger numbers have increased subsequently it is also likely that more roles have been automated. Our analyses did not identify any likely change to the longer-term trend to offshoring of heavy maintenance work on aircraft [165, 166].

The defence industry makes up a significant share of employment, though this has also declined in recent decades and currently sits at just 0.2% of the Australian workforce. The defence industry is a relatively large employer within the Western Parkland City accounting for 1.4% of the region's employment. Most of the activity is located in the Hawkesbury and Liverpool local government areas. Much of this activity is supporting military personnel at the Richmond Royal Australian Air Force Base and Holsworthy Barracks. Defence manufacturing is an interesting sector in terms of economic growth potential but is not well represented with publicly available statistics. The defence sector is highly dependent on Commonwealth Government procurement which is set to increase substantially in coming years.

4.2.1 Insights for Further Analysis

The case studies of Toulouse, Seattle and North West England discussed in this report represent three highly successful and mature aerospace industry clusters with substantial defence components. These clusters have developed over decades and up to a century. New entrants to global markets will be challenged to differentiate and compete with these, and other such, well established aerospace industries. Australia's only recent new airport is Wellcamp in Toowoomba which opened in 2014; according to Flightradar it currently operates a single weekly international freight flight (to Hong Kong) and 20-30 domestic passenger flights a week. Clearly there will be greater demand for both passenger and freight flights into Western Sydney, but this does highlight that an airport alone does not unlock export markets.

A recently emerging policy lever is associated with increased government spending on defence. On 1 July 2020 the Australian Government announced that it would invest an additional $270 billion over the coming 10 years to upgrade the capabilities of the Australian Defence Force [167]. The priority areas for investment identified in the 2020 Defence Strategic Update are [167]:

- Enhancing posture and partnerships including supporting the "Pacific Step-up" objectives;
- More potent capabilities to hold adversary infrastructure and forces at risk including long-range strike weapons, cyber-capabilities and area denial;
- More resilient supply chains and greater industrial sovereign capability to achieve enhanced self-reliance of the defence force;
- Capabilities to respond to "grey-zone" activities including improved situational awareness, electronic warfare and information operations; and

- Detailed planning for the provision of equipment, facilities and logistics to enhance defence force support for civil authorities in response to natural disasters.

Supplying the current and future needs of the Australian Government Department of Defence represents a significant opportunity for the Western Parkland City. However, identifying specific opportunities will require considerable engagement with the defence department. This can help identify how the region's capabilities match up to the defence department's requirements. Smaller manufacturers and service providers may benefit from knowledge spill-over and supply chain clusters; these could be encouraged, and a wider range of firms supported through the provision of shared infrastructure such as secure business parks collaboration facilities.

Furthermore, defence manufacturing could play a key role in developing a deeper and more technologically capable local industry. This can extend far beyond high profile projects such as fighter jets – defence procures an enormous range of products, and will favour locally made, so it could support a range of manufacturing sectors if they can offer sufficient quality and productivity. For example, the United States military is required to use US-made products whenever possible. This has had the surprising side-effect of stimulating the development of automated sewing machines – known as "sewbots" - which allow military uniforms to be made in America at prices close to those offered by labour-intensive factories in low wage Asian countries [168]. While requiring much less labour than traditional garment manufacturing, these factories are still a source of employment, and could contribute to a broader resurgence in United States based garment manufacturing. It is therefore worth considering a broad range of spin-off products from defence related manufacturing.

Overall defence represents a significant future potential industry growth opportunity for the Western Parkland City. The opportunity is associated with substantial new spending by the Australian Government. And unlike other areas of government procurement defence has heightened requirements for provenance and security along the entire supply chain; which could increase the attractiveness of local providers. Securing defence contracts would likely require confidential conversations and business development with the Australian Government Department of Defence. A defence contracting company may also be required.

An example of this approach comes from Queensland where on 15 February 2021 the Premier [169] signed a "Memorandum of Understanding with Rheinmetall Defence Australia reconfirming a long-term partnership that is now firmly focused on attracting to Queensland the LAND 400 Phase 3 contract valued at up to $27 billion". It is estimated that this will create an additional 500 jobs, above the 450 positions already created in phase two. This investments will be centred on Rheinmetall's Military Vehicle Centre of Excellence at Redbank in Brisbane which manufactures advanced land based military vehicles. The customer purchasing these vehicles is the Australian Defence Force.

4.3 Agri-food Industry

Here we define the agri-food sector to include businesses involved in farming, manufacturing and processing of food products. Existing primary production in the Western Parkland City region includes poultry and horticulture, primarily serving the Sydney market [170]. Over the past ten years Australia's agri-food industry has been reasonably stable. It has grown steadily in terms of absolute number of workers and maintained a relatively stable share of about 2% of Australia's total workforce, apart from a recent decline during the pandemic.

Within the Western Parkland City the agri-food industry accounts for a similar proportion of the total workforce and is forecast by the New South Wales Government to continue on a growth trajectory through 2021. Agribusiness employment is spread across all local government areas in the Western Parkland City.

Most of the industry's workers are in the larger local government areas of Liverpool, Fairfield, Campbelltown and Penrith. The industry represents a particularly large share of total employment in Wollondilly; about 4% compared to 2% for the Western Parkland City. Primary production (farming) is also a significant employer, with around 2,500 workers concentrated in the more rural parts of the Western Parkland City.

Food production is a significant source of economic activity and domestic and global markets are growing (Figure 26). Within Australia food spending is increasing in line with incomes, though a greater proportion is being spent on restaurants and higher value foods. Internationally, and particularly in Asia, the growth in food spending is more pronounced as billions more enter the global middle-income class [171]. Agri-food business therefore represents a significant opportunity, particularly for higher value foods and food products.

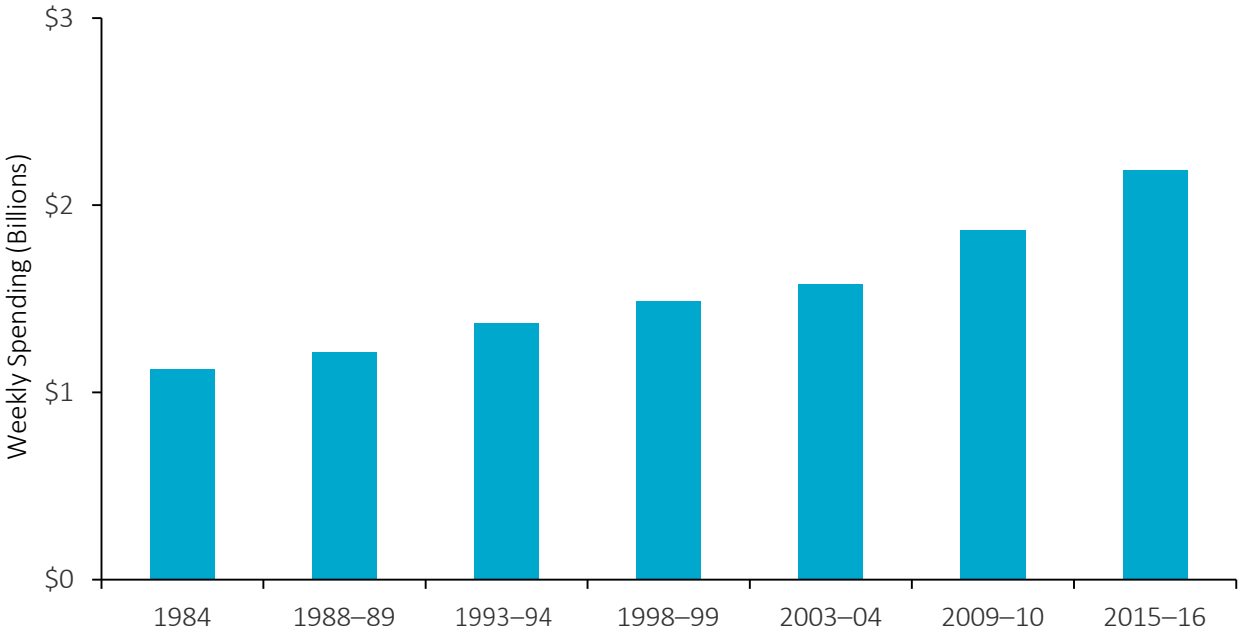

Figure 26 Average Australian household spending on food and drink, current dollars.
Data source: Australian Bureau of Statistics Household Expenditure Survey.

The Western Sydney Airport will increase opportunities to export quality fresh produce to high value markets interstate as well as internationally. In the past we have seen how shifts in the global marketplace have rapidly translated into demand surges and opportunities for local agri-food producers. New markets for powdered milk exemplify this. Export data through Sydney's existing Kingsford Smith Airport show a large jump in 2015 as Chinese consumers sought Australian-produced milk and infant formula. There will be many drivers behind the sudden growth in exports including free trade agreements and marketing initiatives. There were also innovations which extended the "personal shopper" network through social media, creating a new means of trust which allows small scale exporters to meet previously untapped demand [172]. However, air freight is costly relative to the value of most food items, which will limit the potential for exports, particularly given the distance to most overseas markets.

There is also considerable potential to develop higher value domestic markets. For example, the domestic blueberry market expanded rapidly from around 2017 both in terms of overall production and value (Figure 27). Imports represent a small proportion of the domestic market; they increased in 2016 before falling back as domestic supply was scaled up to meet strengthening demand. Exports have remained small, at around 1% of production [173]. The potential advantage of locating this production in the Western Parkland City is its proximity to the Sydney market and the proposed aerotropolis precinct, which is intended to offer supply chain solutions for domestic and international markets [170].

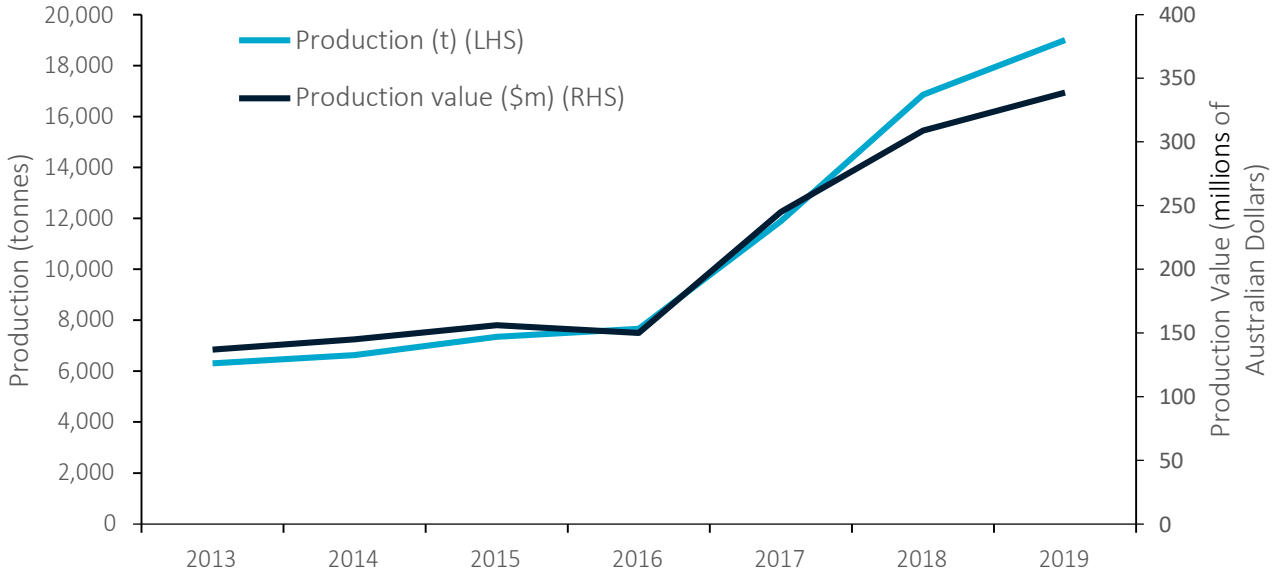

Figure 27 Australian blueberry production.
Data Source: Australian Horticulture Statistics Handbook [173].

There is also potential for advanced horticulture and food manufacturing to substitute imports. For example, Australia imports large volumes of processed tomato products such as canned tomatoes and pasta sauces. In recent years the annual value of these imports has been steady at about $150 million/year, which constitutes around two thirds of domestic demand. Italy represents by far the largest source of imports [174]. Local production and supply would incur much lower freight cost. The reasons why local producers have not yet taken over a greater share of this market is unclear. The barriers to entry would need to be analysed prior to developing this industry in the Western Parkland City. However, if tomato production and processing could be established in the region it would boost jobs in both horticulture and manufacturing. In addition, the proposed agribusiness precinct in the nearby aerotropolis is intended to support the production of value adding pre-prepared consumer foods [171].

4.3.1 Insights for Further Analysis

The fringes of Australia's cities have traditionally housed market garden-style agriculture. Increasing land values and the difficulty of realising scale-economies from small operations have caused much of this activity to be displaced [175]. However, technology can enhance agricultural productivity, particularly in horticulture, and opens opportunities in aquaculture. The Western Parkland City has been found suitable for commercial production of a number of high value horticultural commodities [171]. Hi-tech industrial-style greenhouse developments such as the Agriport A7 complex in the Netherlands, which exports high value fresh produce around the world, highlight the potential. Logistics is an essential part of premium fresh produce supply chains, so the development of the aerotropolis and the broader freight and logistics industry in the Western Parkland City creates substantial opportunities for agribusiness.

The Western Parkland City's comparative advantage in the global marketplace would likely be in quality, trustworthy produce, building on Australia's expertise and institutional capacity (*e.g.* in ensuring food safety). To leverage this advantage supply chain provenance would be integral. There are a range of new tools which could assist in this process, which would require products to be credibly tracked along supply chains, leveraging technologies such as Internet-of-Things (IoT) sensors and RFID tracking. There would be a role for industry, potentially supported by local government, to provide the oversight necessary for such mechanisms to be credible. Distributed ledger technology (blockchain) is often proposed for supply chain

provenance, but this is most applicable when the absence of a central authority means databases must necessarily be distributed across independent parties [176]. It is also important to note that trust is a socio-technical issue, and so requires social as well as technical solutions. Helping exporters large and small demonstrate provenance could facilitate the development of new markets.

Capturing a greater share of domestic markets represents a near term opportunity. This could take the form of both growing new markets for premium produce and substituting imports. With such a large and affluent population on its doorstep the Western Parkland City may be able to address new markets such as artisanal and/or multicultural food production. This could link up with visitor economy initiatives as premium produce is a major tourist drawcard (*e.g.* food and wine trails).

Circular economy initiatives could increase productivity and reduce problems associated with food production (*e.g.* waste management). Co-location of facilities is important and could be encouraged through information on availability of inputs at various sites. For example, in Holland glasshouses which require heating for most of the year are located alongside data centres which require cooling. Intensive horticulture and food manufacturing also produce large amounts of by-product, which could be used by other industries, for example as an input to animal or fish feed or for bioenergy production.

Significant adaptation will be required. For example, traditional glasshouses may be prone to overheating and hail damage. New packaging solutions might also be important, to ensure quality while minimising the environmental footprint of premium produce. In terms of clusters, research and development activities have clear potential for knowledge spill-overs where they are co-located. Agribusiness in general will be spread across a wider area, but there are clear opportunities for input-output clusters, in which the product or by-product of one facility is used in another facility. Encouraging such co-location could be beneficial, and requires information on available material flows as well as flexible land use.

