



NSW Industry Development and Growth

FINAL DRAFT

Prepared for Infrastructure New South Wales

Executive summary

The economic performance of NSW matters for Australia

The economy of New South Wales (NSW) is the largest state economy in Australia, accounting for a third of total national output. The state capital, Sydney, generates a fifth of Australian output and two-thirds of NSW's economy. Meanwhile, regional NSW has abundant natural resources that are crucial for Australian wealth – over 75 percent of the country's exports are primary products (mining, minerals and agriculture). The future economic performance of Sydney and NSW therefore matters for the country as a whole.

Central to NSW's future prosperity will be the adequate provision of infrastructure to meet increasing demand from its citizens and businesses, and support growth in its future industries. The focus of this report is to look at NSW's current industrial comparative advantages, identify where comparative advantages could emerge in the future and how infrastructure can support the growth and productivity of different industries across the state.

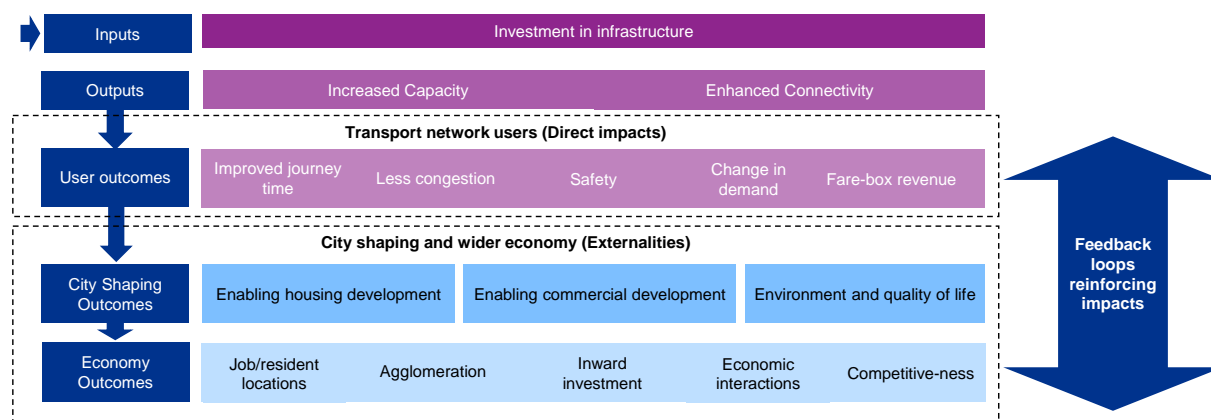
Infrastructure is essential for the economy

The linkages between infrastructure and the economy are well established. Infrastructure is an essential facilitator and enhancer of growth and competitiveness, and it is fundamental to quality of life. It provides a business route to market through transport and telecommunications, and household means of accessing essential services such as energy and water.

In its simplest form, infrastructure is a direct input into the production process of industries, which means that the cost of this input impacts on the performance and competitiveness of firms in that industry, or to the economy as a whole. Network infrastructure, such as transport and water, also impacts on the spatial distribution of economic activity.

The impact of infrastructure on users has traditionally driven investment decisions, such as through transport saving travel time on journeys or energy reducing unit costs. However, major infrastructure projects and programs can have impacts that go beyond the direct users of these services. These linkages are illustrated in Figure 1.

Figure 1- Overview of linkages between transport and the economy



Source: KPMG

From the perspective of industry, this means that infrastructure can enhance competitiveness and efficiency, boost productivity and increase access to labour markets. Understanding which industries

NSW has a comparative advantage in can help maximise the potential economic benefit of infrastructure investment. It can help drive growth in industries and regions that would otherwise would not perform to their full economic potential.

Sydney is expected to drive future growth in NSW

NSW has changed significantly over the past 20 to 25 years. As its population has grown, its economic geography has changed, becoming increasingly urbanised. Almost a third of Australian population growth over the last 25 years has been in NSW, with an additional 1.7 million people calling NSW home by 2015. More than 70 percent of this growth has occurred within Sydney, echoing a trend which is occurring internationally.

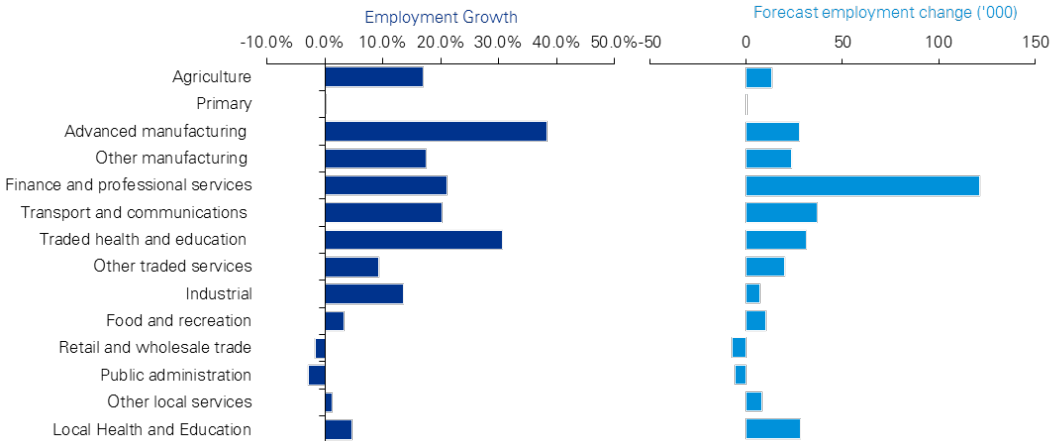
The future shape of the NSW economy is expected to be driven by some of the major trends that have been impacting its recent performance. The structural shift away from manufacturing towards services, continued urbanization, ageing and rapid technological development are all expected to play a role in the future economic performance of NSW. The Base Case for future NSW to 2024, set by the Victoria University Employment Forecast (CoPS), expects growth to be driven by Sydney while regional NSW employment is projected to lag behind.

To help in understanding what this means to individual industrial sectors, this report uses an approach developed in the US (by Harvard University and the US Bureau of Economic Analysis) to identify industrial and locational comparative advantage. This approach splits industries into two classifications. Local Sectors that primarily trade locally (such as general practitioners or dry cleaners) and Traded Sectors that trade nationally or internationally (such as mining or professional services). The later forms the competitive base of regional economies and are more relevant to a region’s comparative advantage. Traded Sectors compete nationally and internationally for business, while Local Sectors rely on the performance of local business and local socio-economic conditions.

The Traded and Local Sectors are then split into industrial clusters that capture the important linkages and technology spill-overs, skills, and information that cut across firms and industries. The definition of these clusters is based on a combination of: the co-location of industry employment; co-location of industry establishments; input-output links; and occupational correlation.

In the context of the Base Case for NSW, growth in skilled labour and technology efficiencies are expected to support the continued growth of knowledge-intensive Traded Sectors, in particular Finance and Professional Services. While the actual growth rate in this industry is not expected to be as strong as Advanced Manufacturing or Traded Health and Education, the Finance and Professional Services industry is projected to generate the greatest absolute employment growth, making up 38 percent of all new jobs in NSW over the period 2016 to 2024 (see Figure 2).

Figure 2 - Forecast employment growth rate and total growth by industry, 2016 to 2024



Source: Victoria University Employment Forecast (CoPS), KPMG

The implication of these projected industrial trends, the concentration of Finance and Professional Services, Transport and Communications, and population-serving Local Industries means that Sydney’s output is projected to grow faster than that for NSW as a whole. Sydney is also expected to see significant growth in Advanced Manufacturing. Meanwhile, growth in Regional NSW will be

predominately driven by the Agriculture and Primary industries, as well as Local Sectors that are expected to be driven by population migration towards the East Coast of NSW.

NSW can sustain its comparative advantages

The types of industries that will drive growth in NSW will be those that have a comparative advantage and can leverage off future industry trends such as technology. NSW has a number of comparative advantages, and these differ regionally depending on factors such as natural endowment, population and distribution of skills throughout the state. There are four key Traded Sectors that NSW has a comparative advantage in, namely: Finance and Professional Services; Agriculture; Primary; and Other Traded Services¹.

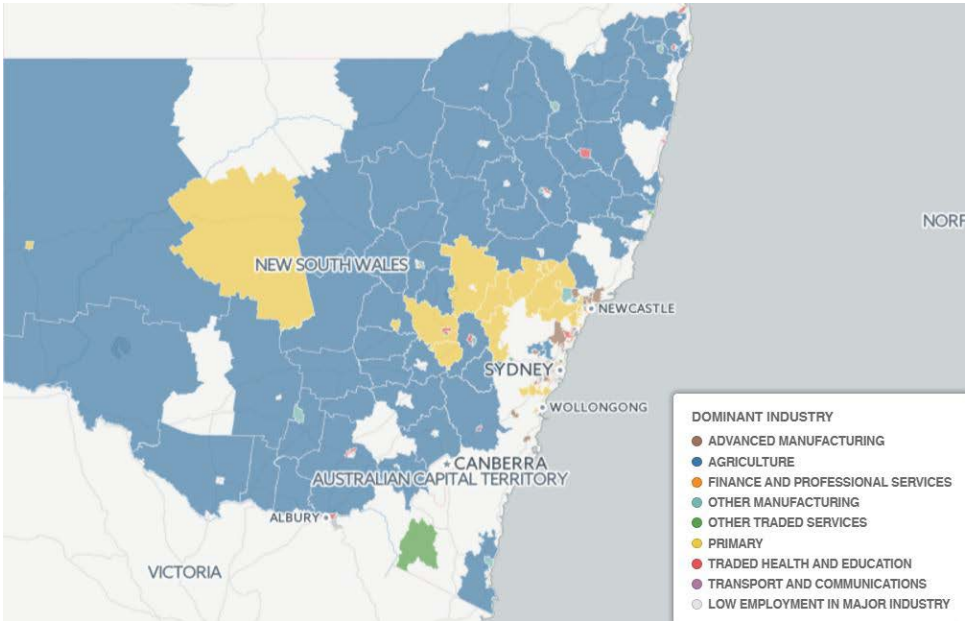
The Finance and Professional Service industry is the key employer and generator of Gross Value Added (GVA) in NSW, with a large proportion concentrated in the major Sydney centres, such as the CBD, North Sydney, Macquarie Park and Parramatta. NSW has been a driver of growth for this Industry cluster. Between 1996 and 2016, NSW made up approximately 40 percent of Australia’s employment and GVA growth in this industry (751,000 jobs and \$161 billion).

The Finance and Professional Services industry is driven by the availability of skilled labour, the proximity of firms to one another, adequate surface and aviation infrastructure, and it is supported by the stable macroeconomic and regulatory environment in Australia that saw Sydney move from a ranking of 16 in the Global Financial Centres Index in 2008 to 11 in 2009 (Z/Yen, 2008 and 2009).

The other key industry strength for Sydney (and NSW more broadly) is in Other Traded Services. This is predominately driven by world-class attractions in Sydney and more widely in NSW. Sydney is effectively the gateway to tourism for many parts of NSW. Employment growth in NSW accounted for 32 percent of total Australian employment growth in Other Traded Services over the past 20 years. Tourism alone contributed a total of \$27.9 billion to the NSW economy in 2013–14, representing nearly one-third of tourism’s direct contribution to Australia’s gross domestic product (GDP).

NSW also have comparative advantages in the commodity focussed industry clusters of Primary and Agriculture. As demonstrated in Figure 3, these are extremely important traded industries for regional NSW. The drivers for NSW’s advantage in these two industries are the same; NSW’s rich endowment in prime agricultural land and coal deposits and strong demand for exports of these good, particularly to Asian markets.

Figure 3 - Major industry clusters by SA2 regions across NSW (Location Quotient, 2011).



Source: ABS, KPMG

¹ Other traded services includes non-residential building construction, engineering construction, gambling, tourism, accommodation and the performing arts. More information on industry clusters can be found in chapter 2.

The Primary industry cluster is particularly focussed in the Hunter Valley, which is home to one of the largest coal export ports in the world (Port Authority of NSW, 2017), with some comparative advantage in the Primary sectors in the Central West region. Growth in the Primary industry over the past 20 years has been strong in NSW, generating a 42 percent increase in employment and a 92 percent increase in GVA.

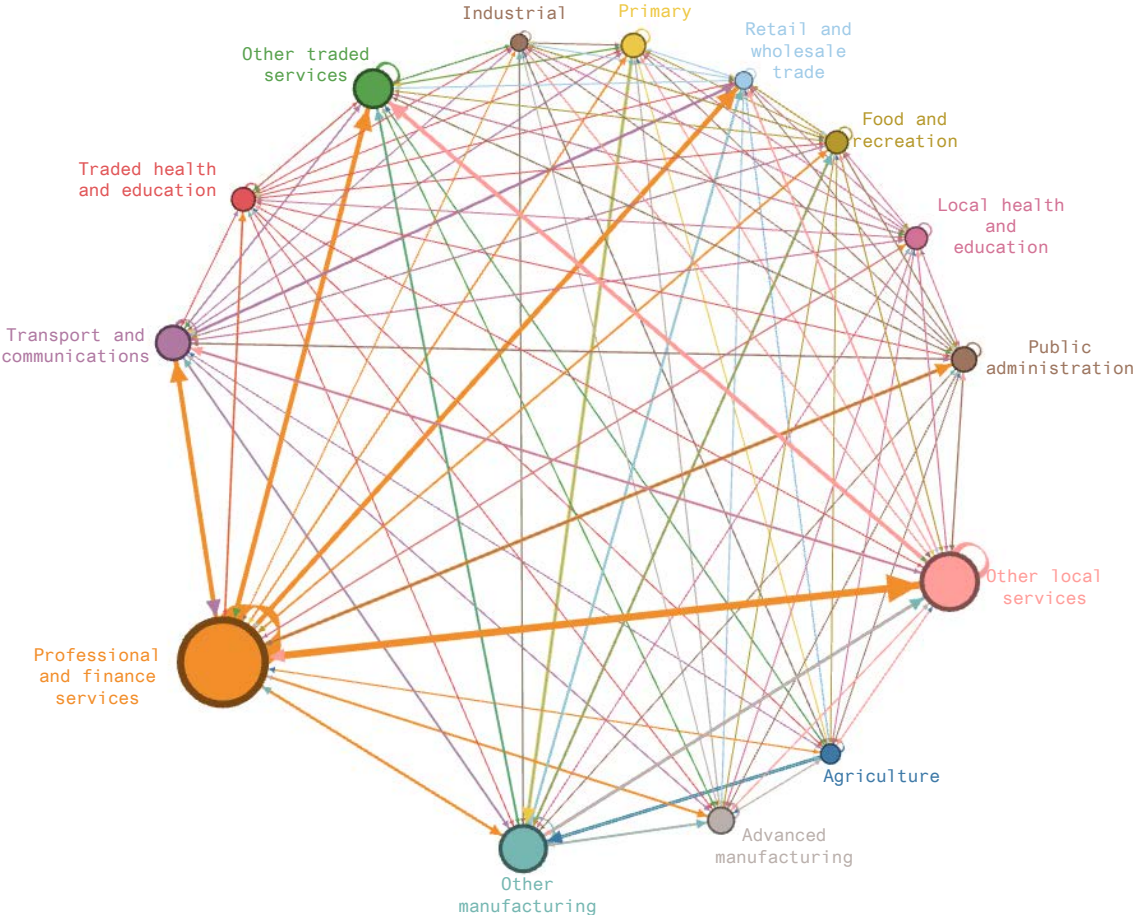
Agricultural production is more widely spread across NSW than the primary cluster and food, in particular beef and meat, is a key export. This industry has benefited from productivity improvements over the last 20 years, with GVA growing by 42 percent in NSW despite a decline in employment as agricultural production becomes less labour-intensive. The strength of this industry is supported by Australia’s international reputation for agricultural production (Meat and Livestock Australia, 2016).

The importance of the spatial distribution of these industries is in the way they support strong Local Sectors across NSW. Local Sectors are driven by population, demographics, socio-economic conditions of the communities and businesses they serve. These include Retail Trade, Food and Recreation and Local Health and Education.

The growth of Local Sectors in Australia has been strong over the past 20 years, with employment increasing by 2.7 million jobs and GVA by \$304 billion. NSW is a dominant contributor to Local Sectors growth in Australia, contributing around 30 percent of national growth (with the exception for local Industrial growth).

As Traded Sectors attract employment, growth in Traded Sectors creates demand for the services and goods of Local Sectors. The strong connections between Local and Traded sectors (and within both the clusters that make up these sectors) has implications to both the future trajectory of industrial growth in NSW. Figure 4 shows the demand between the clusters in NSW – the size of the bubble represents the cluster’s GVA and the thickness of the line represents the size of trade between clusters.

Figure 4 - Intermediate demand between industry clusters



Source: KPMG, ABS

In the context of infrastructure investment, understanding trade linkages between industrial clusters helps in determining the economic impact of linking certain locations where these clusters tend to concentrate. This is particularly important for transport infrastructure which can help enhance productivity by better connecting businesses to their customers, suppliers and importantly to workers for labour-intensive services such as Finance and Professional Services. Strong trade linkages between industries impacts on how the economy as a whole will grow and on individual sectors that may depend on the capacity of their customers and suppliers to facilitate their expansion.

Potential for future industrial comparative advantage in NSW

The fact is that future major trends, combined with the right infrastructure and non-infrastructure policy interventions, have the potential to change the way existing industries operate and interface with one another, and in some cases create brand new industries. The rapid technological development, changing demographics, shifting production practices and growth of Asia are examples of trends that can impact on growth in Australia and NSW. The Traded Sectors that have not traditionally been strong in NSW but have the potential to grow, or those that are already growing, include: Advanced Manufacturing, Other Manufacturing and Traded Health and Education.

Similar to many advanced economies, manufacturing in Australia and NSW has been in decline. However, a combination of new technologies and the increasing labour costs in countries that have historically had a comparative advantage in manufacturing have the potential to support the growth of manufacturing industries in NSW.

Advanced Manufacturing requires highly-skilled labour, a business environment that is research-intensive and supports the adoption of new production technologies (such as 3D printing). Partnerships with universities in research and development, as well as Government regulation and policy, will need to support the emerging trends that are shifting production from larger, vertically integrated organisations to smaller niche units.

There is already strong Government support for the development of Advanced Manufacturing, with plans for Western Sydney, including the new airport and industrial developments around it, acting as a catalyst for NSW. This, combined with on-going collaboration programs between Western Sydney University and industry to investigate new production techniques is creating the conditions for growth in Advanced Manufacturing.

The Other Manufacturing will also experience technology related productivity improvements. In particular, automation of production, and the ability to have smaller more efficient operations will be key drivers of growth as the cost and time required to produce these goods decline. Given NSW's large and wealthy customer base, the development of these types of industries is becoming more viable which can drive growth in parts of the state.

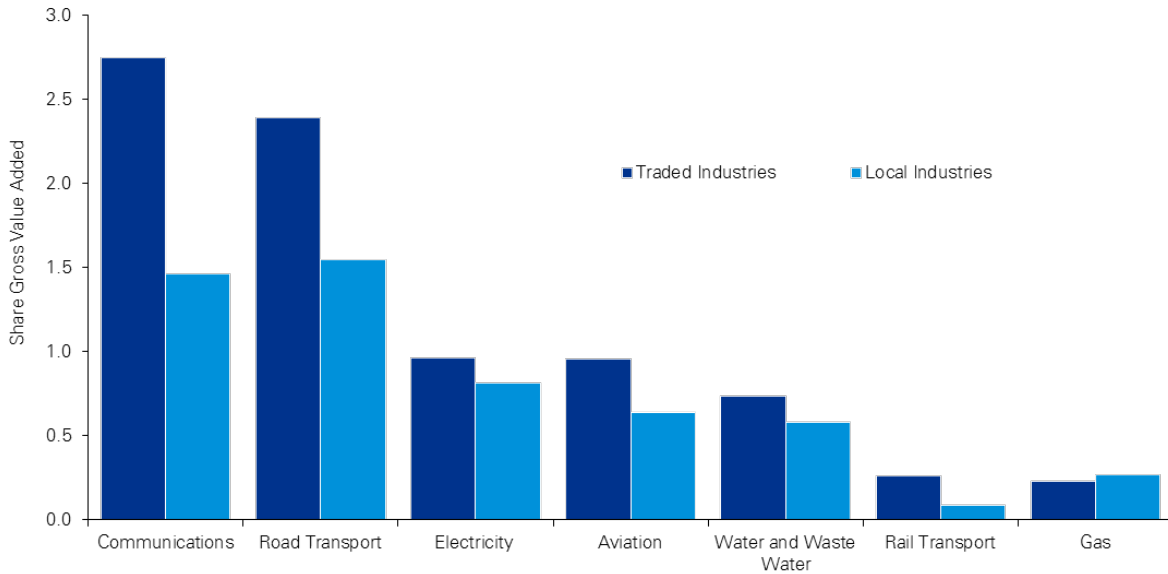
The final industry cluster that has good potential to boost its competitiveness is Traded Health and Education. This industry has experienced strong historical growth, its GVA in NSW has increased by 89 percent since 1996. NSW is therefore well placed to continue this growth given its high level of education, technological development and strong investment in research and development.

International demand for NSW's education sector is also high, particularly tertiary education. The number of international students commencing in 2016 grew by 11 percent compared to 2015, with higher education alone increasing by 15 percent. Demand from Asian international students is a key driver of this growth, with these countries experiencing the highest rate of growth of residents seeking to study abroad.

Infrastructure provision is a key enabler of Traded Sectors growth

The impact of infrastructure investment on the growth of Traded and Local Sectors will vary given their different requirements. Traded Sectors are heavy users of infrastructure, with road transport and communications accounting for the largest share of infrastructure inputs to these industries (see Figure 5). The type of infrastructure usage by industry is of course driven by what has traditionally been provided in NSW, such as roads, and also by the actual requirements of industry itself. For example, the fact that rail infrastructure has traditionally had less investment than roads means that NSW industries have used more of that infrastructure for its production.

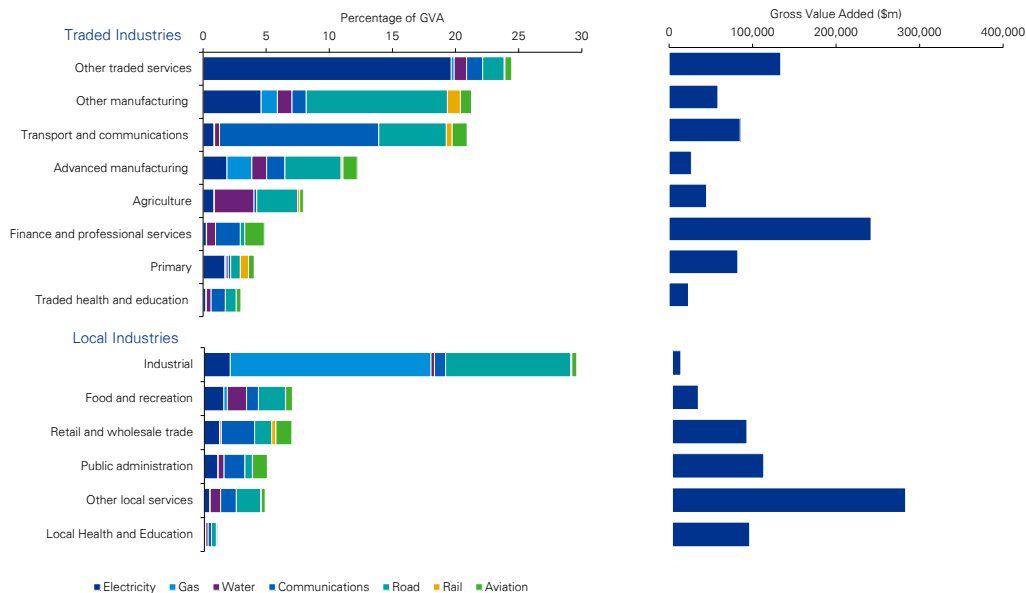
Figure 5 - Traded and local cluster use of infrastructure



Source: ABS, Input Output Table 2013-14, KPMG

These needs also differ in the industries within these sectors. Figure 6 illustrates what infrastructure means to the overall production of each of these industry clusters, and to also show the importance of each of the industry cluster to the NSW economy. Understanding infrastructure demand for each industry and infrastructure type gives an indication of the required location and impact that infrastructure investment can have on an industry’s competitiveness and productivity.

Figure 6 - Infrastructure use and GVA by industry cluster



Source: KPMG, ABS

Going back to the mechanisms with which infrastructure will impact on industrial growth (shown in Figure 1), the key factors to consider are that:

- Infrastructure is a direct input into production – provision of water and road infrastructure in the Agriculture cluster accounts for a significant cost to production. The quality, cost and reliability of both these infrastructure types will in turn impact on the viability of production, cost to consumers and competitiveness of produce, both nationally and internationally. A similar analogy applies to a number of other sectors.

- Infrastructure boosts productivity – physical and virtual connectivity between firms and their customers, suppliers and workers is essential for their productivity and growth. This is effectively what agglomeration economies are all about. While this may not be reflected in the direct contribution of infrastructure to industries (such as in Figure 6), it is nonetheless essential in that it is what impacts on long term economic performance.
- Infrastructure impacts on the spatial distribution of economic activity – investment, household and business location choices are heavily impacted by the quality and connectivity of these locations. Urban sprawl in much of the developed world has been enabled by the development of the road networks and increased usage of cars. The rail and public transport networks in many parts of the world are now being used to reverse these trends, renewing inner urban districts that have been left derelict by urban sprawl.

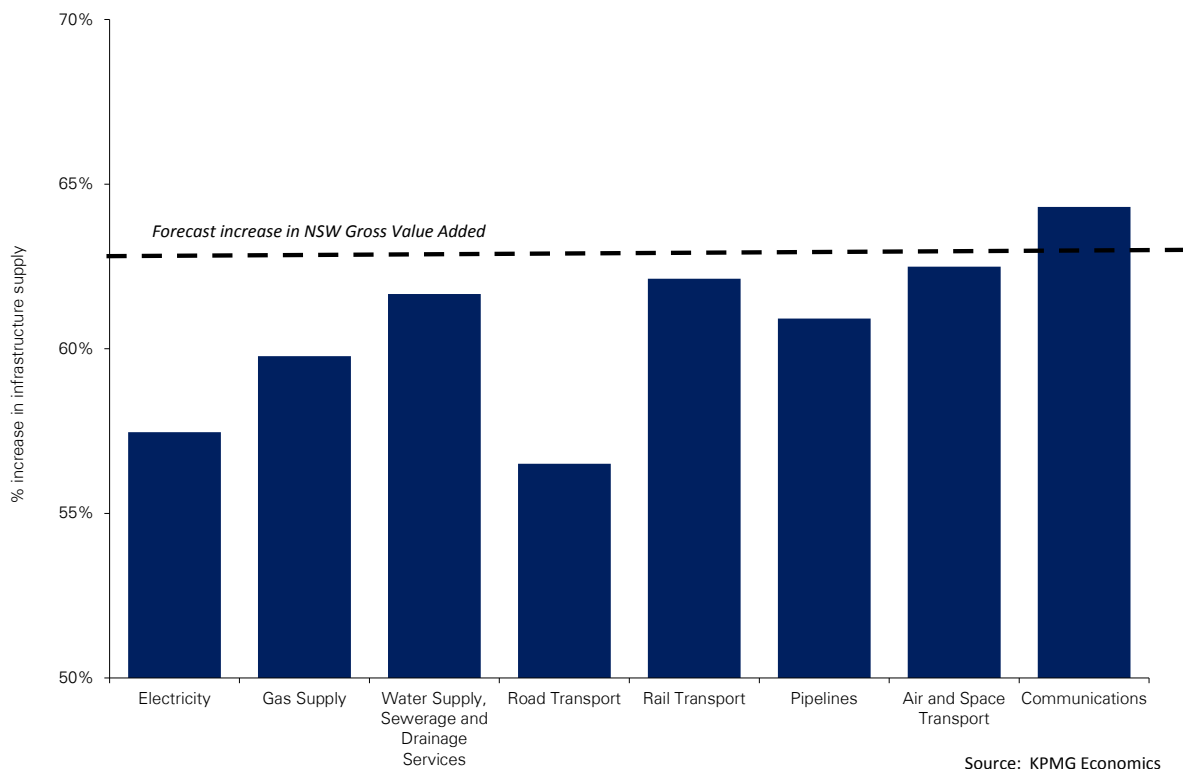
The key point is that the impacts of infrastructure on economic development goes beyond the direct users, whether individuals or industry. This needs to be considered in the context of the development of future infrastructure strategies and plans, as well as how infrastructure impacts directly on industries.

Communications infrastructure will drive growth

Taking direct industrial impacts, the fact is that growth of industries over the next 20 years will increase the demand for NSW’s infrastructure network. Infrastructure NSW have indicated that infrastructure requirements should be assumed to be met in the Base Case, which implies that there are likely to be no constraints on achieving the projected economic growth for NSW.

KPMG has estimated the increases required in physical infrastructure in NSW by type between 2016 and 2036 in order for the Base Case to be achieved (see Figure 7). These forecasts incorporate demand for infrastructure from the production side of the economy, as well as the final use components of the economy, being households, government and export activities. Should capital productivity improve, particularly if technological enhancement develop beyond what KPMG has already assumed in the Base Case macroeconomic forecasts, then the incremental level of infrastructure required may be lower than that presented below.

Figure 7 - Forecast required increase in infrastructure in NSW by type, 2016-2036



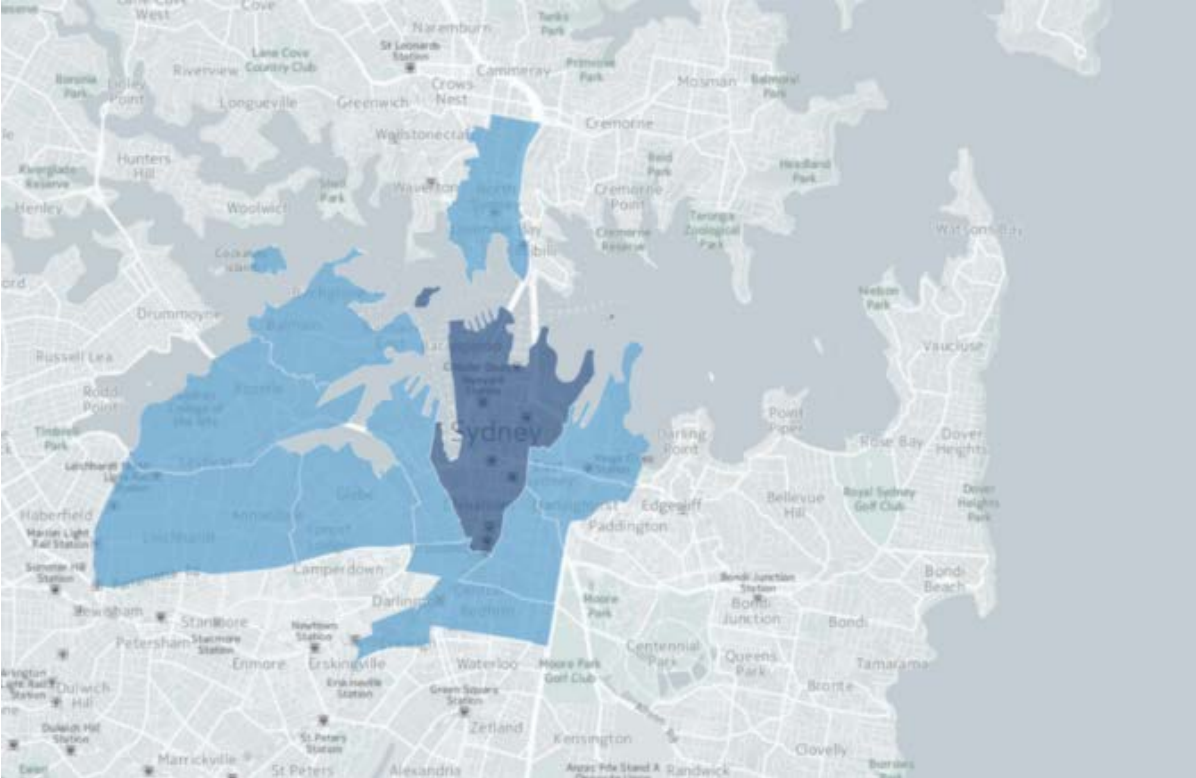
As expected, most forms of infrastructure are required to increase at a rate less than the rate of growth of overall economic activity due to economies of scale and scope, and the non-linear nature of incremental infrastructure development. The key exception is communications infrastructure which is required at a marginally higher rate than growth in GVA. This reflects the growing need for this type of infrastructure for both businesses and households.

In addition to understanding the future demand for infrastructure, the spatial implications of this future demand can be linked to where industries may grow in the future. The infrastructure types that are expected to grow fastest, such as communications, air and space transport and rail transport, are likely to be driven by growth in Sydney-centric industries, such as Finance and Professional Services, both Advanced and Other Manufacturing, Other Traded services, Other Local Services and Transport & Communications.

Financial and Professional Services will create demand for communications, aviation and rail transport within and to key employment centres such as the CBD, North Sydney and Parramatta. The growth of Sydney centric industries is going to drive demand for infrastructure in an increasingly limited geographical area. This means that not addressing infrastructure demand in the right way can impact on the productivity and ultimately growth of such industries.

A potential restriction to this growth is limited floor space availability in the current CBD. Given this, land use planning will need to support future employment growth to 2036 (and beyond) through both the rezoning of adjacent areas and through the review of floor space ratios. The CBD footprint is likely to spread out and encompass areas that are already seeing employment growth such as Surry Hills, Redfern, Eveleigh, and the Bays Precinct. Ensuring adequate space for supporting infrastructure will also be vital to the growth of the CBD, as sub-ground space is increasingly limited due to existing utilities, basements and car parks.

Figure 8 - Future CBD footprint



Source: KPMG

In Western Sydney, growth in professional services and manufacturing is expected to increase the demand for aviation from the Western Sydney Airport. The growth of manufacturing will also create demand for communications and rail (as well as electricity) as the industry increases its use of technology in the manufacturing process. This demand will be particularly strong around the Western Sydney Airport precinct. The demand for infrastructure in regional NSW will also increase. Water infrastructure demand has strong links to Agriculture industry and therefore increasing this infrastructure across NSW will be important to facilitating future growth. Communications may also be

an important industry in regional NSW as industries such as Agriculture and Primary are increasingly adopting communication technology in their operations.

Better asset utilisation is as important as new build infrastructure

Better and more efficient utilisation of existing assets is likely to play as important a part as new construction. Relative to the size of its economy, Australia has one of the highest rates of new build infrastructure amongst OECD countries. Meanwhile, maintenance spending is among the lowest.

Optimising service provision or maintenance schedules can therefore extend the utility of the existing infrastructure assets and in some cases improve its usable life. Examples of these improvements include timetable improvements for rail infrastructure to run additional services on the network, or more frequent schedules to improve the efficiency of electricity generation. Technology will also play a key role in improving asset productivity for most infrastructure types, from driverless trains that facilitate reduction in headway to improved battery storage capacity for electricity.

Demand management will also be a key strategy to managing network usage. User pricing, particularly for peaks (geographically and time of day), behavioural improvements, such as better customer information and land use changes such as densification around existing assets are all levers that can be used to try and change the way the community uses infrastructure. Again, technology will play a role in changing demand patterns such as enabling flexible working practices and improving energy efficiency. Demand side measures will be essential to reduce congestion where space limits the supply of infrastructure such as in Sydney’s CBD.

Understanding industry scenarios and associated infrastructure implications

Regardless of the combination of new build infrastructure and better utilisation of existing assets that is needed to drive industrial growth, a better understanding of how these investments can drive outcomes can come through considering how infrastructure can drive deviations from the Base Case, both positive and negative.

The base case projections outlined above are built on the basis of a range of assumptions so by implication there are other possible outcomes, some of which may be only slightly less likely to eventuate than the base case. For example, there may be a faster or slower uptake of technology than assumed. The five scenarios (outlined in Table 1) are effectively designed to capture potential different outcomes than those assumed in the Base Case for key parameters. The rationale behind this is to help in the understanding of what kind of investment decisions are needed to drive some different outcomes.

Table 1 - Industry impact of growth scenarios

Scenario	Impact of industry growth scenario
Scenario 1: improved productivity of traded goods	Growth in the agriculture and primary sectors will stimulate growth in the manufacturing industries as well as increase demand for support industries such as transport and communications and retail and wholesale trade.
Scenario 2: improved productivity of services	The whole economy benefits from the boost to productivity in the services industries with a relatively uniform expansion of most industries relative to the baseline in 2036, due to their heavy level of trade.
Scenario 3: improved productivity of traded services with strong inter-industry connections	Stimulating enablers of other industries such as transport and communication, energy and finance results in wide-spread benefits to the economy as the costs of key inputs used by all businesses are reduced, which makes trade exposed sectors more competitive and increases demand for income-sensitive non-traded sectors.
Scenario 4: slower manufacturing growth	A scenario where manufacturing continues stagnate results in relatively large negative impact on the trade-exposed manufacturing sectors, which lose competitiveness. Most other sectors of the economy are also negatively impacted because of the flow-on impacts of cost increases in manufactures, which are inputs to many other businesses and because of reductions in incomes.

Scenario	Impact of industry growth scenario
Scenario 5: improved labour productivity	Improved labour productivity may be attributed to better-than-expected education/training outcomes, more flexible work arrangements or improved management practices. In this scenario the whole economy benefits significantly, with the proportional expansion in most industries relatively uniform.

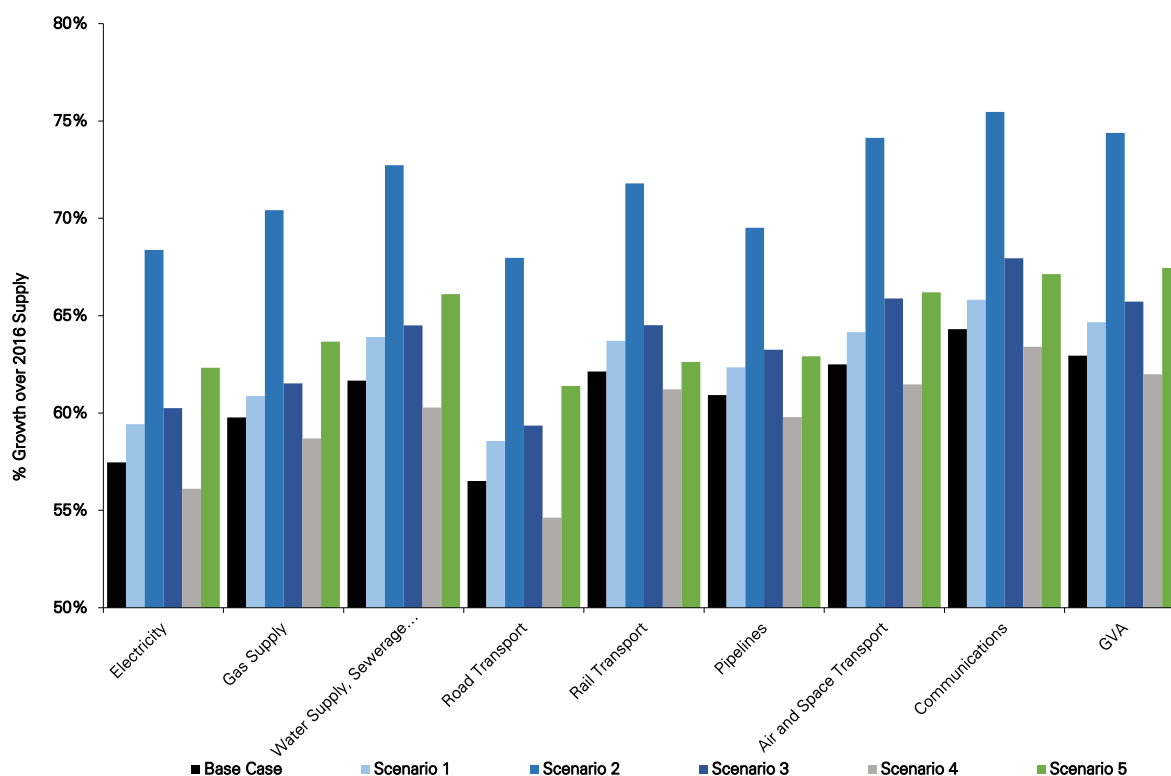
Equally, trends that impact on the growth profiles of industries can have differing impacts on the demand for infrastructure. Table 2 provides a summary of how the industry scenarios may impact on infrastructure demand. The direct infrastructure implications refer to the change in infrastructure demand due to the directly affected industries, while indirect infrastructure implications refer to the change in infrastructure demand due to those sectors that trade heavily with the directly affected industries. Figure 9 below provides a more detailed illustration by infrastructure type.

Table 2 - Industry scenarios and infrastructure implications (beyond the Base Case)

	Direct infrastructure implications	Indirect infrastructure implications
Scenario 1: improved productivity of traded goods	Growth in the agriculture and primary sectors will increase demand most for electricity, water and transport infrastructure	Trade between the agriculture and primary sectors and other sectors is balanced, which means that there will be an overall increase in infrastructure demand across most sectors
Scenario 2: improved productivity of services	Growth across all services sectors means that there will be an increase in infrastructure demand across the board with transport and communications seeing the largest increases	Strong trading between service sectors and other industries means an across the board increase in infrastructure demand
Scenario 3: improved productivity of traded services with strong inter-industry connections	Growth in selected services industries has a similar impact on infrastructure demand to Scenario 2, but a heavier weighting towards communications	By design for this scenario, since the impacted services sectors are those that have strong linkages, other sectors are impacted with an increase in overall infrastructure demand
Scenario 4: slower manufacturing growth	Slower manufacturing growth means a reduction in demand mainly for electricity and roads infrastructure	Given the size of the manufacturing sector as a whole, the impacts will be modest, but will affect the demand for infrastructure across all industries
Scenario 5: improved labour productivity	Increase in infrastructure demand from the predominantly labour-intensive sectors in traded and local industries means higher demand for electricity, transport and communications	Strong connections between labour-intensive sectors and other industries means an across the board increase in infrastructure demand

Source: KPMG

Figure 9 - Industry scenarios and infrastructure implications (incremental on 2016 levels)



Source: KPMG

Understanding the differences and similarities between the infrastructure requirements of each scenario can help identify the infrastructure investments that can have the strongest impact on growth, regardless of the underlying economic, social and environmental trends. From this analysis KPMG have identified:

- Communications infrastructure will play an important role in the growth of nearly all industries and will be a catalyst in facilitating growth in services industries by supporting remote or online service provision, and virtual connectivity between businesses.
- Transport as a whole will still play an important role but with a potential shift in focus – remote and flexible working will impact on peak demand and off peak usage, land use planning will impact on the location of demand, while technology and changing consumer behavior will impact on freight movements.
- Water will be a key infrastructure focus that has the potential to significantly impact upon the growth of the agricultural industry. Demand for water is already high and with increasing pressure from climate change-related drought and flood, innovative ways to capture, store and transport water will become increasingly important.

A different view on decision-making over infrastructure investment

The implication of these alternative scenarios highlights the need to consider infrastructure investment decisions from a wider lens than what is currently used as a basis for appraisal. There is already wide agreement amongst academics and practitioners over the fact that infrastructure drives economic growth. However, decisions are often made without developing a view on the true economic value, which means that there is no effective prioritization of how much money and where it needs to go for government to achieve its strategic objectives.

Similar to Australia, many developed countries are going through a slowdown in productivity growth, unequal spatial development and demographic challenges. At the same time, much of their infrastructure is ageing, their fiscal conditions are heavily constrained and demand on their assets are increasing faster than they are able to provide the necessary levels of service. This having an impact on the relative quality of their infrastructure assets, which presents a risk for future economic development and prosperity.

With business increasingly global and the much sought-after highly skilled labour also globally mobile, the future shape of the economies of Australia and many advanced countries are at risk of underperforming. The implications for future prosperity will be stark. It is little doubt that infrastructure is only part of the equation of future growth, but nonetheless an important one.

The key linkage between infrastructure and economic performance is how infrastructure can improve productivity through higher wages and increased profit. In addition, this also results in increased tax revenues for Government without the need to increase tax rates. Given this, the right projects have the potential to pay back more to the economy through productivity gains than they actually cost.

The forthcoming strategic planning being undertaken by Infrastructure NSW, Department of Planning, Transport for NSW, Greater Sydney Commission and more broadly across the NSW government agencies is an opportunity to focus on improving the way in which infrastructure is appraised and prioritized and forging better links between infrastructure, growth and the revenues that ultimately pay for what is built.

Contents

1	Introduction	15
2	Comparative Advantage in NSW	18
3	Infrastructure and economic performance	33
4	Future projections for NSW	41
5	Industry Sector Analysis	53
6	Alternate scenarios for growth	78
	References	91

1 Introduction

1.1 Background and context

The economy of New South Wales (NSW) is the largest state economy in Australia accounting for a third of total national output. The state capital, Sydney, is the country's largest global city generating a fifth of Australian output and accounts for two-thirds of NSW's economy (Department of Industry, 2016). Meanwhile, regional NSW has abundant natural resources that are crucial for Australian wealth – over 75 percent of the country's exports are primary products (mining, minerals and agriculture).

The economic trajectory of Sydney and NSW therefore matters for the country as a whole. At the heart of NSW's prosperity is the adequate provision of infrastructure to meet increasing demand and to unlock growth in its future industries. While infrastructure is not the only facilitator and enhancer of growth and competitiveness, it is an essential factor of production.

For example, transport infrastructure enables efficient trading between firms, allows workers to access job opportunities and facilitates leisure trips. On its own, transport is not sufficient for growth since many other factors impact on the economy of regions and countries. People and their characteristics, such as skills and experience, as well as the overall economic and investment environments, also matter. But infrastructure is a necessary input into the functioning of an economy and to the spatial distribution of economic activity.

The landmark Eddington Transport Study in the UK in 2006 (Eddington, 2006) set out the channels through which transport impacts on a country's economy. To start with, transport can impact total output, measured as Gross Domestic Product (GDP), by:

- Affecting the number of inputs that are used in production, such as increasing employment through allowing access to labour and/or facilitating the creation of new firms; and
- Improving the efficiency with which firms use inputs and hence impacting on their productivity, such as through reducing journey times and costs, and facilitating labour mobility.

The study points out that these factors can result in a one-off increase in the level of productivity or a sustained effect on productivity growth. The way that transport affects productivity growth is by stimulating innovation through agglomeration economies, trade and foreign direct investment.

Second, transport can help support structural change in an economy. This is through the way an effective transport system can help an economy respond better to structural change, such as through allowing workers to access jobs in growing industries.

Finally, transport can impact on quality of life through broadening consumption activities, such as through opening new leisure opportunities and creating lifestyle options (for example, in terms of residential location choices). Transport also impacts on the quality of life and wider well-being of society by reducing negative environmental impacts, reducing wasted travel time, and increasing leisure time. These types of impacts manifest themselves in improving the overall welfare of society.

The provision of other infrastructure also matters. The importance of mining and agriculture to the Australian economy means that energy and water infrastructure are also crucial to the efficiency and competitiveness of the relevant sectors.

1.2 Scope of this report

In this context, Infrastructure NSW is in the process of developing the 2017 State Infrastructure Strategy (SIS). The previous SIS, released in 2014 made 30 investment recommendations to Government on the next round of critical infrastructure for NSW. The recommendations were for infrastructure projects and programs valued at \$25 billion. These priorities are targeted to reduce congestion, support population growth and stimulate productivity across Sydney and regional NSW.

The development of the 2017 SIS is being undertaken alongside the refresh of *A Plan for Growing Sydney* now called the *Metropolitan Plan*, the refresh of the *Long Term Transport Master Plan* to be called *Future Transport*, being completed by the Department of Planning and Transport for NSW respectively, as well as the work of the Greater Sydney Commission on district plans for Metropolitan Sydney.

A fundamental component of future spatial and infrastructure planning is projected population and economic trends. The NSW government has produced a base case for the future economic and industrial performance of the state. The base case projections for the NSW economy are built on the basis of a range of assumptions about population growth, technical change, changes in preferences, required rates of return and growth in foreign markets, and NSW's Common Planning Assumptions for long term strategic planning.

However, historic economic trends in advanced countries show how major global trends could impact on the structures of these economies. Examples include globalization, rapid technological advances, the decline in traditional manufacturing industries, urbanization and the increasing role of cities, climate change and competition from emerging countries. Given the long planning horizon, it makes sense to investigate scenarios that could impact on the future evolution of the economic structure of Australia and NSW.

Future infrastructure investment decisions will influence the competitiveness of industries in Australia and NSW, and also on the scale and type of infrastructure demand. As discussed earlier, infrastructure is both an enabler and essential input into the functioning of other sectors, impacting on their competitiveness and efficiency, costs of production and productivity. Network infrastructure, such as transport and water, also impacts on the spatial distribution of economic activity.

While planning is often clouded with uncertainties, it is still an essential policy tool since investment decisions will take time to design, build and eventually operate. The trick is how to get the best investment mix with what we can reasonably expect will happen with what we know today, and how flexible we can be to changes that we cannot realistically anticipate. It is about understanding our existing asset base, how we can utilise it best so that we understand what kind of additional investments we need to help achieve our objectives.

The purpose of this project is to support Infrastructure NSW with some of these uncertainties as it prepares for the 2017 SIS refresh and the core scope of work involves analysing industries in NSW and how these industries fair nationally and globally to understand:

- Industrial comparative advantage in NSW so that we can better understand the types of sectors that are better placed to grow in the future;
- Future industry trends and how these may impact on competitiveness so that we can understand what types of policies that can sustain growth or enhance future growth potential;
- How future NSW could look like at a macro level and spatially in light of these trends, consistent with the NSW common planning assumptions and the NSW Intergenerational Report; and
- Implications for infrastructure demand and how investment can help enable growth in certain industries. In particular, opportunities for infrastructure investments to support, grow and develop NSW's comparative advantages.

This will provide a greater understanding of the size and nature of infrastructure demand by different industry sectors, and the potential policy, regulatory and investment options that could meet those demands. The project will also support more detailed economic analysis of the impacts of the infrastructure options to be consideration under the 2017 SIS.

1.3 Wider NSW government context

In undertaking this work, it is important to note the comprehensive programs of work that are being undertaken across the various NSW government agencies, notably:

- The Department for Industry's work on (i) regional economic opportunities and infrastructure priorities, (ii) regional economic growth enablers, and (iii) aspirations for Western Sydney;
- Jobs for New South Wales's work on jobs for the future;
- NSW Treasury's work on intergenerational report and NSW in 2056; and
- The Greater Sydney Commission's work on the draft district plans for the six districts that make up Metropolitan Sydney.

The extensive body of evidence that underpins this work provides a strong base for undertaking this project. The project incorporated existing job forecasts for NSW by LGA as agreed with NSW Department of Industry and adopted by the Common Planning Assumptions group, and where relevant additional academic and industry literature.

It is important to be clear that the intention of this project is to focus, at a high level, on what industry growth scenarios mean for infrastructure demand and hence provide a basis for the type of investments that may be needed in the future to both unlock growth in NSW and to ensure that growth is not held back by infrastructure constraints. It is also intended to provide a basis for Infrastructure NSW to consider which types of investments are likely to provide stronger economic, social and environmental returns to the state as it seeks to prioritise future interventions.

However, while the analysis in this report has been based on the latest available forecasts from the NSW Government, these forecasts are likely to be subject to further revision and scrutiny and as such are subject to change. In addition, the gross value added forecasts are intended to demonstrate the potential high level growth scenarios that may arise when different industry risks and opportunities are taken into consideration and should be treated as indicative only.

The key outputs of the work are:

- Identifying the competitive industries landscape in NSW and understanding how it may evolve in the future;
- A description of how infrastructure demand will change as a result of industrial changes in the alternative scenarios; and
- The alternative industry profile scenarios will be modelled to assess the changes in variables such as GSP, wealth and employment.

1.4 Structure of this report

Against this backdrop, this report is structured as follows:

- First, we consider the historic trends, industries with current comparative advantage in NSW and industries that could have a comparative advantage in the future.
- Second we look at the linkages between infrastructure and economic growth
- Third, we look at the future base case projections for NSW for both employment and gross value and the resulting impact on industry growth across NSW;
- Fourth, we consider future industry scenarios that may support and develop comparatively advantaged industries, how this can impact on the base case and look at how NSW compares nationally and globally.; and
- Fifth, we look at the impact that the varying future industry scenarios can have on the base case projections and consider the implications on infrastructure demand, taking account of NSW and spatial implications across its geography.

2 Comparative Advantage in NSW

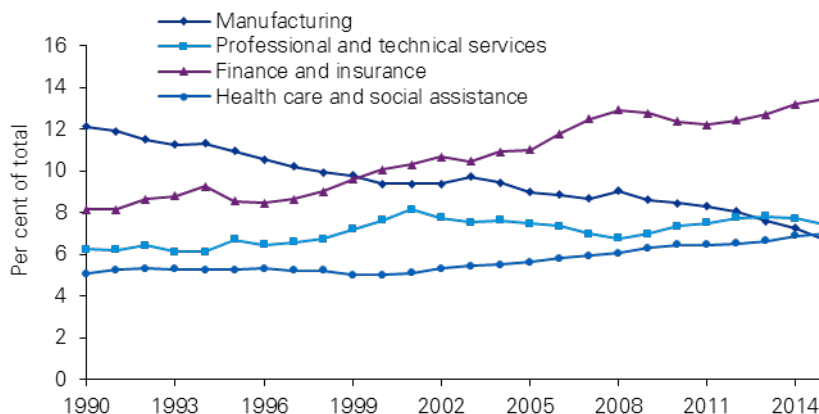
2.1 Historic trends in NSW

NSW has changed significantly over the past 20 to 25 years. As its population has grown, NSW has also shifted spatially, becoming increasingly urbanised. Almost a third of Australian population growth over the last 25 years has been in NSW, with an additional 1.7 million people calling NSW home by 2015. More than 70 percent of this growth has occurred within Sydney, echoing a trend which is occurring internationally. Australia is more urbanised than the OECD average², with 9 out of 10 residents living in urban areas.

This trend, coupled with an increasing participation rate (Jobs for NSW, 2016) has significant implications for industry employment. For example, industries that would have historically had high employment shares (such as agriculture), are not able to locate in cities where the land is scarce. Meanwhile, industries that are services based, and characteristically cluster together in cities, have thrived from urbanisation.

The employment structure has therefore changed as a result of these trends (see Figure 10), becoming more diverse as the knowledge intensive services sector has grown and land intensive industries such as agriculture, mining and manufacturing have decreased their share of employment and economic output (Reserve Bank of Australia, 2010).

Figure 10 - Employment structure, share of total employment, 1990 to 2015



Source: ABS, 2014-15

Over the same period, NSW has experienced a 1.2 million increase in employment, with professional, scientific and technical services and health care and social assistance making up a fifth of this growth respectively. Over the 20 years from 1996, knowledge intensive industries have been a primary driver of GVA growth, with the Sydney CBD alone contributing close to 20 percent of NSW's \$192 billion GVA growth, over half of which is from the finance and professional services alone.

² OECD average is 8 out of 10 people live in urbanised areas, data for NSW was sourced from the 2011 Census.

However, not all of Australia has undergone as substantial structural change as NSW. While growth in GVA in NSW has been driven predominately by services, construction and mining were still key drivers of GVA growth for Australia as a whole.

In Sydney, the growth in knowledge-intensive services has not been shared equally across the city. Western Sydney, while growing in population, has not seen the same growth in tradable employment as Eastern Sydney. The key traded industry in Western Sydney continues to be manufacturing. As outlined in Department of Industry's *Aspiration for Western Sydney*, the region has a lower concentration of high value jobs and residents experience a high cost of commuting long distances. As traditional manufacturing continues to decline in its contribution to the economy, it will be important to encourage similar structural change in Western Sydney as elsewhere in Greater Sydney.

Globalisation and the growth of Asia has impacted heavily on industry change in NSW and more broadly for Australia. Services growth has arisen from Australia's need to specialise and leverage off the country's advantages, such as our highly educated workforce.

Resource-based industries like agriculture and mining, where natural endowments give Australia an advantage, have still played a key role in NSW's prosperity. These two industries are key drivers of the regional NSW's economy, particularly as historically strong industries such as the manufacture of machinery, clothing and footwear have declined, driven by the rise of more competitive manufacturing countries such as China.

The Department of Industry reached similar findings in their *Regional Economic Growth Enablers* pilot and the subsequent research on *Regional Economic Opportunities and Infrastructure Prioritisation*. In terms of specific industries, agriculture and mining are key employers for all regional centres with the exception of the Central Coast, North Coast and the Illawarra, which had strong employment in health, accommodation and in the case of the Illawarra, manufacturing.

While the growth of Asia countries has correlated with the decline of manufacturing in Western economies including Australia, demand from Asia particularly for agriculture and mining products, has played a key role in strengthening the NSW economy. The strong demand for NSW coal and the relative high productivity of the industry means that key mining regions, such as the Hunter, produce a large share of the state's GVA, second only to service-industry intensive Sydney. It must be noted, however, that Sydney's economy contributes some two-thirds of NSW GVA despite only accounting for 1.5 percent of the state's land area (see Table 3).

Table 3 - Gross value added (GVA) by region in NSW

Region	Industry Gross Value Added	Per cent of total
Sydney - Other	122,914	31.0
Sydney - City and Inner South	78,795	19.7
Sydney - North Sydney and Hornsby	27,701	6.9
Sydney - Parramatta	26,626	6.7
Newcastle and Lake Macquarie	19,709	4.9
Hunter Valley exc Newcastle	16,302	4.1
Illawarra	12,855	3.2
Central West	12,679	3.2
Central Coast	11,552	2.9
Richmond - Tweed	10,002	2.5
New England and North West	9,677	2.4
Capital Region	9,266	2.3
Riverina	8,405	2.1
Mid North Coast	8,067	2.0
Far West and Orana	6,836	1.7
Murray	6,232	1.6
Coffs Harbour - Grafton	5,926	1.5
Southern Highlands and Shoalhaven	5,755	1.4

Sources: ABS, Census 2011, Input-Output data 2013-14, KPMG.

These historical industry trends are important, not just to see the way in which NSW has developed as a state, but also to see where it is headed in the future. Continuing urbanisation and the development of Asia, will continue to play a key role in how the NSW economy grows in the future. Trends that have been observed now, such as the growth of knowledge intensive services are likely to continue, albeit with spatial implications. New trends in technology may change the structure of employment, but Australia's competitiveness in terms of land and other natural endowments will also mean that agriculture and mining will continue to be a key part of regional NSW's economy.

Key to understanding how these trends may impact on the NSW economy is painting a picture of the industrial comparative advantages in the state.

2.2 What is comparative advantage?

At this point, it is important to explain what we mean by comparative advantage and how this relates to other widely used terms, such as absolute advantage. The latter simply refers to a nation or region's superior ability to produce goods or services. A good illustration of this concept is food production which can be linked to certain geographic and climatic factors. A country which is naturally endowed with these factors can produce food more efficiently than other countries which simply have no similar attributes. Such a country therefore has an absolute advantage in food production. This is applicable to many parts of Australia or NSW, hence the large share of agricultural products in the country's exports. A similar analogy can be applied to mining products.

Meanwhile, comparative advantage is more complex in that it refers to the ability to produce goods and services that present the lowest opportunity cost versus other production options. With limited resources, a country or a region has a comparative advantage in the production of goods and services that have the lower opportunity cost. In this context, this means that it may well have an absolute advantage in all goods and services but will generate the highest return by producing those goods and services that have the lowest opportunity cost.

Again this is best demonstrated by a simple example so if a country can produce either cars or planes but not both, given limited resources. Country A can produce 10 cars or 5 planes, which means the opportunity cost of producing a car is 0.5 unit of a plane (5/10). The opportunity cost of each unit of car is 2 (10/5). Meanwhile, country B can produce 20 cars and 12 planes, which means it has an absolute advantage in both goods since it can produce more of both. However, the opportunity cost of producing a plane is 0.6 (12/20) and of a car is 1.7 (20/12) then it has a comparative advantage in car production where it has a lower opportunity cost than country A. It would then make sense that country A should specialise in planes and country B in cars.

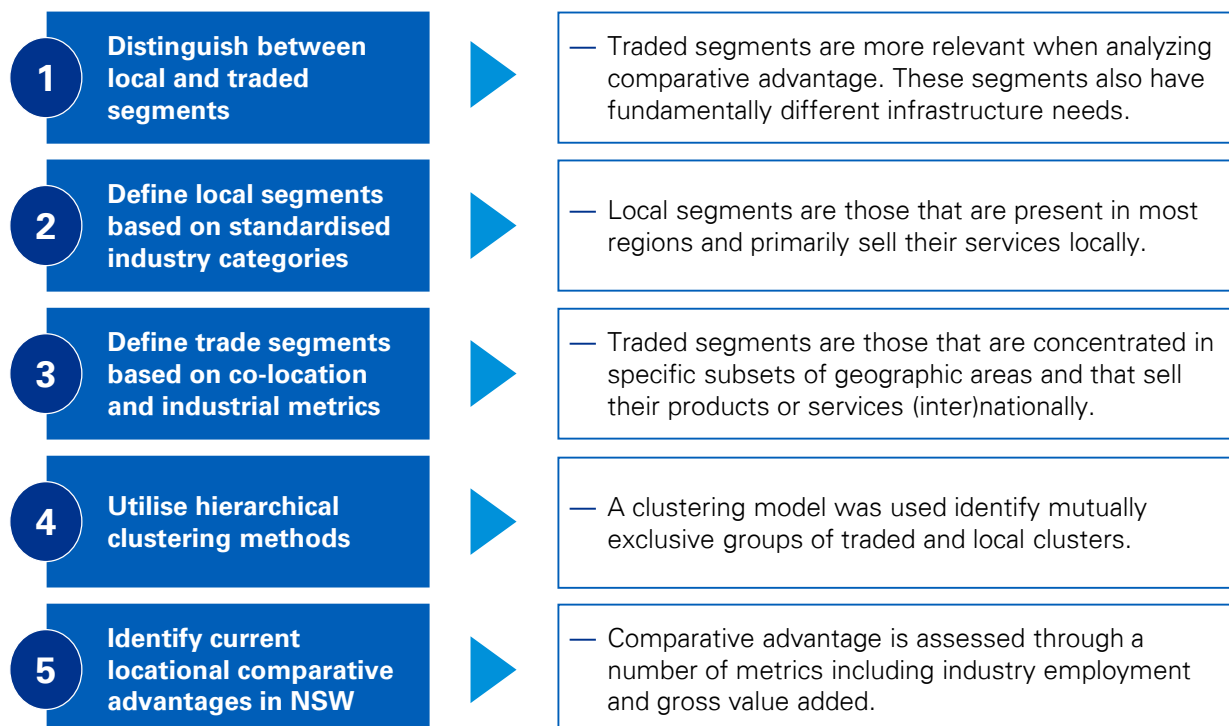
The logic can apply to regions and specific locations which can develop comparative advantages in specific industries. A good example of spatial comparative advantage is the concentration of knowledge-intensive finance and professional services in the central business districts of major cities. One of the key inputs to the production of these types of services is the access to a highly skilled labour force which is more likely to live close to or be able to access jobs in city centres given more extensive transport networks.

The other factors that attract business and highly-skilled workers to these types of locations is also the availability of high quality commercial space, proximity to other businesses (customers and competitors), the ability to access a wide skilled labour pool for business and high paying jobs for workers (who are driven by cost of living such as cost of housing and rate of taxation), and the innovation spill-overs that come from these types of economic agglomerations. This is similar to the Business Council of Australia definition of competitiveness, which focusses on favourable regional market share, labour productivity and input costs at a sector level relative to other regions.

2.3 Measuring regional and locational comparative advantage

The complexity of economic interactions, especially at the regional or local levels, mean that determining industrial comparative advantage is a difficult task. It is made more complicated by the quality of data collected at small geographies. However, it is possible to build a picture using a number of different approaches. For the purpose of this report, we have adopted an approach that follows ongoing work in the US economy. This is set out in Figure 11 below.

Figure 11 - Overview of approach to identifying locational comparative advantage



The approach is effectively split in three parts. The first is concerned with classifying industries into local and traded sectors. Local industries are those that are present in most regions and primarily sell their

services locally. Examples include local health services and dry cleaners. Traded industries, on the other hand, are those that are concentrated in specific subsets of geographic areas and that sell their products or services nationally and internationally. Examples of traded industries include mining and professional services.

Traded sectors form the competitive base of regional economies and are more relevant than local sectors when considering comparative advantage. This reflects the fact that regions are often in direct competition for traded segments and that these industries in certain cases (such as finance and professional services) may have some degree of choice over their physical location. This is of course not the case for resource-based traded sectors that are constrained by the location of these natural resources.

Based on the work by Harvard University and the US Bureau of Economic Analysis, we use three rules were used to gauge whether an industry was a member of the traded or local segment:

- The percent of regions with very little employment (0-10 employees) in that industry is 50 percent or more;
- The share of Australian industry employment in the top 10 percent of regions by employment-based Location Quotient (LQ) is 25 percent or greater; and
- The difference between LQ at the 90th percentile and Location Quotient (LQ) at the median over all regions is 1.5 or greater.

The approach we used was limited by the availability of input-output data at a granular sector level since this data will be used for breaking down the traded sector into industrial clusters and in the analysis of infrastructure implications. The input-output data, published by the Australian Bureau of Statistics (ABS) is available for 115 industry sectors. In contrast, the work carried out in the US covers many more sectors. While this provides limitations in terms of the accuracy of the local and traded splits, it still provides a useful contrast between these sectors.

Table 4 - Local vs traded industries in NSW and Sydney

	New South Wales		Sydney	
	Traded	Local	Traded	Local
Employment	39	61	42	58
Gross Value Added	54	46	56	44

Source: KPMG

Similar to the US data, the analysis we carried out for Australia show that local sectors account for a larger share of employment and traded sectors contribute more to economic output (see contrast between these sectors in Table 4). The analysis from the US shows a local/traded split of 64 percent and 36 percent respectively, but both sectors contribute equally to economic output.