Overall, there is strong forecast domestic and global demand for food products. It has long been noted by agricultural industry groups in Australia that freight and transport costs are a key barrier to accessing lucrative and high growth export markets. The recent analysis from the Australian Farm Institute [177] finds that farm to foreign-customer transport cost for Australian agricultural products represents between 4% to 48.5% of farmgate value with an average of 8.75% for domestic delivery and 23.64% for international delivery. These costs limit the ability of farmers in Australia and the Western Parkland City to access markets. However, the food freight and logistics capabilities associated with new airport could reduce these costs and enable market access for farmers within the region and other parts of Australia.

Another recent event with relevance is the recent decision by Australia Post (as reported on ABC News, 20 April 2021 [178]) to stop transporting food items such as meats, seafood, eggs or frozen meals due to food safety requirements. This has been detrimental to many small food producing businesses across Australia who have lost access to their main markets. It is noted that Australia Post is working with customers and industry regulators to find solutions. However, it has significantly impacted many businesses and has created uncertainty about the future. Again, there is an opportunity for the food freight and logistics capability associated with the Western Sydney Aerotropolis to find solutions for the efficient and reliable transportation of perishable foods.

4.4 Freight and logistics

Freight and logistics is a standout industry in the Western Parkland City with higher concentrations of workers, businesses and revenue compared to other regions in Australia (Figure 28). In terms of employment, the largest parts of the freight and logistics industry are road freight transport and postal and courier services. Road freight's share of national employment has remained reasonably constant over the past few decades, with the number of workers growing roughly in line with population growth (Figure 29).

Postal and courier services have accounted for a shrinking share of national employment since the 1980s, though this dec line appears to have plateaued in recent years.

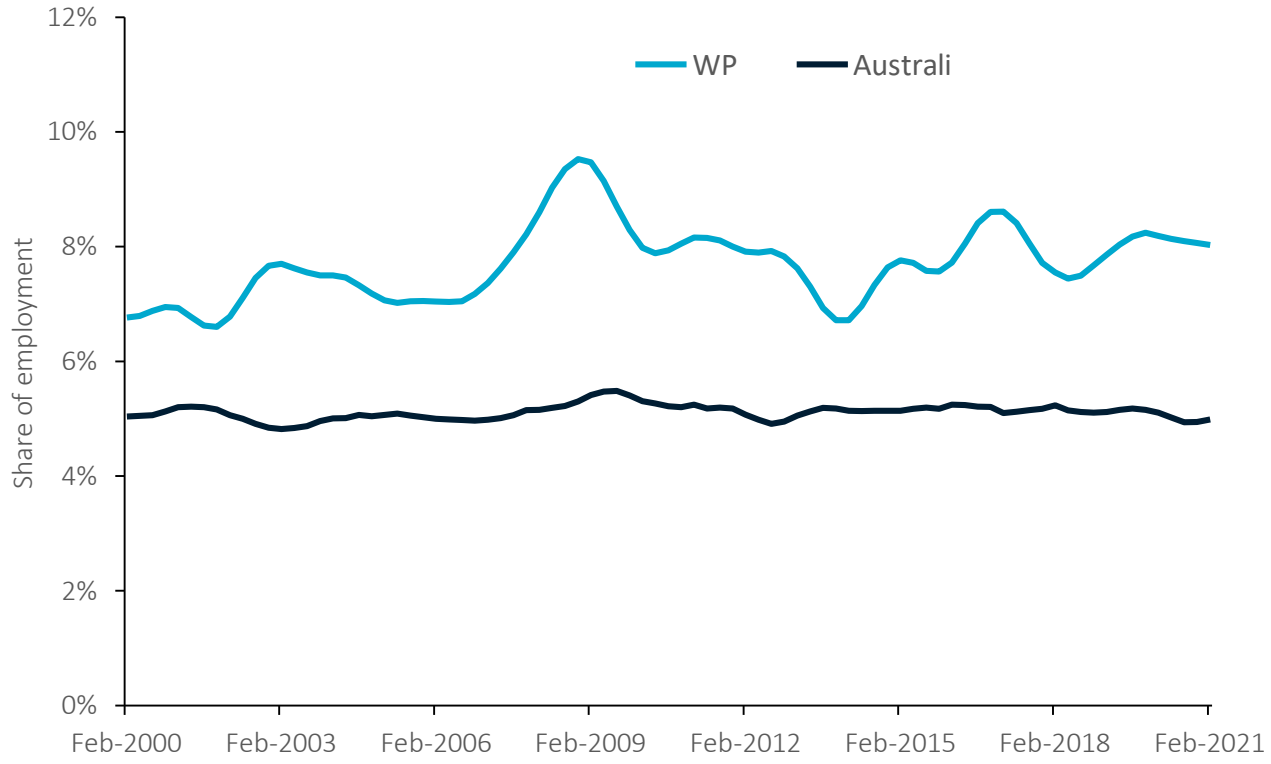

Figure 28. The transport, postal and warehousing industry's share of total employment.
Data source: Australian Bureau of Statistics, Labour Force, Detailed, March 2021.

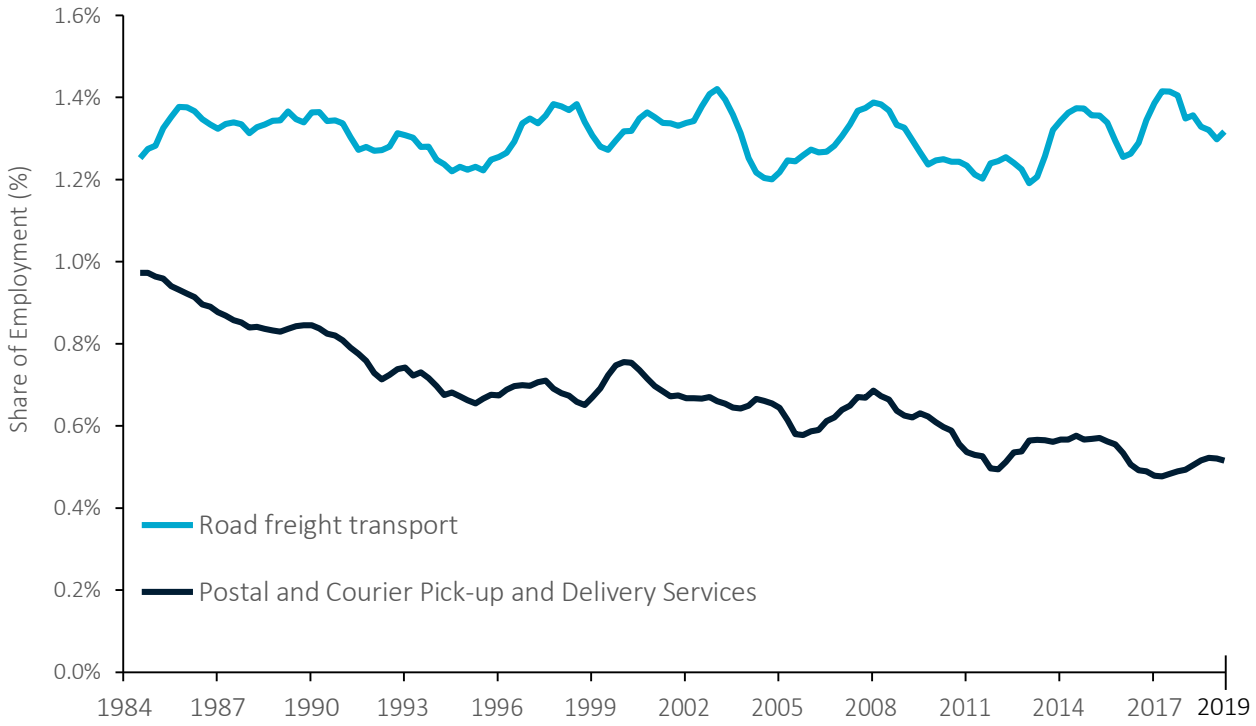

Figure 29 Road freight and courier service shares of employment in Australia.
Data source: Australian Bureau of Statistics Labour Force Survey (five quarter moving averages)

The Western Parkland City is at an advantage in relation to the freight and logistics industry, with several large clusters throughout the region. Being located near Australia's largest market and having an existing pool of workers with relevant skills makes Western Parkland City an attractive location for further investment in the industry. Infrastructure projects such as the Moorebank Intermodal Terminal and Bradfield Airport, along with private sector investments such as the new Amazon distribution centre at Kemps Creek will generate new employment and economic opportunities; though jobs will be lost elsewhere with increased automation at some existing supermarket distribution centres. The sector is therefore likely to continue expanding under existing policy settings. However, there remain several options for further supporting the industry's development.

Within the Western Parkland City freight and logistics accounts for a relatively large share of employment (3.8% compared to 2.4% nationally), with a significant presence in all local government areas except the Blue Mountains. The industry's share of the Western Parkland City workforce remained constant between 2011 and 2016 (Australian Bureau of Statistics census data) and is forecast by the New South Wales Government to grow slightly through to 2021.

The Australian Bureau of Statistics trend data only go up to February 2020 but it is clear that there has been a sharp rise in courier activity in the months during the COVID-19 pandemic. This has been fuelled by growing demand for online retail. How much of this will persist, and for how long, is not clear, though the long-term trends suggest freight and logistics will be a growth area driven partly by rising online shopping (Figure 30). There is also a significant amount of land within the Western Parkland City suitable for freight and logistics expansion. For example, in June 2020 the Mamre Road Precinct in Penrith City Council was rezoned to provide 850 hectares of industrial land and protect a site for a potential Western Sydney freight intermodal terminal.

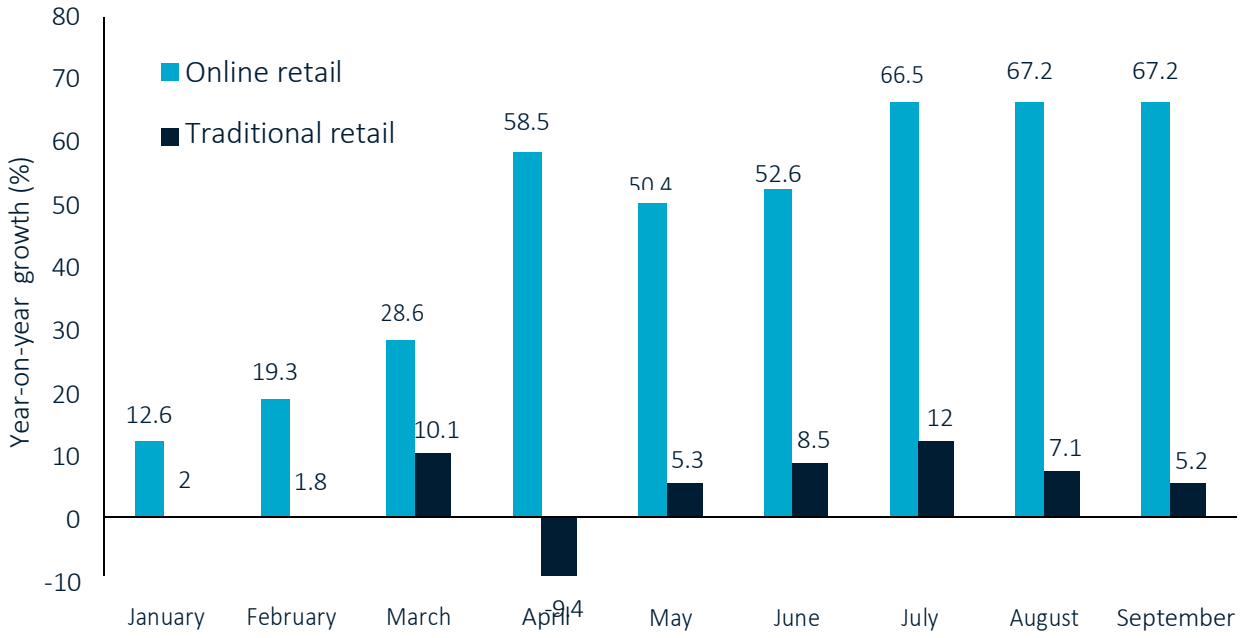

Figure 30 The expansion of online retail is fuelling freight and logistics demand.
Data source: National Australia Bank online retail index.

The Western Parkland City already takes an outsized share of the freight and logistics market compared to the rest of Australia and with new infrastructure is well placed to grow this further. In addition to its direct benefits this does offer broader benefits to the Western Parkland City economy by providing other industries with easy access to its services. The aerotropolis will bring freight and passenger flights into the Western Parkland City making it a hub for high value imports and exports. Logistics is integral to supply chain linkages

and circular economy initiatives, such as advanced e-waste recycling, which offer opportunities across a range of industries in the Western Parkland City.

4.4.1 Technological Advances in Freight and Logistics

Technology is pushing outward the frontier of what's possible in freight and logistics. Freight and logistics technologies improve the cost-effectiveness, quality, safety, traceability, speed, convenience, reliability and sustainability of freight and logistics activities.

The Western Parkland City freight and logistics industry has been quick to adopt cutting edge technology and is likely to develop these capabilities further into the future. Recent years have seen increased technological specialisation of the region's freight and logistics workforce (Figure 31).

Since 2015 the share of freight and logistics job advertisements requiring specialised technical skills (e.g. data science) has risen from 3% to 6% of the total in the Western Parkland City. This compares to 2% for the whole of New South Wales.