Compared to other regions in Australia, Central Business Districts (CBD) typically have a higher proportion of traded industries to local industries. This is reflective of the high proportion of finance and professional services and other traded services clusters. Sydney CBD has the highest concentration of traded employment and output of the different regions (see Figure 12).

Figure 12 - Local vs traded industries across Australia



Source: KPMG

This methodology uses similar methodologies to those engaged by Department of Industry for their *Regional Economic Opportunities and Infrastructure Prioritisation*, which uses an adjusted LQ and historical growth to determine industry strengths. However, for this analysis LQ is predominately used to assist in classifying industries into clusters more aligned with industry trading patterns.

2.4 Identifying industry clusters

The next step in the approach is to identify the industry clusters within the local and traded segments. A cluster is effectively a regional concentration of related industries in a particular location. Recent academic literature has shown that clusters exist in all types of economies and are more prevalent in locations that achieve better performance relative to their overall stage of development. They play a fundamental role in driving regional economic competitiveness by encouraging higher rates of job growth, wage growth, new business formation, and innovation in the regions where they are located.

It is useful to view economies through the lens of clusters rather than specific types of companies, industries, or sectors because clusters capture the important linkages and potential spillovers of technology, skills, and information that cut across firms and industries.

In order to standardize clusters and allow for useful comparisons of clusters across regions, a set of benchmark cluster definitions (or cluster categories) were identified for both local and traded segments based on:

- Co-location of industry employment;
- Co-location of industry establishments;
- Input-output links; and
- Occupational correlation.

The methodology uses the four grouping approaches identified above to determine which one explains relatedness between industries better, and then determines which one provides the clearest similarity between industries to identify the clusters. The results of the analysis are shown in Figure 13 and Figure 14 below which illustrate the clusters defined for the Australian economy and a selection of the industries that fall within those clusters.

Figure 13 - Traded clusters

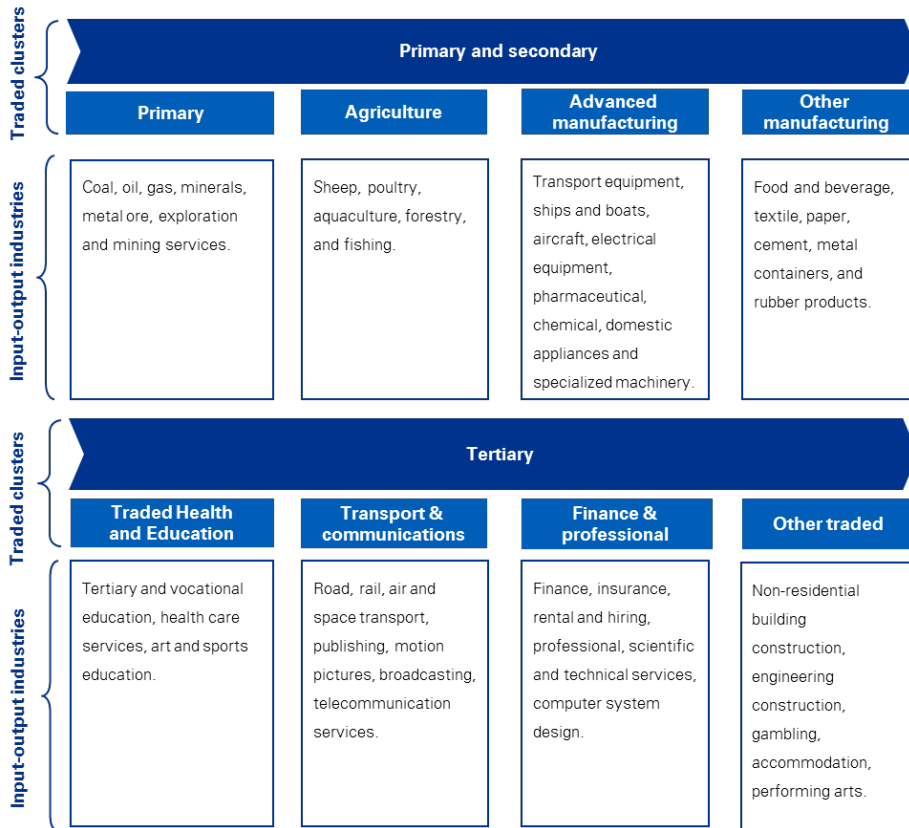
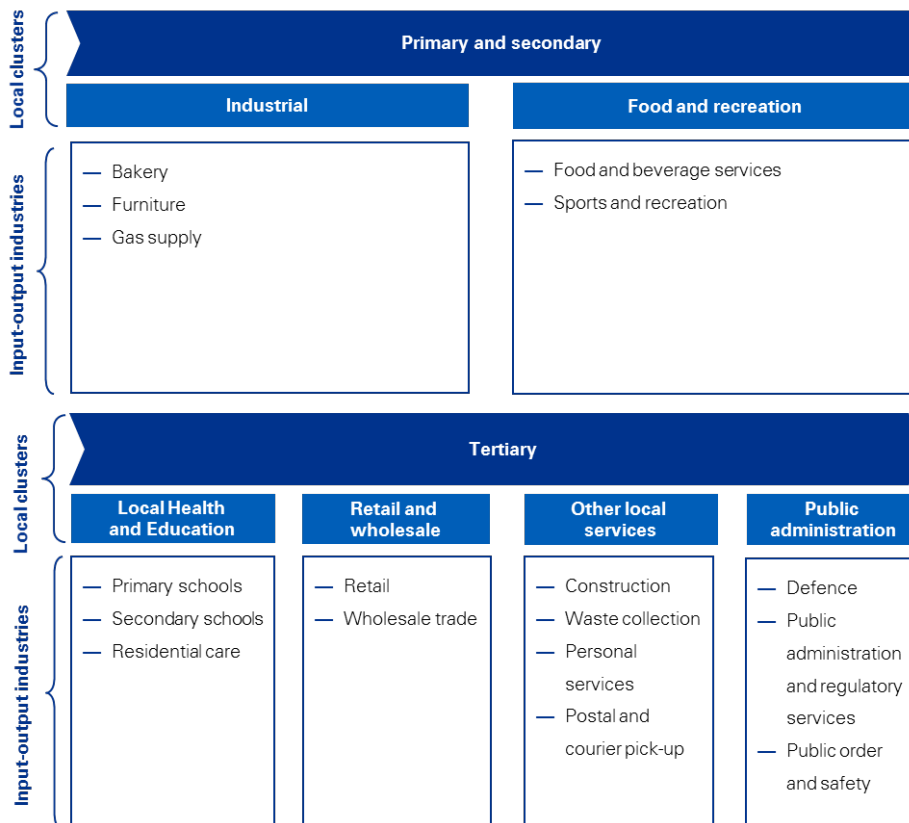


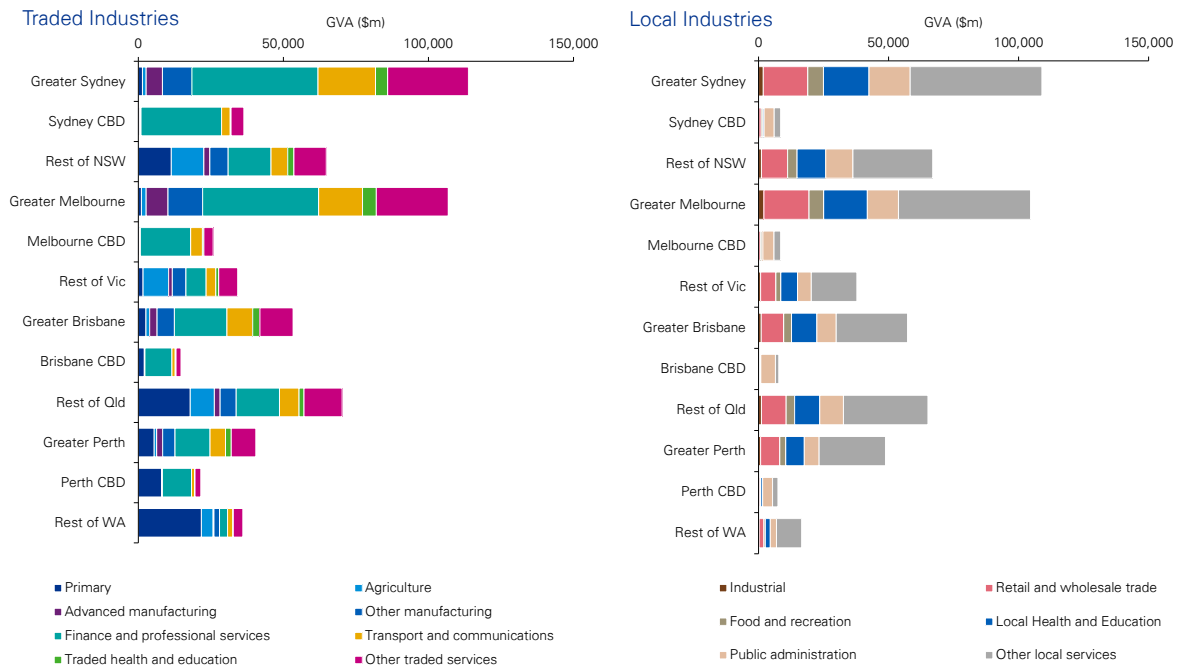
Figure 14 - Local clusters



The results of this analysis are shown in Figure 15 which breaks down the distribution of output (measured as GVA) by selected spatial location. This shows the concentration of certain traded

industries, such as finance and professional services in cities and specifically their CBDs. Meanwhile, the distribution of output by cluster is more dispersed outside of cities.

Figure 15 - Contribution to GVA by cluster



Source: KPMG

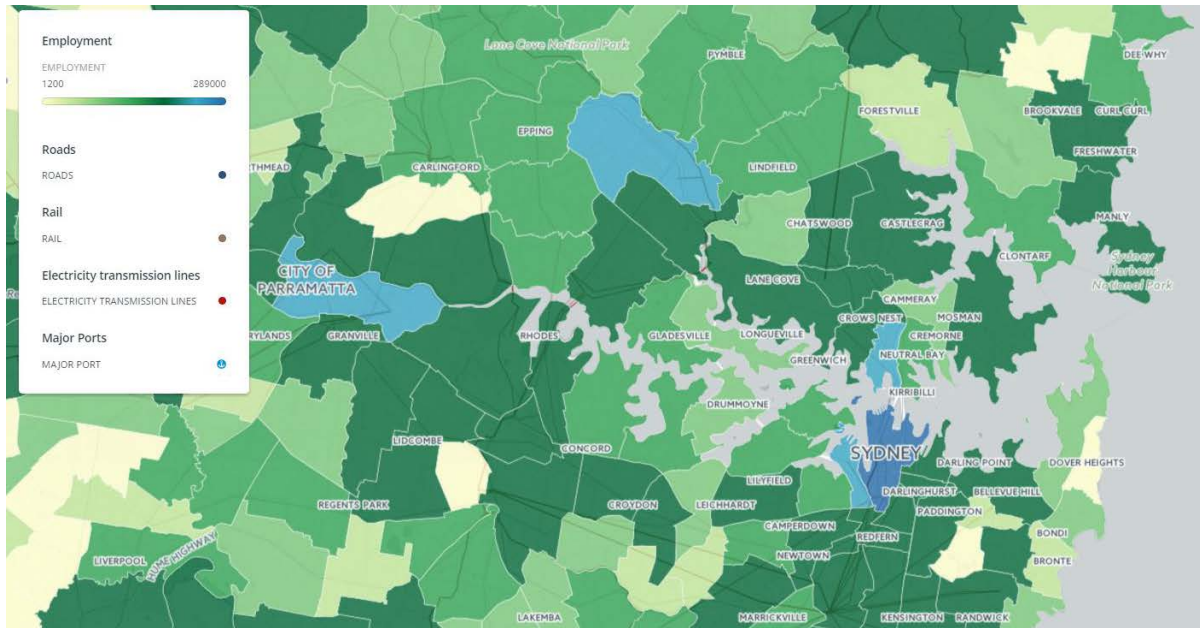
2.5 NSW Industries with a comparative advantage

NSW has a number of industries with a comparative advantage, and these differ regionally depending on factors such as natural endowment, population and distribution of skills across the state. Comparative advantage has been determined through the comparison of a number of factors including location and proximity of industries, size of employment in these industries and Gross Value Added produced by these industries.

There are four key traded employment clusters that NSW has a comparative advantage in: Finance and Professional Services, Agriculture, Primary and Other Traded Services (particularly tourism).

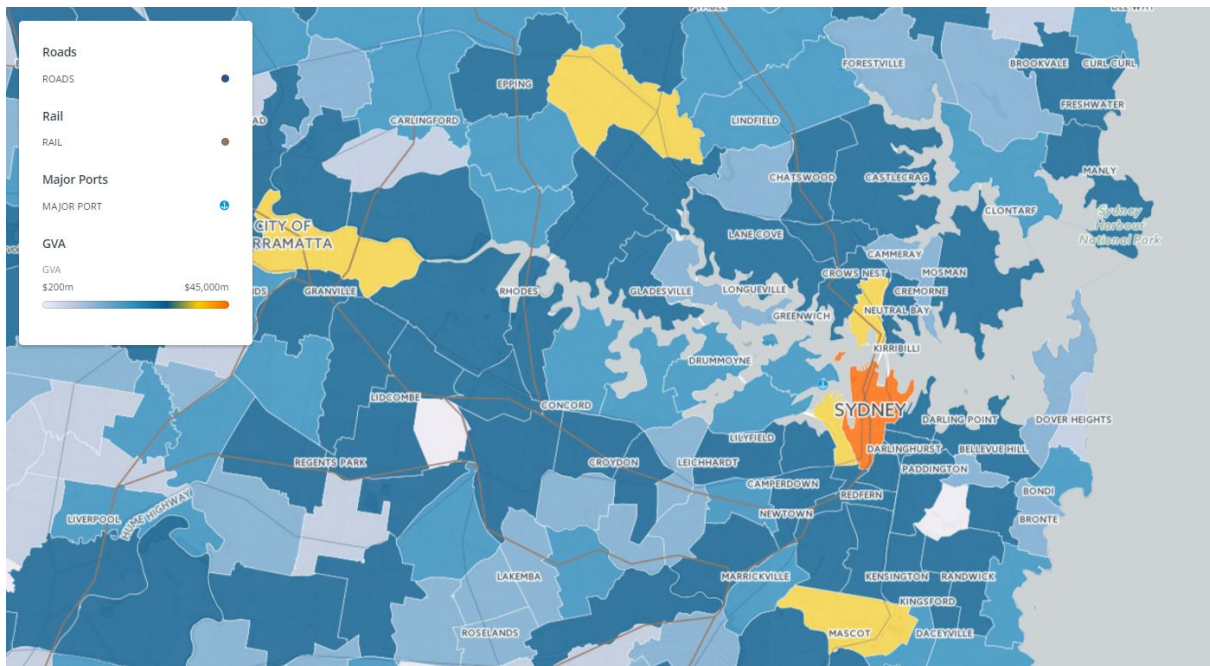
The Finance and Professional Services cluster is the key employer and generator of Gross Value Added (GVA) in NSW, with a large proportion of this employment in major Sydney centres such as the CBD, North Sydney, Macquarie Park and Parramatta as demonstrated in Figure 16 and Figure 17.

Figure 16 - Concentration of employment by SA2 region (2011 figures)



Source: ABS, KPMG

Figure 17 - Gross Value Added output by SA2 region (2016 figures)



Source: KPMG

NSW has been a driver of growth for this Industry cluster. Between 1996 and 2016, Australian employment in the cluster grew by 80 percent, with NSW accounting for half of this growth. Over the same period, GVA growth in this industry is larger than employment growth, reflecting productivity growth in the cluster. GVA in Finance and Professional Services grew by 134 percent in Australia, with NSW accounting for 40 percent (see Table 5 and Table 6).

Table 5 - NSW historical employment growth by industry

	Employment 1996 ('000)	Employment 2016 ('000)	Growth 1996- 2016
Traded Industries			
Agriculture	122	71	-42%
Primary	28	39	42%
Advanced manufacturing	84	83	0%
Other manufacturing	210	136	-35%
Finance and professional services	339	632	86%
Transport and communications	152	196	29%
Traded health and education	69	95	38%
Other traded services	179	210	17%
Local Industries			
Industrial	44	46	3%
Food and Recreation	187	333	78%
Retail and Wholesale Trade	381	457	20%
Public Administration	145	221	52%
Other local services	475	651	37%
Local Health and Education	357	629	76%

Source: ABS, KPMG

Table 6 - NSW historical GVA growth by industry

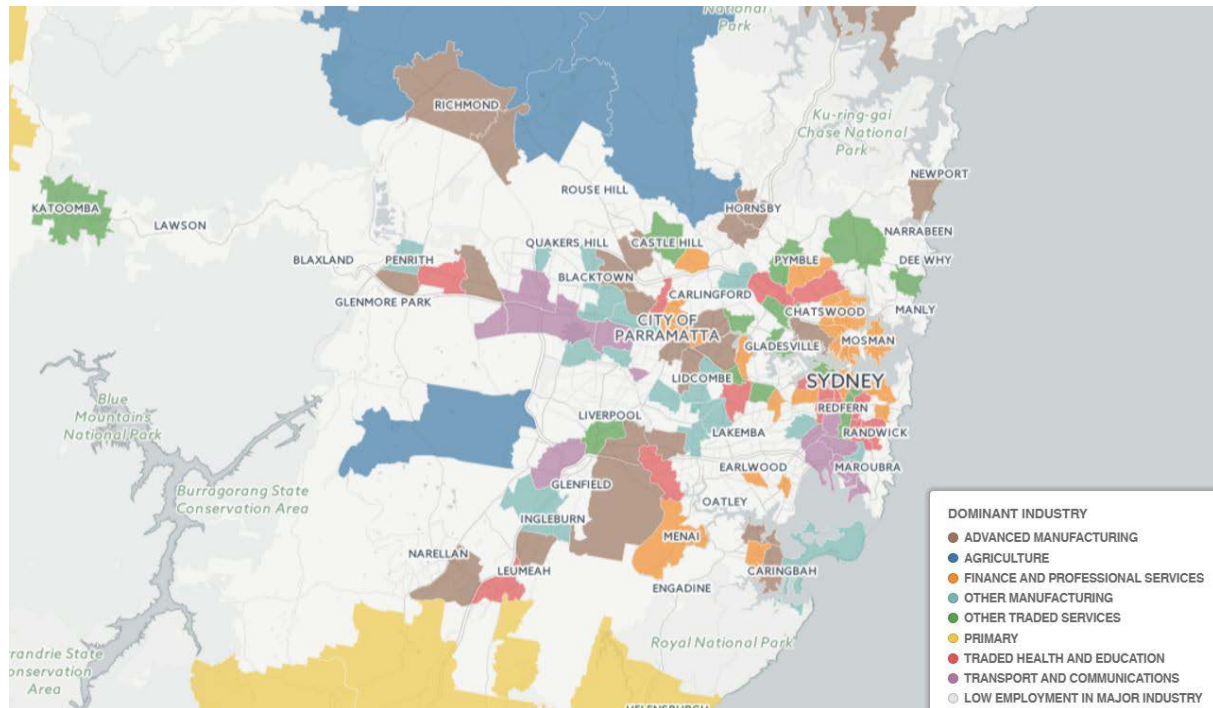
	GVA 1996 (\$M)	GVA 2016 (\$M)	Growth 2016-2036
Traded Industries			
Agriculture	4,467	6,329	42%
Primary	5,246	10,062	92%
Advanced manufacturing	9,009	8,818	-2%
Other manufacturing	19,993	19,569	-2%
Finance and professional services	55,153	118,969	116%
Transport and communications	20,587	39,162	90%
Traded health and education	14,864	28,107	89%
Other traded services	24,399	33,778	38%
Local Industries			
Industrial	3,196	3,160	-1%
Food and Recreation	10,357	15,810	53%
Retail and Wholesale Trade	27,803	46,111	66%
Public Administration	27,725	41,901	51%
Other local services	68,204	103,155	51%
Local Health and Education	6,596	14,464	119%

This industry is supported by strong education levels and supported by the stable macroeconomic and regulatory environment that saw Sydney move from a ranking of 16 in the Global Financial Centres Index in 2008 to 11 in 2009 (Z/Yen, 2008 and 2009). While NSW currently has a comparative advantage in this industry, maintaining a reasonable cost of doing business, including the cost of office accommodation, remaining attractive to foot-loose and highly-skilled international labour, and the effectiveness of infrastructure across a number of sectors will be important to maintaining this competitiveness.

The other key industry strength for Sydney and NSW more broadly is in other traded services. This is predominately driven by tourism in regions such as Sydney city, Katoomba and the Northern Beaches driven by attractions such as the Sydney Opera House, Sydney Harbour Bridge, Sydney's beaches and the Blue Mountains.

NSW represents 32 percent of the Australia's total employment growth in this industry over the past 20 years, and tourism contributed a total of \$27.9 billion to the NSW economy in 2013–14, representing nearly one-third of tourism's direct contribution to Australia's gross domestic product. Cultural institutions in Sydney such as the State Library of NSW, and the Art Gallery of NSW, also play a major role in stimulating tourism, attracting the majority of Australia's total international arts and cultural visitors (61 percent of the total). Major industry clusters in Sydney are shown in Figure 17.

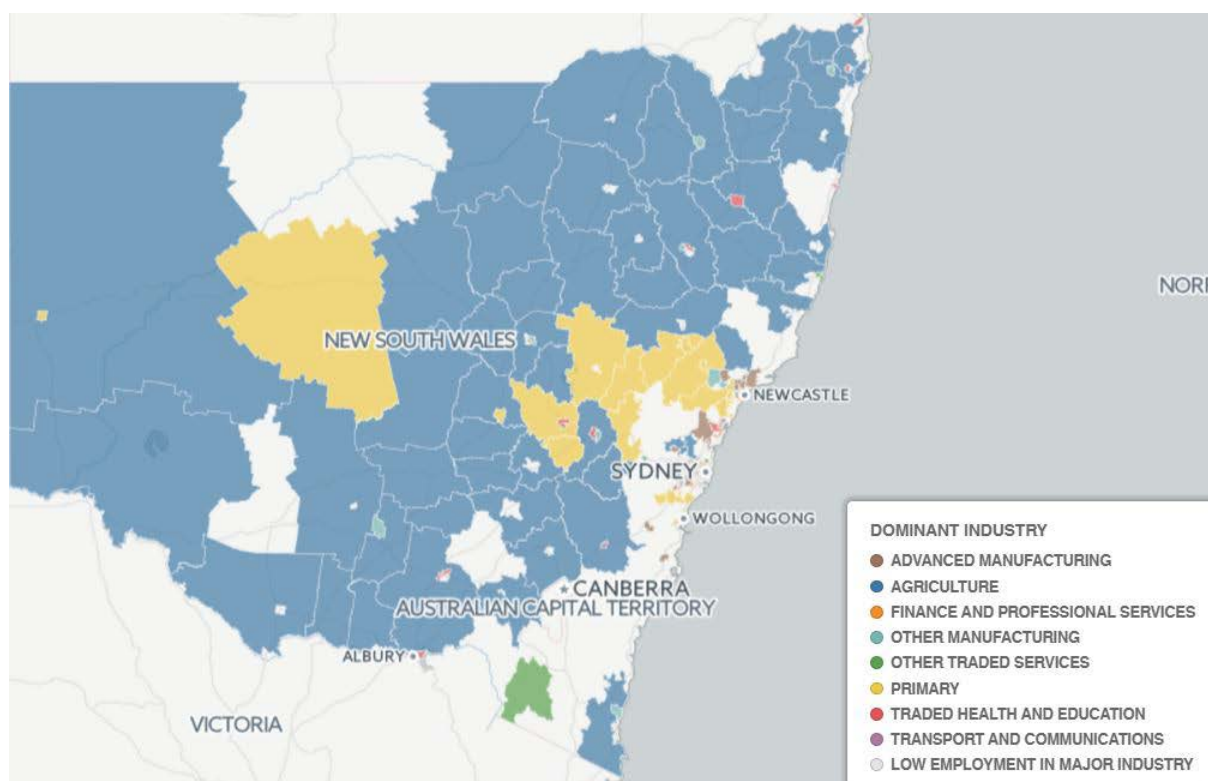
Figure 18 - Major industry clusters by region across Sydney (Location Quotient)



Source: KPMG

NSW also have comparative advantages in the commodity focussed industry clusters of Primary and Agriculture. As demonstrated in Figure 19, these are extremely important traded industries for regional NSW. The drivers for NSW's advantage in these two industries are the same; NSW's rich endowment in prime agricultural land and coal deposits and strong demand for exports of these good, particularly to Asian markets.

Figure 19 - Major industry clusters by regions across NSW (Location Quotient)



Source: KPMG

The Primary industry cluster is particularly focussed in the Hunter Valley, which is home to one of the largest coal export ports in the world (Port Authority of NSW, 2017), with some comparative advantage in Primary industries in the Central West region. Growth in the Primary industry over the past 20 years has been strong in NSW with a 42 percent increase in employment and a 92 percent increase in GVA output. After Finance and Professional Services and Local Health and Education, the Primary cluster has experienced one of the highest growth rates in GVA in NSW. Strong demand from Asian markets, such as Japan and China, and productivity improvements from technology are expected to help maintain NSW's comparative advantage.

Agricultural production is more widely spread across NSW than the Primary cluster. Notable regions for agriculture include New England and the North West, and the Far West and Orana and food, in particular beef and meat, are key exports. While employment has declined Australia wide over the past 20 years, GVA has grown by 62 percent, with NSW growing by 42 percent over the same period. Australia's agricultural products such as beef have a strong reputation in Asian markets due to best practice management measures adhered to throughout the production process (Meat and Livestock Australia, 2016).

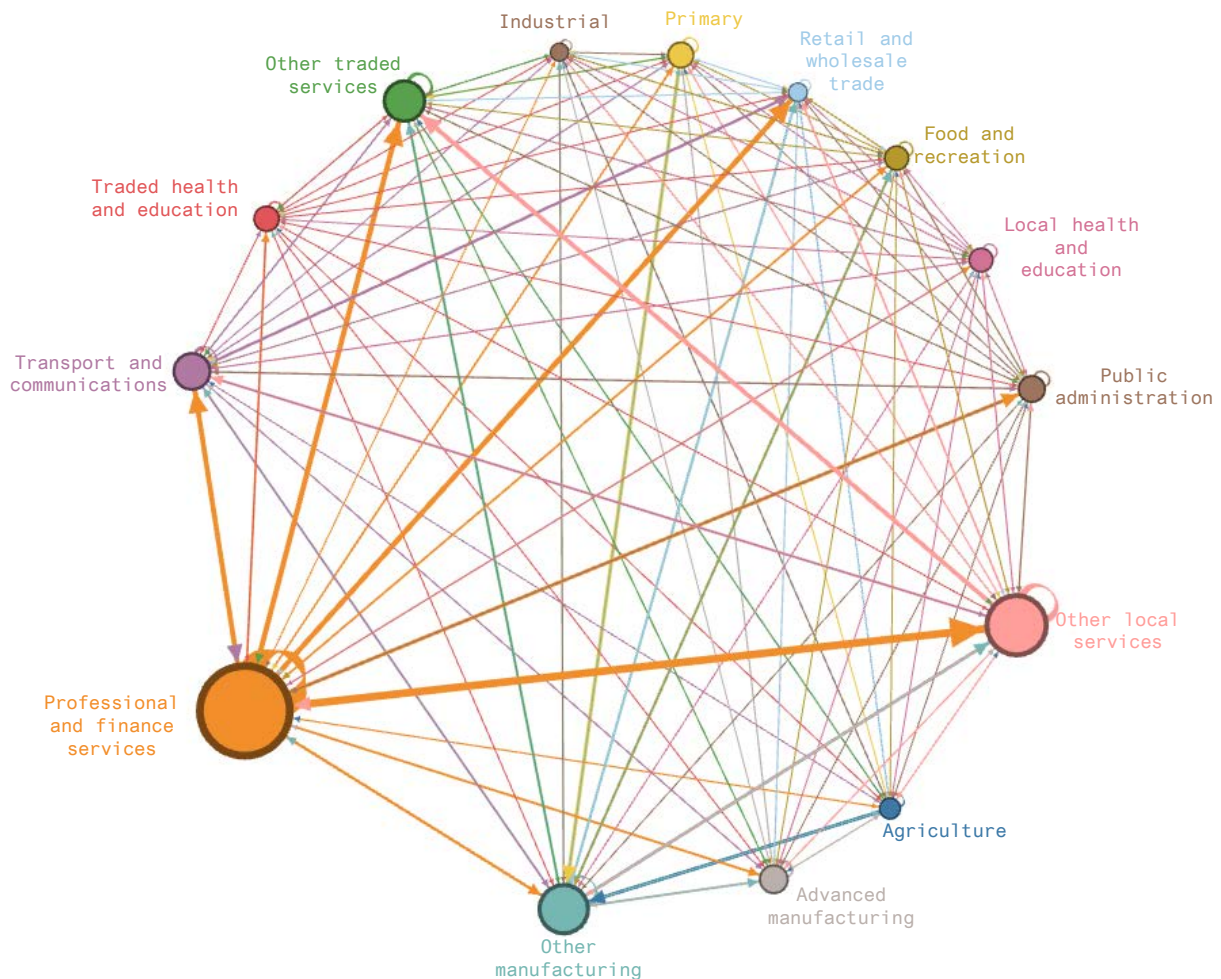
The importance of the spatial distribution of these comparatively advantaged industries is how they support strong local industry clusters across NSW. Local industry clusters are shaped by population, demographics and income of the communities and strength of businesses they serve and include Retail Trade, Food and Recreation and Local Health and Education.

Local industry growth has been strong over the past 20 years. In NSW, employment in Food and Recreation, as well as Local Health and Education, has increased by 78 and 76 percent respectively. NSW is a dominant contributor to local industry growth in Australia, in both employment and GVA, local industries have contributed approximately 20-30 percent of national growth (depending on the industry cluster and with the exception of the local Industrial cluster which has not performed as strongly).

2.6 Industry linkages and interactions

Of relevance to this work is how these industry clusters interact and trade with one another. This has implications to both the future trajectory of industrial growth in NSW and to the economic returns that can be generated from infrastructure investments. In terms of industrial growth, the key point is that industries don't exist independently of one another, but rather, they trade with each other so that the existence of one industry creates demand for another. Figure 20 shows the demand between the clusters in NSW using input-output tables constructed by KPMG Economics from National I-O tables prepared by the ABS – the size of the bubble represents the cluster's GVA and the thickness of the line represents the size of trade between clusters.

Figure 20 - Intermediate demand between industry clusters



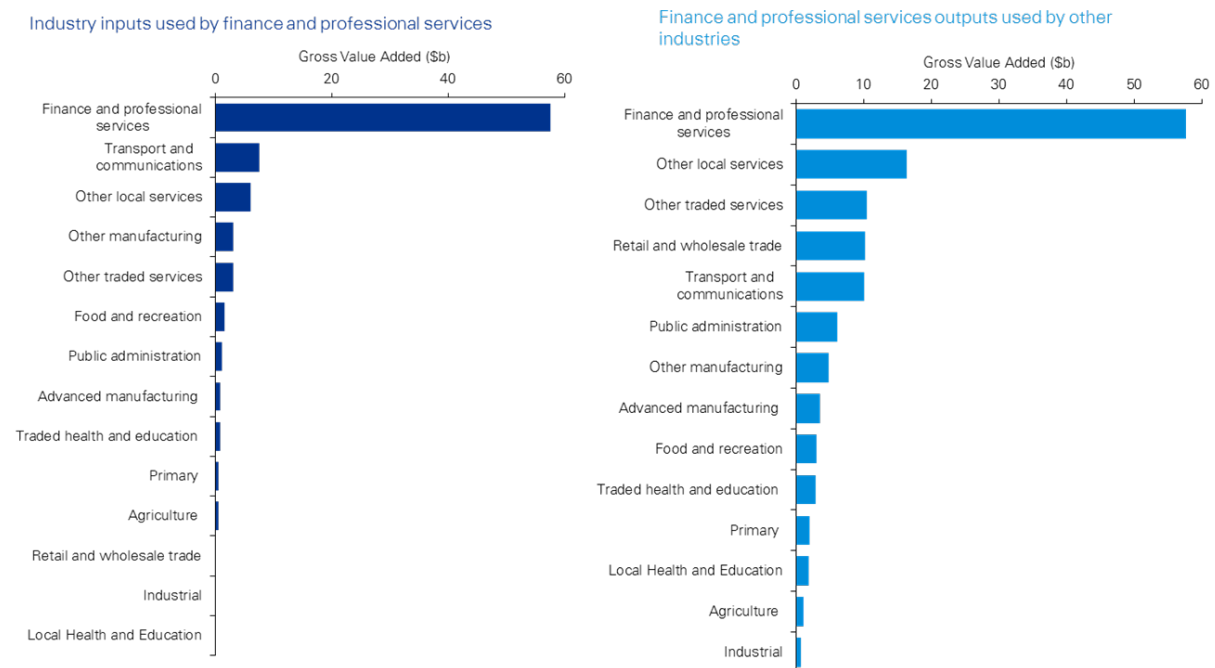
Source: KPMG, ABS

In the context of infrastructure investment, understanding trade linkages between industrial clusters helps in determining the economic impact of linking certain locations where these clusters tend to concentrate. This is particularly important for transport infrastructure which can help enhance productivity by better connecting businesses to their customers and suppliers. In terms of services, strong communications networks that can facilitate alternatives to face-to-face interaction such as video conferencing are also essential. To achieve this, the industries that are being connected have to be already trading with one another and/or are likely to given their industrial demand profile.

These trade connections are also essential to understanding how industries may grow and change into the future. Growth in an industry that trades strongly with the rest of the economy, such as finance and professional services, has the potential to drive growth in other industry clusters as a result. Likewise, the ability for a sector to grow may be dependent upon the capacity of other sectors to support such growth.

Taking finance and professional services as an example, the data suggests that firms in this sector trade mostly with one another (see Figure 21). From an infrastructure perspective, this means that connecting these types of firms can enhance trade between them. This is a fundamental aspect of agglomeration economies whereby reducing the cost of travel (through say lower journey times) can increase the productivity of firms in this sector. Given that businesses in the finance and professional services tend to concentrate in the central parts of cities, it then follows that better connecting these dense centres of activity can boost productivity by increasing their market size which effectively mean enhancing their ability to access more competitive suppliers and a larger customer base.

Figure 21 - Intermediate demand between finance and professional services in NSW



Source: KPMG

The data also shows that the finance and professional services sector is also a key buyer and supplier to other sectors. The future demand trajectory for these sectors is therefore closely interlinked with growth in that sector. The finance and professional services sector has been one of the fastest growing sectors in Australia and NSW which then has implications for growth of other sectors, such as other local services, transport and communications and other traded services. This will have future growth implications for the economy, as the growth of clusters such as finance and professional services will also drive growth in connected industries more broadly.

2.7 Future industries with a potential comparative advantage

The fact is that future major trends, combined with the right infrastructure and non-infrastructure policy interventions, have the potential to change the way existing industries operate and interface with one another, and in some cases create brand new industries. The rapid technological development, changing demographics, shifting production practices and growth of Asia are examples of trends that can impact on growth in Australia and NSW. The Traded Sectors that have not traditionally been strong in NSW but have the potential to grow, or those that are already growing, include: Advanced Manufacturing, Other Manufacturing and Traded Health and Education.

Similar to many advanced economies, manufacturing in Australia and NSW has been in decline. However, a combination of new technologies and the increasing labour costs in countries that have historically had a comparative advantage in manufacturing have the potential to support the growth of manufacturing industries in NSW.

Manufacturing is not a strength for NSW with the industry as a whole declining in its share of economic output as other industries, such as Finance and Professional Services grew, and decreasing employment by 25 percent (predominately from the Other Manufacturing cluster). However, rapidly developing technologies and the increase in wages in countries that have historically had a comparative advantage in manufacturing have the potential to support the growth of manufacturing industries in NSW.

Advanced Manufacturing requires highly-skilled labour, a business environment that is research-intensive and supports the adoption of new production technologies (such as 3D printing). Partnerships with universities in research and development, as well as Government regulation and policy, will need to support the emerging trends that are shifting production from larger, vertically integrated organisations to smaller niche units.

There is already strong Government support for the development of Advanced Manufacturing, with plans for Western Sydney, including the new airport and industrial developments around it, acting as a catalyst for NSW. This, combined with on-going collaboration programs between Western Sydney University and industry to investigate new production techniques is creating the conditions for growth in Advanced Manufacturing.

The Other Manufacturing will also experience technology related productivity improvements. In particular, automation of production, and the ability to have smaller more efficient operations will be key drivers of growth as the cost and time required to produce these goods decline. Given NSW's large and wealthy customer base, the development of these types of industries is becoming more viable which can drive growth in parts of the state.

The final industry cluster that has good potential to boost its competitiveness is Traded Health and Education. This industry has experienced strong historical growth, its GVA in NSW has increased by 89 percent since 1996. NSW is therefore well placed to continue this growth given its high level of education, technological development and strong investment in research and development.

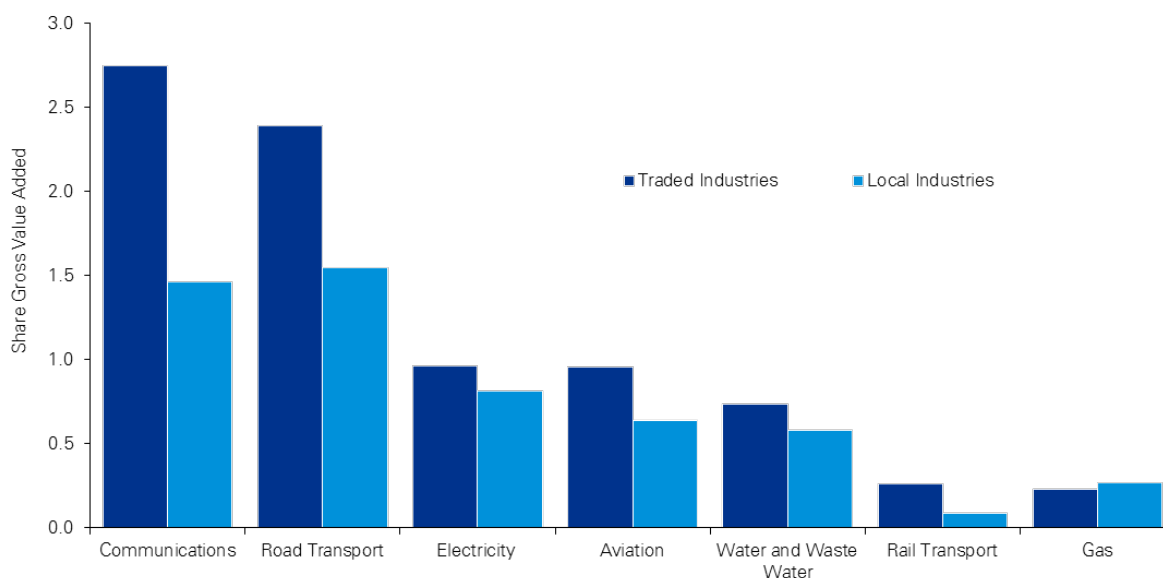
There is already a high international demand for NSW's education sector, in particular tertiary education. The number of international students commencing in 2016 grew by 11 percent compared to 2015, with higher education alone increasing by 15 percent. Demand from Asian international students is a key driver of this growth. Currently, the top three countries that international students in Australia are originating from are China, India and Malaysia. These same countries are also experiencing the highest rate of growth of residents seeking to study abroad at 17 percent, 11 percent and 16 percent respectively (International Education, 2016).

3 Infrastructure and economic performance

Equally as important as forecasting the growth in future industries is ascertaining how these industries will impact on infrastructure demand over time and equally how infrastructure will be required to support industry growth.

The linkages between infrastructure and the economy are well established. In its simplest form, infrastructure is a direct input into the production process of industries, which means that the cost of this input impacts on the performance and competitiveness of firms in the economy. The scale of impact will depend on the relative use of infrastructure sectors in production across different industries. Figure 21 shows the direct use of infrastructure by Local and Traded clusters in NSW. When infrastructure use is measured as a share of an industry's GVA, it is effectively reflecting the cost to that industry of directly using each type of infrastructure to produce a unit of output.

Figure 22 - Traded and local cluster use of infrastructure



Sources: ABS, Input Output Table 2013-14, KPMG

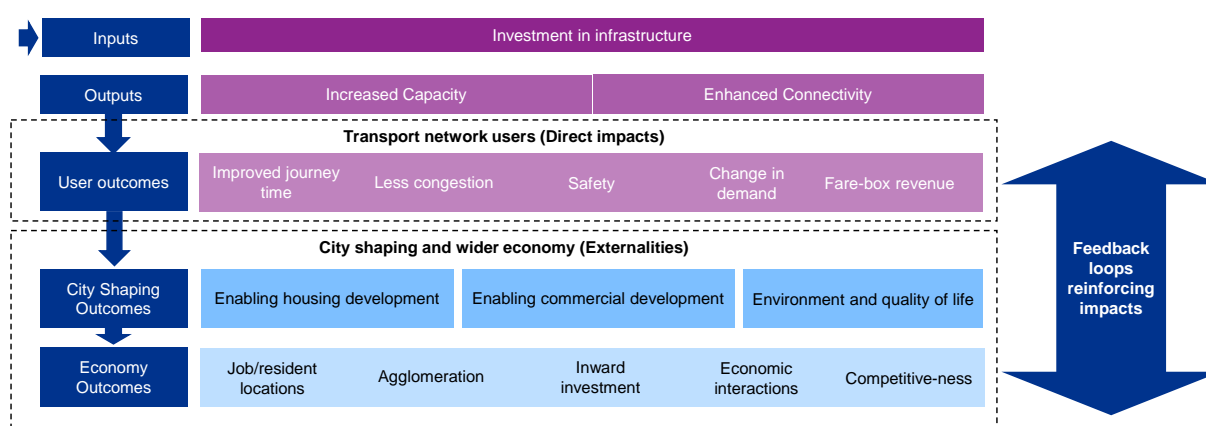
The cost to industry from using this infrastructure is determined by a number of factors, including the direct charge a firm pays for that infrastructure, the quality of the infrastructure assets used and the efficiency of these assets. Taking transport as an example, an industry's cost of usage of that infrastructure will be impacted by any form of direct user charging, travel times and congestion. An investment in the transport network that reduces the cost to business, say through improved travel times and reduced congestion, will therefore lower the cost of that input to these businesses.

The direct linkages between infrastructure and the economic performance of industries has traditionally driven investment decisions through the impact of reducing costs on users (both individuals and business). These impacts are well understood and have formed the backbone of the investment appraisal process.

However, the impact of infrastructure on the economy extends well beyond the direct users of the service. For a start, infrastructure investment impacts on land use patterns by enhancing land values, making it viable for development. For example, flood-prone areas need defences to make development viable and transport increases potential increase in densities, hence increasing land values in the areas affected by the investment.

In addition, infrastructure can impact on productivity by enhancing connectivity between businesses, which gives rise to agglomeration economies. This is when these enhanced connections can lead to pooling of resources, larger market size of customers and suppliers, and increased knowledge sharing and innovation. These types of impacts are often referred to as the wider economic benefits of infrastructure investment. Figure 23 shows an illustration of the mechanisms through which investment in transport (as one type of infrastructure) can impact on economic performance.

Figure 23 - Overview of linkages between transport and the economy



Source: KPMG

In the context of this report and as Infrastructure NSW develops the 2017 State Infrastructure Strategy, the following challenges emerge:

- 1) First, are the current planned infrastructure investments and any associated technology improvements that can enhance the performance of current networks sufficient to meet the future population and economic projections in the Base Case that is currently used for NSW?
- 2) Second, how can future infrastructure investments help boost the economy beyond what is projected in the Base Case (such as through productivity enhancements or increasing the competitiveness of certain industries)?

These challenges and their impact on infrastructure demand are discussed in more detail later in this report. But to be clear, the analysis in this report is not intended to provide a detailed response to each of these challenges.

The report provides a high level view of the likely trajectory of infrastructure demand for each of the sectors, based on the future projections for the NSW economy and how different economic growth scenarios may impact on this demand. To this end, the discussion will centre on the following:

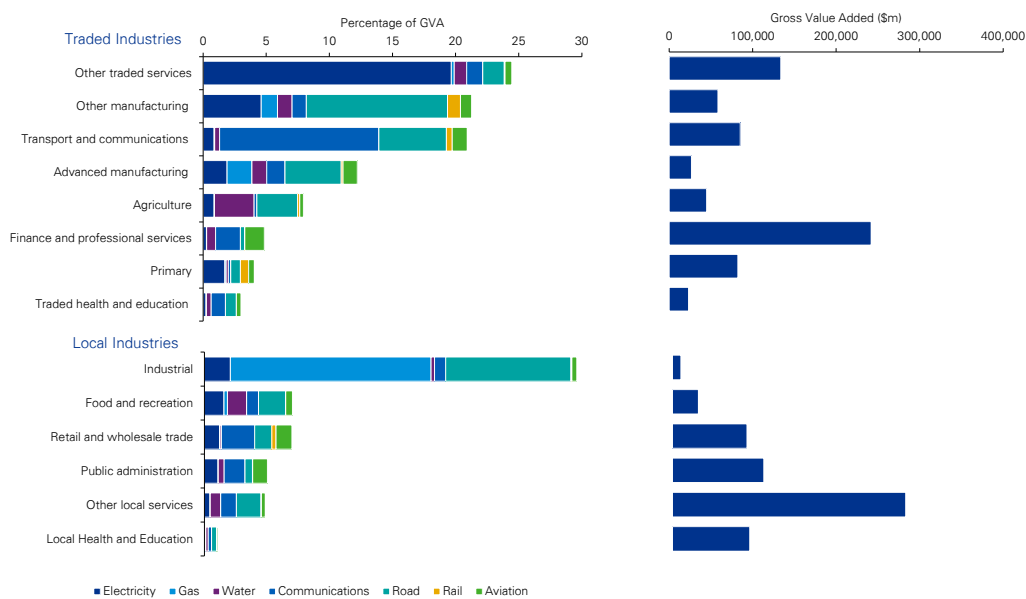
- The direct use of infrastructure by industry and the relative importance of each industry to the NSW economy, so that there is some appreciation of the scale of economic return that can be expected from infrastructure investments that will impact on these industries;
- The spatial implications of infrastructure demand across the NSW geography, since the type of economic activity across the state differs and NSW is undergoing a program of transformational change in parts of the geography (mainly through the work of the Greater Sydney Commission);
- The relevance of the indirect use of infrastructure that is not covered by the stand-alone industry analysis, given that certain inputs to the production of certain industries (such as the labour market in the case of the Finance and Professional Services industry) that are heavily reliant on infrastructure assets;

- The implications of the forecast economic growth and associated scenarios on infrastructure demand, reflecting the fact that infrastructure investment may be needed to help the realisation of the upside scenarios; and
- The relevance of technology change in infrastructure provision that are likely to impact on the efficiency and utilisation of the existing asset base, and hence impact on the need for capital investments to meet future demand and in the cost of infrastructure per unit of production for each of the industry sectors.

3.1 Direct use of infrastructure services

As discussed in Chapter 2, local and traded sectors have different infrastructure needs. These needs also differ in the industries within these sectors. Figure 24 shows the infrastructure use by each local and traded industry cluster. It also shows the size of each industry cluster by GVA. The objective is to illustrate what infrastructure means to the overall production of each of these industry clusters, and to also show the importance of each of the industry cluster to the NSW economy. For example, the direct use of infrastructure by the finance and professional services cluster is just under 5 percent of its GVA, but the sector as a whole one of the largest in NSW. This means while the relative impact of infrastructure investment on finance and professional services is less than most other clusters, improvements in its productivity and competitiveness is worth more to the NSW economy than most other sectors.

Figure 24 - Infrastructure use and GVA by industry cluster



Source: KPMG, ABS

Staying with the Finance and Professional Services cluster, the analysis also shows that the type of infrastructure that will most impact on its operations is communications and aviation infrastructure. In contrast, electricity infrastructure is the most important production input for Other Traded Services and the Primary clusters. Meanwhile, road infrastructure is the dominant production input for Advanced and Other Manufacturing.

Within the Local Sectors, the high reliance on gas reflects the fact that the gas supply industry is defined to be a member of the industrial cluster. This is partly because there are currently no significant conventional gas reserves in NSW. The overwhelming majority of gas supplied to the State is sourced from South Australia and Victoria via the Moomba, Eastern Gas Pipeline (EGP), and Culcain interconnect pipelines. The production of coal seam gas (CSG) is becoming more prominent to ensure the sustainability of gas supply in NSW as exploration continues at Narrabri by Western Star Gas and in the Gloucester and Gunnedah Basins.

The Retail and Wholesale Trade, Food and Recreation, Public Administration, and Local Health and Education clusters use smaller levels of infrastructure relative to their GVA. In these clusters, infrastructure needs are fairly evenly distributed across electricity, water and other utilities, rail and other transport, gas and aviation.

3.2 Spatial pattern of infrastructure use

Before considering how future industry growth can be supported by infrastructure, it is important to understand current industry demand for infrastructure and how this is distributed throughout NSW. Infrastructure use can be measured using a number of different methods, including: physical usage as an input to production; or through its estimated contribution that infrastructure provides to an economic region. The direct economic contribution of infrastructure (estimated by the Australian Infrastructure Audit) is presented in Table 7 below.

Table 7 - Direct economic contribution of infrastructure by region, 2011 (\$m)

Audit region	Urban transport	National Highways	Ports	Airports	Rail	Electricity	Gas	Petroleum	Water & Sewerage	Telecommunications	Total
Greater Sydney	20 413	96	4 641	5 134	43	2 416	349	202	1 808	7 654	42 756
Capital region	0	351	0	15	0	168	28	0	54	64	680
Central West	0	396	0	45	188	387	14	0	62	75	1 167
Coffs Harbour – Grafton	0	164	6	60	4	98	0	0	44	68	444
Far West and Orana	0	5	0	10	4	85	11	0	81	28	224
Hunter Valley exc. Newcastle	2 082	270	0	0	423	711	0	0	74	47	3 607
Illawarra	1 914	552	147	0	2	161	14	0	187	111	3 088
Mid North Coast	0	453	0	40	8	151	0	0	93	50	795
Murray	0	271	0	45	1	89	5	0	89	40	540
New England and North West	0	160	0	45	26	133	1	0	46	65	476
Newcastle and Lake Macquarie	3 096	0	420	181	150	400	22	37	173	246	4 725
Richmond – Tweed	0	240	0	55	2	171	0	0	71	105	644
Riverina	0	230	0	45	7	243	23	0	127	43	718
Southern Highlands and Shoalhaven	0	410	46	0	4	66	10	0	63	34	633

Source: Infrastructure Australia, 2015

The Australian Infrastructure Audit uses a methodology known as Direct Economic Contribution (DEC) to measure the 'value-add' or output of the services delivered to the economy by Australia's infrastructure networks. Put simply, DEC is a measure of the direct cost associated with the use of infrastructure. As a result, the measure does not take account of any additional value that businesses might place on infrastructure above what is actually paid (i.e. businesses may value water infrastructure and feel it contributes more to its operations than the direct overhead cost may suggest) (Infrastructure Australia, 2015).

This data was supplemented with KPMG analyses of the aggregate infrastructure use of traded and local clusters across NSW, which analysis was based on two components:

- Estimates of gross value added by cluster across NSW; and
- The aggregate infrastructure use data presented above (infrastructure use as a share of GVA by cluster).

Conceptually, the estimates sourced from the Australian Infrastructure Audit and KPMG are quite distinct. The former looks to measure the cost of physical infrastructure, while the latter is a measure of the value or cost of infrastructure services. For example, KPMG estimates road and rail transport services provided to clusters across NSW, while the equivalent direct economic contribution is the cost of road and rail infrastructure and user charges. Table 8 below shows the results for the Traded Sectors and Table 9 for the Local Clusters.

Table 8 - Infrastructure services usage of traded clusters by region, \$million

Audit region	Primary	Agriculture	Advanced manufacturing	Other manufacturing	Finance and professional services	Transport and communications	Traded health and education	Other traded services
Sydney	209.8	140.8	864.3	2748.2	4272.9	5922.6	157.8	8098.3
Hunter Valley exc. Newcastle	514.6	87.8	69.3	230.1	79.2	134.6	1.7	327.5
Central West	297.1	194.0	26.0	125.3	58.7	137.8	5.8	225.3
Central Coast	19.8	17.4	36.7	118.8	95.1	131.2	5.0	252.9
Far West and Orana	114.6	141.0	4.4	44.2	30.2	76.6	2.0	138.3
Newcastle and Lake Macquarie	122.5	10.8	92.1	262.6	218.8	261.3	20.2	475.7
Illawarra	101.2	8.5	19.3	276.8	117.0	137.9	15.6	237.6
New England and North West	39.4	235.0	12.5	114.3	54.9	125.7	7.5	177.9
Murray	13.7	128.8	18.5	82.3	33.9	92.1	3.1	157.0
Mid North Coast	21.5	74.8	16.2	83.3	53.0	83.7	2.3	201.8
Southern Highlands and Shoalhaven	5.2	30.0	21.5	62.1	43.2	63.2	1.7	140.1
Capital Region	7.4	137.6	9.8	103.1	53.4	109.2	2.2	247.6
Richmond - Tweed	6.6	93.0	12.5	130.1	75.1	111.7	6.8	236.9
Coffs Harbour - Grafton	3.9	52.5	7.0	57.1	42.1	71.8	2.2	134.7
Riverina	3.5	178.1	13.3	182.7	45.3	124.9	6.3	181.2

Sources: KPMG, Census 2011, Input-Output Tables, 2013-14

Table 9 - Infrastructure services usage of local clusters by region, \$million

Audit region	Industrial	Retail and wholesale trade	Food and recreation	Local Health and Education	Public administration	Other local services
Sydney	531.1	1551.0	528.9	220.3	1429.5	2676.1
Hunter Valley exc Newcastle	23.2	82.8	29.7	10.3	72.5	185.8
Central West	27.0	69.2	20.9	11.5	74.7	124.9
Central Coast	42.5	113.8	38.8	17.0	77.8	175.9
Far West and Orana	21.3	41.2	11.7	7.3	50.3	65.3
Newcastle and Lake Macquarie	32.7	139.1	48.5	24.3	109.0	245.7
Illawarra	20.9	86.0	36.9	15.8	82.0	175.2
New England and North West	40.1	65.4	19.2	10.4	55.9	110.4
Murray	19.1	40.8	16.1	6.0	42.6	71.8
Mid North Coast	21.0	72.8	22.9	11.9	44.5	119.5
Southern Highlands and Shoalhaven	16.0	51.6	18.2	7.7	37.3	89.9
Capital Region	33.9	69.8	26.7	9.5	68.2	136.8
Richmond - Tweed	32.3	92.1	29.9	14.2	52.9	142.8
Coffs Harbour - Grafton	17.3	54.2	17.1	8.1	45.6	86.7
Riverina	26.8	61.6	15.9	8.5	59.4	93.0

Sources: KPMG, Census 2011, Input-Output Tables, 2013-14

Clusters located within Greater Sydney are heavily reliant on urban transport, ports, airports, electricity, with the Finance and Professional Services, Transport and Communications, and Other Traded Clusters using close to 60 percent of infrastructure services in the region. The Finance and Professional Services cluster is particularly reliant on telecommunication services and internet and digital services to support their operations and transfer knowledge across key stakeholders. These clusters are also heavily reliant on rail, bus and road infrastructure to access key labour pools across the state. In response to the growing size and scale of business clusters in Greater Sydney, a number of infrastructure projects are currently in the planning and/or construction stages, such as Sydney Metro Northwest, which includes the delivery of eight new railway stations and 4,000 commuter car parking spaces to Sydney's growing North West.³

The Hunter Valley, Newcastle, Lake Macquarie and Illawarra also have a heavy reliance on transport infrastructure and electricity, reflecting the concentration of agriculture, primary, and manufacturing clusters in the region. In response to increasing interstate and international trade, the Lower Hunter Freight Rail Corridor (LHFC) project, among others, has been announced to provide a dedicated freight link that bypasses Newcastle, providing improved regional and interstate connections. The LHFC is also

³ For more information, please see: <http://www.sydneymetro.info/northwest/project-overview>

critical in providing sufficient capacity to accommodate the expected growth in freight demand, which is forecast to double by 2031 (NSW Government, 2014).⁴

Infrastructure networks within NSW enable the efficient flow of products and knowledge across the state. For example, rail infrastructure is vital for coal mining output from Central West, Orana, and North England and North West to be transported to Sydney ports for interstate and intentional export, while road infrastructure (e.g. via M31 and A1 highways) is heavily used to transport agriculture and manufacturing goods to key markets in Brisbane, Melbourne and Adelaide. Road infrastructure is also essential for intra-regional trade in agriculture and manufactured products.

3.3 Indirect use of infrastructure

Industry clusters also rely on infrastructure to provide access to labour markets. Table 10 below shows the infrastructure used by households to access workplaces in New South Wales.⁵ While road is the predominant infrastructure used by labour to access most clusters located outside the Sydney CBD, the finance and professional services and the information media and telecommunications clusters, (which are predominately located in the high density districts of Inner Sydney), rely heavily on rail infrastructure. Accommodation and food services and agriculture, forestry and fishing are unique clusters in the sense that a large pool of labour walk to work.

Table 10 - Mode of transport used to travel to work, New South Wales, 2011, per cent of industry total

Industry	Predominant cluster	Road	Rail	Water	Bicycle	Walking	Employees ('000)
Accommodation and Food Services	Food and recreation	75.9	11.8	0.0	1.0	11.3	167.9
Administrative & Support Services	Other	78.8	16.3	0.0	0.7	4.3	87.6
Agriculture, Forestry and Fishing	Agriculture	85.2	0.6	0.0	0.4	13.8	40.6
Arts and Recreation Services	Food and recreation	79.4	11.7	0.0	1.7	7.2	34.6
Construction	Other traded	94.1	4.4	0.0	0.3	1.1	203.7
Education and Training	Local education and health	86.8	7.1	0.0	1.1	4.9	214.8
Electricity, Gas, Water and Waste	Other traded	89.2	7.6	0.0	1.2	2.0	31.1
Financial and Insurance Services	Finance and professional	58.9	35.3	0.0	1.0	4.7	139.7
Health Care and Social Assistance	Local education and health	87.2	7.0	0.0	0.7	5.1	300.3
Information Media and Telecommunications	Transport and communication	68.4	24.3	0.0	1.7	5.5	61.9
Manufacturing	Advanced manufacturing	91.7	5.1	0.0	0.9	2.4	239.4
Mining	Primary	96.4	2.2	0.0	0.4	1.0	25.4
Other Services	Other local	87.0	7.3	0.0	0.8	4.9	100.0

Source: ABS, Census 2011, Journey to Work data

⁴ For more information, please see: https://www.nsw.gov.au/sites/default/files/miscellaneous/rebuilding-hunter_sis2014.pdf

⁵ Journey to work data was only available by 1 digit industries, which could not be accurately mapped to the clusters defined by KPMG.

4 Future projections for NSW

4.1 Baseline projections for employment growth

NSW is likely to experience as much industry change in the future as it has in the past. The impact of technology and innovation is a driving force behind the forecast structural changes to 2024. Technology will improve competitiveness in traded industries, such as advanced manufacturing, where large warehouses are no longer required and everything is customisable and built on demand using 3D printers. It will improve the resilience of agriculture to climate fluctuations, and maximise crop yield through the use of smart sensors to track destructive weather patterns and target harvest dates to maximise crop growth.

Technology will drive future productivity, decreasing relative employment as a consequence.⁶ As previously noted, primary and a number of local industries will be impacted by this change, particularly in regional NSW, as technology enables the local population and businesses to outsource local services in urban centres who can achieve greater economies of scope and scale. As a result, traded industries will grow their share of employment as demonstrated in Table 11.

Table 11 - Traded share of employment by traded and local industries (%)

	2016	2017	2018	2019	2020	2021	2022	2023	2024
Traded	38.1	38.2	38.8	39.5	40.0	40.5	41.0	41.5	42.0
Local	61.9	61.8	61.2	60.5	60.0	59.5	59.0	58.5	58.0

Source: Victoria University Employment Forecast (CoPS), KPMG

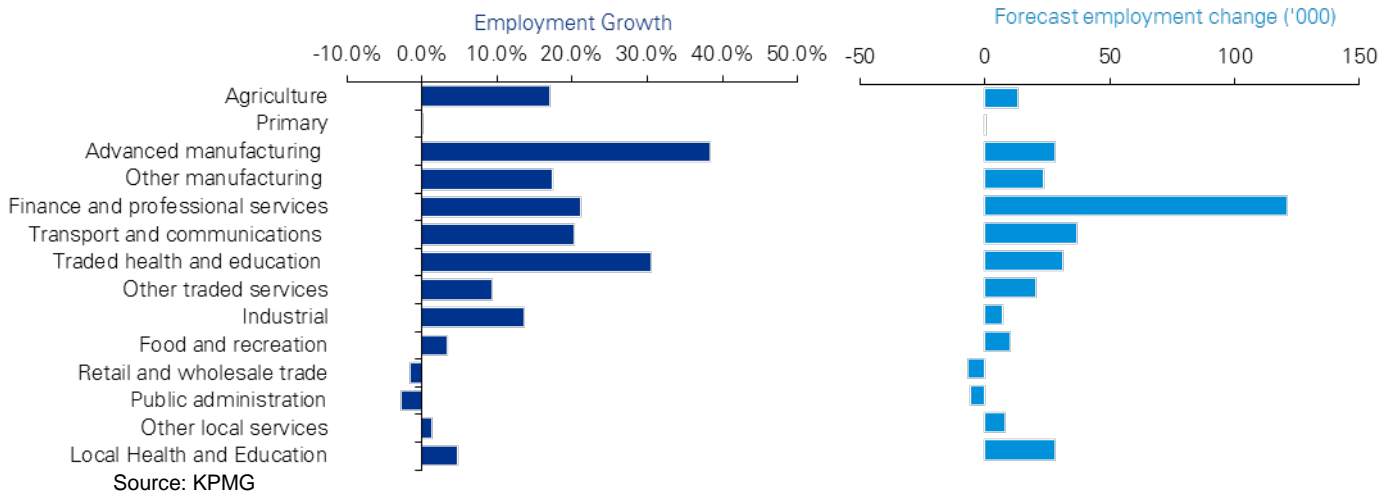
The services industry is also likely to change dramatically as technology is enabling enormous flexibility in the way that we work. The CSIRO suggests that freelance and contracting work will increase and drive and increase in flexible working (NSW Treasury, 2016); from home, shared offices or other sites. Even in the traditional workplace, 80 percent of workers would stay in a role longer if flexible working from an offsite location were made available (McCrindle Research, 2013).

This is only going to support the growth and dominance of knowledge intensive services, in particular finance and professional services. While the growth rate is not as strong as advanced manufacturing or traded health and education, this industry will experience the greatest actual employment growth, making up 38 percent of all new jobs in NSW.

This growth will be driven by Sydney which will have an additional 100,000 jobs in this industry by 2024 with over 60 percent of this growth to occur in computer system design, depository financial intermediation, legal and accounting services and architectural, engineering and technical services.

⁶ Relative employment is the number of FTE jobs per \$1m of gross value added.

Figure 25 - Forecast employment growth rate and total growth by industry



This corresponds with Sydney’s strong position as a financial centre, within Australia and internationally, and is consistent with historical growth in this industry. It is being driven by Australia’s relatively high level of education and according to the IMD *World Competitiveness Index* is a key element of international competitiveness for this industry.

Demographic change will be another driving force behind these industrial restructures. By 2056, NSW is projected to have almost double the number of people as today, who will live an average of 3.5 years longer and have a median age of 41 – four years older than the median age now. Because of the ageing workforce and other preferences, such as increased time in study for younger cohorts, the participation rate is expected to fall, partial offset by a rise in part-time work and the retirement age (NSW Treasury, 2016). However, some trends don’t change. Urbanisation will continue to occur with 80 percent of NSW’s population growth occurring in Sydney. As a result, more jobs suited to the urban environment will be required.

Table 12 - NSW projected population growth ('000) to 2036

Region	2011	2016	2021	2026	2031	2036	Total Change	Total percentage Change
Sydney	4,286	4,682	5,106	5,538	5,976	6,422	2,136	49.8
Regional NSW	2,932	3,066	3,191	3,307	3,411	3,504	571	19.5
NSW	7,219	7,748	8,298	8,845	9,387	9,926	2,707	37.5

Source: Department of Planning and Environment, KPMG

Projected employment growth in NSW is broadly aligned with the continued trend in urbanisation. While the rate of employment growth in Sydney is consistent over time, employment in regional NSW is projected to decline, driven predominately by the Far West and Orana region and the Mid North Coast. These two regions have relatively large local industry based economies, which are expected to experience declining employment over the forecast period, with industrial and food and recreation employment an exception.