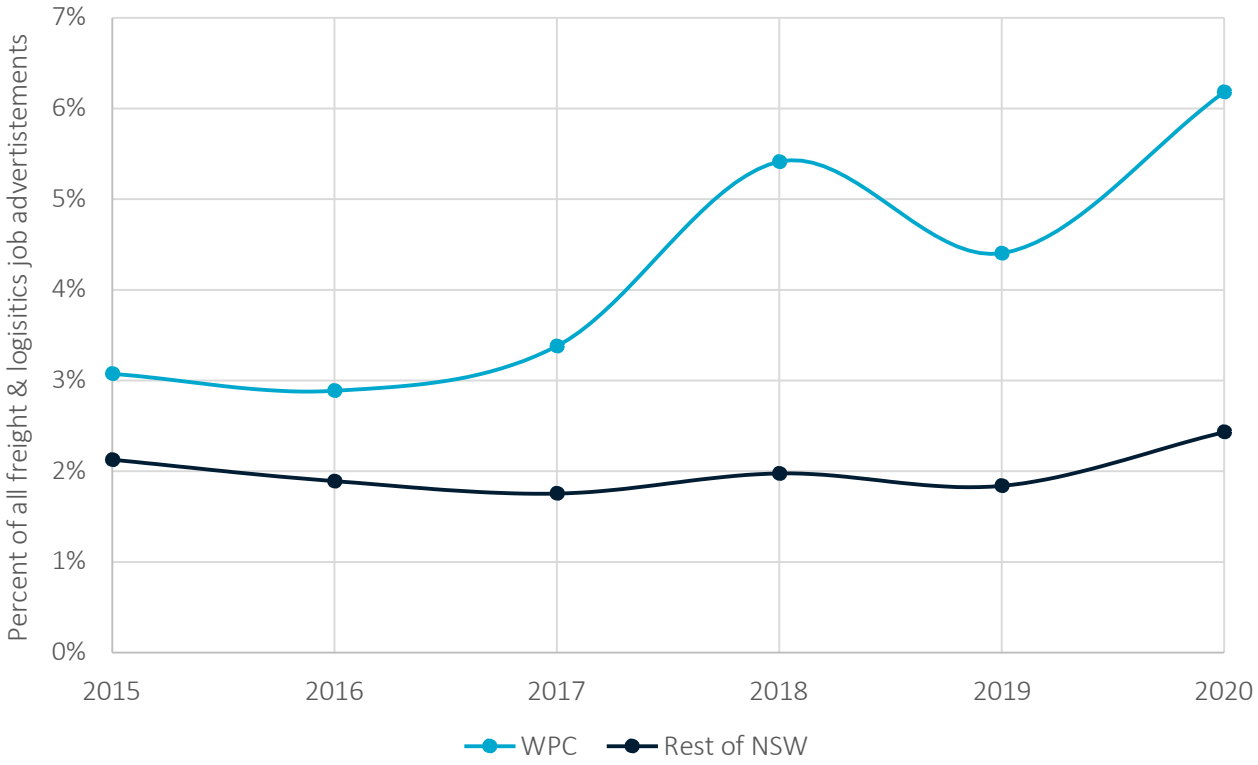

Figure 31 Job advertisements in the freight and logistics sectors seeking specialised technology skills. Data source: Adzuna Jobs Advertisement Data (Appendix C)

Scientific and technological advances in fields such as artificial intelligence, operations research, robotics and management science are leading to improved freight and logistics operations. Some of these advances will be associated with new products and services which could be supplied from the Western Parkland City worldwide. Providing a detailed and comprehensive list of all technological products within the freight and logistics industry is beyond the scope of this report. A recent review paper examined 152 published studies about 13 freight and logistics technologies [179]. Here we briefly describe some examples of freight and logistics technological products:

- *Warehouse automation technologies.* Warehouses are needed to create stock inventories and store deliveries before they are provided to recipients. Warehousing operations are becoming increasingly automated making use of artificial intelligence, robotics and related technologies. For example, the

200,000 square metre Amazon "fulfilment" centre planned for completion in late 2021 at Goodman's Oakdale West Industrial Estate in Western Sydney will use a workforce of robots along with 1,500 human workers [180]. The robots can perform sorting, moving, lifting and other operations leading to space, time and cost savings. However, a wider range of technologies are used in automated warehouses. For example, data science plays an important role for tracking, monitoring and informing decisions about all warehouse operations. A recent review paper of warehouse automation [181] identifies several main categories of technology (a) automated storage and retrieval systems; (b) robotics; (c) transport systems such as autonomous forklifts; (d) data collection technologies; (e) labelling technologies; (f) picking technologies; (g) management solutions; (h) software solutions; (i) routing of mobile robots and (j) simulation solutions. The researchers of this study conclude that "results showed the key point to achieve a flexible automated warehouse is the combination of automated equipment, data collection technologies, and management solutions" [181]. Startups, small companies and large companies in the Western Parkland City could develop and supply these technologies and solutions to other companies building automated warehouses across the globe.

- *Last mile logistics (LML) solutions.* Delivering a package from the warehouse to recipient within an urban context is sometimes referred to as a last mile logistics (LML) problem. This is an important but costly and inefficient part of most supply chains. A range of technologies and solutions are being explored including vehicle drone deliveries, electric bicycle/tricycle deliveries, 24/7 neighbourhood storage lockers, residential delivery post boxes, strategies for handling unattended deliveries, route analysis/optimisation tools, ride-sharing approaches, global positioning systems for finding delivery addresses and unmanned aerial vehicles [182]. Given that LML is a pain point for most supply chains it is likely that logistics companies will invest in these, and other such, solutions. Companies within the Western Parkland City could develop and supply these technologies into the freight and logistics sector worldwide.
- *Tracing and tracking technologies.* The ability to track and trace goods from seller to buyer over a complex supply chain is a central requirement for efficient and effective freight and logistics operations. Two of the significant technologies attracting attention include global positioning systems (GPS) and radio frequency identification (RFID). However, research has shown that whilst these technologies provide accurate and timely data on the location of goods being transported; few transportation companies have the ability to use these data effectively in operational decisions [183]. Data science and management science capabilities are also an important part of the tracing challenge. Another area of technological development involves the use of blockchain system to verify records of product movements along the supply chain. These highly tamper-proof system can potentially increase trust and transparency when goods are moved long distances over numerous jurisdictions. Companies in the Western Parkland City could develop and sell technologies, capabilities and know-how for tracking and tracing goods during transportation. There are significant capabilities in these technologies within numerous companies and research institutes in Greater Sydney.
- *Data science and optimisation technologies.* The world is increasingly moving towards dynamic supply chains that are continually being reshaped and redesigned in line with social, economic and environmental events. Supply chains and freight transportation networks are also increasingly data rich. Data science can be used to acquire, analyse, interpret and apply complex freight data in decision making. This can help companies optimise supply chains and optimise complex freight operations. WiseTech is an example of an Australian ASX-listed company with headquarters in southern Sydney which provides these services. WiseTech has developed, and sells, software to support freight and logistics operations to improve productivity, connectivity and resource usage. One of their most important products is CargoWise – a supply chain software platform that helps companies optimise freight movements from origin to destination. There is vast scope for more Australian companies to

develop software/digital and information technology products and services with related purpose from within the Western Parkland City.

These are a few of many categories of technological products and solutions for improved freight and logistics which could be developed by businesses in the Western Parkland City. It would be possible for the Western Parkland City to become recognised as a centre of excellence in any one of these areas. To achieve this would most likely require investments in research and development linked to industry activity and investments in education and training. This will create the talent and capability which seeds new start-ups. As freight and logistics expands so too will the demand for innovative products and solutions.

The main demand driver for technological innovation in freight and logistics is associated with the growth, and during COVID-19 explosion, of e-commerce and online retail. Whilst COVID-19 has boosted these trends they have been occurring for a long time. E-commerce increases the volume and complexity of delivery operations. Before online retail one large purchaser (a retailer) would bulk buy goods from a wholesaler and then place them in a physical store for shoppers. Online retail changes this model. Online retail has a much greater number of buyers and sellers with a much larger number of pick-up and delivery requirements. In a world where online retail is more significant, or dominant, the ability to transport goods from seller to buyer is a key to competitive advantage. This creates rising demand for technological innovations freight and logistics. Companies and governments with the best capabilities are likely to attract greater market share.

Another demand-side driver is the rapid and continuing growth in food demand from domestic and international markets which is creating rising demand for food freight and logistics innovations. For some time, Australian governments and industries have documented the huge demand growth for food and fibre products in Asian markets [184]. Also, well documented is the diversification of Asian diets and the demand for high-quality, safe and provenance assured food products associated with income growth [184]. Asian countries will continue to increase imports of agricultural products over the coming decades. Whilst Australia's agricultural exports have risen it would appear there's substantial room to expand. However, one of the key barriers to meeting Asian food and fibre demand identified by agricultural industries is the cost of freight and especially air freight. In a recent study it was found that transport-to-market is the single largest cost item for many types of agricultural product reaching as high as 48.5% of farm-gate costs in some cases [185]. Solving the freight cost problem for Australian farmers is a critical key for unlocking agricultural industry growth driven by demand from Asia.

The challenge of air freight costs for Australian farmers have been highlighted during COVID-19. During the pandemic there has been a decrease in passenger aircraft leading to decreased availability of belly-hold cargo. In response the Australian Government introduced the International Freight Assistance Mechanism (IFAM) with $110 million in funding in April 2020, another $241.9 million in July 2020 and an additional $317.1 million in funding announced in October to extend the program till mid-2021. The Australian trade agency Austrade [159] reports that to date IFAM has enabled 160 tonnes of Australian goods to be exported to 66 international destinations. This has been an important source of support for farmers across Australia who depend on air freight to reach international markets. The demand for the IFAM program has highlighted the importance of air freight to Australian farmers. It has also highlighted the challenge of freight costs. Lastly, whilst demand for agricultural produce from Asia represents strong growth, so too does the domestic Australian and Greater Sydney market. Freight and logistics solutions need to be equally focused on cutting domestic freight costs to catalyse agricultural industry growth.

4.4.2 Insights for Further Analysis

The freight and logistics industry is benefiting from infrastructure investments in the Western Parkland City. It is an industry which clusters naturally around transport infrastructure. As the transport infrastructure is developed the industry is likely to grow further. The proximity to warehouses and other facilities means that

the Western Parkland City could become a natural home for advanced freight and logistics operations, particularly if a precinct which promotes knowledge spill-overs emerges. While there is little existing freight and logistics R&D activity to build upon proximity to so many industry facilities make it an excellent fit with good prospects for sustainable activity [186]. Freight and logistics R&D could be combined with more bespoke training across a range of skill levels addressing the gap between vocational and higher education in freight and logistics. As more technology is employed in the industry, workers will need increasing digital skills. Training builds the skilled workforce which encourages companies to locate in the Western Parkland City. This may also attract students, some of whom may remain in the area once qualified.

4.5 Visitor economy

The visitor economy captures tourists, business travellers and other people visiting the region for family and personal reasons. The largest parts of the visitor economy by revenue are the accommodation sector and food (dining) industry. In recent years these industries have maintained reasonably constant shares of the national (about 7%) and Western Parkland City (5-7%) workforces. The industry currently accounts for a significant share of the workforce in each Local Government Area within the Western Parkland City, particularly in the Blue Mountains (10%).

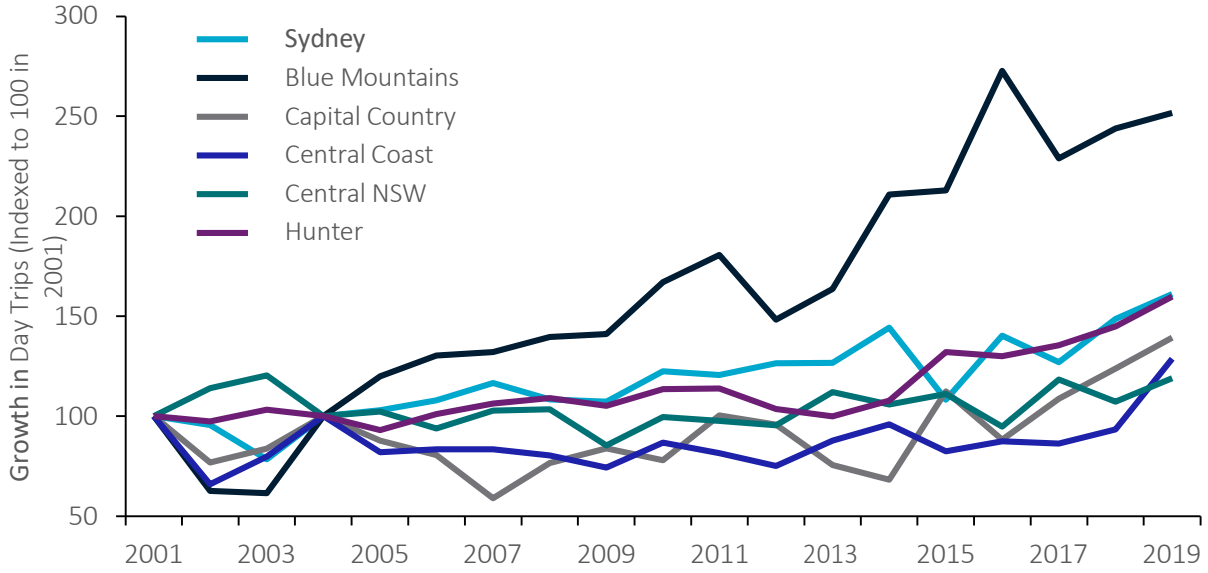

Figure 32 Growth in day trips to regions around the Western Parkland City.
Data source: Tourism Research Australia National Visitor Survey, day and overnight trips for holiday/leisure by Australian residents. Note 1: These data are reported in "tourism regions" and do not distinguish from the other Western Parkland City local government areas which are included in "Sydney". Note 2: Capital Country is one of 16 NSW tourism regions for the area surrounding Canberra and the ACT.

The domestic market has been relatively flat over an extended period, despite increased recreational spending more generally, possibly weighed down by high petrol prices and cheap flights. High petrol prices deter day trips and cheap flights attract Sydney-sourced tourists to more distant destinations. The Blue Mountains has however been attracting an increasing number of day trips (Figure 32). This highlights the location of the Western Parkland City as both positive and negative for its visitor economy. Having such a large population nearby, in addition to the large number of national and international visitors who travel to Sydney, is positive for the region's visitor economy. However, the downside is that day trips are likely to involve much lower spending; driving to a national park for a walk and a picnic could add nothing other than congestion to the local economy. This has a negative impact on tourism earnings.

In terms of overnight trips, data only appear to be collected at the local government area level across regional New South Wales, though this includes the Blue Mountains and Hawkesbury. The Blue Mountains have 121,000 interstate and 715,000 intrastate visitors for one or more nights (locals average 2 nights, interstate 3.3), along with 40,000 overseas visitors staying an average of 4 nights. Hawkesbury has 46,000 interstate and 179,000 locals staying for similar periods (there is no data on international visitors). Increasing the number of overnight stays is clearly central to growing this industry, but this is likely to require more attractions to keep people in the region, particularly beyond the existing scenic attractions of the Blue Mountains.

The new airport will bring more visitors to the Western Parkland City region. It is built to service 10 million passengers per year when it opens in 2026 and can be expanded to handled increased volumes of passenger movements into the future. Infrastructure Australia forecasts it will have 61 million passengers per year in 2030 and 102 million passengers per year by 2050. This clearly represents a huge opportunity for the local visitor economy. However, to attain full benefit there will need to be sufficient attractions within the Western Parkland City; otherwise tourists may travel to, and spend their money in, other locations nearby.

The influx of passengers is likely to attract tourist-sector investors which could help develop local facilities and attractions. However, investors are likely to hold back until international travel resumes. Currently hotel occupancy rates are low in Western Sydney (and Greater Sydney) due to the pandemic. The most recent data from Destination NSW for September 2020 show that after years of growth year-on-year visitor numbers are down by 28.6%, accommodation nights are down by 48.1% and expenditure is down $11.6 billion (48.8%). An article in the Urban Developer (21 March 2021) reveals that hotel occupancy rates in Sydney averaged at 40% in 2020 compared to a longer-term average of 80%. These statistics suggest that the visitor economy in Greater Sydney depends upon international travel. However, as the pandemic restrictions lift most forecasts are for a resumption of international travel and the continuation of a growth trajectory. There is no firm date on a re-opening of Australia's borders but many expect it will occur in 2022 as the population becomes vaccinated. As for the broader international tourism market, a recent press release from the United Nations World Tourism Organisation [187] says "*most experts do not to see a return to pre-pandemic levels happening before 2023 … In fact, 43% of respondents point to 2023, while 41% expect a return to 2019 levels in 2024 or later*". Most of the scenarios from the International Air Travel Association show a "strong recovery" in 2021 and 2022 with a resumption of the strong growth trend in subsequent years [188].