Table 13 - NSW projected employment growth ('000) to 2024

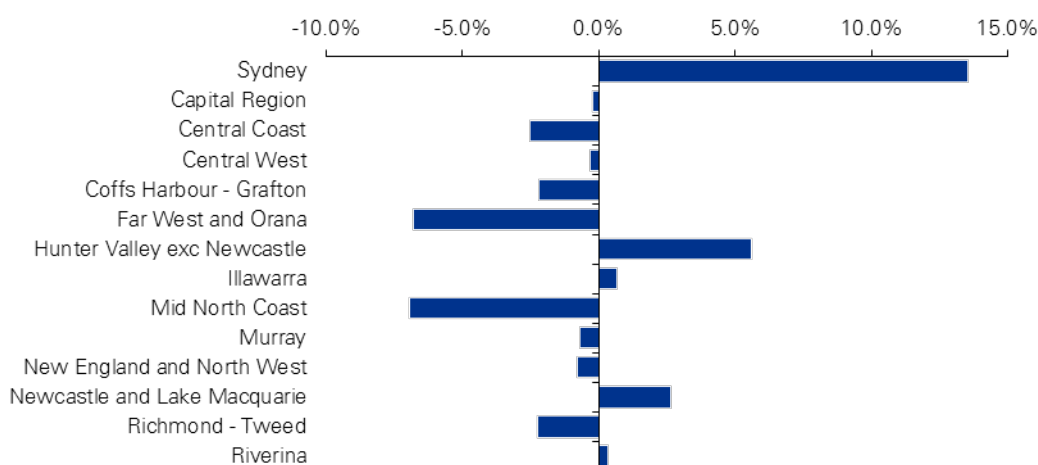
Region	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total Change	Total percentage Change
Sydney	2,371	2,429	2,471	2,510	2,548	2,585	2,621	2,657	2,692	321	13.5
Regional NSW	1,306	1,315	1,317	1,317	1,315	1,312	1,306	1,303	1,300	-6	-0.4
NSW	3,677	3,744	3,788	3,827	3,863	3,896	3,928	3,960	3,992	315	8.6

Source: Victoria University Employment Forecast (CoPS), KPMG

Declining population growth, and in some cases a decline in absolute population, is a key driver of this drop in employment in regional NSW. However, there are a number of other industry specific impacts that will contribute to this outcome. After strong growth early in the forecast period, driven by increasing demand for aged care services, the decline in the local health and education industry sectors⁷ later in the forecast period is being driven by the decline in the population of the baby boomer generation, a large proportion of whom will be well into their 70s by the 2020s. This decline will also be offset to a degree by increases in traded health and education services, as hospitals, specialists, medical research and universities clusters grow due to increasing incidence of chronic disease and aged related illness (Australian Institute of Health and Welfare, 2014).

Technology will also contribute heavily to these decreases through greater automation and the growing provision of services remotely, such as in the retail sector and the impact of online trading. The ABS suggest that close to 3 percent of domestic retail sales are already purchased online. If other collaborative consumption platforms, such as E-Bay and Gumtree, are also accounted for then it possible that this figure may be closer to five per cent (ABS, September 2016).

Figure 26 - Forecast employment growth to 2024 by region



Source: KPMG

There are notable exceptions to the decline in NSW regional employment. The Hunter and Newcastle regions experience positive growth annually to 2024. While primary is still a key employer for the Hunter Valley it will experience a contraction of employment to 2024 reflecting the current and future planned closure of coal mines in this region, such as the Drayton open cut mine, and technology driven productivity improvements, such as automation.

Growth in the Hunter Valley will be driven by strong growth in advanced manufacturing, supported by technological innovations like 3D printing and structural changes such as an increased concentration of smaller, more targeted firms. This trend is already apparent in the recent opening of Helweld's Mt

⁷ The local health and education industry sector as defined through KPMG clustering analysis.

Thorley facility, targeting employees with mechatronics and electronics skills. A key driver of this growth will be partnerships with education and research institutions, such as that between Helweld and TAFE to develop and trial training courses in advanced manufacturing skills.

Advanced manufacturing and traded health and education will be expected to grow in Newcastle with more moderate growth in financial and professional services. Finance and professional services is the key employer for Newcastle and will make up 36 percent of employment in 2024. The Newcastle CBD has seen a large growth in this industry over the past ten years, supported by the revitalisation of the foreshore, the growth of Honeysuckle and the University's growing CBD presence.

The growth in traded health and education is being driven by University of Newcastle's (UoN) strong collaboration with local and regional hospitals. The Hunter Clinical School allows students to work closely with four hospitals in the Greater Newcastle area. UoN also has a leading health and medical research facility, which generates the majority of research funds for UoN and employs over 300 researchers and 360 research higher degree students.

The adoption of technology and increased collaboration between industries such as health and education will require Government policy support and willingness by Government and the business community to implement and embrace change. Australia has historically been relatively slower to generate world-leading technological advancements across all sectors (World Intellectual Property Organisation, 2015), or implement a 'fast-follower' approach to technology developed in other jurisdictions, which as a consequence has not seen the benefits of innovation applied within the economy as quickly as some other jurisdictions.

Government coordination and support for collaboration and innovation as well as investment in communications infrastructure will be important to the realisation of this growth. International examples of collaboration between industry and academia and between industries (such as in Akron, Ohio or Eindhoven, Netherlands), has typically required government intervention in the form of facilitation – establishing a shared vision and creating collaboration programs with governance frameworks that encourage companies to share ideas but ultimately protect the intellectual property that is developed from that initial collaboration. Government is also a provider of incentives, such as start-up capital and infrastructure to drive the success of these programs (Agtmael and Bakkar, 2016). A key ingredient in the success of these cities and countries is leveraging off existing knowledge and utilising technology to apply it in new and innovative ways, such as those outlined in Box 1.

How countries are leveraging their comparative advantage(s)

As outlined above, NSW is expected to record solid growth in activity and employment within clusters that have a national and/or international comparative advantage, such as finance and professional services. The strong growth in these clusters will help support other domestic industries that provide inputs and a part of a broader supply chain.

Businesses that are fortunate enough to have a comparative advantage in their chosen market typically aim to maximise income and profits from that market as well leverage their advantage to move into new markets. For example, a business that has a comparative advantage in clothing manufacturing may look to leverage that advantage to move into broader textile markets. The same is true for clusters and national industries. Clusters with comparative advantages will not just benefit other clusters within a broader supply chain but will leverage their advantage and develop new markets. This box examines how other countries are leveraging their technology to improve their comparative advantage(s) in the current economic environment to provide a sense of what may occur in Australia if similar investment and support were to occur.

Japan

The use of robotics in production processes and other household applications has grown exponentially in recent years. Japan is leveraging its domain expertise in electronics and advanced manufacturing toward the production of robotics. Japan currently employs over a quarter of a million industrial robot workers, and in the next 15 years, Japan estimates that number to jump to over one million and revenue sourced from robotics to be near \$70 billion by 2025.

Germany

The breadth and depth of data & analytics is growing rapidly with the advent of the internet of everything and similar innovations. Germany is attempting to leverage its domain expertise in logistics and household appliances to control the analytics markets in those areas of traditional strength through the initiative Industrie 4.0. The objective of this initiative is to take a pioneering role in industrial IT which is currently revolutionizing the manufacturing engineering sector.

New Zealand

New Zealand has been active in developing and exporting precision agriculture technology to help boost agriculture production. The pasturemeter, for example, is a local invention that enables quick measurement of pasture height and replaces old time consuming manual devices, such as Plate meters. This innovation has helped New Zealand farmers increase production as well as generating export earnings.

4.2 Baseline projections for Gross Value Added (GVA) growth

In this section we present the baseline GVA forecasts for NSW and its regions. The baseline forecasts represent KPMG's central views about how the size and structure of the NSW economy will change from 2015-16 to 2035-36.

NSW economy

The NSW economy will grow and its structure will change due to trends that are already well established, those that are starting to emerge as well as trends we cannot yet foresee but, consistent with historical experience, will almost certainly emerge over the next 20 years. The growth and structural change projected for the economy will have spatial implications and will impact the way in which the people of NSW live and work.

Table 14 summarises the baseline projections for Gross Value Added (GVA) at the industry level for NSW. The latest available historical data is for 2015-16 and this is reported in the column headed "GVA 2016 (\$m)". As the historical data shows the finance and professional services industry is the largest in terms of GVA, followed by the other local services industry. At the other end of the scale, the industrial and agriculture industries are the smallest in terms of GVA.

Table 14 - Baseline Projections for NSW Real GVA - 2016-2036

	GVA 2016 (\$m)	GVA 2036 Baseline (2016\$m)	Growth 2016-2036
Traded Industries			
Agriculture	6,329	10,803	70.7%
Primary	10,062	18,381	82.7%
Advanced manufacturing	8,818	15,169	72.0%
Other manufacturing	19,569	24,049	22.9%
Finance and professional services	118,969	191,365	60.9%
Transport and communications	39,162	65,540	67.4%
Traded health and education	28,107	48,692	73.2%
Other traded services	33,778	53,166	57.4%
Local Industries			
Industrial	3,160	4,403	39.3%
Food and Recreation	15,810	25,432	60.9%
Retail and Wholesale Trade	46,111	75,670	64.1%
Public Administration	41,901	72,824	73.8%
Other local services	103,155	166,653	61.6%
Local Health and Education	14,464	25,312	75.0%
Total	489,395	797,458	62.9%

Source: KPMG

The baseline projections for the NSW economy are built on the basis of a range of assumptions about population growth, technical change, changes in preferences, required rates of return and growth in foreign markets.

“Achieving average annual productivity growth of 1.5 per cent in the future will in all likelihood require further significant micro-economic reform at both the national and state level. Many possible reforms, as outlined in the Harper Competition Policy Review, are in areas where state governments will need to play a prominent role — areas such as government provision of human services, transport and planning.”
(NSW Treasury, 2016)

KPMG’s baseline projections assume that industries such as agriculture and primary maintain their competitiveness and benefit from growth in foreign demand. Maintenance of competitiveness for these industries requires that NSW businesses adopt technologies and have access to infrastructure that allows them to produce and deliver goods at a cost and quality-grade that is internationally competitive. On the demand side, projected growth in the agriculture and primary industries is driven by the continued development of Asia. On the supply side, the uptake of technology such as industry automation and Agtech is expected to underpin the competitiveness of these sectors as employment growth moderates over time, particularly for the primary industry, which is projected to record negative employment growth in the early 2020s.

The finance and professional services industry is projected to maintain its status as the state’s largest industry, although growth in this industry over the next 20 years is expected to be slower than in the previous 20 years.

Traded health and education is a growing part of the economy that has been supported by increasing demand from developing Asian economies. Traded health and education is also expected to benefit from technology and the continued development of Asian economies. As outlined in chapter five, there is already strong demand from countries such as China, India and Malaysia for Australian education. Health is also anticipated to be a key export, particularly in pharmaceuticals, hospital operation and aged care, enabled through trade deals such as the China-Australia Free Trade Agreement.

China will be a key target market for investment in health trade for three key reasons: first, China is projected to have 248 million citizens aged 60 years and over by 2020; second, high rates of smoking by Chinese citizens (about a fifth of the world’s population consumes about a third of the world cigarettes) are expected to have adverse health implications; and third, high levels of pollution lead to health problems with an estimated 4000 deaths each day due to pollution induced health problems (Brown, 2016). The free trade agreement allows wholly Australian owned hospitals and aged care facilities to be operated in China (Austrade, 2016).

Local industries will also play an important role in growing GVA. The strongest performing of these in terms of industry growth is the local health and education industry, with the health component primarily driven by the ageing population, longer life-spans and increased consumer preferences for non-essential health services. Growth in education is driven in part by technology that increases the demand for highly skilled workers and by structural change that increase the demand for continual education and for re-skilling.

Sydney economy

Consistent with the urbanisation trend discussed earlier in this report, Sydney’s real GVA is projected to grow faster than that for NSW over the next 20 years. In real terms Sydney’s GVA is projected to increase by 70 percent from 2015-16 levels to be about \$553 billion in 2036. Over the same period real GVA in NSW is projected to increase by about 63 percent.

Table 15 - Baseline Projections for Sydney Real GVA - 2016-2036

	GVA 2016 (\$m)	GVA 2036 Baseline (2016\$m)	Growth 2016-2036
Traded Industries			
Agriculture	558	1,565	180.6%
Primary	1,395	3,210	130.1%
Advanced manufacturing	6,198	11,804	90.5%
Other manufacturing	11,727	15,222	29.8%
Finance and professional services	96,831	160,126	65.4%
Transport and communications	29,807	52,426	75.9%
Traded health and education	18,169	34,496	89.9%
Other traded services	23,601	37,305	58.1%
Local Industries			
Industrial	1,997	2,973	48.9%
Food and Recreation	9,453	16,435	73.9%
Retail and Wholesale Trade	27,536	48,360	75.6%
Public Administration	25,556	45,555	78.3%
Other local services	63,826	108,008	69.2%
Local Health and Education	8,323	15,672	88.3%
Total			
	324,977	553,157	70.2%

Source: KPMG

The agriculture and primary industries are projected to grow rapidly but these two industries are relatively small (estimated to account for just over 0.5 percent of Sydney's GVA in 2015-16). The traded and local health and education industries are projected to grow fastest. Sydney's transport and communications industry is also projected to grow slightly faster than average GVA growth in Sydney. Among Sydney's local industries the food and recreation, retail and wholesale trade and public administration industries are expected to outperform the Sydney economy as a whole. Population growth is the main driver of the projected robust performance of these local industries.

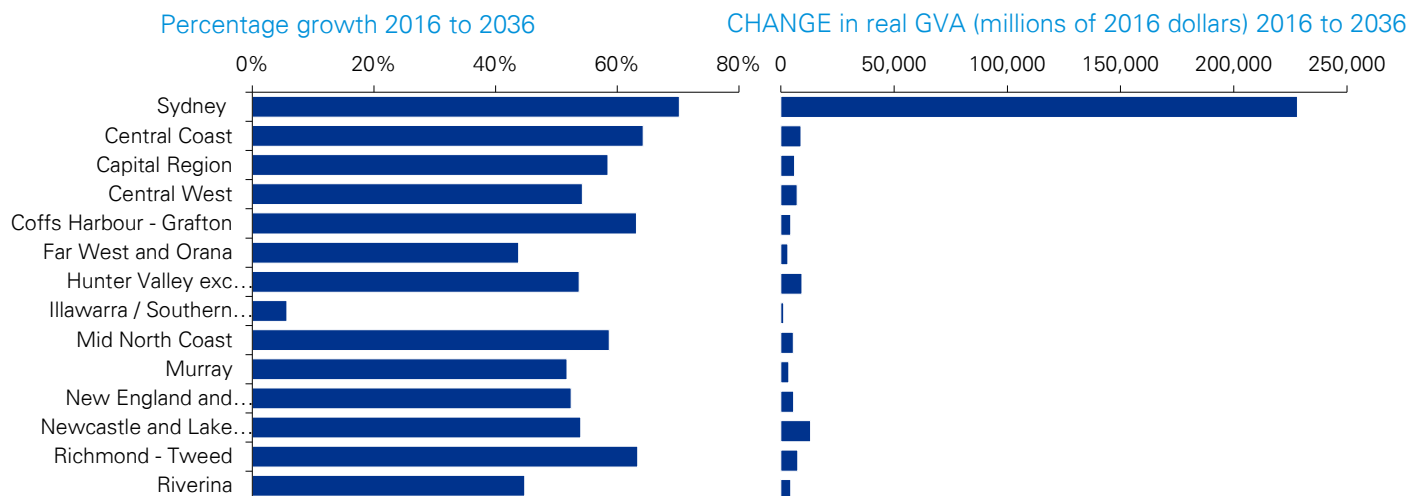
The finance and professional services industry is currently Sydney's largest industry in terms of GVA and it is projected to remain so in 2036. However, growth in this industry is projected to be modest relative to the Sydney-wide average. Over the last 20 years compound annual growth in real GVA for the NSW finance and professional services industry has been just under five percent, which is about double the corresponding rate for NSW as a whole. We are projecting that over the next 20 years the rate of growth in the finance and professional services industry will be more closely aligned with the broader economy than the industry services.

Regional NSW economy

While Sydney's growth is projected to be driven by services industries, regional NSW will be predominately driven by the agriculture and primary industries. Robust growth is expected in regional areas; notably for the Central Coast, Coffs Harbour-Grafton and the Richmond-Tweed regions, all experiencing GVA growth of over 60 percent between 2015-16 and 2035-36 (see Figure 27).

Growth in the Coffs Harbour-Grafton region is expected to be driven by other local services and public administration. These two industries are projected to record the largest increases in real GVA, with the other local services industry expected to account for about 23 percent (or \$1.1 billion) of the increase in the Coffs Harbour-Grafton region's GVA between 2016 and 2036.

Figure 27 - GVA growth between 2016 and 2036



Source: KPMG

The Richmond-Tweed region is projected to grow by 63 percent between 2016 and 2036, which is about the same rate as for NSW as a whole. The main contributor to this growth in real GVA is the other local services industry which is expected to account for about 30 percent of the increase in the Richmond-Tweed region’s real GVA between 2016 and 2036. The retail and wholesale trade and public administration industries also make significant contributions to the increase in the Richmond-Tweed region’s real GVA between 2016 and 2036 (around 14 percent and 12 percent respectively).

There are two key factors behind the growth of these two regions. The first is population growth driven by migration. As previously noted, the trend in NSW of migration towards large urban centres is expected to continue but this may be less pronounced than in the past with a more dispersed east-ward movement of the population projected. It is projected that far western NSW will experience a decrease in population while coastal areas will experience growth, a trend that has been magnified by the ageing population, a key demographic group that is leading this east-ward migration.

The second driving factor is tourism and the popularity of the mid-north coast and north rivers regions as holiday destinations. The growth of tourism, which is part of the other traded sectors industry cluster, has strong trading connections with local industries such as retail trade and will support the creation of demand for local services.

The Hunter region (including Newcastle) is projected to record an increase in real GVA of \$22.5 billion between 2016 and 2036, which is the largest increase in real GVA outside of Sydney. However, in proportional terms the Hunter region underperforms the state as a whole, with real GVA growing by about 54 percent from 2016 to 2036 (compared with 62 percent for NSW). The primary industry makes a strong contribution to the Hunter region’s real GVA growth, accounting for just under 18 percent of the increase in the region’s real GVA between 2016 and 2036.

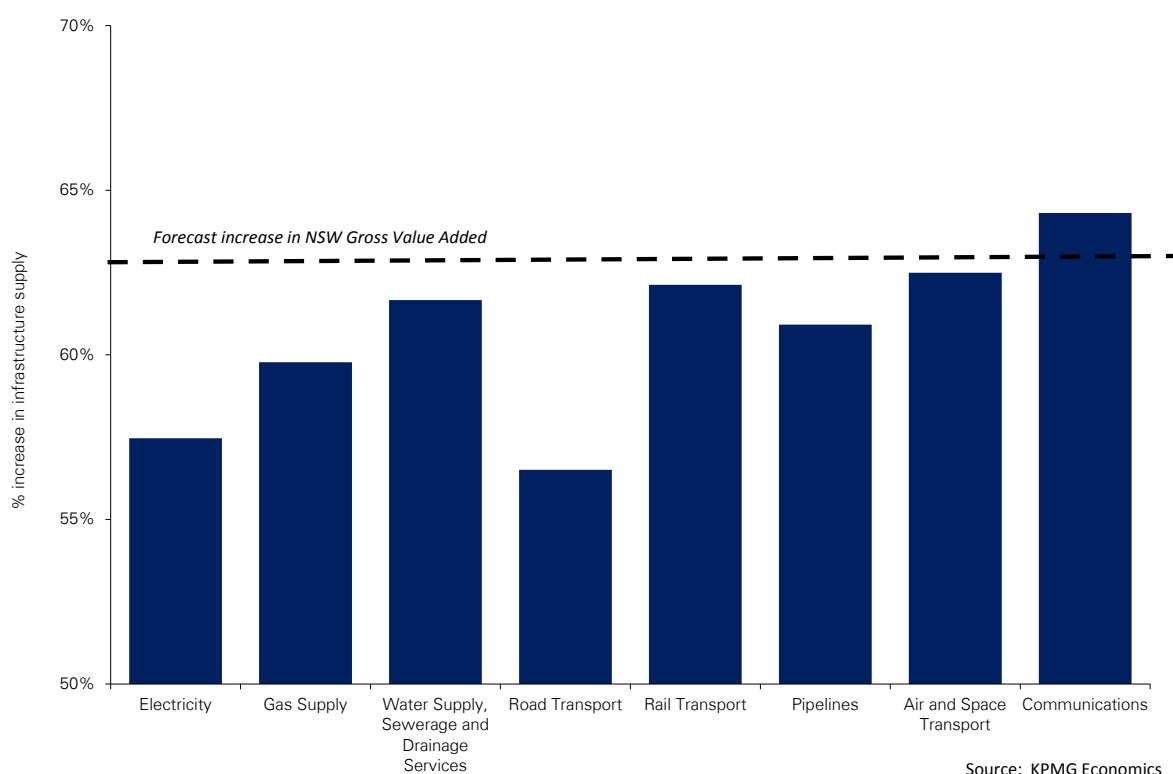
The Illawarra and Southern Highlands region is expected to undergo the least GVA growth of the State’s regions. This is primarily driven by decreases in key industries of employment for the region; other manufacturing and primary as well as associated decreases in local industry employment. Public administration will undergo the most significant decrease, falling from a 10 percent share in 2016 to five percent in 2036. However, growth in finance and professional services will offset losses in other industries, accounting for 28 percent of GVA in 2036, up from 15 percent in 2016.

4.3 Implications of forecast economic growth for Infrastructure in NSW

The growth of industries over the next 20 years will increase the demand for NSW's infrastructure network. Infrastructure NSW have indicated that infrastructure requirements should be assumed to be met in the base case, which implies that there are likely to be no constraints on achieving the projected economic growth for NSW in the base case.

KPMG has estimated the increases required in physical infrastructure in NSW by type between 2016 and 2036 in order for the base case to be realised. These forecasts incorporate demand for infrastructure from the production side of the economy, as well as the final use components of the economy, being households, government and export activities. In preparing these forecasts we have followed a similar approach to the DEC analysis described earlier, including assuming the share of gross value added for each form of infrastructure is maintained at a constant ratio throughout the forecast period. Should capital productivity improve, particularly if technological enhancement develop beyond what KPMG has already assumed in our base case macroeconomic forecasts, then the incremental level of infrastructure required may be lower than that presented below.

Figure 28 - Forecast required increase in infrastructure in NSW by type, 2016-2036

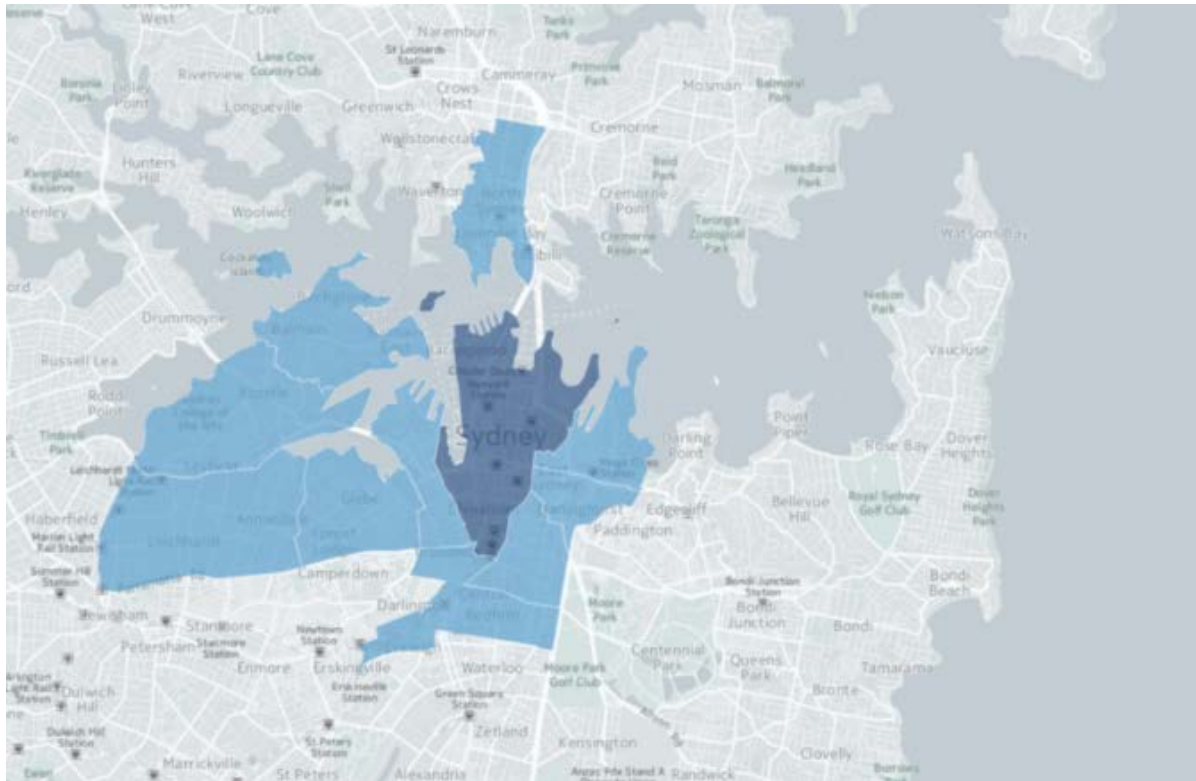


As expected, most forms of infrastructure are required to increase at a rate less than the rate of growth of overall economic activity due to economies of scale and scope, and the non-linear nature of incremental infrastructure development. The key exception is communications infrastructure – internet, telecommunications – which is required at marginally higher amounts than growth in GVA. This reflects the growing reliance on this type of infrastructure for the delivery of both work and household activities.

In addition to understanding the future demand for infrastructure, the spatial implications of this future demand can be linked to the projected spatial distribution of growth industries. The strongest growing infrastructure types; communications, air and space transport and rail transport will be driven by growth in Sydney centric industries such as finance and professional services, both advanced and other manufacturing, other traded services, other local services and transport and communications.

Financial and professional services will create demand for communications, aviation and rail transport within and to key employment centres such as the CBD, North Sydney and Parramatta.

Figure 29 - Future CBD footprint



Source: KPMG

Given finance and professional services strong trade links with other traded and local industries, growth will also occur in associated industries, such as retail and wholesale trade, other local services and other traded services. The growth of Sydney centric industries is going to drive demand for infrastructure in an increasingly limited geographical area. This means that not addressing infrastructure demand in the right way can impact on the productivity and ultimately growth of such industries.

A potential restriction to this growth is limited floor space availability in the current CBD. Given this, land use planning will need to support future employment growth to 2036 (and beyond) through both the rezoning of adjacent areas and through the review of floor space ratios. A vision for an expanded CBD footprint is outlined in Figure 26. It takes into account the transformation of The Bays as a key ICT centre, driven by Google's decision to relocate once the area has been developed. It also includes the Central to Eveleigh precinct, as well as encompassing already productive areas, such as Pyrmont-Ultimo, Surry Hills and North Sydney. Ensuring adequate space for supporting infrastructure will also be vital to the growth of the CBD, as sub-ground space is increasingly limited due to existing utilities, basements and car parks.

In Western Sydney, growth in professional services and manufacturing is expected to increase the demand for aviation from the Western Sydney Airport. The growth of manufacturing will also create demand for communications and rail (as well as electricity) as the industry increases its use of technology in the manufacturing process. This demand will be particularly strong around the Western Sydney Airport precinct.

Similarly to Sydney, demand for infrastructure in regional NSW will also increase with demand for communications infrastructure common across NSW. Water infrastructure demand has strong links to the agriculture industry and therefore increasing this infrastructure across NSW will be important to facilitating growth. Communications may be an important industry in regional NSW as industries such as agriculture and primary are increasingly adopting technology in their operations.

While future demand for infrastructure can be estimated based on likely industry trends over time, choices around asset investment and policy can also impact on total demand or demand for certain types of infrastructure. For example; not addressing communications infrastructure demand will also have flow on effects for other infrastructure types, for example; if remote working options are not feasible, more people will commute to work.

Optimising service provision or maintenance schedules can extend the utility of the asset and in some cases improve its usable life. Examples of these improvements include timetable improvements for rail infrastructure to run additional services on the network, or more frequent schedules to improve the efficiency of electricity generation. Technology will also play a key role in improving asset productivity for most infrastructure types, from driverless trains that facilitate reduction in headway to improved battery storage capacity for electricity.

Demand management will also be a key strategy to managing network usage. User pricing, particularly for peaks (geographically and time of day), behavioural improvements, such as better customer information and land use changes such as densification around existing assets are all levers that can be used to try and change the way the community uses infrastructure. Again, technology will play a role in changing demand patterns such as enabling flexible working practices and improving energy efficiency. Demand side measures will be essential to reduce congestion where space limits the supply of infrastructure such as in Sydney's CBD.

5 Industry Sector Analysis

While forecasts can be a commonly agreed picture of how employment, population, land use and economic growth may occur in the future, there is always uncertainty as to whether these forecasts will be realised. High level forecasts rely on broad assumptions such as the global economic climate, policy and regulation, and environmental impacts. Rather than relying on a strategic view of NSW's economy, this chapter looks at the current strengths and weaknesses of each industry cluster and their potential to grow in the future.

5.1 Primary

One of NSW's key strengths lies in its abundance of coal deposits and supports the primary industry's comparative advantage. While the industry may face a decrease in demand for coal, this is not likely to occur until the long term, and as a result demand for coal exports will likely continue. In addition, this industry will benefit the potential productivity gains from technology such as automation, are anticipated to improve the rate of return for the industry.

The primary cluster relies heavily on professional and financial services and other local services to support its business operations. It also provides vital inputs into the domestic primary, other manufacturing, and other traded clusters. This cluster relies on infrastructure services and is most reliant on electricity, rail and road infrastructure to support business operations and transport goods to interstate and international markets.

The primary industry is a key generator of output in a number of locations in NSW, and in line with employment, chief among these is the Hunter Valley and the Central West regions. This industry is likely to maintain competitiveness into the future due to its vast mineral endowments. Indeed, Geoscience Australia notes:

"Compared to many countries, Australia has a comparative advantage in the production of mineral commodities. This stems from a rich and diverse mineral endowment, high quality regional-scale geoscience information which lowers the risks of exploration, advanced exploration, mining and processing technologies, a skilled work force, generally benign physical conditions and low population density. These factors mean that modern mining can be undertaken in line with increasing community expectations for environmental and social performance."



Australia is endowed with natural resources

Resource availability is strong with Australia the highest exporter of resources such as brown coal.

Strength



Exports in resources are strong

Currently, international exports are strong but resource prices are below the peak levels observed in 2011/12. More recently, there have been tentative signs of recovery, particularly the price of coal which has increased strongly after new mining restrictions curbed production in China. While commodity prices are expected to recover, it is unlikely that they will increase to previous peak levels.

Neutral



Climate change may impact demand

Coal is one of NSW's biggest exports and may experience a reduction in demand if world policy on climate change tightens.

Risk



Automation of routine jobs is likely

Technological advances such as automation will impact heavily on the primary industry. There will be a loss of jobs, however it is likely to have positive economic effect overall.

Neutral



Regulatory environment reducing competitiveness

Environmental and other regulations are reducing the opportunities for growth.

Risk

The primary industry's strength is derived from Australia's abundance of natural resources. There is enough mineral deposits in Australia to maintain the primary cluster as a key contributor to the NSW and Australian economy.

Recoverable black coal in New South Wales consists primarily of thermal and semi-soft metallurgical coal. These are located predominantly in the Sydney–Gunnedah basin that extends from south of Wollongong to north of Newcastle, through the Hunter Valley and up to Narrabri. The Hunter Valley coalfield in New South Wales supplies thermal coal to both export and domestic markets (Bureau of Resources and Energy Economics, 2012).

However, not all mineral deposits are accessible due to government policy, land restrictions (such as environmental protection areas), and other competing uses e.g. less than 40 percent of iron ore and coal reserves are accessible⁸ (Geoscience Australia, 2015).

Regardless, primary exports remain strong, with the top two resources iron ore and coal accounting for 20.2 percent and 11.6 percent of Australia's export value respectively.

According to the Bureau of Resources and Energy Economics, between 2010 and 2025, there will be growth in consumption of key resources in NSW and in Australia more broadly. Global thermal coal consumption is projected to grow at an average annual rate of 1.7 per cent, metallurgical coal at 3.6 per cent, iron ore at 4 per cent and natural gas at 1.5 per cent. Reflecting higher global consumption, world trade in these commodities over the period 2010 to 2025 is projected to increase at an average annual rate of 2.6 per cent for thermal coal, 3.6 per cent for metallurgical coal, 4.3 per cent for iron ore and 1.4 per cent for natural gas.

⁸ 38 percent of Iron Ore deposits and 36 percent of coal deposits are currently accessible

Most mineral prices are set to rise after falling from highs reached in the early 2010s, although they are unlikely to reach the previous price highs. Iron ore is an exception, experiencing downward pressure from increasing supply (Heber, 2014). The price of coal has recently recorded a strong rise after new mining restrictions curbed production in China.

“Of all the goods that NSW exports internationally, coal is the highest export earner, representing \$12.8 billion in 2014-15.”(DFAT, 2015)

Coal accounts for 61 percent of primary industry employment, primarily being mined from the Hunter Valley. This means that climate change, and more specifically, climate policy may have a significant impact on demand for coal into the future. Japan is Australia’s largest export market for coal, buying 34 percent or \$12 billion, followed by China at 24 percent or \$8.6 billion (Latimer, 2016).

Both countries have ratified the 2015 Paris climate treaty, which seeks countries to adopt emission pathways consistent with holding the increase in the global average temperature to well below two degrees centigrade above pre-industrial levels, and pursuing efforts to limit the temperature increase to 1.5 degrees centigrade above pre-industrial levels and implement a post-2020 emissions reduction policy (United Nations, 2015).

As part of this agreement, Japan will be pursuing a reduction of 26 percent by 2030 compared to 2013 levels, with a key policy being increasing the use of renewable energy (to 22-24 percent) and nuclear power (20-22 percent). China’s CO2 emissions are forecast to peak in 2030, with their target being a reduction of 60-65 percent of CO2 emissions per GDP unit in 2030 compared with 2005 (Ministry of Foreign Affairs Japan, 2016).

Low carbon energy sources are growing rapidly, with renewable accounting for approximately half of all new power generation in 2014. This was led by growth in China, the United States, Japan and Germany (International Energy Agency, 2015). These changes will likely decrease the demand for coal exports in the long term as coal fired electricity generation decreases.

However, technology could improve competitiveness. According to the Department of Industry, Innovation and Science (DIIS), there is a strong potential that technology will be capable of automating the tasks of 44 per cent of Australian jobs in the coming decades, with routine tasks; those not requiring a level of creativity, the most likely become automated. A study conducted by Oxford University of the potential automation of industries in the United States was adapted to meet an Australian context by DIIS. This paper notes that a large proportion of jobs that may be found as part of the primary industry have a high likelihood of automation. However, a notable exception are jobs that will plan, design and oversee operations such as mining engineers. There are already a large number of NSW based companies that assist in the design and development of automated systems such as *NSW Automation*, *Automation Group*, *AUSCO Automation Engineering Services*, and *Switch Automation*.

Table 16 - Likelihood of automation in the Primary industry by occupation

ANZSCO	Occupation	Score
1111	Chief executives and managing directors	14.0
1112	General managers	14.0
1323	Human resource managers	11.3
1332	Engineering managers	25.0
2336	Mining engineers	12.0
3123	Electrical engineering draftspersons and technicians	77.3
3124	Electronic engineering draftspersons and technicians	82.8
3125	Mechanical engineering draftspersons and technicians	56.1
3126	Safety inspectors	21.1
3223	Structural steel and welding trades workers	83.2
3999	Other miscellaneous technicians and trades workers	46.6
7119	Other machine operators	75.2
7121	Crane, hoist and lift operators	72.0
7122	Drillers, miners and shot firers	75.0
7123	Engineering production systems workers	81.8
7129	Other stationary plant operators	61.7
7212	Earthmoving plant operators	93.2
7213	Forklift drivers	91.0
7219	Other mobile plant operators	82.1
7313	Train and tram drivers	75.8
7331	Truck drivers	78.4

Source: Department of Industry, Innovation and Science

The primary industry cluster is already undergoing significant changes due to technology, and automation isn't a new concept, with companies such as Rio Tinto already embracing automation through their *Mine of the Future* program⁹. This program includes 69 autonomous trucks already in operation in the Pilbara and automated drilling systems that were trialled at West Angelas in preparation for deployment across the Pilbara operations (Rio Tinto, 2014).

Despite this roll out and the likelihood of automation in the future, over 150,000 new jobs were created in the mining sector between 2003 and 2014 (Bradley and Edmonds, 2015). This is likely due to the fact that while some routine jobs are being replaced by machines, other non-routine jobs are being created to support new operations.

In the event that the primary industry experiences a contraction in employment numbers, the productivity of the industry will increase as labour costs decrease and operational hours extend.

5.2 Agriculture








Agriculture, like the primary industry has a comparative advantage in NSW. Agricultural production is more widely spread across NSW than the primary cluster. As outlined in chapter 2, notable regions for agriculture include New England and the North West, and the Far West and Orana and food, in particular beef and meat is a key export. The sector may come under threat by climate change, particularly by the increasing challenge of water, and increased competition in international export markets from developing countries. However, the high agricultural growth rates in ASEAN and South Asian regions are from oilseeds and coarse grains, especially feed grains for livestock (Keogh, 2016).

⁹ Rio Tinto's Mine of the Future™ programme is about finding advanced ways to extract minerals deep within the Earth while reducing environmental impacts and further improving safety. More information on this program can be found at: <http://www.riotinto.com/australia/pilbara/mine-of-the-future-9603.aspx>

Australia is not a major exporter of these products, so it is likely that NSW, and more broadly, Australia will maintain its competitiveness in this industry.

This industry is an integral part of supply chains across the State and is estimated to employ close to 77,000 workers in NSW and generate approximately \$6.3 billion of GVA (or economic output) in 2016, which represents between one and two percent of total economic activity across the State.

The agriculture cluster relies heavily on professional and financial services and manufacturing clusters to support its business operations. Agricultural outputs are used in the other manufacturing and other traded services clusters including furniture manufacturing and residential construction. The agriculture cluster relies on infrastructure services, in particular water and road infrastructure.

	Australia is endowed with natural resources	Australia is home to large amounts of prime agricultural land that supports a variety of produce and livestock.	Strength
	Exports in resources are strong	Agricultural exports account for some 16 percent of total goods exports (in value). Over 60 percent of total goods exports are destined to the fast growing Asian markets. However, agricultural producers in South America and Asia are increasing their market share at the expense of Australian farmers.	Neutral
	Climate change may impact on production	Climate change may impact on the viability of some parts of NSW. It can also increase the risk of natural disasters (such as flooding and fire), and on the supply of water.	Risk
	Technology will play a large role in the development of agriculture	Technological advances such as agtech and automation will impact on the agriculture industry. The effect overall is likely to be positive.	Strength
	Regulatory environment reducing competitiveness	Environmental and other regulations are reducing the competitiveness of Australian farmers (AFI and PC).	Risk
	Limited land supply	Limited supply of suitable land and in some areas, competition for that land is putting a cap on production growth.	Risk
	The population is increasing	Demand for food will increase as the global population grows, with NSW alone expected to grow to 9.9 million people by 2036	Strength

Food is a key export of NSW, with beef and meat (excluding beef) both within the top 10 good exports in 2014-15¹⁰, taken together beef and meat (non-beef) represented roughly 20 per cent of the value of coal exports in 2014-15 (DFAT, 2015).

¹⁰ Beef came in a number three (\$1.7 billion) and meat (excluding beef) is number 7 (\$682 million).

However, competition for agricultural exports may increase with agricultural production now growing in regions like Latin America and Asia. According to the World Bank, Latin America now represents 13 percent of agricultural up from either percent in the mid-1990s.

“Latin America is home to about 28 percent of potential new arable land (second only to sub-Saharan Africa). And despite droughts and water scarcity in some sub-regions, it also holds the highest share of renewable water resources.” (World Bank, 2016)

Despite this, it is not all bad news for Australian competitiveness going forward. Unlike minerals, which experienced a decline in value, the value of food exports increased by \$5 billion, or 14 per cent, between 2014 and 2015 (Austrade, 2015). This has been supported by the fact that Australian produce, particularly beef, has a strong reputation with Asian markets as being ‘clean, green and safe’, due to the best practice management measures adhered to throughout the production process; the provenance of Australian products is largely traceable throughout the export process (Meat and Livestock Australia, 2016).

In addition, as global population grows there will be a compensating increase in demand for food. To meet future food demand, agricultural production will need to increase by 50-70 percent. By 2050, population growth in six countries alone are expected to exceed 300 million: China, India, Indonesia, Nigeria, Pakistan, and the USA (United Nations, 2015). This is likely to strengthen our trade balance as three of these nations are in the top 10 Australian agricultural export markets. In addition, the continuing development of Asia will increase the demand for key exports, such as beef.

Table 17 - Major agricultural export markets

Major agriculture export markets	CY2014 A\$m	Share of Total
Total all countries	42,093	
China	8,290	19.7
United States	4,320	10.3
Japan	3,992	9.5
Indonesia	3,329	7.9
Republic of Korea	2,602	6.2
EU28a	2,589	6.15
New Zealand	1,568	3.7
Malaysia	1,283	3
Vietnam	1,227	2.9
Singapore	1,083	2.6

Source: Department of Foreign Affairs and Trade

Agriculture has always been a key industry for Australia, with over 50 percent of land being classified as agricultural. However, the percentage of land that is used for agricultural purposes has declined since when it peaked at 63.5 percent, dropping to 51.6 percent in 2013. There is a correlated increase in the land under cereal production and permanent cropland (World Bank, 2016), which may reflect that crops require 28 time less land than beef production, the most land intensive of livestock (Eshel, G, et al, 2014). In addition, mixed farming; using the same land for both crops and livestock can improve the productivity of land.

Climate change will be a key concern for the agricultural industry. There are three primary risks arising from climate change, namely increasing water scarcity, impact on soil properties, and the impact of more severe and frequent natural disasters. Australia’s long-term annual average rainfall is 472

millimetres (mm), the lowest of all the continents (except Antarctica) and average annual rainfall across much of Australia has already dropped by a third since 1980, but appears to have stabilised at these levels (World Bank, 2016). The variability in Australia's climate exacerbates this issue, with drought resulting from El Nino years, and higher than average rainfall in periods of La Nina.

These weather patterns also exacerbate the incidence of extreme events. Climate model projections indicate an additional warming of between 1 and 5°C for Australia by the end of this century, depending on the emissions scenario. In the near term, warming in NSW is expected to be highest in spring and summer by still expected to be below 1 degree (Olson, et al, 2016). For rainfall extremes, projections for 2100 show longer dry spells interspersed with periods of increased extreme rainfall over much of Australia. Extreme fire weather will become more frequent and intense in the south and east, with a shorter period for controlled fuel-reduction burning. Droughts will be more frequent in the south. Tropical cyclones will occur less often but with a greater proportion of high intensity storms (CSIRO, 2015).

The Department of Environment and ABARE modelling conducted in 2007 has forecast declines in key agricultural sub-sectors, in comparison to a world without the effects of human-induced climate change.

Table 18 - Potential decrease in production attributable to climate change

	Approximate decline in production by 2030 (percent)	Approximate decline in production by 2050 (percent)
Wheat	8.4	11.6
Beef	0.7	3.0
Sheep meat	8.1	13.2
Dairy	5.5	11.3

Source: Department of Environment

In a recent report released by the Office of Environment and Heritage regarding the potential impacts of climate change on soil properties the following expected changes over the coming decades were noted:

- An overall slight to moderate decline in SOC stocks over most of the state is predicted, although a slight increase is predicted over some regions, particularly in the western and central western regions.
- Only a minor change in pH (acidity) over most of the state is predicted. Most regions are predicted to undergo a slight increase in pH (i.e. they will become more alkaline), whereas the western regions will undergo a substantial decrease in pH (i.e. they will become more acidic).
- A moderate and complex pattern of change is predicted in the sum of bases (reflecting soil macro-nutrient content) over most of the state. Most regions will undergo a modest increase, whereas many northern, and some central, areas will undergo a substantial decrease (Office of Environment and Heritage, 2015).

Despite the number of potential weaknesses and sources of uncertainty noted in the modelling approach and forecast period, the results were said to be important for guiding the management of agricultural and native landscapes in NSW over the coming decades.

Government policy may also be a risk to agricultural growth. However, in terms of encouraging exports, the outlook is positive. The Australian Government has been involved in a number of agricultural trade reforms to support export competitiveness such as; bilateral and regional negotiations like the Australia-China Agricultural Cooperation Agreement (ACACA) Programme. Australia has participated in the WTO Ministerial Conference and is actively working to reduce subsidies.

Technology will be key to improving productivity and adapting to climate change. The Internet of Things, or the agriculture industries subsector of IoT Agtech, will be key to improving productivity in agriculture. Agtech is defined as the collection of digital technologies that provide the agricultural industry with the tools, data and knowledge to make more informed and timely on-farm decisions and improve productivity and sustainability. Modern Agtech sets itself apart from the ongoing historical technological contribution to agriculture because of the speed with which the technology can scale and reach a global market.

There are already Agtech innovations being implemented on farms such as The Yield, which uses on farm sensors and customised data services to assist farmers to maximise their yield. NSW is already playing a key role in the development of this technology. The Department of Primary Industries (DPI) is working with various partners to develop Agtech products including Farm Decision Technologies (FDT), Precision Livestock Management in sheep, unmanned aerial vehicles (UAV), decision support tools via smartphone apps, and IrriSAT Irrigation Management.

DPI is also collaborating with University of NSW, Cisco, Data 61 and NSW Farmers to development Innovation Central Sydney (ICS), a connected community focussed on cloud, analytics, cybersecurity and Internet of Everything platforms (KPMG, 2016). This sort of technology can be used to monitor peak harvest times, and track soil and weather conditions. These sorts of innovations will be crucial to improving productivity and minimising the impact of climate change.







5.3 Advanced Manufacturing

Advanced manufacturing (A-M) is currently not a strength for NSW, with manufacturing decreasing its share of GSP as other industries such as finance and professional services grew. However, NSW has the potential to grow this industry given the state's high education rate and the growth of professional and technical jobs, particularly in Western Sydney. Investment in research and development and government support for the uptake of new technology will be important to facilitating this growth.

The A-M sector includes any manufacturing process that takes advantage of high-technology or knowledge-intensive inputs as an integral part of its manufacturing process, such as chemical and medicinal manufacturing, vehicle and transport manufacturing, professional and scientific equipment manufacturing, computer and electronic manufacturing and specialised machinery and equipment manufacturing (ABS, 2013-14). The A-M cluster is estimated to employ close to 62,000 workers across the State and generated approximately \$8.8 billion of GVA in 2016. This represents between one and two percent of total economic activity across the State.

Even though the manufacturing industry has generally been in decline, it still makes up a substantial part of NSW's exports. For example, medical instruments (including veterinary) and miscellaneous manufactured articles (mainly orthopaedic appliances) were the 6th and 9th highest good export earners respectively for the State in 2014-15. Taken together, the value of these exports in 2014-15 are similar to the value of beef exports (Department of Foreign Affairs and Trade, 2015).

The A-M cluster is most reliant on road infrastructure to access/transport products to markets as well as electricity given the high capital intensity of production. It also relies heavily on professional and financial services and other manufacturing industries to support its business operations.

	Advanced manufacturing is not currently competitive	Currently, manufacturing is not a strength for Australia and the rate of manufacturing has been in decline. The recent closures of the last automotive plants are a notable example.	Risk
	Climate change may create opportunities	Green energy is a growing market, creating jobs in the manufacture of green technology. There are also opportunities in the production of other growing technological industries.	Strength
	Technology is going to revolutionise manufacturing	Automation and the development of 3D printing will be key to making manufacturing a viable industry for growth in Australia.	Strength
	Regulatory environment needs to support investment	Government regulation and policy will need to support the rise of 'smart specialisation'; a shift from larger, vertically integrated organisations to smaller niche production units. Support for innovation and research and development is also essential.	Risk
	Other countries are making investments in manufacturing	First mover countries will have an advantage in this industry. Germany, Japan, Korea and the UK have current capacity for growth and Brazil and China have emerging capabilities. (Wilson centre, 2016)	Risk
	Australian education levels are among the highest globally	The Program for International Student Assessment (PISA) ranked Australia 13 th globally. High education levels and skilled labour were the 2 nd and 3 rd most cited reasons for the reasons for competitiveness in Australia by (IMD World Competitiveness Index).	Strength

Around the world, structural changes are taking place in the manufacturing sector and Australia will have to adapt to keep up. The growth of the IoT, as well as the rate at which everyday life is becoming digitised, means that manufactured goods are becoming more complex. Manufacturing plants are also benefiting from this technological development. Smart specialisation involves the shift from larger, vertically integrated organisations to smaller, independent, niche production units across global value chains. There are over 1,000 Australian micro-multinationals already, spread across high value segments such as media, defence electronics, medical devices, renewables and precision engineering. A notable example is NSW based microphone manufacturer RØDE Microphones.

Two key examples of countries with emerging capabilities in advanced manufacturing are Brazil and China. Brazil has focussed research and development investment as well as requiring industry to invest in research through several programs that encourage development geographically across states. It has also focussed on education, encouraging students to obtain manufacturing relevant advanced degrees and working for the industry post-graduation. China has invested in several innovation strategies to grow its advanced manufacturing sector, primarily through early adoption on new technology, and tailoring it for both defence and domestic purposes. Target industries include energy, information technology and biotechnology (Wilson Centre, 2016).

NSW is well positioned to support the growth of these niche companies, given the high level of education, and growth in professional and technical services in regions such as Western Sydney.

Manufacturers are increasingly looking for breakthrough innovations and are increasing investment into research and development.

Investment in research and development as well as partnering with universities is a crucial requirement to foster innovation. Western Sydney University (WSU) has focussed on improving courses and facilities to do just that. As part of this transformation, WSU opened a 'MakerSpace' in its Penrith campus offering open access to its 3D Printers, fabrication equipment and robotics, key technology that will transform the way manufacturing is undertaken. In addition, a major change in manufacturing production in the short term is not unrealistic. According to KPMG International's 2016 Global Manufacturing Outlook (GMO), a quarter of manufacturers have invested in 3D printing, with a further 31 percent certain to invest over the next two years.

"The possibilities are endless when you take away the limitations of traditional building and manufacturing processes. The true potential of 3D printing will be unleashed with the next generation who will grow up not thinking that a house needs to be built with bricks and mortar over a year, but printed as a holistic single product in a matter of hours." (Ismail, 2015)

The automation of routine jobs will support the development of micro-multinationals, as fewer employees are required per firm, and it will reduce the need to warehouses and other overheads. The likelihood of automation of traditional manufacturing jobs is high, however; skilled non-routine workers such as engineers and ICT workers will be in high demand. The productivity increases afforded by automation will also make manufacturing more productive and profitable.

However, Government will have to be agile in dealing with any regulatory conflicts that may arise, such as those resolved and ongoing in NSW for Uber and Airbnb respectively. Delays in supporting changes to production process, location preferences or a number of other potential conflicts could hamper the growth of this industry in NSW.

In NSW, the growth of Western Sydney Airport is an opportunity to develop the currently uncompetitive advanced manufacturing industry, especially if there is support for the growth of micro-multinationals. It is an ideal industry for investment given Australia's access to raw materials and the relatively capital (rather than labour) intensive nature of advanced manufacturing.

Looking forward, there will be significant opportunity to accommodate industries in this cluster further in Western Sydney, with the construction of Western Sydney Airport and Moorebank Intermodal Terminal, as well as the associated transport improvements. Strong motorway connections to Port Botany and regional NSW (and beyond) as well as freight rail connections, suit advanced manufacturing's reliance on transport. In addition, Sydney's highly educated workforce, and the likelihood that this region will have new, fast and reliable fibre optic internet installed as part of the land release will also support the growth of this industry.

Table 19 - Likelihood of automation in the Advanced Manufacturing industry by occupation

ANZSCO	Occupation	Score
1334	Manufacturers	3.0
1335	Production managers	5.5
2335	Industrial, mechanical and production engineers	2.1
2344	Geologists and geophysicists	53.2
2346	Medical laboratory scientists	59.8
3112	Medical technicians	61.7
3114	Science technicians	55.0
3122	Civil engineering draftspersons and technicians	63.0
3123	Electrical engineering draftspersons and technicians	77.3
3124	Electronic engineering draftspersons and technicians	82.8
3125	Mechanical engineering draftspersons and technicians	56.1
3211	Automotive electricians	59.2
3221	Metal casting, forging and finishing trades workers	92.2
3222	Sheetmetal trades workers	80.7
3223	Structural steel and welding trades workers	83.2
3231	Aircraft maintenance engineers	52.4
3232	Metal fitters and machinists	64.4
3233	Precision metal trades workers	55.8
3234	Toolmakers and engineering patternmakers	79.0
3241	Panelbeaters	80.7
3242	Vehicle body builders and trimmers	68.2
3243	Vehicle painters	79.6
3422	Electrical distribution trades workers	7.3
3423	Electronics trades workers	47.9
7119	Other machine operators	75.2
7123	Engineering production systems workers	81.8
7213	Forklift drivers	91.0
7219	Other mobile plant operators	82.1





Source: Department of Industry, Innovation and Science

5.4 Other Manufacturing

The other manufacturing industry's share of the economy has been decreasing as other industry clusters grow such as finance and professional services. While it is still and will continue to be an important and even nationally competitive industry for NSW, particularly for food manufacturing it is not likely to be internationally competitive.

The other manufacturing (O-M) cluster is estimated to employ close to 133,000 workers across the State and generate approximately \$19.6 billion of GVA (or economic output) in 2016, which represents between four to five per cent of total economic activity across the State. The O-M cluster relies on infrastructure services such as road infrastructure to access/transport products to markets as well as electricity given the high capital intensity of production.

In contrast to A-M, O-M is more spread out across the NSW geography. While the sector can grow, it is unlikely to be as significant as A-M due to its labour intensive nature and strong international competition, although it is still an important industry in terms of food processing, such as meat and poultry. This is particularly important for centres throughout regional NSW, such as Tamworth, Dubbo and Griffith.

	Other manufacturing is not currently competitive	Manufacturing has been in decline. According to the World Bank decreasing by 1.2 percent in Australia in 2014 because of the high cost of wages. (World Bank, 2016)	Risk
	Technology is going to revolutionise manufacturing	Automation and the development of 3D printing will be key to making manufacturing a viable industry for growth in Australia.	Strength
	Regulatory environment needs to support investment	Government regulation and policy will need to support the rise of 'smart specialisation'; a shift from larger, vertically integrated organisations to smaller niche production units. Support for innovation and research and development is also essential.	Risk
	Other countries are making investments in manufacturing	First mover countries will have an advantage in this industry. Germany, Japan, Korea and the UK have current capacity for growth and Brazil and China have emerging capabilities. (Wilson Centre, 2016)	Risk

O-M will still experience some productivity improvements. Like A-M, the automation of routine jobs will improve the efficiency of the sector, as fewer employees are required per firm, reducing the cost base of businesses as a consequence. The likelihood of automation of traditional manufacturing jobs is high, however, skilled non-routine workers such as engineers and ICT workers will be in high demand. The productivity increases afforded by automation will also make manufacturing more productive and profitable.

In addition, other countries are investing in their O-M industry as wages rise in traditionally strong manufacturing countries like China. The Welsh Government has invested heavily in a plan to grow their Food and Beverage industry by 30% by 2020 with a strategy called 'Towards Sustainable Growth – An Action Plan for the Food and Drinks Industry 2014-2020'. Wales has an interesting mix of characteristics that have previously made it appealing to global manufacturers such as Kellogg's and Unilever and have leveraged off those strengths. The strategy involves offering non-repayable loans and schemes to support capitalisation and establishment in the Welsh market. Additionally, the government is throwing support behind innovation and R&D, and is developing technologies that are being used in food products globally (Welsh Government, 2016).

However, it is not likely that this industry will be internationally competitive. O-M is tied heavily to Australia's strong agricultural industry, and while this provides a base, it is likely Australia will still find it difficult to compete with overseas markets and is heavily reliant on Government support and contracts with local retailers.

A good example of this is Coca-Cola Amatil-owned fruit processor SPC and their efforts to secure the future of their cannery operations at Shepparton and Kyabram. SPC, with government support, agreed a five year supply contract with Woolworths in 2014 to supply tinned fruits to the supermarket under their 'Woolworths select' branding.

This was despite the fact that it was cheaper for the supermarket to source tinned Italian tomatoes and canned and processed fruit imported from China instead. However, Woolworths has now decided to








source tinned tomatoes overseas, rather than through the agreement with SPC, leaving the business more vulnerable.

5.5 Finance and Professional Services

Finance and professional service industry is a key employer in NSW. It is supported by high rates of education and a relatively young urban population. While NSW currently has a comparative advantage in this industry, maintaining a reasonable cost of doing business including the cost of office accommodation, and the effectiveness of infrastructure will be important to maintaining this competitiveness.

This cluster is estimated to employ close to 500,000 workers across the State and generate approximately \$120 billion of GVA in 2016. This represents between 15 to 20 percent of total economic activity across the State. The finance and professional services cluster relies heavily on transport and communications and other local services to support its business operations and relies on infrastructure such as communications and aviation in order to share knowledge and ideas with key stakeholders.

Finance and professional services are heavily concentrated in the centre of Sydney and in other centres of activity, such as Parramatta. The finance and professional services sector is expected to continue to grow, however, the rate of this growth will be reliant on changes to Government policy to address Australia's competitiveness.

	Sydney is a competitive financial centre	The Global Financial Centers Index ranks Sydney as the 11 th most competitive globally, up 6 places from the previous period. However Singapore, Hong Kong and Tokyo are ranked higher than Sydney in the GFCI overall index and may impact on this competitiveness as Asia continues to develop.	Neutral
	Australian education levels are among the highest globally	The Program for International Student Assessment (PISA) ranked Australia 13 th globally. High education levels and skilled labour were the 2 nd and 3 rd most cited reasons for the reasons for competitiveness in Australia by (IMD World Competitiveness Index).	Neutral
	Young urban and fast growing population	Compared to developed countries, Australian cities have the second youngest populations and projected to grow fastest.	Strength
	Automation of routine jobs is probable	Technological advances such as automation will replace some routine jobs in this sector, however; the improvement in flexibility and ability to collaborate will have a positive economic outcome.	Strength
	Institutional strengths are key to competitiveness	The effective legal environment and strength of corporate governance were cited as the 1 st and 4 th most attractive factors about the Australian economy (IMD WCI).	Strength
	Cost of living in Sydney is among the highest in the World	House prices in Sydney are nearly 10 times median incomes, making it the 3 rd most expensive city in the world. Coupled with high costs of living overall and taxation levels might make it less attractive for footloose international staff.	Risk
	Uncompetitive and inefficient taxation system	The IMD World Competitiveness Index cited Australia's taxation system as a key weakness.	Risk

Sydney rates well internationally for its finance industry, and this has been improving according to the 2016 Global Financial Centres Index. Noting a slightly weakened position on factors, Sydney is still rated in the top 10 for the business environment, infrastructure and reputation competitiveness sub-indices.

“Australasian centres are doing well. Three of the top five global centres are Asian. Hong Kong and Singapore had some small declines. Sydney and Melbourne both saw solid increases in their ratings.” (Z/Yen Group, 2016)

High rates of education and a relatively young urban population support the performance of this cluster. NSW has key strengths in the banking, accounting, computer system design, legal and engineering sub-sectors, making up almost 50 percent of employment in the financial and professional services

sectors. While there are a range of positive influences on this sector, cost of living pressures, and relatively high taxation will continue to be a key risk for financial and professional services.

KPMG's 2016 *Competitive Alternatives* report identifies Sydney as third of the four Australian cities ranked (Sydney, Melbourne, Adelaide and Brisbane), with Brisbane cost of industrial leasing and utilities increasing its business costs. Although Australia as a whole has experienced an improvement in competitiveness, the key cost factor trends for Australia since 2014 include:

- 22.3 percent currency depreciation against the USD;
- Below-average increase in total labour costs;
- Increase in lease costs for industrial and downtown office space; and
- Decrease in utility costs, for both electricity and natural gas.

In addition, the World Economic Forum rates Australia's 'effect of taxation on incentives to invest' lower than both the developed and developing country averages (World Economic Forum, 2016).

"The rise in value of the US dollar relative to the Australian dollar in 2015 is the primary driver of Australia's improved cost index in 2016 and the improvement in rankings for the Australian cities. However, other cost trends as noted in the table help Australia to move ahead of France, the UK and Japan in the current study."

However, when taking into account the broader business environment, Australia's competitiveness is decreasing. The IMD 2016 *World Competitiveness Yearbook* looks at economic performance, government efficiency, business efficiency and infrastructure. While still ranking 18th out of the 61 countries assessed, Australia has decreased in all categories with major concerns including:

- Australia's ability to foster innovation in the services sector;
- The need to invest in technological and scientific infrastructure; and
- Government efficiency, including taxation (CEDA, 2015).

Providing adequate opportunities for finance and professional services to utilise technology improvements (through Government facilitation programs and partnership with universities) will be key to improving competitiveness. Fast and reliable communications infrastructure will be essential to facilitating the uptake of technology in this sector.

5.6 Transport and Communications

Transport and Communications are essential to support our open economy. Australia's openness to trade and reliance on agricultural and primary resources as exports is a positive outcome for transport and communications, as these industries generate strong demand for freight transport. The growth of finance and professional services is also key because of their strong reliance on communications. As these industries grow, so will the demand for supporting services, such as logistics. Transport and communications will grow in line with the key traded industries of agriculture, primary and finance and professional services.

The cluster is estimated to employ close to 170,000 workers across the State and generate approximately \$37 billion of GVA in 2016. This represents between five to eight percent of total economic activity across the State. The transport and communications cluster relies heavily on professional and financial services and other local services to support its business operations.

The transport and communications cluster is an essential enabler of growth and competitiveness in New South Wales. It facilitates efficient trading between firms, allows workers to access job opportunities, transfer knowledge and ideas to key stakeholders across Australia. In particular, the transport and communications cluster provides a range of services to the domestic traded and local clusters including

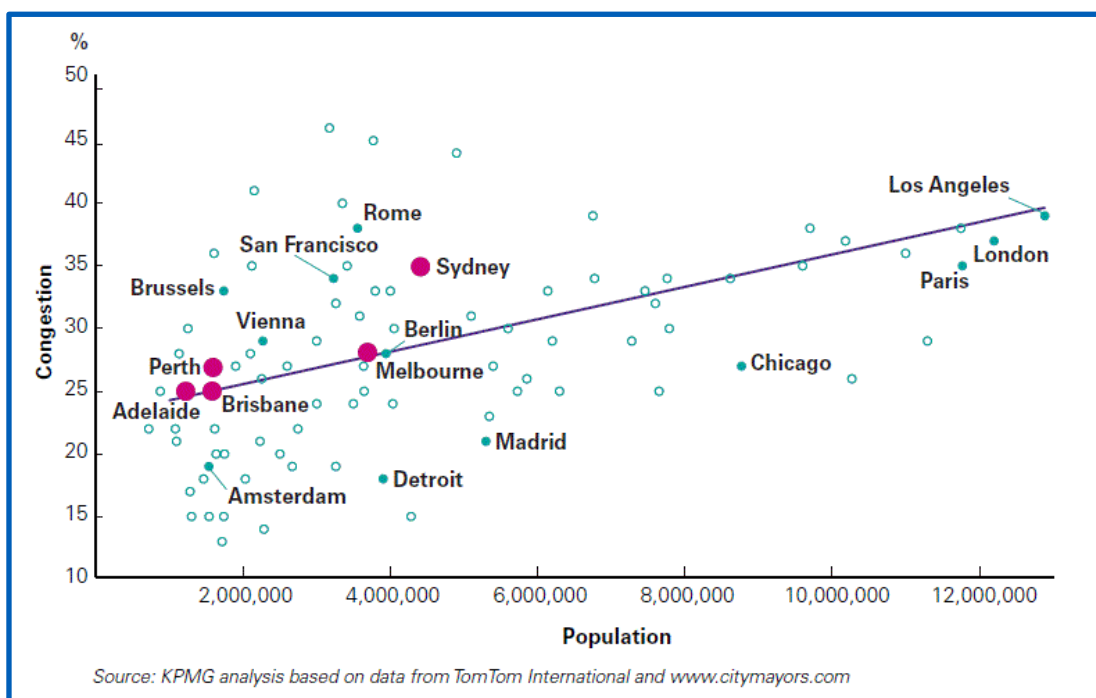
professional and services cluster, in the form of internet services providers and telecommunication services, and transport services to the retail and wholesale trade cluster.

	Agriculture and Primary are buyers of traded transport	The strength in the agriculture and primary industries means strong demand for logistics.	Strength
	Freight is being impacted by network congestion	Freight is impacted by congestion on urban roads and face timetabling issues where freight rail must share with passenger rail services.	Risk
	Automation will revolutionise freight transport	Technological advances such as automation will impact heavily on transport and communications. While efficiency gains will be made, this will also result in some job losses.	Neutral
	Regulatory environment reducing competitiveness	Government policy and regulation will be essential to reducing congestion and implementing new technology such as automated vehicles.	Risk

This cluster is becoming increasingly impacted by network congestion. While in the communications space, the National Broadband Network (NBN) will help cater for some of this increased demand, there are physical restrictions on the expansion of roads and rail networks, particularly in and around Sydney that are impacting on travel times and efficiency. More recently, the rise of e-commerce is creating new delivery patterns for freight vehicles, delivering goods and services directly to people's homes. Online sales continue to experience double digit growth and are expected to see sustained growth in the future. The rise of alternative retail platforms has meant that freight and light commercial vehicles are more prevalent on the inner city road network.

Analysis by Infrastructure Australia shows that the cost of road congestion in the Sydney-Newcastle-Wollongong region will grow by almost 300 percent from \$5.5 billion in 2011 to \$14.7 billion in 2031 (Infrastructure Australia, 2015). In comparison to other international capital cities, Sydney is particularly congested for its population as demonstrated in Figure 30. Without intervention, these delays will have serious impacts on the direct and indirect cost to logistics and those industries that rely on them.

Figure 27 - Rate of congestion across cities



Source: KPMG

There are two key changes that have the potential to grow and support this industry. The first key change is government policy through regulatory support. For example, through the implementation of travel demand measures (such as pricing to help reduce the demand from private vehicles), and/or supporting technological development and innovations (such as regulation of automated vehicles; and in supporting the separation of freight and passenger transport where possible).

The second key change is technology and innovation. There are some realistic changes in the pipeline, such as automated vehicles, which will significantly improve the competitiveness of logistics transport. Already automated vehicles are being utilised in close network settings such as the use of automated trucks in mines, and driverless train systems internationally – examples include the Barcelona Metro and Vancouver SkyTrain.