The Western Parkland City should also be well placed to participate in the lucrative conference market, with its combination of high amenity values and good transport access. From the year 2000 to 2019 the events management industry in Australia grew its workforce rapidly from 10,400 people to 38,700 people. It then dropped to 24,400 in 2020 due to COVID-19. The Australian Industry and Skills Committee forecasts it will return to growth reaching 46,900 people by 2024 [189]. However, there is some uncertainty around the growth trajectory which hinges on the extent to which physical (in person events) will be replaced by partly/fully online events. Rural areas on the city fringe could offer more "retreats" which can be secluded but still readily accessible. This would be a point of differentiation from the eastern city which is heavily developed and highly urbanised. The Western Parkland City also offers easier access to and from regional New South Wales which will be an important factor in many gatherings.

4.5.1 Insights for Further Analysis

Western Parkland City has natural amenity, culture and a large pool of potential visitors, but growing its visitor economy requires developing new markets beyond low-spending scenic day trips. The "experience economy" offers opportunities to generate economic activity and employment from visitors. The Penrith Whitewater Stadium is an existing example of this which brings visitors into the region; though it is reliant on public funding as it does not fully cover its costs. There is great potential to develop other facilities in the

region, for example mountain biking, triathlons or adventure tours. By bringing visitors in such keystone attractions can also support clusters of other business such as food and accommodation; the Museum of Old and New Art (MONA) in Hobart provides an example of this. Given the area covered by the Western Parkland City there is room for, and need for, a number of new attractions to ensure multiple regions benefit from the visitor economy.

Food tourism also has great potential, with local strengths in artisanal and multicultural produce and which could further support the agri-food sector. This is a sector that requires scale – a single small business is unlikely to attract many visitors, but a larger number will. This is another sub-sector in which there are strong spill-overs in terms of collectively attracting customers; collective reputation is also important. The visitor economy will benefit from a range of attractions which suit different types of visitors to more of the Western Parkland City than is currently the case. Activities which involve services such a coaching and guiding will create far greater employment opportunities than simple physical attractions.

The international student market has been massive for Australia but is mostly restricted to the centres of our largest cities. Medical tourism is growing globally [190] and might just offer an alternative for the Western Parkland City, leveraging Australia's medical expertise and institutional standards to attract visitors seeking treatments not available, or trustworthy, in their home countries. Unlike the international student market, medical visitors would be less likely to insist on congregating in inner city locations. There is no formal Australian data, but there is evidence of both outgoing (especially for cosmetic surgery) and incoming activity in Australia [191]. It has economic potential, though a key concern would be that unless the supply of medical professionals and facilities also increased it could make it harder for locals to access treatment.

The main economic challenge for the region's visitor economy is converting visitors from low-spenders and day-trippers into high-spenders and overnighters. The adventure-based tourism sector shows promise for achieving this. Mountain biking, canyoning, kayaking, hiking, mountain climbing, horse riding and other adventure-based recreation activities are typically associated with longer visits and increased expenditure. An European Union report shows adventure tourism is growing and involves more local spending that more traditional holidays [192]. For example, the United Kingdom triathlon industry report that participation has increased steadily over the last 20 years; up to 165,000 in 2019. This study found that 19% of triathletes took training holidays and 24% went overseas to compete. A United States study found mountain biking was particularly popular among affluent people who spent an average of US$2,000 per year on short breaks [193].

4.6 Health and education

The healthcare industry has grown to become one of the largest sources of employment across Australia; currently accounting for about 10% of the national workforce. The largest subsectors are "medical and other health services", which includes allied health services (*e.g.*, physiotherapy) and has more than doubled its share of the national workforce since the 1980s, and hospitals, which have maintained a more constant share of employment over the period (Figure 33). The other major subsector is residential care services, which has undergone moderate growth across the period. The healthcare industry accounts for similar shares of employment within Western Parkland City: 3.5% for medical and other health services, 4.1% for hospitals, 2.0% for residential care services, and 9.6% overall (2016 Census data). This is a service industry in which employment typically aligns closely with population, albeit with strong clustering at the local scale around hospitals and related health precincts.

The education and training industry is also a large employer currently accounting for about 8.2% of national employment. The main subsector within education and training is schools, which has represented a reasonably stable 4-5% share of national employment across recent decades, as expected for a population-serving industry. Other significant subsectors are tertiary education and adult, community and other

education (*e.g.* sports and arts instruction), which have grown strongly in recent years. Within the Western Parkland City the education and training industry is a particularly large employer accounting for 9.4% of the region's employment. This is mainly due to the school sector's relatively large share. Childcare is also significant. Direct employment in childcare is increasing, but it also supports greater workforce participation so is systemically important to the local economy. Supporting the provision of childcare across the Western Parkland City will be vital to growing the local economy.

Spending on both healthcare and education have increased dramatically both for governments and individuals (Figure 34). While some of this increase reflects increasing uptake of these services, they are also sectors which have become relatively more expensive over time. For example, productivity in manufacturing has increased greatly, as technology enables individual workers to produce more than ever. The same cannot be said of a teacher, or even many doctors – while technology may help in places (*e.g.* with timetabling and appointments), lessons and consultations have not changed much in 50 years. That means these labour-intensive sectors become relatively more expensive over time compared to other activities, which economist William Baumol termed the "cost disease" [194, 195].

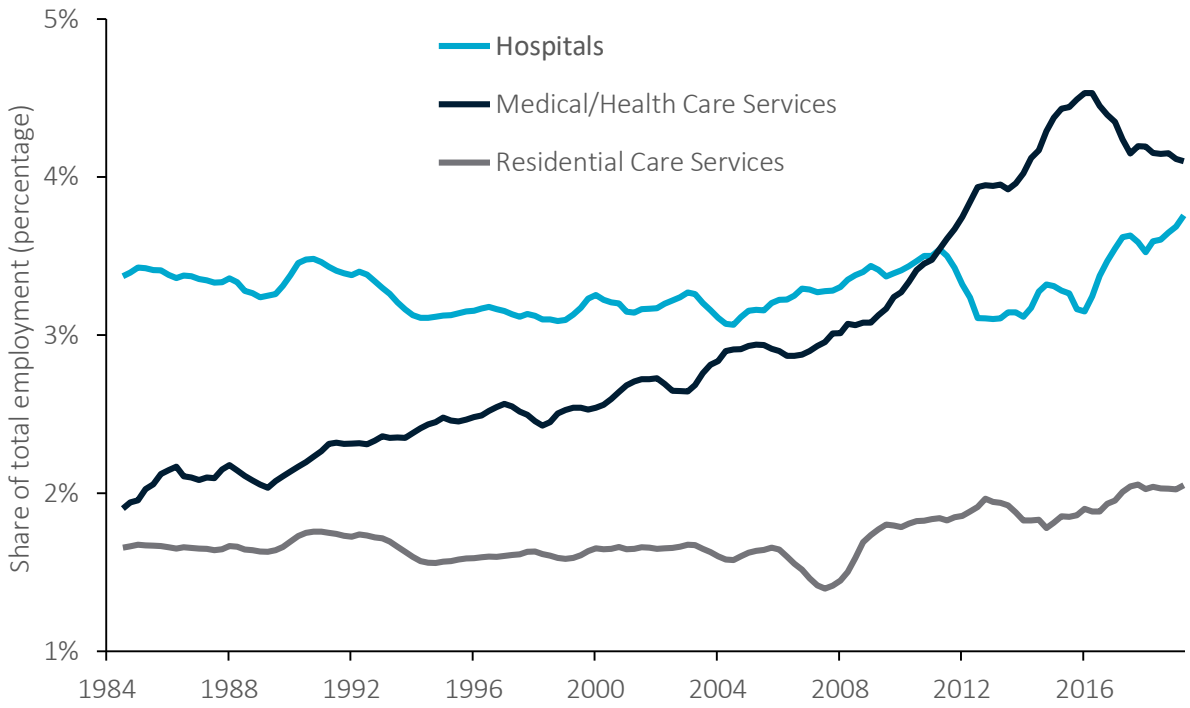

Figure 33 Health care industry component shares of national employment.
Data source: Australian Bureau of Statistics Labour Force Survey (five quarter moving average).

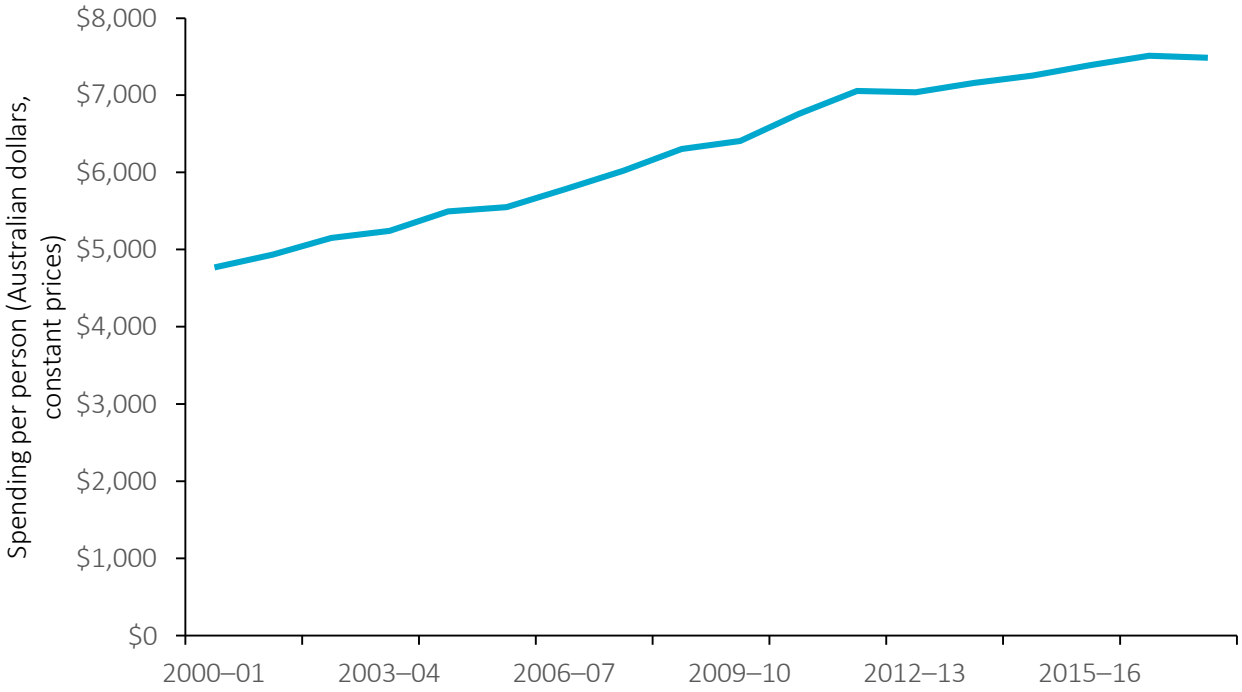

Figure 34 Australian spending on medical and health care expenses.
Data Source: Australian Institute of Health and Welfare health expenditure database.

The availability of new health services and treatments, along with increased lifespans, contribute to increased household health spending, which has more than doubled its share of the average household budget since 1984. Government spending has also increased significantly over this time. The university sector has grown rapidly in recent years, driven by a combination of increased demand from domestic students and (higher fee-paying) international students. The domestic market is likely to remain strong; the international market is less certain. In the short term it has been devastated by COVID-19 and in the longer term is subject to the vagaries of international trade and relations. The Western Parkland City does not have a university of its own but is home to a number of campuses including the Western Sydney University.

The fastest growing occupation in Australia over the last 10 years has been “aged care assistant”; reflecting our ageing population. This demand will continue to grow. The rollout of the national disability insurance scheme (NDIS) is forecast to create 90,000 new jobs in the field of disability support and associated allied health services over the next five years [196]; 71% of NDIS roles are support workers, 12% allied health (e.g. physiotherapy), 11% case and social workers and 6% managerial [197]. It is likely these sectors will grow strongly in the Western Parkland City. These will create significant employment opportunities, though unfortunately many such jobs tend to casualised or insecure and relatively poorly paid [196].

4.6.1 Insights for Further Analysis

Higher education is a strongly clustered industry dominated by a small number of campuses. These generate significant economic activity through teaching and research. They also lead to significant knowledge spill-overs, with many of the world’s most successful economic clusters centred around universities. These benefits are spread unevenly, and the Western Parkland City is one of those regions which largely misses-out with limited presence of universities. Satellite campuses of existing universities are a common approach to broadening the geographic footprint of higher education. They have proved an effective method for getting non-traditional students into higher education, but their broader economic impact is limited [198]. Satellite campuses represent the most obvious model of expanding higher education into a new region but there is an opportunity for a bolder approach in the Western Parkland City.

Universities typically bundle teaching and research activities. Teaching contributes to economic development through increasing the skills of the workforce, provided the subject matter is relevant; education can also have broader social and cultural benefits [199]. Expanding access to higher education in the Western Parkland City is also important in terms of equity. Teaching has traditionally been concentrated on university campuses. Technology renders this model less relevant as online course material can now be drawn from anywhere in the world, so students can access the best rather than whatever happens to be available locally. This trend was greatly accelerated by the pandemic as most universities shifted to online teaching. However, most students still benefit from in-person support and tutoring and many subjects require hands-on practical training so a hybrid model of online and in-person delivery would seem ideal [200].

A multiversity could therefore draw on partners from around the world in collaboration with local instructors, rather than relying on a single local university. This should mean that world-class education can now be delivered in far more places. This would benefit residents of the Western Parkland City for whom travel to the university campuses in the eastern city significantly increases the costs of higher education. It should also provide access to a far greater range of subjects and greater choice of institutions.

There is also an opportunity and need to bridge the increasingly anachronistic divide between vocational training and higher education, particularly as technology becomes more pervasive in previously lower skilled industries such as manufacturing. Workers and their employers could benefit from training in higher-level skills traditionally provided by universities, but without the need to commit to a full three-year course. Similarly, university graduates, whose numbers have grown rapidly in recent years, can often benefit from more practical and industry-specific technical training to complement their degrees [200]. The Western Parkland City should be well placed to lead this.

Research also contributes to broader economic activity and is also the key source of knowledge spill-overs. Attracting research to the Western Parkland City is therefore highly desirable. However, it is important that it is relevant research. Locally relevant research in areas such as high-tech manufacturing or logistics technology is most likely to profitably spill-over to local firms; knowledge from local firms can also contribute to the innovation process [186]. Manufacturing, agri-food and logistics researchers should find opportunities in the Western Parkland City that would be harder to find elsewhere. The Australian Manufacturing Research Facility planned for the Western Parkland City should be well placed to address these needs.

The healthcare industry will continue to grow as the population becomes larger (in both senses), older and more affluent. Much of this follows population, and the Western Parkland City is already well represented in terms of healthcare employment. Some parts of the industry cluster around hospitals, with Liverpool Hospital forming a particularly large cluster. Healthcare is clearly vital to the wellbeing, and productivity, of society, but is not especially associated with spill-overs into other sectors. Health research is more amenable to clusters which could spill-over to support other industries, such as pharmaceuticals or manufacturing medical devices. However, this subsector is already well represented in New South Wales, Australia and overseas. We could not identify a clear source of comparative advantage in the Western Parkland City for healthcare technology or “med tech”, unlike for other sectors such as hi-tech manufacturing, logistics and agri-tech.