The potential growth of micro-multinationals in the manufacturing space may also impact on the way in which domestic logistics operate. The small scale operations afforded by technology such as 3D printing could facilitate these companies clustering close to either domestic users of the goods or close to international gateways, reducing the need for long distance haulage.

The rise of online retailing is also impacting on this industry. Customers expect faster response times to both domestic and international orders and many sites offer same day delivery services. This has resulted in a higher demand for air freight and an increase in small and midsize delivery vehicles. Analysts predict that the Global Air Cargo market to grow at a compound average annual growth rate (CAGR) of 6.0 percent over the period 2014-2019 (Research and Markets, 2015).

However, with Australia's growing appetite for the convenience of the internet and being increasingly connected, and a fast developing and changing technological landscape, communications networks and operation will need to consider how to handle this future demand. Government support will be essential to ensuring Australia can be a leader, and not a follower, in this sector.

5.7 Traded Health and Education

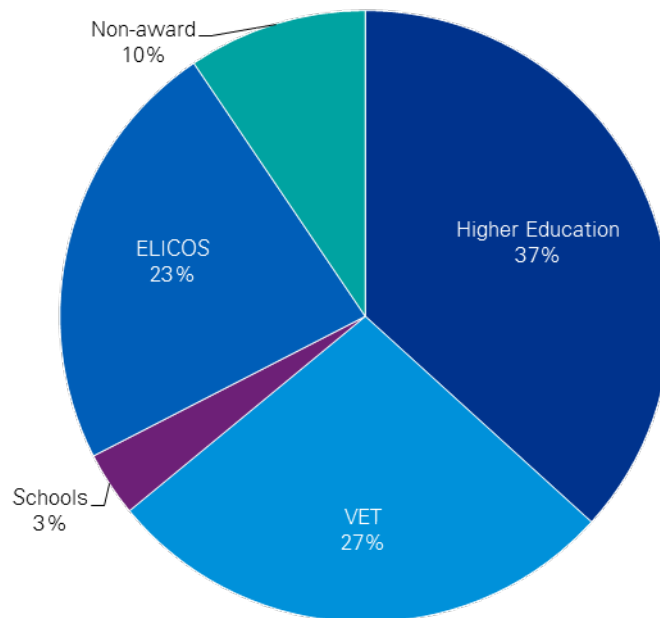
NSW is well placed to support the growth of the traded health and education sector due to NSW's high level of education, technological development and strong investment in research and development. Health research is predominately conducted and funded through the higher education sector, so encouraging collaboration between universities and hospitals with strong research facilities will be important to growing traded health in NSW and a key strategy to developing a comparative advantage in this industry in the future

This cluster is estimated to employ close to 64,000 workers across the State and generate approximately \$28 billion of GVA in 2016, which represents between three to five percent of total economic activity across the State. The traded health and education cluster relies heavily on professional and financial services and advanced manufacturing to provide instruments and machinery. It is broadly reliant on a range of infrastructure services (including communications, road, aviation, and electricity). Traded health and education is concentrated in Sydney's Eastern Suburbs, Illawarra and Macquarie Park.

The provision of education services in Australia is highly regarded internationally. Australia has six of its universities in the top 100 universities globally, of which two are based in NSW. *In the Times Higher Education World University Rankings 2016-17* Sydney University came in 60th place, and the University of NSW was 78. University of Newcastle was in the top 250, while Griffith University, Macquarie University, University of Technology and University of Wollongong were all in the top 300.

This is also reflected in the high demand for education from international students. In 2016, almost 330,000 international students studied at various institutions across Australia, with 37 percent of those classified as higher education students (see Figure 31). This represents an 11 percent increase on commencing students in 2015, although when higher education student numbers are only considered, this increase lifts to almost 15 percent.

Figure 281 - International students by education sector









Source: International Education

As Asia continues to develop, there will likely be an increase in demand for education from international students. Currently, the top three countries that international students in Australia are originating from are China, India and Malaysia. These same countries are also experiencing the highest rate of growth of residents seeking to study offshore at 17 percent, 11 percent and 16 percent respectively (International Education, 2016).

International demand for education also has positive flow on effects in the economy. Education-related travel services was the third highest good or service exported in 2015, totalling \$18.8 billion and making up 5.9 percent of exports. This represents a 10 percent increase on 2014 figures (Austrade, 2015).

However, the anticipated growth in demand for education may not necessarily be predominately fulfilled by Australia. Asian universities are also highly regarded and may be a preferred choice for their citizens. When comparing the same university rankings, there are a number of Asian universities that already perform better. Notably, the National University of Singapore and Peking University in China are ranked

at 24 and 29 respectively – compared to Australia’s highest ranking university, which is the University of Melbourne (ranked at 33rd).

	Australian education levels are among the highest globally	The Program for International Student Assessment (PISA) ranked Australia 13 th globally. High education levels and skilled labour were the 2 nd and 3 rd most cited reasons for the reasons for competitiveness in Australia by (IMD World Competitiveness Index).	Strength
	Australian universities are globally recognised	Six Australian universities made the 2016 QS World University and Times Higher Education Rankings top 100.	Strength
	Demand for international education is strong	There is strong demand for education from international students, with commencements growing by 11 percent between 2015 and 2016.	Strength
	Demand from Asia is expected to increase	As Asian nations continue to develop, it is likely that there will be a corresponding increase in demand for health and education services in Australia. However, the development of these offerings in Asian countries may also increase competition.	Neutral
	Health and Medical Research investment is significant	Australia invests heavily in health related research and development and more than half of all research is undertaken in the higher education sector (Research Australia, 2016).	Strength
	Technology will make education more accessible	Technological advances will enable education and in some cases health research to be conducted remotely and will improve access to knowledge and data.	Strength

Fostering collaboration between health and education as health research is predominately conducted and funded through the higher education sector as demonstrated in Table 20, so encouraging collaboration between universities and hospitals with strong research facilities will be important to growing traded health in NSW.

Table 20 - Health research and development funding by sector

Location of expenditure (\$m)					
Aust. Govt. (including agencies)	States & Territories	Higher Ed.	Not For Profit	Business	Total
198	479	3,271	824	1,124	5,896
3%	8%	56%	14%	19%	100%

Source: Research Australia

In NSW, The Office for Health and Medical Research with NSW Ministry of Health is a key support for the research and development in medical health through the provision of governance, fostering

education and research partnerships, supporting clinical trials and providing grants (Chief Scientist and Engineer, 2017).

Case studies of traded health and education clusters

There are many domestic and international examples of the well-established relationship between higher education research and innovation in the health sector. Health and education, by their nature, are geographically diverse industries when considering the breadth and depth of offerings. More technical elements of these industries, such as speciality practices in health and tertiary education benefit from clustering, and from co-location of health and medical education and research. These industries, while beneficial to one another, are not necessarily reliant on being centrally located, and therefore are ideal industries for satellite centres. However, it is not as easy as collocating a university and a hospital, specialisation and collaboration have to occur between the services, such as a high rate of STEM graduates and strong research and development at both the university and hospitals, as has occurred in Melbourne and Boston.

Melbourne, Victoria

Melbourne has a number of significant health and education clusters including the Parkville Precinct, Alfred Medical Research and Education Precinct, and the Monash University/Health Research Precinct. The Parkville Precinct, cluster contains many of Victoria's pre-eminent health research and education facilities, including the University of Melbourne, hospitals and research facilities located along Flemington Road and Royal Parade and the CSL site in North Parkville. In addition, there are numerous smaller health, research and education facilities within Parkville and Carlton. Many of the major institutions, such as the University of Melbourne and the Royal Melbourne Hospital, have been located in the precinct for over 100 years. Residential encroachment within the precinct has been limited by the small areas available for residential use and the heritage significance of the residential neighbourhoods.

The Parkville Precinct cluster has grown and developed organically and through the assistance of government policy and planning. The Parkville Precinct Strategic Plan was commissioned in 2004 and endorsed by the State Government in March 2006 after consultation with key stakeholders. The Plan put forward 20 recommendations for improving and sustaining the collaboration within the cluster, including:

- That strategic development of the Precinct be guided by a Network Body representing health services, research and educational facilities,
- That a communication strategy be developed to promote the Precinct locally, nationally and internationally, and
- That the institutions within the Precinct share infrastructure and common facilities where possible in order to reduce costs and boost integration (Parkville Precinct Planning Committee, 2006).

The precinct generates a relatively large number of research grants and has a number of nationally significant medical research institutions, including:

- The Bio21 Molecular Science and Biotechnology Institute, a flagship multidisciplinary research centre specialising in medical, agricultural and environmental biotechnology with 500 researchers, students and industry partners ranging from large biopharmaceutical research and development, to small emerging biotech companies; and
- The Melbourne Brain Centre which is a collaboration between the University of Melbourne, the Mental Health Research Institute, the Florey Neurosciences Institutes, Austin Health and Melbourne Health. It is the largest brain research centre in the southern hemisphere, and it houses over 700 employees, across two campuses, at The University of Melbourne in Parkville and the Austin Hospital in Heidelberg.¹¹

Boston, Massachusetts

Boston is a prime example of health, education and high tech industries benefiting from one another. As well as excelling in a number of high tech fields, Boston is also a centre for medical research in the Longwood Medical Area and surrounding Massachusetts General Hospital (MGH). Proximity to, and

¹¹ For more information, please see: <http://www.vcccproject.vic.gov.au/ThePrecinct>

opportunities to collaborate with researchers from institutions like MIT and MGH help Boston companies innovate.

The Longwood Medical Area is home to over 46,000 scientists, researchers and staff, and over 21,000 students and it continues to grow – in 2014 the Longwood Centre opened, adding an additional 350,000 square feet of research and development space in Boston's strongest life sciences cluster. In addition, the South End is home to Boston University's BioSquare Research Park, a 2.5 million square foot biomedical research park featuring the National Emerging Infectious Diseases Lab and fully built biotechnology startup space. In Cambridge, Charlestown and the West End, MGH has large research facilities with 6,000 researchers and almost one million square feet devoted to research activities.

In financial year 2014, Massachusetts received the most funding from the National Institutes of Health, five times the national average, with Boston receiving the most funding of any U.S. city for the 20th consecutive year. One example, of collaboration between institutions in Boston and Cambridge is the Broad Institute for biomedical science, which brings together researchers from Harvard, MIT, and five Harvard-affiliated hospitals located in Boston.

The Boston area is home to world class colleges and universities such as Boston University, Northeastern, Harvard, Boston College, UMass Boston, Tufts, Suffolk, Bentley, and MIT enroll over 150,000 students a year. A significant proportion of students study in the fields of Science, Technology, Engineering and Mathematics (STEM), which is consistent with the broader population of the Boston area, of which nearly 25 per cent of residents are qualified with a Bachelor's degree majored in a STEM field.

Future sites for traded health and education clusters

Greater Parramatta would be an ideal site for future health and education clusters, with strong growth in these industries already predicted. The district already has a strong base in health care and research through the partnership between Sydney University and Westmead Hospital through the Westmead Clinical School, Westmead Institute, and another ten research centres based in and around Westmead Hospital. The Westmead Institute is one of the largest medical research institutes in Australia. It has state-of-the-art laboratories with 400 staff focused on research into a wide range of human disorders affecting both adults and children. Westmead is also home to one of five Western Sydney local health district facilities.

In addition, University of Western Sydney (UWS) has a strong background in medical research and education, receiving funding for seven research projects from the Health and Medical Research Council in 2015. The UWS also plans to establish a Translational Health Research Institute, which will bring together clinical trials, insights into health practice changes, and emerging trends in community health.

Strong transport connections already support the partnership between Sydney University and Westmead, however, the growth of these industries may increase the demand between Parramatta and Macquarie Park and Norwest Business Park, where a number of international pharmaceutical and medical device companies are located.

As outlined in the examples above, as well as co-location of education and health facilities, there must be a strong focus on research and development within both sectors. In Boston's case, an important feature is that there is a large proportion of students studying and conducting research in medical and technical fields that also partner with major specialist hospitals in the area. In Melbourne's case, strategic coordination and planning across the health and education institutions supports such collaboration. These are key learnings that can be applied to emerging precincts in NSW.

5.8 Other Traded Services

Growing demand for tourism from Asia will be a key driver of growth for the other traded services sector. The introduction of a second casino in NSW, and the increasing share of digital gambling providers will also support the growth of this cluster. Ensuring good transport connections for tourist areas will be important to supporting this comparatively advantaged industry cluster.

This cluster includes the sub-sectors of electricity generation, the wholesale trade industry, employment, travel agency and other administrative services, gambling, heritage, creative and performing arts. The O-T-S cluster is estimated to employ close to 220,000 workers across the State and generate

approximately \$34 billion of GVA in 2016, which represents between six to nine percent of total economic activity across the State.

The O-T-S cluster is most reliant on electricity and road infrastructure. The high reliance of the other traded services cluster on electricity reflects the fact that other traded services includes the utility generation and distribution industries. It has strong trade connections with industries such as professional and financial services and other local services.

	The performing arts sector is growing	The performing arts sector in NSW is nationally significant, making up 38.4 percent of value added in 2012. The services have experience three percent growth since 2008, reflecting the increasing importance of touring as an income generator for the arts (Ernst & Young, 2014).	Strength
	Climate change may impact on production and services	Industries such as electricity generation and tourism will be impacted by the effects of climate change e.g. generation of renewable energy is likely to grow.	Strength
	Technology is changing traded services	Technology is already impacting on a number of other traded industries, for example; interactive gambling is the fastest growing mode of gambling, and the rise of airbnb is changing the way tourism accommodation is provided.	Strength
	Changes to policy and regulation will impact on gambling	Potential regulatory changes required to keep up with technology, the gambling industry being a key example will impact upon the growth profile of these sub-sectors	Risk

“NSW is Australia’s pre-eminent State for film and television production, with 57 percent of all Australian drama production in 2012-13 taking place in NSW with production expenditure of \$430 million; 81 percent of all Australian drama production was generated by NSW-based production companies.” (Arts NSW, 2016)

The NSW performing arts sector is the largest in Australia – in 2012, 37 percent of Australia’s live performing arts revenue was generated in NSW, and NSW is home to 11 of the country’s 28 major performing arts companies.

NSW is also home to key cultural institutions such as the Sydney Opera House, the State Library of NSW and the Art Gallery of NSW. These institutions play an important role in NSW attracting the majority of Australia’s total international arts and cultural visitors (61 percent of the total). The Department of Industry expects the creative arts to be a key driver of the state’s economic growth, exports and innovation over the next decade (Department of Industry, 2016). In 2012, these visitors spent an estimated \$4 billion in NSW, and stayed 42.6 million nights in the State. The Department of Industry expects the creative arts to be a key driver of the state’s economic growth, exports and innovation over the next decade (Department of Industry, 2016).

Sydney has twice been voted the world’s top festival and events city by the International Festivals and Events Association, and it is home to a world-class program of major arts festivals, including the Sydney

Festival, Sydney Writers Festival, Biennale of Sydney, Vivid and Sydney Film Festival, with a combined attendance of up to 2 million visits per year (1.3 million in non-Biennale years).

The tourism sector is likely to continue to grow as NSW is a key destination for international and local visitors alike, with more people visiting NSW than any other state and territory in Australia holidays, business, events and visiting family and friends.

This is growth is already occurring with tourism contributing a total of \$27.9 billion to the NSW economy in 2013–14, representing nearly one-third of tourism's direct contribution to Australia's gross domestic product. In 2014-15 this increased to 30.6 percent share of Australia's tourism income.

"In 2014-15, tourism consumption in NSW was equal to \$37.1 billion, the highest level since 2006-07. This equates to 30.6 per cent of total tourism consumption in Australia." (Destination NSW, 2014)

Growth in tourism GVA is driven by Sydney's popularity as a destination, as well as the NSW's natural attractions such as the Blue Mountains and NSW beaches. Sydney's share of tourism in NSW is over 60 percent.

Sydney has been consistently voted among the world's best cities by international travellers and is home to international icons such as the Sydney Harbour Bridge and Sydney Opera House. Kingsford Smith Airport is also the busiest in Australia, catering to 40 percent of Australia's international flights (Department of Industry, 2016).

Table 21 - Number of tourism related businesses by location

Sydney Vs Regional NSW	Businesses	Share of NSW Total (percent)
Sydney	59,867	63.9
Regional NSW	33,763	36.1
Total - Tourism	93,630	100

Source: Destination NSW

5.9 Local Industries

Local industries will also be subject to future traded industry trends and impacts. In particular, these industries are likely to grow to support NSW's growing population, as well as to support the growth of industries, such as finance and professional services.

Local clusters typically serve local or regional catchments, and include:

- Industrial (e.g. furniture manufacturing);
- Retail and wholesale trade;
- Food and recreation (e.g. cafes and takeaway, pubs, and amusement parks);
- Local health and education (e.g. primary and secondary schools and general hospitals);
- Public administration (e.g. local, state and federal government and police services), and
- Other local services (e.g. gardening, pest control, religious, and real estate services).

The local clusters employ close to 1.9 million workers across the State and generate approximately \$225 billion of GVA in 2016, which represents between 45 to 50 percent of total economic activity across the State.

	NSW's population is growing	The population of NSW will grow to 9.9 million by 2036 (Department of Planning and Environment, 2016). Local industries, in particular services such as local health and education, will need to grow to support this increase.	Strength
	Climate change will impact local industries	Local industries will be impacted by climate change, such as public administration, which is a large owner of at risk infrastructure assets.	Risk
	Automation of routine jobs is likely	Technological advances such as automation and the Internet of Things will impact heavily on the some local industries such as retail. While efficiencies can be realised, there will also be potential job losses.	Neutral
	Local industries are interdependent on traded industries	As traded industries, especially finance and professional services grow, local industries will be required to support them.	Strength

Broadly speaking, local clusters can be categorised into two groups or segments:

- 1) Clusters that primarily serve households located within a local catchment (e.g. food and recreation); or
- 2) Clusters that primarily serve (traded and local) businesses located within a local catchment (e.g. segments of the retail and wholesale trade cluster).

Local clusters servicing households

For local clusters that are primarily focussed on households, future growth profiles are likely to be shaped by:

- The growth and distribution of NSW's population;
- The income levels of NSW households; and
- The share of household budgets allocated to local clusters as distinct from traded clusters or imports.
- The challenges of meeting local service needs in regional communities such as health and education.

According to the Australian Bureau of Statistics, the population across New South Wales is expected to grow at an annual compound growth rate of 1.1 percent over the next 20 years to 2036. This is broadly in line with the annual growth recorded over the past five years, and slightly below the projected annual compound growth rate of Australia over the same period (close to 1.3 percent) (ABS, 2015). The sustained growth in population that is expected over the next twenty years in itself will help to expand household consumption across the State.

The future trajectory of household income levels over the medium-term will be largely driven by changes in productivity levels that are important for long term income growth, albeit not the only factor. The Productivity Commission produces an annual publication that analyses productivity trends across ABS-defined industries. Between 1989-90 and 2013-14, the average annual multi-factor productivity growth was highest in agriculture, forestry and fishing (2.7 per cent) and financial and insurance services (2.3

per cent). Given the relatively high proportion of workers these industries employ within NSW, the State appears to be in a relatively good position to increase productivity and income levels over time which will support demand of goods and services produced by local clusters.

Local clusters servicing businesses

In regard to the local clusters that serve traded and local businesses, the future growth profile are likely to be driven by:

- The growth and distribution of physical and online traded businesses within NSW;
- The level of business activity and associated outlays and overheads; and
- The share of business expenditure that is allocated to local clusters as distinct from trade clusters or imports.

The level of employment in NSW, and the associated number of businesses, is expected to grow strongly over the next 20 years. This growth will occur mainly in Sydney, which will have an additional 100,000 jobs in this industry by 2024, with over 60 percent of this growth to occur in the professional and financial cluster within the fields of computer system design, depository financial intermediation, legal and accounting services and architectural, engineering and technical services. As outlined above, the professional and finance cluster requires a wide range of inputs from local clusters across NSW.

Future changes in cluster composition and labour intensity

Future changes in technology and innovation have the potential to alter the composition of local and traded clusters. For example, the small scale operations utilising technology, such as 3D printing, could facilitate manufacturing businesses clustering close to either domestic users of the goods or close to international gateways, reducing the need for long distance haulage. This may result in some industries within the traded manufacturing cluster transitioning from a traded to local orientation.

In addition, local clusters have a higher share of low-value added jobs than traded clusters which are at risk from future automation. As outlined above, a study conducted by Oxford University of the potential automation of industries in the United States was recently adapted to meet an Australian context by DIIS and notes that a large proportion of jobs that may be found as part of the local cluster have a high likelihood of automation. This suggests that there may be a divergence between future profiles of gross value added (or economic output) and employment in local clusters.

6 Alternate scenarios for growth

6.1 Alternate scenarios for industry growth

In Chapter 4 we presented the baseline forecasts for NSW and its regions. The baseline forecasts represent KPMG's central views about how the size and structure of the NSW economy will change from 2015-16 to 2035-36. These views are not held with certainty and there are key risks to the forecasts that may have important implications for infrastructure demands. We have identified five key risks that are aligned with the likely trends for industries that will be outlined in Chapter 5 and designed a scenario for each to simulate how different the economy may look relative to the baseline if the risk eventuated.

The baseline projections for the NSW economy are built on the basis of a range of assumptions about population growth, technical change, changes in preferences, required rates of return and growth in foreign markets. These assumptions reflect central views or most likely outcomes for the key exogenous variables. By implication there are many other possible outcomes, some of which may be only slightly less likely to eventuate than the central case. For example, there may be a faster or slower uptake of technology than assumed. In this sub-section we report the results of five scenarios designed to capture significantly different outcomes than those assumed in the baseline for key parameters.

Description of the five scenarios

Scenario 1: Improved productivity of traded goods

Scenario one models an upside surprise to productivity growth in the traded goods sectors. The results show that the agriculture and primary industries benefit most from this shock because it has a direct, positive impact on their competitiveness. The supply chain impacts of this increase in the competitiveness of the traded goods industries is reflected in the boost to GVA in advanced manufacturing, other manufacturing and industrial industries, whose production processes use inputs from the agriculture and primary industries. The transport and communication and retail and wholesale trade industries supply services to the agriculture and primary industries and so benefit from the increased activity in those industries.

Scenario 2: Improved productivity of services

Scenario two, which models additional productivity improvements for all services industries, is the complement to scenario one. The whole economy benefits from the boost to productivity in the services industries with a relatively uniform expansion of most industries relative to the baseline in 2036. In proportional terms the benefit to the export-oriented industries, such as agriculture and primary, is less than that to the economy as a whole. These sectors benefit mainly from the increase in competitiveness but get less of a boost from the increase in the economy's income. The import-competing industries, such as advanced manufacturing, other manufacturing and industrial, benefit from an increase in competitiveness and the increase in domestic incomes. The labour-intensive industries that are relatively heavily exposed to government demands, such as public administration and local health and education, expand but at a proportionally lower rate than the economy as a whole.

Scenario 3: Improved productivity of traded services with strong inter-agency connections

Scenario three is a variation on scenario two where the productivity upside shock is focussed on a subset of the services industries. Specifically, the upside shock to productivity is confined to the transport and communications, finance and professional services and the energy related subsectors of other traded services. These particular industries are generally considered to be enablers of other industries because they provide goods and services that are critical inputs to the production processes of other businesses. Productivity boosts to these enabling businesses result in wide-spread benefits to the economy as the costs of key inputs used by all businesses are reduced, which makes trade exposed sectors more competitive and increases demand for income-sensitive non-traded sectors.

Scenario 4: Slower manufacturing growth

Scenario four models a downside surprise to productivity growth in the manufacturing sector. Manufacturing has not grown in real terms since the early 90s, halving its share in the economy in the last 20 years. The baseline scenario has a relatively optimistic outlook for manufacturing, consistent with the idea that the uptake of new technologies combined with Australia's skilled workforce will stimulate growth in advanced manufacturing that offsets the continued decline of traditional labour-intensive manufacturing activities. Scenario four is designed to illustrate how the economy might be impacted if the assumptions about the manufacturing sector in the baseline prove overly optimistic (e.g., if the uptake of technology by NSW manufacturers is slower than their competitors or if the infrastructure available to local manufacturers is inadequate). This shock has a relatively large negative impact on the trade-exposed manufacturing sectors, which lose competitiveness. Most other sectors of the economy are also negatively impacted because of the flow-on impacts of cost increases in manufactures, which are inputs to many other businesses and because of reductions in incomes.

Scenario 5: Improved labour productivity

Scenario five models an upside surprise to economy-wide labour productivity. This shock may be attributed to better-than-expected education/training outcomes, more flexible work arrangements or improved management practices. In this scenario the whole economy benefits significantly, with the proportional expansion in most industries relatively uniform.

Scenario results for NSW

The scenario results for the NSW economy are summarised in Table 22. The numbers in Table 22 represent the percentage difference between the scenario and baseline values of real GVA in 2036. For example, for scenario 2 real GVA in 2036 for the primary industry is 5.6 percent higher than in the baseline.

Table 22 - Percentage deviation between scenario and baseline real GVA in 2036 for NSW

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
	Traded goods productivity shock	All services productivity shock	Enabling services productivity shock	Manufacturing under-performance	Labour productivity shock
Traded industries					
Agriculture	5.09%	3.18%	0.84%	-0.49%	2.08%
Primary	5.92%	5.62%	1.57%	1.08%	3.36%
Advanced manufacturing	2.48%	8.90%	1.90%	-4.02%	5.09%
Other manufacturing	2.48%	8.90%	1.90%	-4.02%	5.09%
Finance and professional services	0.97%	8.65%	2.90%	-0.43%	3.24%
Transport and communications	1.12%	8.33%	3.30%	-0.60%	3.33%
Traded health and education	0.04%	4.61%	0.57%	-0.01%	2.08%
Other traded services	0.98%	7.29%	2.06%	-0.47%	3.05%
Local Industries					
Industrial	2.34%	8.83%	2.12%	-3.69%	4.91%
Food and recreation	0.46%	8.21%	1.12%	-0.36%	3.41%
Retail and wholesale trade	1.61%	6.29%	1.18%	-1.25%	3.06%
Public administration	0.01%	2.70%	0.40%	0.00%	1.17%
Other local services	0.71%	7.65%	1.00%	-0.34%	2.05%
Local Health and Education	0.14%	4.03%	0.51%	-0.05%	1.85%
Total	1.05%	7.02%	1.70%	-0.59%	2.76%

Source: KPMG

6.2 The infrastructure impact of different growth scenarios

Just as different future economic, social or environment trends can impact on the growth profiles of industries, these can just as dramatically alter demand for infrastructure. Table 23 provides a summary of how the industry scenarios outlined above will impact on infrastructure demand. The direct infrastructure implications refer to the change in infrastructure demand due to the directly affected industries, while indirect infrastructure implications refer to the change in infrastructure demand due to those sectors that trade heavily with the directly affected industries.

Table 23 - Industry scenarios and infrastructure implications (beyond the Base Case)

	Direct infrastructure implications	Indirect infrastructure implications
Scenario 1: improved productivity of traded goods	Growth in the agriculture and primary sectors will increase demand most for electricity, water and transport infrastructure	Trade between the agriculture and primary sectors and other sectors is balanced, which means that there will be an overall increase in infrastructure demand across most sectors
Scenario 2: improved productivity of services	Growth across all services sectors means that there will be an increase in infrastructure demand across the board with transport and communications seeing the largest increases	Strong trading between service sectors and other industries means an across the board increase in infrastructure demand
Scenario 3: improved productivity of traded services with strong inter-industry connections	Growth in selected services industries has a similar impact on infrastructure demand to Scenario 2, but a heavier weighting towards the communications	By design for this scenario, since the impacted services sectors are those that have strong linkages, other sectors are impacted with an increase in overall infrastructure demand
Scenario 4: slower manufacturing growth	Slower manufacturing growth means a reduction in demand mainly for electricity and roads infrastructure	Given the size of the manufacturing sector as a whole, the impacts will be modest, but will affect the demand for infrastructure across all industries
Scenario 5: improved labour productivity	Increase in infrastructure demand from the predominantly labour-intensive sectors in traded and local industries means higher demand for electricity, transport and communications	Strong connections between labour-intensive sectors and other industries means an across the board increase in infrastructure demand

Source: KPMG

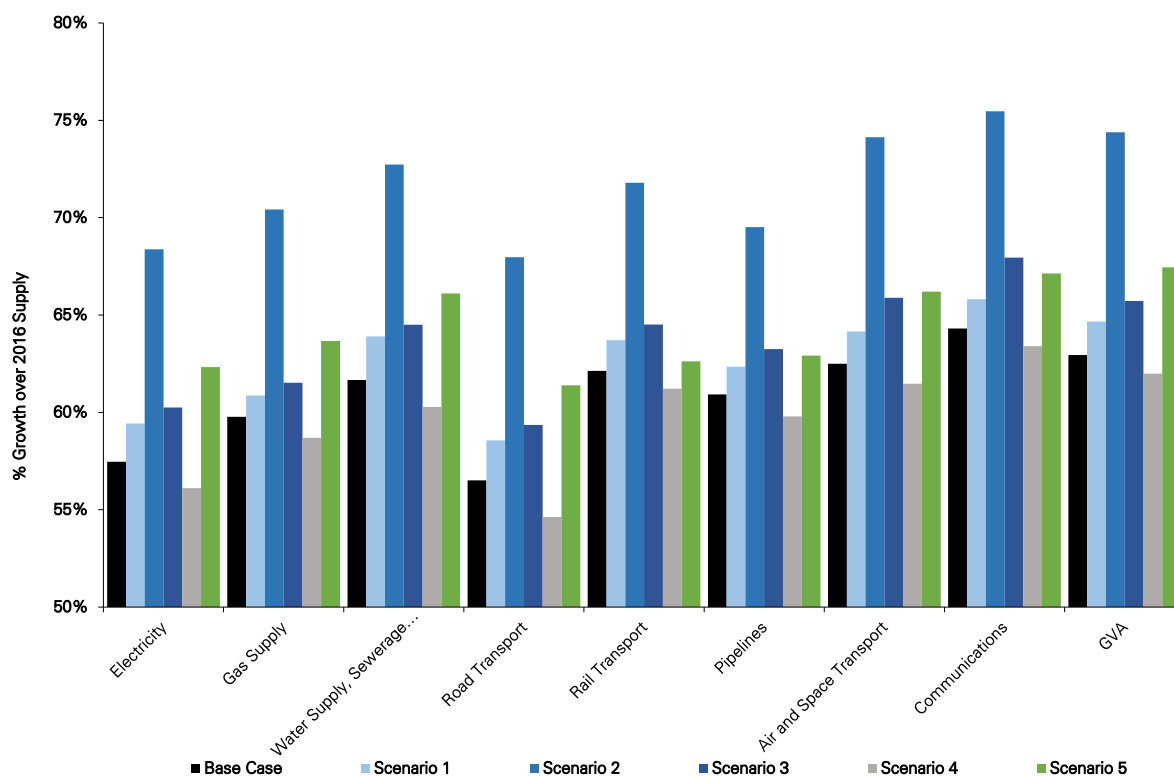
What is important to point out in the context of these scenarios is that infrastructure on its own is not sufficient for the economy of NSW to achieve the upside outcomes. A number of other factors will impact on the economy of the State, including; people and their characteristics, such as skills and experience; the policy and regulatory setting; and the overall economic and investment environments. Nonetheless, infrastructure is a necessary input into the functioning of an economy and to the spatial distribution of economic activity.

Against this backdrop, the mechanisms through which infrastructure can help in achieving the base case outcomes, the upside scenarios and removing constraints that may impact on the competitiveness of certain sectors are discussed below under each of the scenarios. To be clear, the analysis below focusses on infrastructure implications and not those that are specific to non-infrastructure interventions, or those that are the result of changes in technology impacting on the industry's operational models.

The way the mechanisms through which infrastructure can impact on economic outcomes are discussed by using a specific theme that is relevant to each of the scenario. This is done to reflect the fact that some of these themes will replicate across the scenarios. As outlined in earlier in this chapter, the following themes are covered in each scenario:

- Scenario 1: Improved productivity of traded goods – the key theme here is the impact of infrastructure as a direct input to the production of primary and agriculture goods, which means that investment in infrastructure can enhance the efficiency and competitiveness of NSW products in these sectors;
- Scenario 2: Improved productivity of traded services – the key theme here is the indirect impact of infrastructure investment on attracting business and inward investment to highly productive areas or to locations that are set for transformation;
- Scenario 3: Improved productivity of traded services with strong inter-industry links – the key theme here is the importance of telecommunications to service-type industries and the ability of investment in this type of infrastructure to boost competitiveness and productivity;
- Scenario 4: Slower manufacturing growth – the key theme here is the impact of infrastructure as an input to manufacturing production, since the enablers of this sector are likely to be non-infrastructure interventions (as discussed in Chapter 4); and
- Scenario 5: Improved labour productivity – the key theme here is the wider economic benefits that can flow from investment in infrastructure, specifically through agglomeration economies.