Aged and disability care will continue to grow strongly in line with the demographic changes [200, 201]. The demand for workers will be strong and the sector is likely to face shortages both of carers and associated roles such as allied health professionals [202, 203]. These tend to be unglamorous industries but are of the utmost importance to society. It is also clear from recent events such as the Royal Commission that there is a pressing need for improved training and standards, particularly for dealing with the increasing number of people with challenging conditions such as dementia. There are opportunities to support better working conditions and career pathways in these sectors [202]. An example is helping aged care providers better manage rosters, so staff have predictable and manageable timetables, while still meeting the complex and often unpredictable needs of clients [204].

Investing in a centre of excellence for aged and/or disability care could therefore be a great way of driving both improved employment and career prospects in Western Parkland City while also making a much-needed contribution to a pressing issue at the state and national level. Such an institution could support improved training and a range of research and innovation activities. There is a great need for innovation due to unsustainable cost growth in the sector. Some of this may be classified as “med tech”, but mostly it will be around improved methods of service delivery and making better use of existing technologies. Research into care services could support long-term improvements in both standards and efficiency, providing better and safer care for vulnerable Australians and improving the opportunities for career pathways in this important sector. A focus on innovation and excellence can move the industry from being a population-serving service industry to a higher-growth knowledge industry. This is already a major industry in the Western Parkland City so the foundations are in place to establish a position of much-needed national leadership.

Aged care services also represents a significant potential export market, building on Australia’s health services expertise and the fact that we are “ahead of the curve” in terms of our ageing population; potential exports include technology, facility design and management expertise (and their various combinations), and Australian companies could sell advice to, or operate directly in, overseas markets [205]. Our NDIS will also build capability and expertise which can be exported; again Australia is likely to be ahead of the curve in developing and delivering such services on a large scale and would be well positioned to provide advice and services internationally. Increasing incomes and demographic changes across our Asia Pacific region mean there is likely to be strong demand for such services in the future. Given the size of the global aged and disability care market, and its growth prospects, this should be considered as a serious opportunity.

5 Emerging Industry Development

Emerging industries are in the early stages of growth. They are as yet unproven but have future potential associated with shifts in demand and supply. Investing in the development of emerging industries carries risk due to uncertainty; but the payoff can be substantial for first movers who gain competitive advantage. There is an unavoidable degree of speculation associated with investing in emerging industries. However, the source of risk is also the source of opportunity.

Emerging industry growth strategies are an important part of an economic development portfolio which balances varying levels of risk-and-reward across alternative growth options. Emerging industries are hard, if not impossible, to quantify in the current economic landscape of the Western Parkland City; they don't exist yet. Emerging industries depend on future demand-side and supply-side shifts associated with new products and services.

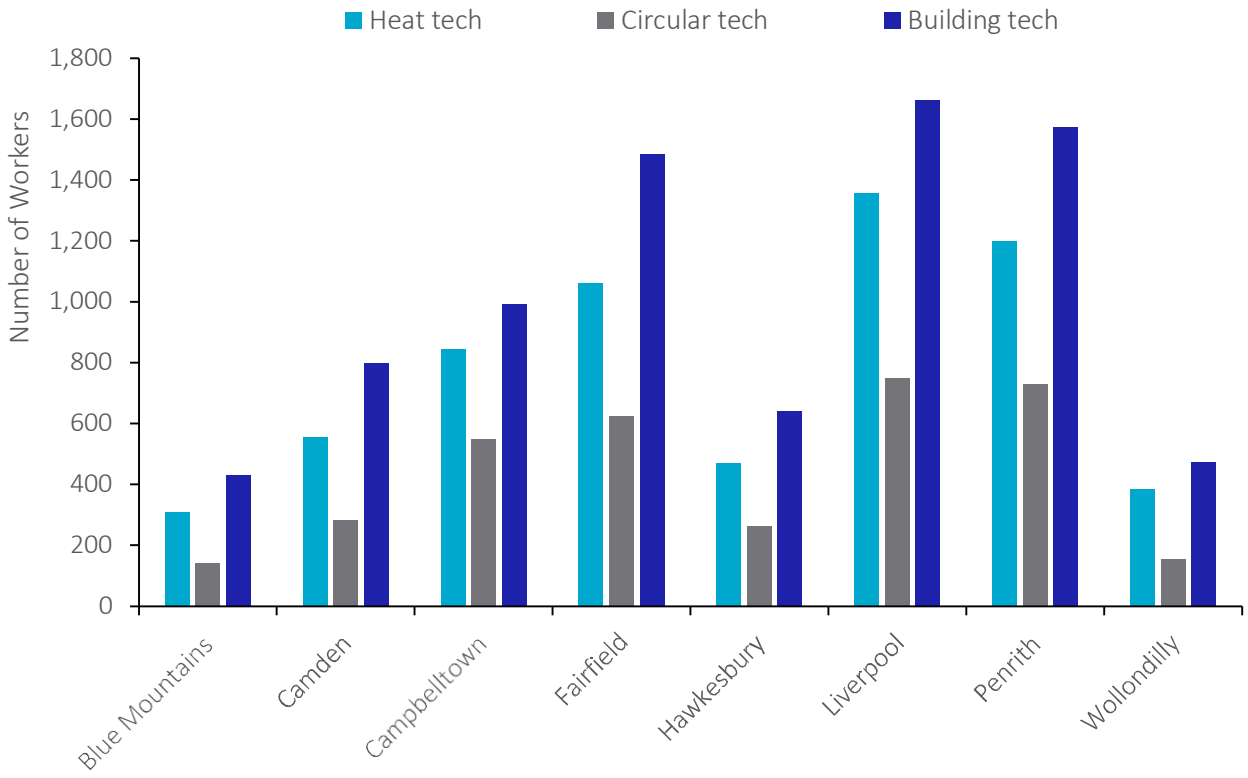

Figure 35 Estimates of workers with the right skills for the emerging industries.
Data source: Remapping of occupations from the Australian Bureau of Statistics Census (by place of work) to the emerging industries.

In this section we describe high-potential emerging industries for the Western Parkland City and identify strategies for growth. For each emerging industry we identify a significant workforce within the region with the right mix of skills to work in that new industry (Figure 35). We examine demand-side and supply side drivers of growth. The emerging industries identified here adhere to principles of path dependency; they are related to existing industries and activity within the Western Parkland City.

5.1 Heat-Tech - Mitigating Heat in Urban Areas

The Australian Bureau of Meteorology is forecasting increased frequency and severity of heatwaves and hot weather over the coming decades [75]. Western Sydney is one of the areas likely to experience significant impacts. On 17 March 2020 the Bureau of Meteorology issued a "special climate statement" [206] about the

extreme heat and fire weather of December 2019 and January 2020. They report that 18 December 2019 was the hottest day on record for Australia averaging at 41.9 Degrees Celsius across the entire continent. They also note that on 4 January 2020 the most extreme heat occurred in New South Wales and the Australian Capital Territory and that the temperature reached 48.9 Degrees Celsius in Penrith which is the highest known temperature in Greater Sydney surpassing 47.8 Degrees Celsius at Richmond in January 1939. A number of other sites in metropolitan western Sydney exceeded 47 Degrees Celsius. Extreme heat of this nature is dangerous for human health, disrupts the normal functioning of cities and can cause costly damage to infrastructure.

The urban heat mitigation technology industry doesn't yet exist. However, there is a plausible pathway for its emergence due to demand and supply drivers. The urban heat technology industry supplies products and services that mitigate the impacts of heatwaves and unseasonably hot weather on infrastructure, wildlife and humans within urban and peri-urban environments. The demand for heat-tech products and services is associated with the continued rise in temperature, and increased frequency and severity of heatwaves, associated with climate change. The supply-side of this industry has also seen growth with an explosion of research publications and technological innovations for heat mitigation. In the following sections we explore the demand-side and supply-side drivers in more detail.

Already Penrith City Council within the Western Parkland City is investing in research and development to mitigate the impacts of extreme heat in urban environments. The council commissioned a research project through the University of Western Sydney to document and map heat across the local government area over recent years. The report [207] was published on the Penrith City Council website in 2020 and observes that maximum air temperatures of over 50° C were recorded at six locations within the local government area. The report also notes that "regional development and building regulations across Western Sydney, and especially Penrith City must address the permanent implications of Urban Heat Islands and be prepared to respond to the acute shocks of extreme heat" (page4) [207]. The report makes 12 recommendations including the need to implement cooling initiatives and the formation of a multi-disciplinary "heat task force".

5.1.1 Demand Divers

The Western Parkland City, Greater Sydney, Australia and much of the world has an increasingly urgent need for solutions to heatwaves and unseasonably hot weather (Figure 36, Figure 37). At the time of writing this report (25 November 2020) the Bureau of Meteorology published a three-day heatwave warning indicating that "a large area of severe heatwave conditions covers much of New South Wales, northeast SA, southwest QLD and parts of the southern NT" [208]. Significant parts of New South Wales are also forecast to experience "extreme heatwave" conditions. Severe heatwave conditions are forecast for the Western Parkland City with temperatures for cities and towns within the region predicted to reach the low/mid 40s in Degrees Celsius. The Bureau of Meteorology's new heatwave forecasting service indicates "a heatwave occurs when the maximum and the minimum temperatures are unusually hot over a three-day period at a location" [209].

The CSIRO and Bureau of Meteorology 2020 State of the Climate Report provides compelling data showing that Australia's climate has warmed on average by 1.44 degrees Celsius since national records began in the year 1910. This has been accompanied by an increased frequency and severity of heatwave and bushfire conditions. Australia's warmest year on record was 2019 and the seven years from 2013 to 2019 are ranked within the nine warmest years in recorded history. Extreme heat that occurred 2% of the time during 1960-1990 and 4% of the time 1990-2004 now occurs 12% of the time. The gap between actual and predicted climate conditions is closing and climate forecast models are becoming increasingly reliable. The most recent results from Australia's climate model ACCESS show that over the coming decades there will be "continued

warming, with more extremely hot days and fewer extremely cool days" and that there will be "a longer fire season for the south and east and an increase in the number of dangerous fire weather days" (page 22).

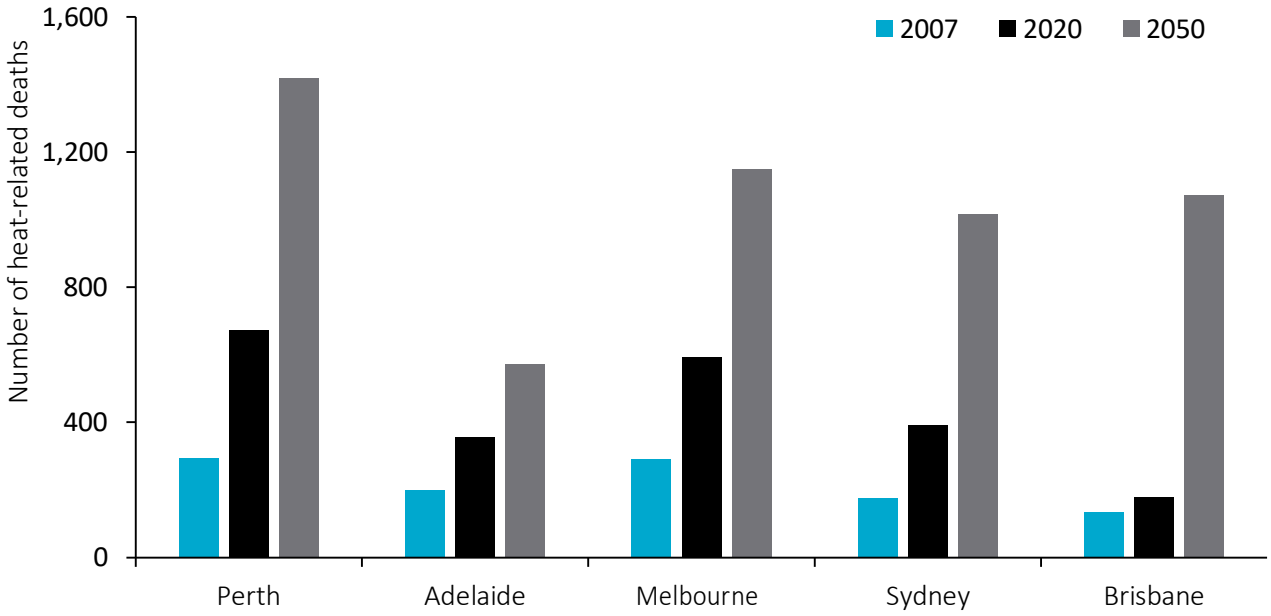

Figure 36 Projected annual number of heat-related deaths in Australia by selected capital cities.
Data source: Australian Government, Department of the Environment and Energy [210].

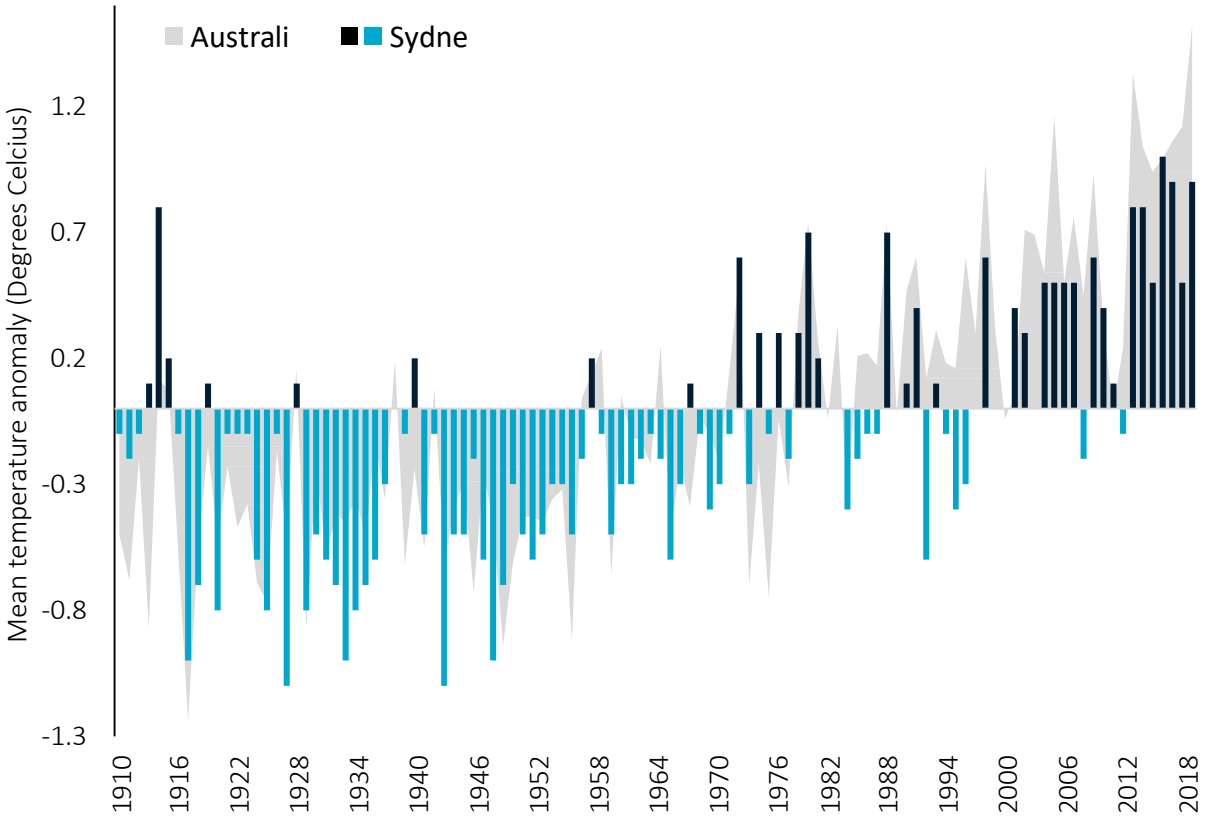

Figure 37 Annual mean temperature anomaly in Sydney and Australia 1910-2019.
Data source: Australian Government Bureau of Meteorology [211]. Note: The mean temperature anomaly reflects the deviation in temperature from the average over the reference period (1961-1990).

Similar long-range climate forecasts are being made across the globe. A 2017 paper published in the world leading science journal Nature finds that "around 30% of the world's population is currently exposed to climatic conditions exceeding this deadly (temperature-humidity) threshold for at least 20 days a year. By 2100, this percentage is projected to increase to ~48% under a scenario with drastic reductions of greenhouse gas emissions and ~74% under a scenario of growing emissions" [7]. In Australia and across the globe heat related morbidity and mortality is expected to rise. Heat is also expected to impact human performance and liveability in many ways. For example, a Harvard University controlled study found that heat exposure during a "high stakes" exam reduced student performance by 15% [212].

5.1.2 Products and Services

In the past few decades there has been a substantial increase in scientific publishing related to all aspects of extreme heat and heatwaves. The global research community is identifying many effective solutions which can substantially mitigate and effectively solve problems of extreme heat. Innovations will happen within many existing industries. However, due to rising demand for solutions and scientific and technological innovations which enable supply a new heat-tech industry may emerge. This industry will provide products and services to mitigate the impacts of extreme heat on infrastructure, economy activity and human health, wellbeing and lifestyles. Some of the product/solution categories include:

- *Tree planting and vegetative cover solutions.* Councils within the Western Parkland City are already actively implementing tree planting to mitigate heat and achieve other benefits. The techniques and knowledge being developed could be exported to other jurisdictions in Australia and globally. Arguably some of the most cost-effective solutions to urban heat problems will come from tree planting. For example, in Phoenix Arizona it was found [213] that a 1% increase in tree canopy cover reduced air temperature by 0.14° C and that an increase of canopy cover from 10% to 25% yielded an air temperature reduction of 2° C up to 2m above ground level. Another study [214] in the United States using satellite imagery found that during a heatwave a 1% increase in tree cover decreased the temperature by 0.2° C. A study in Brisbane [215] found that "vegetation cover had the strongest impact on [reducing urban] temperatures, more so than building height and height/width ratio". This study found an increased frequency of heatwave conditions without vegetative cover and that medium-density vegetation led to an average urban temperature reduction of 1.3° C. Another finding from research published in the journal Nature [216] is that climate change is accelerating growth rates of urban trees worldwide leading to increased benefit-cost ratios of tree planting projects.
- *Building and architectural services.* Architects, engineers, builders, designers, solar-power technicians, electricians and air-conditioning technicians all have a critical role to play in redesigning existing buildings and making new buildings which can provide occupants with comfort and shelter from extreme heat with minimal (or zero) energy consumption. This includes both passive and active cooling systems. Passive cooling has attracted much attention because more than 40% of energy consumption is due to buildings [217]. Passive cooling systems can reduce costs and decrease emissions. For example, in Phoenix Arizona it was found that cool roofs with higher light reflectivity decreased air temperatures in surrounding urban neighbourhoods by 0.3° C when implemented on residential homes [213]. However, active cooling is an important part of the solution which ensures comfort and shelter for people in extreme heat. The active systems may use solar or other renewable energy sources to reduce emissions and keep energy costs low. A recent review paper in the Journal of Physics [217] describes the state-of-the-art in passive and active cooling technologies for buildings. Innovations include shading systems, glazing systems, insulation systems, efficient ceiling fans, efficient air conditioners, ventilation systems, radiant heat barriers, evaporative cooling and wide range of routine/available and experimental/new technological solutions. An industry supplying these services in the Western Parkland City is likely to be embedded within the existing industries of architecture, design, construction and technical maintenance (a wide range of

trades). Possibly the modular and prefabricated construction industry in the region could play a role. However, it could be given visibility in the Western Parkland City as a standalone industry or cross cutting capability given the extent of emerging demand.

- *Outdoor misting/spraying systems.* This emerging solution (and product) category involves the use of spraying systems which create a fine mist in an open or semi-enclosed urban environment (Figure 38). The temperature reduction is achieved via evaporative cooling. A review paper [218] published in 2019 examined 28 research papers about the development and use of misting systems in 12 countries across 7 climatic zones across the globe. The bulk of the papers and technological innovation came from Japan where "Uchimizu" has long been practiced and is the sprinkling of water in Japanese gardens and streetscapes to reduce temperatures and decrease dust and pollution. Of the studies reviewed by the researchers 18 examined temperature reductions and changes in humidity associated with the misting systems. Experimental data in controlled settings showed temperature drops for semi-enclosed and open urban environments ranging from 5° C though to 20° C and actual data in real-world situations showed temperature drops ranging from 2° C to 14° C. Increases in relative to humidity ranged from 5% to 45% (as read from graph). The researchers conclude that "overall, the collected data qualify water spraying as a cost-effective, versatile and high-impact blue mitigator" to the problem of extreme heat. As temperatures rise and heatwave frequency increases local governments, construction site operators and outdoor and semi-outdoor property developers/owners are likely to be interested in buying misting systems. There are already companies specialising in this equipment in the Greater Sydney area. With a strong manufacturing and construction workforce the expertise, products and services associated with misting systems could potentially be supplied from within the Western Parkland City.

Figure 38. Example of an outdoor misting system to reduce temperature from Marunouchi, Tokyo.

Image source: Shutterstock

- *Mitigating the impacts of heat on health and human performance.* Without additional mitigation and adaptation heat-related mortality and morbidity are expected to rise due to climate change over the coming decades [219]. The impacts on elderly and vulnerable persons are anticipated to be disproportionate. For example, researchers from Adelaide university identified increased incidence of urolithiasis, acute kidney injury, chronic kidney disease and lower urinary tract infections associated with heatwaves and unusually hot weather[220]. Heat has also been shown to impact human cognitive and physical performance [221]. The healthcare sector is likely to develop new and improved methods and technologies for the diagnosis and treatment of heat related conditions. This will also include public and preventative health measures. Other innovations emerging include solutions such as cooling vests to protect construction workers. For example, researchers in Hong Kong [222]have developed a cooling vest for construction workers. In a controlled study they found that workers wearing the vest and working in hot conditions had mean skin temperatures of 35.8° C (compared to 36.6° C for those without the cooling vest), a heart rate of 110 beats/min (compared to 116 beats/min) and were able to perform exercise for

22.08 minutes (compared to 11.08 minutes). There are many companies in Australia currently selling a wide range of cooling vests for the construction (and other) sectors. The technology exists in Australia with CSIRO and the Defence Science and Technology Organisation developing cool vests for soldiers in 2001. A wide range of diagnostic, treatment and preventative technologies for heat stress could be developed and sold by companies in the Western Parkland City.

- *Heat forecasting and advisory services.* The Bureau of Meteorology now provides a heatwave forecast service from October to March showing three levels of intensity by maps across Australia [223]. The levels are low, severe and extreme. The Bureau of Meteorology considers people's ability to adapt to heat in determining the severity level. This is a comparatively recent service. It is likely that as heatwaves become more frequent and severe the quality, comprehensiveness and granularity of heatwave forecasting and advisory services will improve. These may be tailored to meet the unique requirements of specific industry and/or demographic sectors. The know-how and technologies behind heatwave forecasting systems combined with advisory services which help people and organisations assess risk and invest in mitigatory solutions could be part of the Western Parkland City heat technology industry.
- *Bushfire risk mitigation*. Extreme heat is associated with increased bushfire risk and can exacerbate air pollution problems. Clearly bushfire management is a larger sector/industry than urban heat mitigation technology. However, urban heat-tech products and services are likely to overlap with bushfire disaster management technologies.

5.2 Building-Tech

Prefabricated construction is sometimes called modular construction and refers to a building method whereby most or all of the building is constructed offsite in a factory. In most prefabricated systems around 80-90% of construction occurs offsite with the remainder onsite. Prefabrication has become increasingly popular due to advances in materials science, architecture, additive manufacturing (3D printing), digital design, freight and logistics. Prefabricated systems allow construction to occur in a controlled environment with the possibility of mass production and economies of scale. When compared to traditional building approaches prefabricated and modular construction can potentially provide quicker build-times, cost savings and environmental benefits.

5.2.1 Demand Drivers

Prefabricated building construction systems have become common across the world's advanced economies. In Sweden, home to the furniture multi-national Ikea, prefabricated building systems account for approximately 80% of market share. However, in Australia 4% of new buildings are prefabricated. Researchers from the Department of Engineering at the University of Melbourne [8] have studied the prefabricated building industry in Australia and have concluded that the "major hindrance to the growth of prefab construction in Australia is that systems are developed under commercial and confidential conditions" and that "there are limited publicly-available research and case studies for certifiers, regulators, engineers and academia to provide independent information on the performance, advantages and disadvantages of prefabricated building systems" and lastly that robust academic research will "increase the market demand for prefabricated building systems in Australia as well as in other countries" [8]. Overcoming these barriers could see rapid growth in demand for prefabricated buildings in Australia so we reach a similar level to world-leading countries. Some of the benefits associated with prefabrication include [8]:

- Decreased overall cost of construction largely associated with quicker builds and lower labour costs but also resulting from efficient manufacturing processes on the factory floor with minimal material waste and the benefits of a controlled environment.

- A reduction of building construction duration by 40% on average via the production of modules in a controlled and well-resourced factory-setting free from site issues/complexities where multiple modules can be built simultaneously.
- Improved safety as risks can be better controlled within a factory compared to an outdoor construction site with uneven land, extreme weather, complex lifting/moving tasks and the need to work at height.
- Improved environmental performance with decreased waste/pollution and increased rates of recycling. Prefabricated buildings can have lower embodied energy and fewer greenhouse gas emissions.
- Decreased noise impacts on the neighbourhood where the house/building is sited.

There are also some challenges associated with prefabricated construction. For example, greater importance is loaded onto the design and planning phases. Costly errors can occur if the modular building components are incorrect for the size, shape, views or topography of the construction site. There is also a requirement to transport modular components to the site. This can be a challenging process with impacts on traffic. Nevertheless, if these issues are well managed prefabricated construction can deliver high quality buildings which are economically and environmentally efficient.

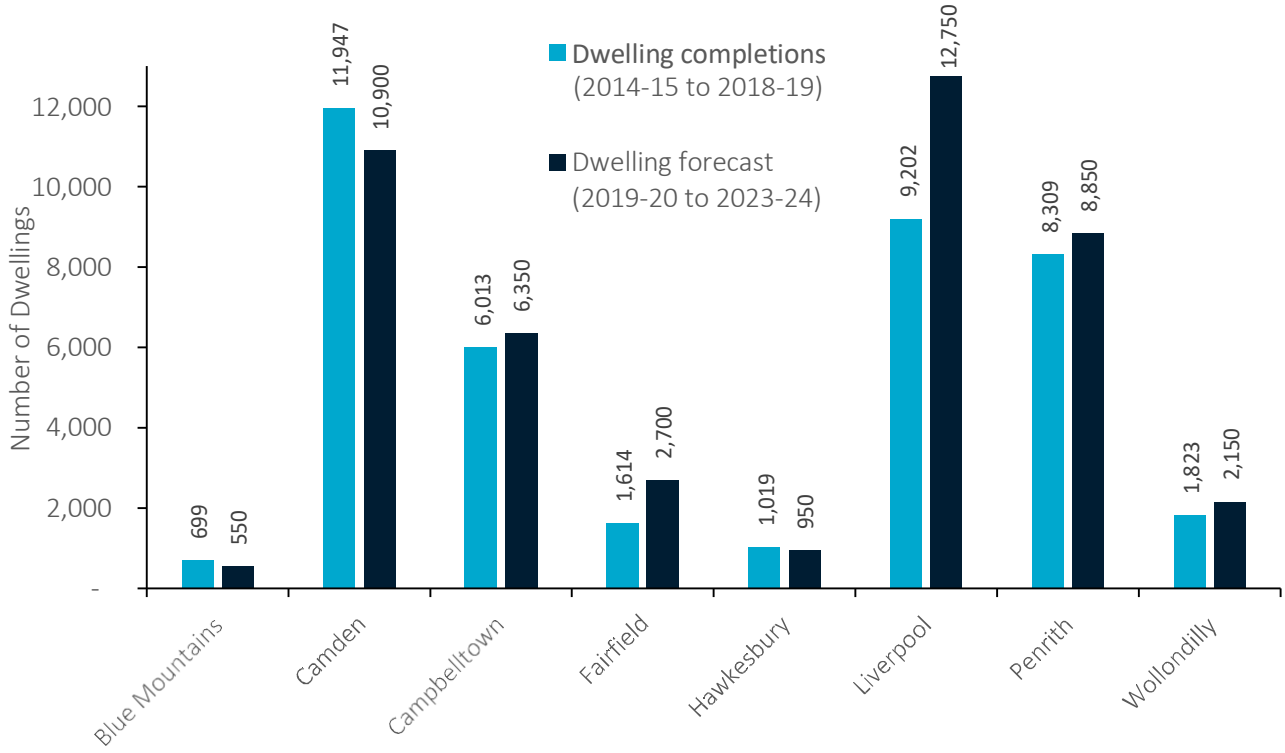

Figure 39 Dwelling completions and forecasts for houses in the Western Parkland City.
Data Source: Department of Planning, Industry and Environment, New South Wales Government [9].

One of the most significant demand drivers for prefabricated buildings in Western Parkland City will come from the local demand for houses (Figure 39). Due to population growth hundreds-of-thousands of new houses and buildings will be needed within the region over the coming decades. Forecasts are available for the 5-year period 2020 – 2024 during which time the Western Parkland City will see 45,200 new houses built with 191,050 new houses in greater Sydney [9]. This will fuel construction sector demand. It will also fuel demand for modular and prefabricated homes. Local demand is a powerful springboard for local industry to develop and then supply the nation and the world. However, we note that the demand for new homes will come from both the Western Parkland City and the Greater Sydney region.

A McKinsey report titled "Modular Construction: From projects to products" [224] argues that despite a few false starts now, in the year 2020, is the time when the prefabricated building sector is set for growth. The drivers are the new technologies such as 3D printing and digital technology which allow people to easily visualise, customise and order a prefabricated home. There's also a huge demand driver as billions of people will be moving to cities for the coming decades. The McKinsey report estimates that the prefabricated construction industry could be worth US$130 billion in Europe and the United States alone by 2030.