Figure 32 - Industry scenarios and infrastructure implications (incremental on 2016 levels)



Source: KPMG

These scenarios and the links with the above themes are discussed below in more detail.

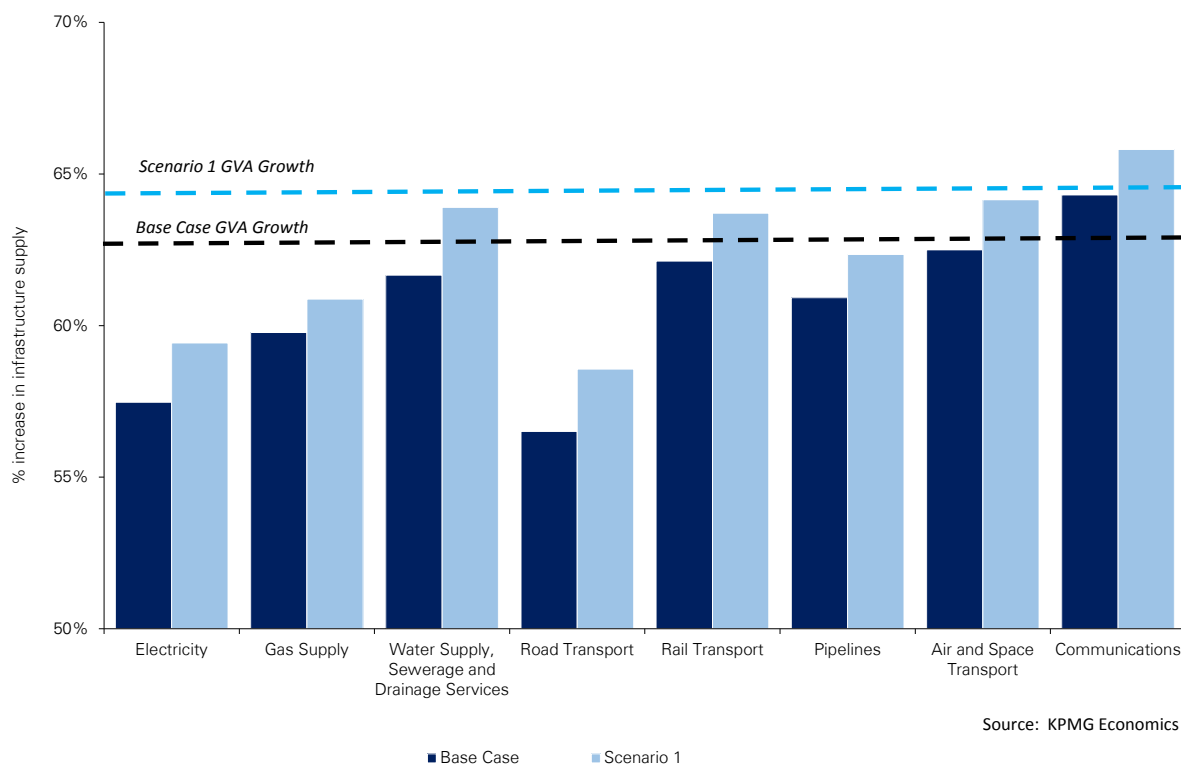
Scenario 1: Improved productivity of traded goods – reducing input

GVA growth in the primary sector will increase demand for electricity and transport infrastructure. For example, the largest direct user of rail are the manufacturing and primary industries, particularly in the Hunter region. The *Australian Infrastructure Audit* projects that the direct economic contribution for freight rail is going to rise by 48 percent over the 20 years from 2011. Of these freight rail links, mining freight dominates the NSW freight network with sub-networks such as the Hunter Valley Coal Chain essential to coal haulage in the Hunter and New England regions. ARTC has just undertaken a period of investment on this network and is now looking to operational and technological efficiencies to manage future demand on the network. These efficiencies include the introduction of the ARTC network control optimisation (ANCO), which will look to increase data availability and enhance whole of supply chain efficiencies such as peak spreading. However, there will still be requirements to increase capacity between Muswellbrook and Narrabri, where a single track is shared between coal freight, cotton, grain and flour freight and NSW trains passengers services (ARTC, 2016).

The growth of agriculture in this scenario will also drive growth in water requirements and road infrastructure, particularly in the Riverina. Currently 40 percent of water supplied in NSW is to irrigate the Riverina and Murray regions. The DEC for water in this region is going to grow by 16 percent, or one percent higher than the state average, which will be exacerbated by the loss of natural rainfall and increasing heat driven by climate change. Water storage solutions have been highlighted as a key infrastructure requirement by Infrastructure Australia, as well as targeting policy solutions such as efficiency measures and water trade (Infrastructure Australia, 2015).

The following chart summarises forecast incremental infrastructure by type for Scenario 1, and compares the relative growth of each type of infrastructure against the base case. While economies of scale and scope are achieved in most asset forms, the dynamics of Scenario 1 are such that additional pressures for electricity, water/wastewater and roads occur with marginally higher production output of traded industries.

Figure 33 - Forecast required increase in infrastructure in NSW by type, 2016-2036, Scenario 1 & Base Case

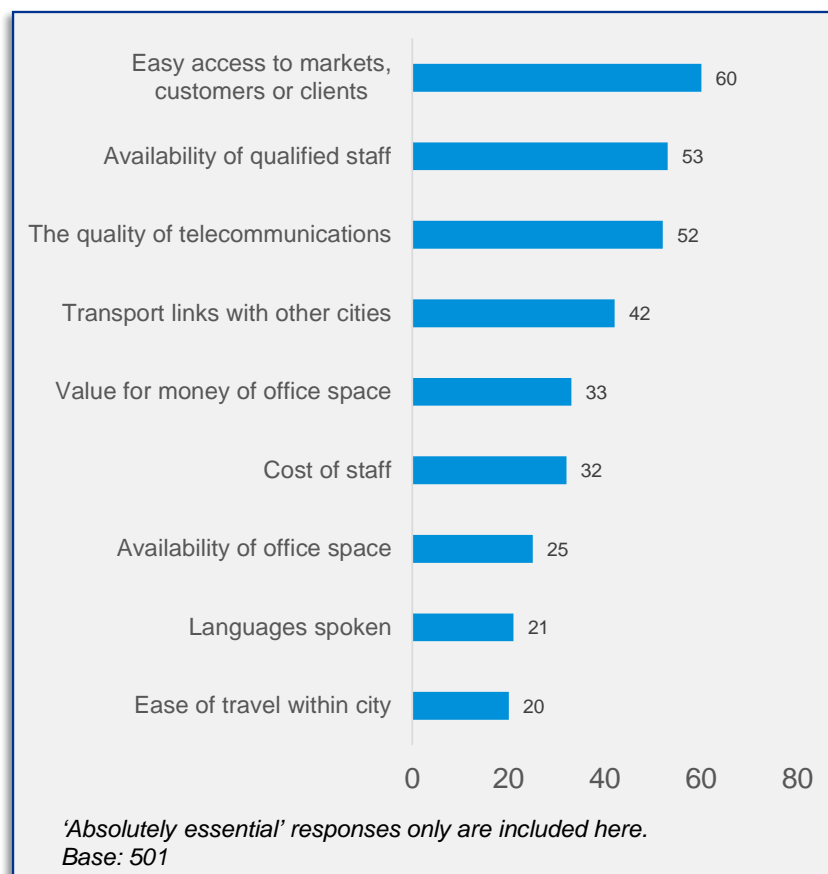


Scenario 2: Improved productivity of traded services

For most of the service industries, infrastructure is a modest input into the overall production process, when considered as a direct input. Instead, what matters is how infrastructure contributes indirectly to investment, competitiveness and productivity in these sectors.

In this context, the fact is that for the base case or an upside scenario to materialise, the investment in infrastructure will also have to create additional capacity in the economy, such as through unlocking employment space (commercial development) or increasing the attractiveness of an area to inward investment. One example of this is how infrastructure can attract commercial occupiers to a location. Cushman and Wakefield's European Cities Monitor asked 501 companies 'which factors they consider when deciding where to locate their business'. Figure 34 shows the results of the most recent European Cities Monitor, conducted in 2011. Most of the factors rated highly by the respondents are related to infrastructure, such as access to markets, quality of telecommunications and transport links.

Figure 34 - Factors considered for business location decisions



Source: Cushman and Wakefield European Cities Monitor, 2011

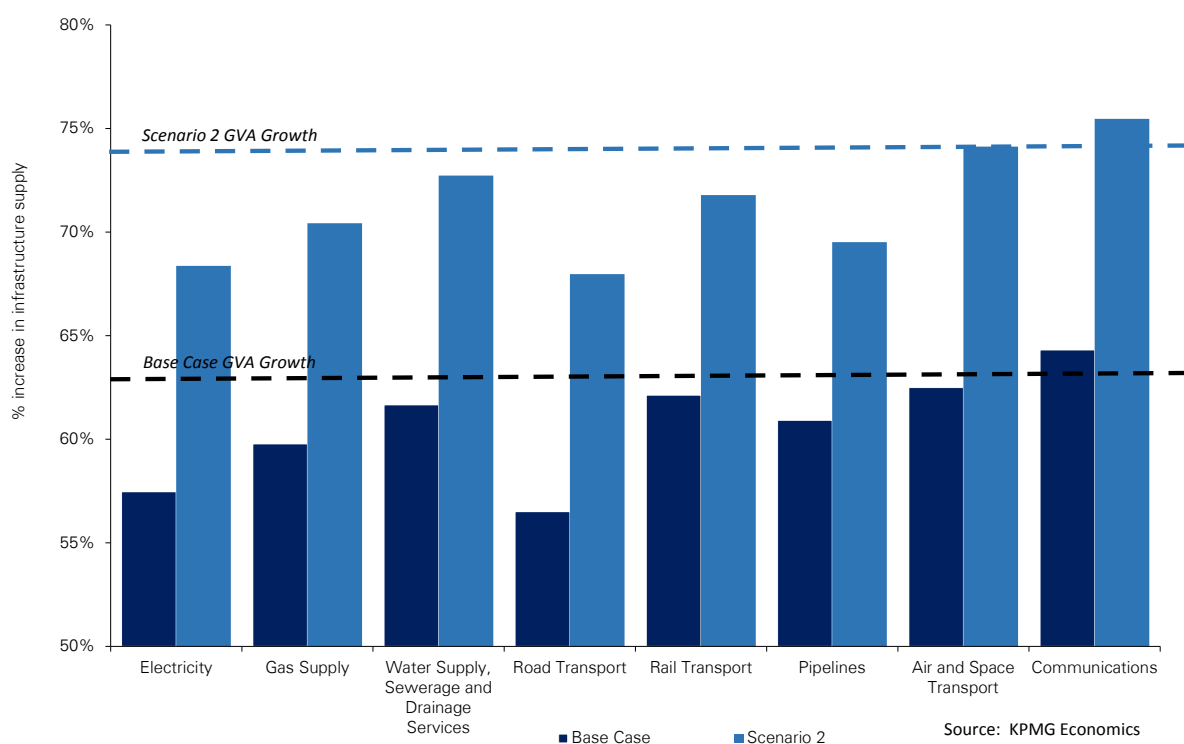
The position of NSW against its competitors in these factors must be considered so that its industries' competitiveness is enhanced in future. The key point here is that, alongside other policy interventions, infrastructure will play a role in ensuring that the state continues to be an attractor of business occupiers and investors, which will create the capacity to grow the NSW economy.

The implications for the spatial distribution of activity in NSW is that infrastructure investment can help to unlock assets (such as land) in parts of the geography where such assets are in abundance but currently underutilised. For example, infrastructure can play a key role in the state's strategy to boost growth in Western Sydney, which has historically lagged behind the prosperous Eastern part of the city. A fundamental component of achieving this vision will be the ability of future investments to Western Sydney through improving the region's access to a larger market and link businesses to a wider pool of labour. The analysis also suggests that the communications infrastructure will be key to attracting high value business and investors.

The kind of employment capacity that can be unlocked by transport and communications infrastructure must also be considered alongside other types of infrastructure. For example, with the significant growth expected to occur in the Sydney CBD over the next 20 years, the existing utilities infrastructure will become increasingly constrained. Another physical restriction that will arise is the size of existing pipes that carry communications, utilities, water and sewerage through the city and their ability to accommodate additional cables or sewerage capacity. This means that the provision of infrastructure, such as transport and communications, may not be sufficient to unlock significant employment capacity in the CBD, which is the most productive part of the NSW economy, which in turn will impact on the overall productivity of the service sectors in NSW.

Simply accommodating expected growth in other part so the NSW geography is unlikely to lead to the same outcomes for the economy. The Sydney CBD is a classic example of a dense cluster of high value economic activity, which is difficult to replicate in another location within NSW since the businesses that operate there can often choose to move to another similar global city within Australia (such as Melbourne) or to other global locations.

Figure 35 - Forecast required increase in infrastructure in NSW by type, 2016-2036, Scenario 2 & Base Case

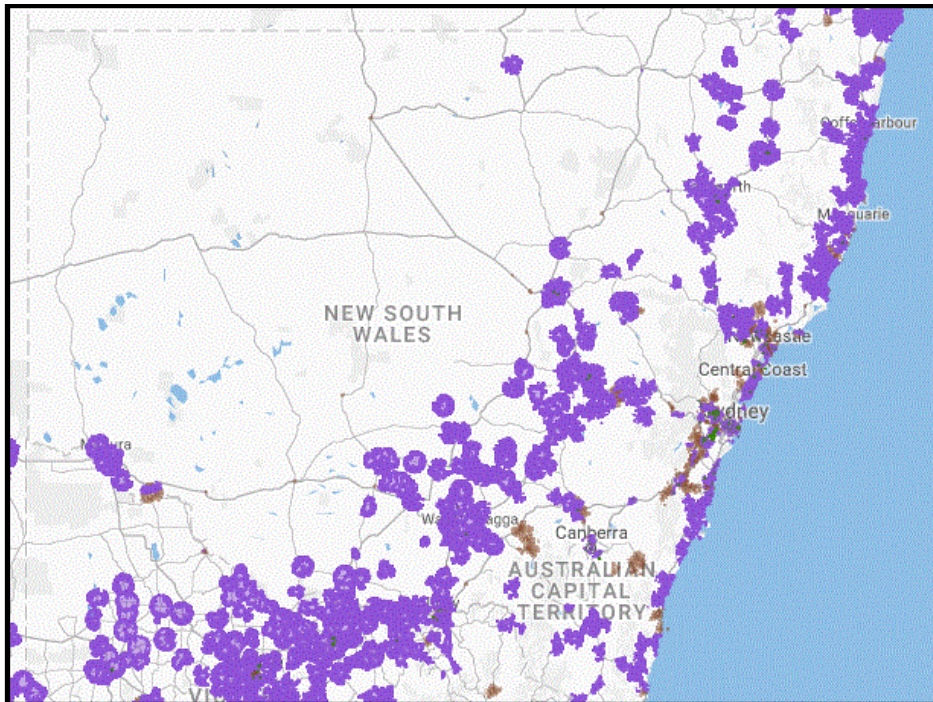


As discussed previously, Scenario 2 generates the greatest positive incremental economic benefit relative to the base case, and with it, the greatest incremental ask for supporting infrastructure. However, the difference between GVA growth and required infrastructure growth is also greatest under this scenario, which means a high productivity growth environment also creates the strongest economies of scale and scope in the provision of infrastructure. So while the infrastructure ask is much higher under Scenario 2, firstly the economy has a better ability to pay for it, and secondly, the 'required' marginal supply of infrastructure occurs (slightly) more gradually.

Scenario 3: Improved productivity of traded services that have strong inter-industry links

For Scenario 3, much of the analysis for Scenario 2 applies but the provision of high quality and reliable communications networks will be key to driving growth across NSW. This is of particular concern to regional NSW. While investment in the National Broadband Network (NBN) will improve connectivity for a large proportion of the NSW population, it is still focussed on eastern NSW as demonstrated in Figure 36. Areas that have NBN in operation, have services in construction and have construction planned are highlighted, with other remote regional areas therefore expected to continue to rely on satellite connections.

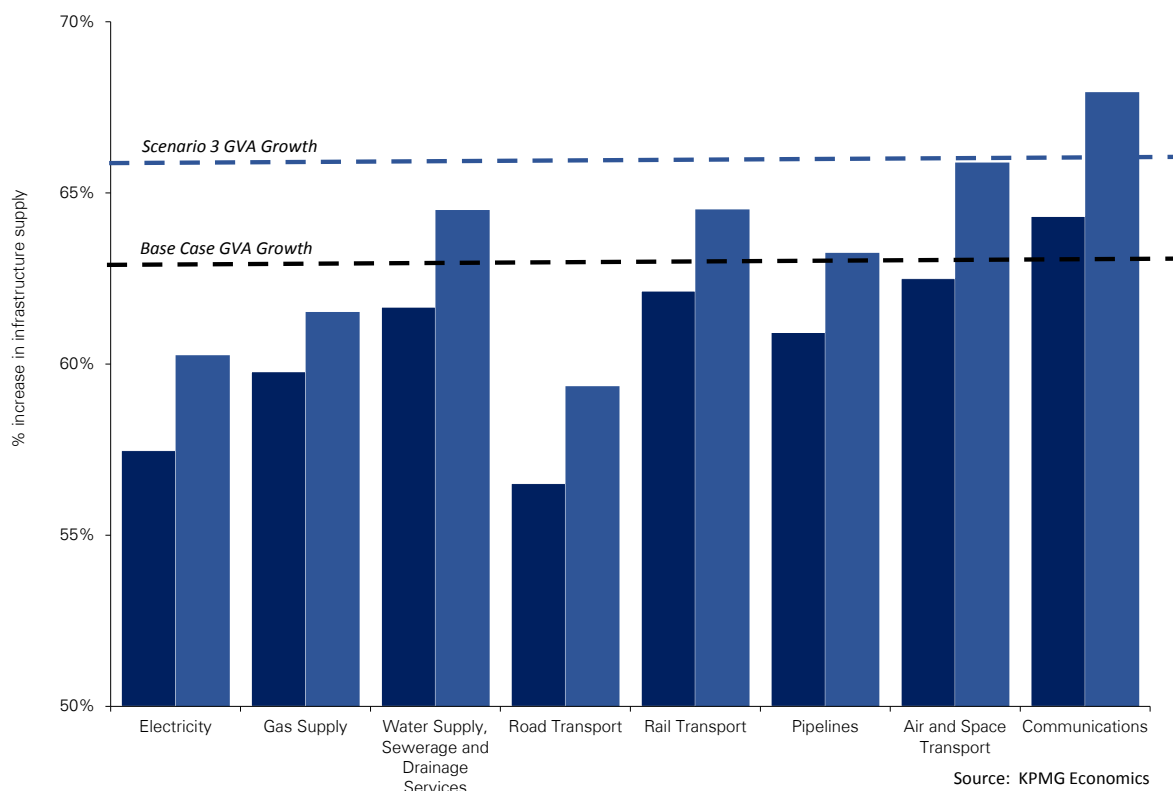
Figure 36 - NBN rollout map - complete, in progress and planned services



Source: NBNC0

The lack of adequate communications services may be an impediment on achieving this growth as current internet and mobile coverage is unreliable and of poor quality in some remote areas. Satellite options are limited in data usage and the cost is far greater than those plans offered to urban users. Comparing a standard NBN plan and a satellite plan from Telstra, users can access 1 terabyte of data at speeds up to 100mps for \$95 a month, where those users only able to access satellite can access a maximum 20 gigabytes at speeds up to 6mps for \$599 a month. While there are intermediate options available in some areas, and services such as NBN Sky Muster satellite is being developed, the quality of internet connectivity is poor when compared to urban NSW.

Figure 37 - Forecast required increase in infrastructure in NSW by type, 2016-2036, Scenario 3 & Base Case



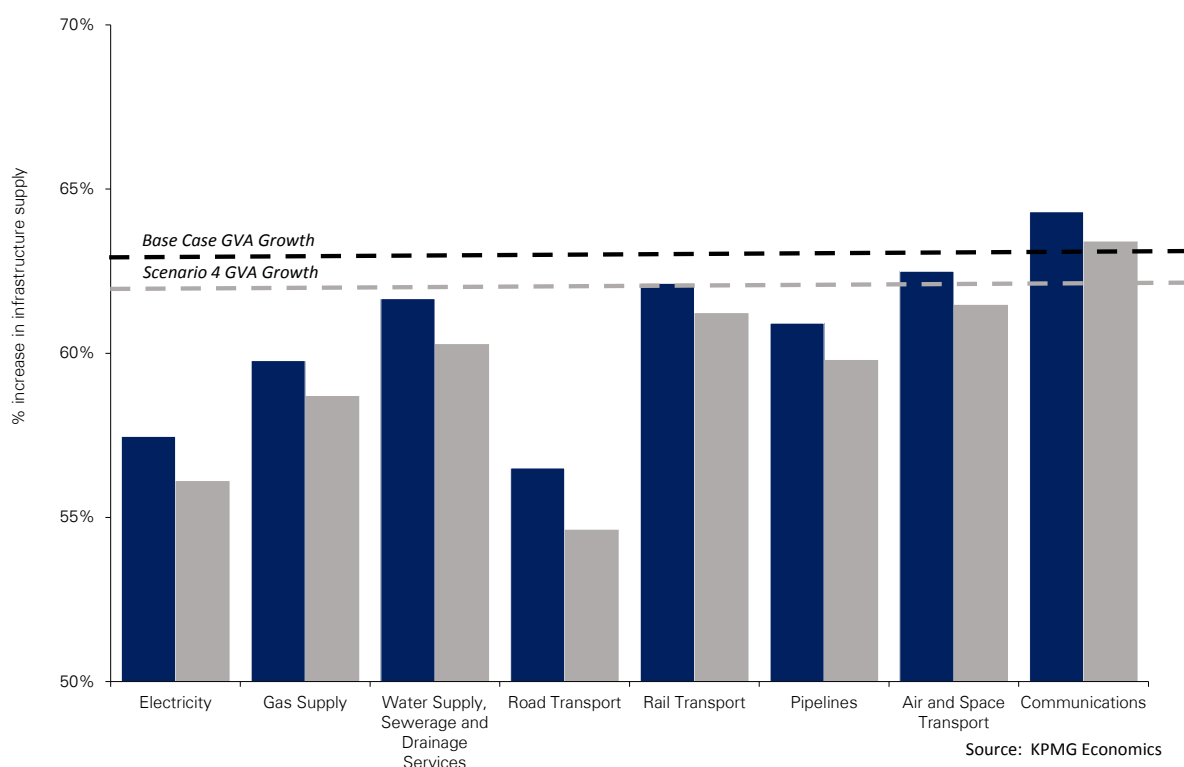
The remedy associated with these concerns regarding quality (and quantity) of communication services is a significant increase in associated infrastructure, which is pushed strongly under Scenario 3. The differential between GVA growth and required supply of communication infrastructure is most pronounced under Scenario 3, which most likely reflects the bias in demand for this form of infrastructure from the traded services sector, but also most likely a 'catch-up' in the efficient provision of communication assets for the state.

Scenario 4: Slower manufacturing growth

In terms of the manufacturing sector, infrastructure is a major input into production. Manufacturing is a heavy user of electricity, gas and transport infrastructure (both road and rail). Future projections for NSW in the base case suggest that the majority of employment and GVA growth is likely to occur in urban centres, particularly in the Hunter region and Western Sydney. In terms of the latter, if the growth of advanced manufacturing in conjunction with Western Sydney Airport (WSA) is to be realised, it will be essential to provide adequate electricity, gas and road connections within this region. Endeavour Energy, the provider for many key growth precincts in Western Sydney has identified WSA as a key driver for major capital works. It has undertaken a review of network capacity and notes several release areas in and around the proposed airport site such as Bringelly and Leppington as requiring major sub-transmission development works in order to service growth in the area (Endeavour Energy, 2015).

Road access is also an important infrastructure requirement for manufacturing. Major upgrades around WSA are already underway with \$3.6 billion being invested in both state and local road enhancement works including The Northern Road, Bringelly Road, Werrington Arterial Stage 1 and the new M12 motorway, parallel to Elizabeth Drive.

Figure 38 - Forecast required increase in infrastructure in NSW by type, 2016-2036, Scenario 4 & Base Case



The 'drag' on infrastructure supply of slower manufacturing growth is predominately felt in the energy and water/wastewater sectors and road transport. As electricity, gas, and water are often primary elements of manufacturing production processes, any slowdown in this sector will naturally delay, or even potentially deter, new infrastructure investment. Road transport infrastructure is also a large component of manufacturing activities, both from the transportation of inputs into the factory and outputs from the factory to markets and/or end users. Again, it is not surprising that a scenario involving a slowdown in the manufacturing sector relative to the base case results in a corresponding slowdown in the need for road transport infrastructure.

Scenario 5: Improved labour productivity

Much of the impact of infrastructure investment on productivity will come through the reduction in the cost of inputs to the production process. However, there are wider economic benefits that can also materialise. Chief among these is agglomeration benefits.

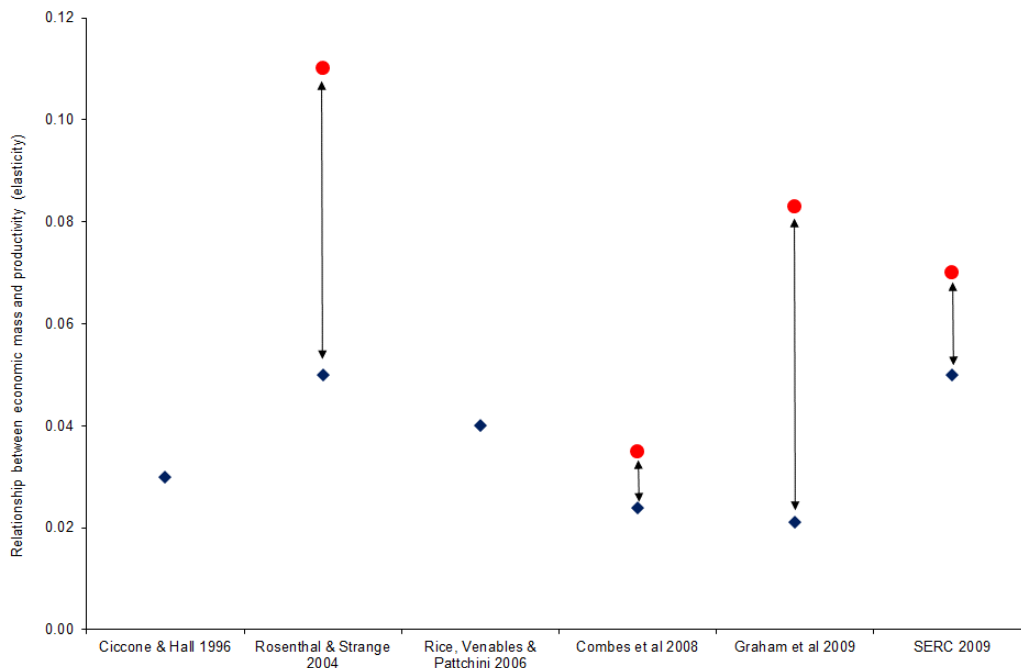
One of the earliest evidence of agglomeration economies was the emergence of the cotton mill cluster in Lancashire in the UK in the 19th century. The rail infrastructure connecting the regional towns, and producers with the port, helped to create the most efficient cotton industry in the world where production costs were the lowest globally, even though wages were around six times higher. The UK's cotton industry accounted for 80 percent of global production by the late 19th century. The proximity of producers to each other allowed for innovation in the form knowledge spill-overs in spinning technology, rail links supported trade between specialised districts, and it enabled efficient movement to and from ports.

The development of London was also facilitated by the investment in its transport infrastructure. The development of the canal and shipping infrastructure in the 18th and 19th centuries allowed the city to grow its maritime services. These were fundamental in developing complementary services, such as insurance and finance, which eventually led to London's position as one of the leading global financial centres. Meanwhile, the development of the railways allowed the movement of labour and goods within the city.

At a broad level, the literature studying the relationship between transport connectivity and productivity has produced different results across countries and sectors. The results also differed by the type of analytical technique used, such as the measure of productivity (for example GVA or wages), the transport mode (rail or road) and the relationship that describes economic mass.

The results of some of these studies are shown in Figure 39 below. The evidence shows that for every 10 percent increase in economic mass, productivity rises by somewhere in the region of 0.02 percent and 0.11 percent - this is usually referred to as the elasticity of connectivity (or economic density) to productivity.

Figure 39 - The relationship between connectivity and productivity

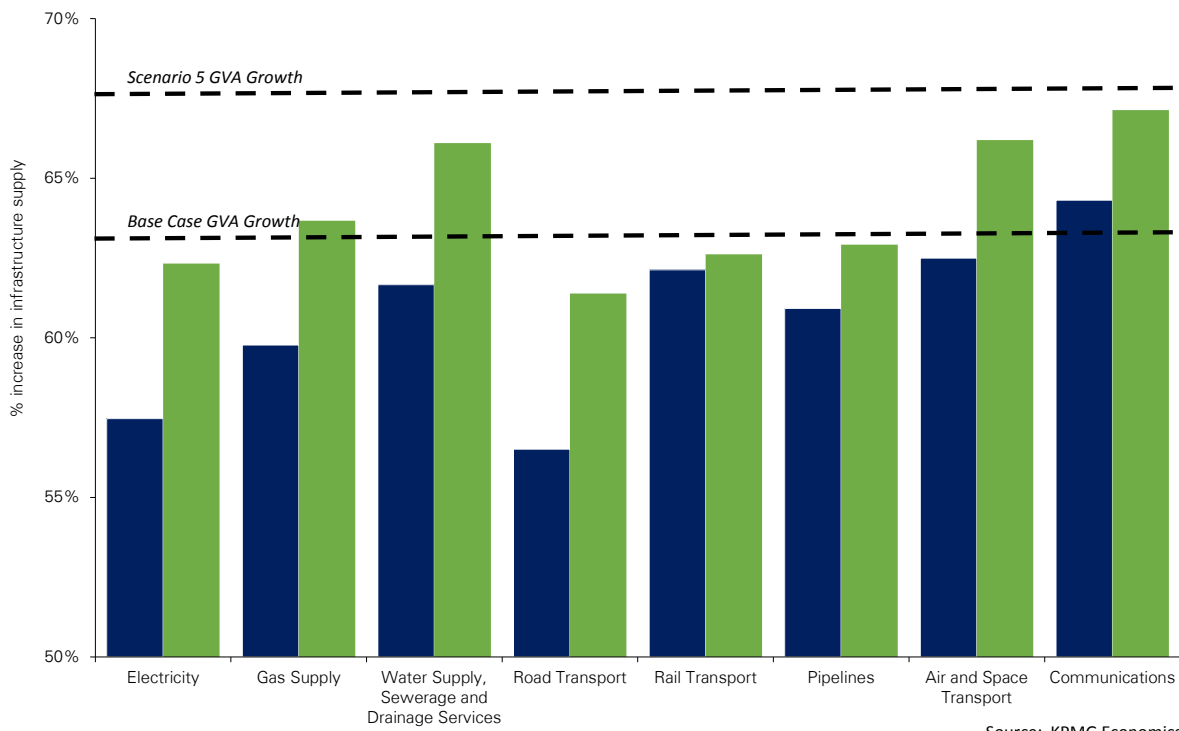


What is important to point out in the context of the 2017 State Infrastructure Strategy for NSW is that productivity increases are stronger in the type of sectors that are concentrated in urban centres, such as business services. Taking the work by Graham et al (2009) for the UK economy as an example, the elasticity of productivity with respect to economic mass was reported at 0.021 for the manufacturing sector and 0.083 for the production sector (such as finance, professional and technical services sector). This means that for a similar increase in economic mass, the impact on the productivity of the finance and professional sector is some four times that in manufacturing.

The other main observation is that the elasticity estimates reported here are 'lower bound' in that the researchers attempted to isolate the impact of the transport infrastructure from all other factors, such as people's skills and experience. This means that there are no other policy levers at play. For example, the work by the Social and Economics Research Centre (SERC) at the London School of Economics has shown that when there is no constraint on skills and experience (in that other policy instruments that could complement transport are also being implemented), the elasticity estimate for rail investment would rise from 0.05 to 0.26. That means that the impact could be five times the estimate when transport is supported by other policy levers, such as skills. This highlights the role that complementary economic development policy can have in boosting the productivity of places.

Another study by Melo, Graham, Levinson and Aarabi (2012) on US cities investigated the presence of nonlinearities in the relationship between labour productivity and agglomeration economies. Their findings suggested that there is considerable nonlinearity between productivity and transport-induced agglomeration effects. Specifically that elasticity estimates vary by the degree of economic density that is already in the location. Effectively this means that already dense and productive places will benefit more from the change in connectivity than those that are less dense.

Figure 40 - Forecast required increase in infrastructure in NSW by type, 2016-2036, Scenario 5 & Base Case



Finally, Scenario 5 generates an infrastructure ask similar to the base case, with the exception of rail transport, where significant economies of scale and scope are being achieved. This is not surprising given the earlier discussion regarding agglomeration benefits, and the role rail transport plays in achieving these. The other notable results is the relatively smaller increase in pipelines under Scenario 5, again reflecting the benefits of density and achieving improved utilisation of existing assets.

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