5.2.2 Products and Services

There are already suppliers of prefabricated buildings and building components/materials within the Western Parkland City. However, industry growth will speed up as all parts of the ecosystem develop; leading to the supply of provision of all relevant products and services along the supply chain. Some of the current and emerging products and services include:

- *Modular building factories.* A central part of this industry are factories that make entire buildings or modules of buildings which can be transported and assembled onsite; often as shipping container sized modules loaded onto a semi-trailer truck. There are already well-established companies in the Western Parkland City providing prefabricated homes to customers in Australia and around the world. There is scope for these companies, and new market entrants, to grow in the Western Parkland City. The region could become a world-recognised centre of excellence for the design, construction and delivery of prefabricates homes.
- *Architectural, engineering, certification and design services.* For many customers professional expertise will be required to plan, design and approve the construction of their modular home. Part of this industry will include small and large firms that supply the architectural, engineering, design and drafting services to ensure the prefabricated building meets customer requirements. There may be value in having these firms located near the companies actually building the prefabricated houses to ensure what is built adheres to the plan and site requirements.
- *Tailored freight and logistics services.* Building modules are large, heavy and can sometimes be fragile. They call for customised and skilled transport professionals and equipment. As the prefabricated building industry develops so too will the freight and logistics providers who transport building modules and materials from the factory to the site.
- *Construction materials.* Prefabricated buildings often make use of advanced construction materials. For example, operating through a company called DesignMake Lendlease in 2015 commenced operations of a cross laminate timber (CLT) factory in Western Sydney. This advanced construction material can be used for structural components of potentially large buildings. Products from this factory were used in Australia's largest timber skyscraper which was recently completed in Brisbane on King Street at Fortitude Valley. According to the builder the CLT product was lighter than concrete which sped up construction and decreased costs along with environmental sustainability benefits [225]. There are many other construction materials made from steel, aluminium, plastics (including acrylics), recycled timber/materials and precast concrete which could be supplied by this emerging industry in the Western Parkland City.
- *Software solutions, building information systems and digital tools.* The prefabricated building industry is increasingly being serviced by software tools, BIM systems and a wide range of information technologies. These tools are powerful because prefabricated building systems place the emphasis on design and planning aspects of construction to a greater extent. There is also a requirement for architects, engineers, designers and customers to view the building onsite before construction commences. This can be achieved by digital visualisation tools which give the viewer a realistic 3D and/or virtual or augmented reality experience.

- *Additive manufacturing (3D printing) services.* Prefabricated building systems are making increased use of additive manufacturing technologies such as 3D printing [226]. These technologies can provide low-cost customised solutions which can be mass produced as parts of building modules. Although mostly for demonstration and experimental purposes these technologies can be used to print entire houses with onsite or offsite 3D printers [227]. However, 3D printers are more routinely used on the factory floor to print components or modules of prefabricated buildings.

These are a few of many products and services within the prefabricated building industry. It's worth noting that this industry is seeing very high levels of innovation. Companies are providing customers with simple, easy-to-use and highly graphical websites where they can customise and then order a prefabricated house. The behind the scenes supply chains and production processes use additive manufacturing technologies, advanced materials and sophisticated freight and logistics systems to deliver a house onsite to almost anywhere in the world. There is a plausible pathway via which this industry can develop within the Western Parkland City.

5.3 Circular-Tech

This emerging industry responds to the rising generation of complex waste products, often associated with technology, and the increasing consumer demand for environmentally responsible handling of waste. It is also being driven by innovations in recycling science and technology combined with high value waste streams. For example, researchers estimate that old mobile handsets contain up 350 grams per tonne of gold and that computer circuit boards contain 200-250 grams per tonne [228]. By comparison natural gold ores extracted by mining companies in Australia would be considered high grade if they contained 9 grams per tonne with most gold ores yielding around 3-5 grams per tonne [229]. E-waste is rich in a wide range of other precious metals. It's just much harder to extract. However, science and technology will make this increasingly feasible. Furthermore, technologies such as electric vehicles and solar power which use lithium ion batteries and photovoltaic cells are generating new waste streams. We will see strong and growing demand for recycling services for these types of waste streams.

5.3.1 Demand Drivers

Waste generation in much of the world, Australia and New South Wales is typically growing at a rate above population growth. Between 2019 and 2040 annual waste generation in New South Wales is expected to grow 2.3% per year and increase from over 21 million tonnes to 31 million tonnes [230]. In 2017-18 around 60% of generated waste was from construction and demolition, 20% were categorized as commercial and industrial waste and the remaining 20% was municipal solid waste. Large construction and infrastructure projects are the drivers of the recent growth of waste generation in New South Wales [231].

In 2010-11 Australians produced 2.2 tonnes of waste per capita on average. Around 60% of this waste was recycled or recovered for embodied energy. In New South Wales waste generation in 2010-11 was above national average at 2.38 tonnes per capita, making it one of the nation's largest waste generating jurisdictions. However, the resource recovery rate was also above average at 65% compared to the national average of 60% [232]. The resource recovery rate in New South Wales has been growing faster than the waste generation rate; between 2006–07 and 2010–11 resource recovery increased by around 20% while waste generation increased by around 7% [232].

The New South Wales waste management sector today is valued at $1.5 billion and employs over 10,000 people. With the rise of the circular economy in Australia and globally this sector has a potential to grow, particularly in regional New South Wales, and build a nationally competitive resource recovery sector [230]. According to a report by KPMG Economics commissioned by CSIRO, circular economy initiatives in food,

transport and the built environment sectors in Australia will add $23 billion to GDP by 2025 [233]. Recycling is also a big employer. Revenue generated in the recycling industry creates 3.3 jobs for every 1 job created by revenue generated in the landfill industry [234].

The waste management system of New South Wales is facing emerging challenges as export markets for waste materials are getting disrupted, landfill capacity approaching its limits and new complex waste materials emerge. The challenges require strategic actions to define the new approaches in waste management and to harness the emerging market opportunities [230].

Overall, there is no shortage of waste being generated in Greater Sydney. Community expectations for recycling and environmentally safe disposal are rising. These issues represent strong drivers of demand for an advanced waste management and recycling capability in the Western Parkland City.

5.3.2 Products and Services

The waste management and advanced recycling industry is large and diverse offering many different types of products and services to customers. Whilst potentially all types of recycling could occur in the Western Parkland City we identify a subset here where, by our analysis, there is scope for growth and specialisation. These needn't occur at the expense of other types of recycling and waste management activities. However, they represent areas where technology is fuelling new demand for new types of products and services. The advanced recycling and waste management products and services we identify are:

- *Lithium-ion battery recycling*. A recent report by researchers at CSIRO examines the potential for lithium-ion battery recycling in Australia [235]. This study finds that owing to drivers such as electric vehicles, household solar systems and a wide range of other household and industrial applications lithium-ion battery waste is growing at a rate of 20% per year and reached 3,300 tonnes in 2016. This is forecast to grow to between 100,000 – 188,000 tonnes by 2036. At the current time only 2% of this waste stream is recycled. If a lithium-ion battery is recycled around 95% of the components can be converted into new batteries or valuable materials for other products. Achieving much higher rates of lithium-ion battery recycling is possible. For example, Australia currently recycles 98% of lead-acid batteries. Currently the majority of Australia's lithium-ion battery waste ends up in landfill where it can harm the environment. The CSIRO researchers find that an Australian onshore lithium - ion battery recycling industry is both economically and environmentally achievable. The Western Parkland City could be where this industry concentrates in Australia. The CSIRO researchers also found that standards for lithium-ion recycling - relating to labelling, safety, transport, discharge and processing - were required for the creation of this industry.
- *Solar panel recycling*. A research paper published in the journal of Waste Management in May 2018 reviews the current status of recycling waste solar panels [10]. In Australia and globally the demand for photovoltaic solar panels has exploded over the past few decades rising from 1 GW in 2004 and reaching 57 GW in 2015 creating an annual growth rate of 20%. This has resulted in the mass production of solar panels with the majority made in China. The normal useful life of a solar panel is 25 years and the total quantity of "end-of-life" photovoltaic panels is expected to reach 9.57 million tonnes by 2050. The International Renewable Energy Agency (IRENA) estimates that total solar panel waste will increase from 250,000 tonnes in 2016 and reach 78 million tonnes by 2050 [236, 237]. The Chinese Association of Renewable Energy has indicated there will be a solar panel recycling and waste disposal crisis by 2030 [10]. Solar panels contain precious metals and minerals such as silicon, silver, cadmium, gallium and glass. The technology is improving but already recycling of solar panels is economically and technically feasible. The environmental problems associated with putting solar panels into landfill are significant. The Electric Power Research Institute [238] in the United States examined the environmental impacts of solar panel disposal and concluded "Disposal in regular

landfills not recommended in case modules break and toxic materials leach into the soil" (page 20). There is an urgent need for a solar panel recycling and disposal capability in Australia and given the rapid growth in solar panel adoption, and 25-year end-of-life issues, there will be strong demand for this industry in the Western Parkland City.

- *E-waste recycling*. This service is focused on the extraction of high value minerals such as copper, platinum, gold, silver, lithium, cobalt and other high-value minerals experiencing increasing demand associated with the rise of digital technology which depends on these minerals. An experimental "urban mine" at the University of New South Wales uses e-waste to extract gold, silver and copper. The researchers have done economic modelling and found that an e-waste recycling "micro-factory" which costs $500,000 to establish can pay itself off in 2-3 years [239, 240]. Another study by researchers from Macquarie University in Australia and Tsinghua University, Beijing examined the extraction of precious metals from e-waste in China [11]. In this paper they state "we demonstrate utilizing real cost data from e-waste processors in China that ingots of pure copper and gold could be recovered from e-waste streams at costs that are comparable to those encountered in virgin mining of ores" (page 4835). The title of the paper is "Urban Mining of E-Waste is Becoming More Cost-Effective Than Virgin Mining". This is a significant finding which means the development of an e-waste recycling industry in the Western Parkland City could potentially compete with traditional rare-earth mining.

We acknowledge that many other products and services are possible under an advanced waste management and recycling industry. However, these three are comparatively new and are associated with novel supply and demand drivers.

6 Policy Considerations

This report has covered a comprehensive range of issues and opportunities relating to industry development within the Western Parkland City. In this section we distil the issues into a set of policy considerations. These considerations are relevant to government, industry and community decision makers as they seek to build future industries for the Western Parkland City.

6.1 Geographic Industry Clusters

The analysis presented in this report finds that businesses located within relevant industry clusters grow revenue faster, grow their workforces faster and innovate more. These observations have been repeatedly made by economic geography researchers studying the formation and growth of industry. It is for these reasons that most economic development strategies use a cluster approach. For example, the Scottish Development Agency designed and implemented an industry cluster development approach to build what is now the highly successful Glasgow knowledge, technology and arts/culture cluster [241]. This was a highly purposeful cluster strategy involving the selection of specialisations and locations combined with a range of place-based measures – such as transport systems, urban renewal and university campus development – to develop the clusters. They also achieved sustained commitment to the clusters from successive governments.

The development of clusters in the Western Parkland City will also require careful selection of cluster locations and careful selection of industry specialisations. In this report we have identified growth options for existing industries and growth options for new and emerging industries. These could become areas of specialisation. Decisions about where clusters are best located are beyond the scope of this report and require detailed analysis. The cluster locations will be influenced by existing and planned infrastructure such as the Western Sydney Airport, the precincts surrounding the airport and the new metro rail link. The massive planned infrastructure upgrades can be leveraged to create more successful clusters.

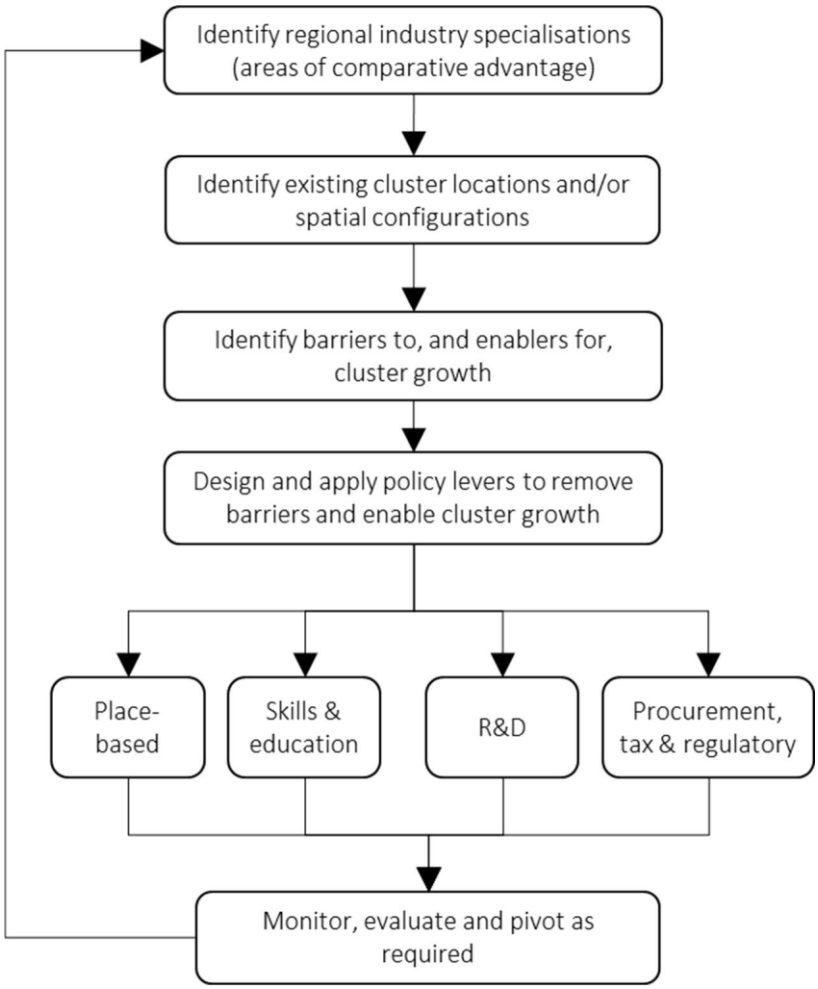

Figure 40 Cluster identification process

Overall, we are recommending that a cluster-based approach be taken to develop existing and new industries. If this approach is taken decision makers will be challenged with identifying specialisations and locations. Once this is done the right

policy levers will need to be applied to catalyse growth and development of the clusters (Figure 40). They will also need sustained government support over decades.

6.1.1 Identifying Cluster Locations - Criteria for Consideration

Choosing locations and specialisations for proposed cluster is an important task within a broader industry cluster development strategy. In this section we identify potential criteria that could be considered when choosing locations for clusters related to the focus industries and the emerging industries:

Advanced Manufacturing

- Concentration of existing manufacturing-sector companies.
- Transport connectivity to the Aerotropolis manufacturing precinct and the new Advanced Manufacturing Research facility.
- Proximity to research institutes within and near the Western City Parkland including CSIRO, the University of Western Sydney and other research institutes.
- High speed and reliable digital connectivity.
- Road, rail, shipping and air-freight connectivity.
- Secure, reliable and cost-effective supply of electricity and gas. The high cost of gas is a limiting factor in Australia for many advanced manufacturing companies. Gas is a critical input in many types of manufacturing; particularly in the plastics and chemicals manufacturing industry.
- Concentration and/or connectivity to high skilled workers (engineers, technicians, tradespeople…).

Defence and Aerospace

- Proximity to Western Sydney Airport or the Richmond RAAF Base and associated aviation precincts and facilities.
- Proximity and transport connectivity to Holsworthy Barracks and other defence facilities.
- Concentration of advanced manufacturing facilities, companies and workers.
- Secure, high speed and reliable digital connectivity.
- Suitable for a major defence-sector and/or aerospace anchor tenant organisation or company to establish.
- Aligned with the procurement priorities of the Australian Government Department of Defence.

Agri-food industry

- Availability of cost-effective and productive land and water resources.
- Road and rail connectivity to air freight facilities at the Western Sydney Airport and to the markets of Greater Sydney.
- Concentration of, and/or connectivity to, skilled workers in the fields of horticulture, agronomy, food science and other types of agri-food expertise.
- Co-location potential of food processing, food packaging and intensive livestock and horticultural production systems.

Freight and logistics

- Concentration of existing freight and logistics companies providing warehousing, packing, sorting, storing, tracing and transportation services.
- Excellent connectivity to road and, rail connectivity to airports and shipping ports with cargo capability.

- Locations with minimal impacts on residents and visitors in terms of safety, noise and aesthetics associated with heavy freight and logistics operations.
- A concentration of skilled workers and small and large companies that comprise all the components of the freight and logistics supply chain.
- Proximity to education and training facilities and institutions specialising in freight and logistics.
- Proximity to universities and research institutes specialising in freight and logistics.
- Road and rail connectivity for cargo to the Greater Sydney region.

Visitor economy

- High rates of tourist visitation and expenditure compared to other parts of the Western Parkland City Region.
- Iconic or well-known natural assets likely to attract tourists.
- Aesthetically pleasing landscapes and recreation opportunities.
- Excellent pedestrian and cycle connectivity and safety.
- Excellent connectivity via road, rail and air transport from Greater Sydney, Australia and worldwide.
- Concentration and connectivity of a skilled tourism workforce.
- Concentration of tourism businesses (cafes, restaurants, tour operators…)
- Density of accommodation providers.
- Access to tourism infrastructure (hiking trails, mountain bike trails, …)
- Proximity to education and training institutes specialising in tourism.

Health and education

- Proximity to existing healthcare facilities and services including Westmead Hospital (although outside the Western Parkland City it is nearby and has impact).
- Concentration of healthcare workers and companies supplying healthcare products and services.
- Connectivity to research institutes engaged in healthcare within/near the Western Parkland City such as the University of Western Sydney and CSIRO.
- Good pedestrian and cycle connectivity.
- Excellent transport connectivity to/from population centres.
- A concentration of skilled education workers (teachers, librarians…)
- A concentration of vocational training and education institutes.

Heat technology

- Concentration of advanced manufacturing companies and skilled workers in various types of manufacturing (likely to have skills transferrable to heat technology).
- Proximity and/or connectivity to research organisations engaged in heat technology solutions such as CSIRO, the University of Western Sydney, the University of Sydney and others.
- Proximity to Local Governments - such as Penrith City Council – investing in innovative heat mitigation and management solutions already.
- Proximity to locations/areas where the impacts of extreme heat will be significant.
- High speed and reliable digital connectivity.

Prefabricated construction

- Connectivity and proximity to existing construction companies, and in particular, several companies already doing prefabricated and modular construction.
- Road and rail connectivity for the transportation of prefabricated and modular building components to site locations within Greater Sydney and beyond.
- Availability of cost-effective land for the development of large factories, facilities and showrooms.
- Proximity and/or connectivity to universities and research institutes specialising in prefabricated construction.
- High speed and reliable digital connectivity.

Circular technology

- Road and rail connectivity to Greater Sydney to obtain e-waste streams and transport recycled products.
- Proximity to existing recycling facilities in the region.
- Proximity and/or connectivity to advanced manufacturing companies and workers in the region.
- Capacity to separate heavy industry activities from residential areas.
- Reliable electricity supply.
- High speed and reliable digital connectivity.

6.2 Industry Ecosystems

In this report we identify and describe six focus industries including (1) defence and aerospace; (2) food and agriculture; (3) freight and logistics; (4) health and education; (5) advanced manufacturing and (6) visitor economy. We also identify emerging industries which have path dependence and can be developed upon the foundations of existing industries: (1) heat-tech; (2) prefabricated construction; and (3) advanced waste management and recycling. We note there is already considerable activity underway with the Western Sydney Aerotropolis precincts in developing these industries. However, we identify considerations which may help further develop the industry ecosystems:

1. *Developing advanced recycling facilities/capabilities for e-waste, lithium ion batteries and/or solar panels within the region accompanied by education, training and research and development*. Our initial analysis suggests strong demand for recycling these waste streams and due to recent technological advances and improved cost effectiveness. Demonstrating how it can be done in the region could lead to further investment and industry growth.
2. *Improving freight and logistics training, education and research and development within the region attracting competitive bids to develop and supply these services from a broader market.* The physical locations of these activities could be varied to suit the needs of industry, students and researchers. A competitive tendering process could be an effective mechanism for attracting the best providers with are likely to be consortia of universities, research institutes and companies.
3. *Developing heat solutions technology parks or precincts housing researchers, scientists, technicians, companies and start-ups working on a wide range of technologies and services to map, monitor, forecast and mitigate the effects of extreme heat on humans and infrastructure.* The services could be supplied to councils, industries and residents within the region and beyond. This could build upon existing activity for heat mapping and management occurring within the region.
4. *Developing institutes and/or centres-of-excellence for modular and prefabricated construction research, training, standards and development within the region.* This could be established via a competitive

tendering process and the institute would be developed in partnership with existing businesses engaged in these activities within the region.

5. *Identifying defence investment priorities relevant to the Western City Parkland's capabilities in consultation with the Australian Government Department of Defence to attract and secure contracts for local suppliers.* There has been a huge increase in national defence spending and the region's manufacturing capabilities could help supply products and technologies needed by Australia's armed forces.
6. *Identifying and attract anchor tenant organisations and companies into the Western Parklands City likely to invest in growing and training their workforces and likely to invest in research and development within the region.* This requires targeted appraisal of multi-national corporations and other companies to identify a shortlist which are most likely to invest in the region. These companies can then be attracted to invest in the region.
7. *Assessing the potential to establish an aged care centre of excellence within the region designing and delivering world-class aged care service programs, technologies and skills/capabilities*. Aged care demand will expand substantially in the region and beyond. Our analysis suggests that demand for aged care services will outstrip supply and that few other jurisdictions in Australia have established centres of excellence.
8. *Investing in science and research talent attraction, development and retention program for all institutes and precincts within the region*. Our analysis found that talented individuals and groups are critical for the success of science and technology parks and precincts. The physical building won't be enough to catalyse economic activity on their own; they need to be filled with the world's best human talent in relevant areas of science, research and technology.

We appreciate that establishing these institutes and implementing these actions carries cost implications for government. The costs would need to be assessed against the benefits and prioritisation of these (and other) actions would need to occur considering budget constraints.

6.3 Education and Training

We acknowledge that the Western Parkland City Authority, the local governments and the New South Wales State government are already developing the concept of a "multiversity" within the Western Parkland City. The multiversity is a concept under development but could have a campus (yet to be located) which accommodates multiple universities and technical training colleges.

Our analysis suggests that the multiversity, or similar facility, is a linchpin for the development of industry and economic growth in the Western Parkland City. Universities and training institutes have been central to the growth and development of practically every successful industry cluster worldwide. For example, the Fort Collins City Council has placed Colorado State University at the centre of their economic development strategy for decades. This has been a highly successful strategy for developing and retaining a skilled workforce which, in turn, has attracted tech-sector companies which fuel demand for more workers.

We suggest that the multiversity, or related facility, be at the centre of economic development strategy for the Western Parkland City. Finding a suitable physical location for the multiversity campus, or campuses, will be a complex and critical task. Consideration needs to be given to transport connectivity, urban landscape amenity, cycle/pedestrian connectivity and an environment likely to attract research experts, teachers and students who can choose from many other desirable locations. Overall, the physical campuses need to be highly desirable places to live, work and play. A range of other town planning and engineering criteria would also need to be observed. Even though university and college courses are being increasingly taught online a high-quality physical campus remains critical.

Given the Wester Parkland City's existing strengths in manufacturing, agri-food and logistics, such an institution should not be bound by the anachronistic separation of vocational and higher education. There is a need for workers in these industries to acquire more skills than has previously been the case, in order to increase productivity and ensure economic viability. As so much teaching can now be delivered online it is possible to access the best material from around the world and combine it with locally-delivered tutoring, mentoring and hands-on instruction. A multiversity could therefore draw on partners from around the world in collaboration with local instructors, rather than relying on a single local university. However, research does need to be based in the Western Parkland City to promote knowledge spillovers (in both directions) between researchers and local industry.

In addition to the physical qualities of the campus the university and technical college will deliver greater benefits as they achieve higher (world-class) standards of teaching, learning and research. Universities in Asia which have developed quickly, leading to regional and national-level economic benefits, have invested heavily in research and teaching excellence. Examples are Hong Kong University and the National University of Singapore. Both these institutes have achieved world-class standing in various fields of expertise via investing in excellence within chosen areas. Making the Western Parkland City university a success will depend on similar investments in addition to the physical campuses. This could require a human talent attraction strategy so that the universities, technical colleges and research institutes are filled with skilled and world leading scientists and teachers.

6.4 Research and Development

Practically all the successful industry clusters across the globe have invested in research and development linked to the needs of industries within the clusters. The research and development investments have been associated with the creation of original equipment manufacturers (OEMs) which the founder of clustering theory – Professor Michael Porter of Harvard University – has shown are critical for competitive advantage and fast-tracking growth. However, the OEM needn't just be a physical manufactured product. In the digital economy it could be software or ideas and knowledge which can be commercialised. An example comes from the invention of Cross Laminate Timber (CLT) in 1994 by a PhD student at the Graz University of Technology in Austria [242]. CLT is a revolutionary product that is now being used in structural elements for buildings across the world; it is lightweight, extremely strong and delivers high levels of environmental performance. This invention spurred the creation of a job-generating and wealth-generating CLT manufacturing industry in Austria which is the major supplier of CLT products to Europe.

The "spill-over" benefits of the original research have been substantial for Austria and the world as observed by researchers [242] who studied the phenomenon and reported that "the establishment of CLT production capacities grew rapidly, at 15–20 % per year … these developments had been realized primarily in Austria and Germany, with a worldwide production volume of roughly 500,000 m^3; 95 % in Europe and a share of two thirds solely in Austria. In 2014, the worldwide production volume increased to 625,000 m^3" (page 334). Due to the original invention Austria has remained at the centre of European and Global manufacturing of CLT for over 20 years.

The development of industries such as freight and logistics, the visitor economy, advanced manufacturing, aerospace and others within the Western Parkland City will be boosted by research and development breakthroughs which are converted into new commercial products and services. Original and innovative products and services give the inventors, and inventing regions and institutions, a sustained competitive advantage in the marketplace. The benefits can happen on a small scale or, as with CLT, on a large scale. To achieve these benefits its necessary to invest in world-class discovery-oriented science and research related to the region's specialisations but also allowing for the serendipity of the research process.

Another ingredient for success relates to commercialisation. The inventors of new technologies need support, incentives and pathways to commercialise. Many Australian scientific and research breakthroughs have created commercial benefit offshore because the researchers, who made the critical discoveries and breakthroughs, had no opportunity to commercialise them in Australia nor even attractive career pathways associated with the path to commercialisation [243-245]. This has dampened both the extent of commercialisation and the number of scientific discoveries associated with new technologies. Investments in research and development within Western Parkland City will achieve greater outcomes if scientists and researchers have incentives to commercialise their discoveries with industry partners also located within the region. The investors in research and development could be Local, State, Federal Governments and large Australian or international companies.

6.5 Adventure Based Recreation

Adventure recreation includes outdoor nature-based activities associated with thrill-seeking which involve elements of skill, stamina and physical exertion. Some of the adventure recreation activities happening in the blue mountains include mountain biking, trail running, hiking, rafting, climbing, abseiling and canyoning. These activities represent an opportunity to boost the visitor economy of the Western Parkland City and attract a segment of tech-sector workers.

One of the key opportunities relates to the mountain biking economy which has expanded significantly across the globe in recent years. Researchers from the University of Queensland recently reviewed 33 published studies of mountain bike developments across the world including places such as Whistler Canada, Derby Tasmania, Utah United States and many others [246].

The mountain bike trails built in Derby Tasmania demonstrate the regional economic development potential of this type of adventure recreation. According to the MTBA [247] the 80km trail network cost $3.1 million to build with $2.5 million from the federal government. Today it attracts 30,000 visitors/year who spend 4-5 nights in Derby and another 5 nights elsewhere in Tasmania. There are numerous media reports about the transformative impact mountain biking has had on the Derby and regional economy with jobs, salaries and property prices increasing rapidly [248]. Mountain bikers tend to have high daily expenditure rates; akin to skiing tourists. There would be a large population of mountain bikers in the Greater Sydney region and beyond likely to visit the blue mountains more frequently, and stay longer, if the network of trails were improved. Marketing would also be an important part of the strategy.

We acknowledge the existence of trails, facilities and other activities to support and promote adventure tourism in the Blue Mountains. There is an opportunity to upgrade these facilities to meet and exceed world-class standards and develop the industry via marketing and high industry-wide standards of tourism service catered the preferences and lifestyles of adventure tourists.

7 Conclusion

This report has identified strategies for the development of existing and new industries in the Western Parkland City. This includes the identification of four new and/or emerging technology industries driven by shifts in supply and demand. The report has drawn upon case studies of relevant industry growth and development strategies from across the globe. The report identifies a set of policy levers which can be used by governments to catalyse growth.

The policy considerations in this report are by necessity at a relatively high level. We identify where the best opportunities are likely to exist. The next steps will involve bringing the analysis down to ground level to identify exactly what and where specific activity can occur to achieve industry growth. This will involve detailed analysis and consultation. We note that through the course of this project we have identified cases where local governments are already actively developing the new industries.

Lastly, it's worth noting the importance of long-term commitments to industry growth. Whilst a plan is vital, an industry development strategy won't succeed as a static document. The economic and technological landscape will evolve rapidly and dynamically. Many opportunities will present themselves serendipitously. Other avenues of development which looked prospective at first may at a later stage be deemed not worthwhile. Most industry development activities will require several strategic "pivots" into new areas as marketplace conditions evolve.

The change taking place in the Western Parkland City is amazing. There are few precedents from Australia, or any of the world's advanced economies, for this level of intensity of infrastructure development, economic growth and population growth. The Western Parkland City is on track to become one of the best places to live in the world.

The overall objective of this report is to ensure the infrastructure upgrades happening within the region are matched by the creation of good jobs with good salaries for citizens. To achieve this existing industries need to develop and new industries need to be created. Science and technology will play a critical role in shifting the dial and fast-tracking growth.

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