Building Momentum

State Infrastructure Strategy 2018-2038

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Infrastructure
New South Wales

Contents

Chairman's foreword

It is with great pleasure that I provide the State Infrastructure Strategy 2018-2038 to the NSW Government on behalf of Infrastructure NSW, in accordance with the *Infrastructure NSW Act 2011*.

Dear Premier,

On behalf of the Board of Infrastructure NSW, I am pleased to present the State Infrastructure Strategy 2018-2038 (2018 SIS). As required by the *Infrastructure NSW Act 2011*, this 20-year strategy sets out Infrastructure NSW's independent advice on the current state of the State's infrastructure and the needs and priorities over the next 20 years.

NSW currently has the largest state infrastructure building program in the nation, supported by the strongest state economy and significant capital funding commitments – including $30 billion in the Restart NSW fund generated over the past five years from asset recycling and other sources, including over-budget tax receipts. These Restart NSW funds are earmarked for essential new economic and social infrastructure.

Infrastructure NSW is proud to have played our part in helping the Government to deliver its infrastructure program. By providing advice and fulfilling two further roles – delivering designated projects through Projects NSW and providing external review of all major projects under the Infrastructure Investor Assurance Framework – we have provided vital support to the Government in selecting and overseeing the effective delivery of the State's substantial project pipeline.

Unlike the two prior strategies, the 2012 SIS–First Things First – and the 2014 SIS Update, this strategy looks beyond existing infrastructure backlogs and current projects and identifies the policies and strategies needed to maintain the State's leadership in providing highly productive infrastructure in a timely manner to meet the needs of a growing population and a growing economy.

This forward-looking emphasis is reflected in the title of this strategy: *Building Momentum*.

The 2018 SIS focuses on the three essential ingredients for economic prosperity – population, productivity and participation – with a particular focus on making NSW enterprises more productive and encouraging workforce participation (especially by women and older citizens) by providing infrastructure that creates convenient and time-efficient access to jobs. With the State expecting significant population growth over the next 40 years, improving economic productivity and liveability will require the Government to make smart choices about how its limited funds are allocated to maximise social and economic benefits.

Accordingly, this strategy is less a list of projects – recognising that the State already has a healthy pipeline of capital works – and more a set of policies and strategies required to make more efficient use of existing and new infrastructure and to deploy digital technologies to optimise efficiency, reduce maintenance and manage peak demands while delivering essential infrastructure in the most cost-efficient way.

This strategy also emphasises the importance of 'joined-up' planning and delivery of infrastructure. When combined with the *Greater Sydney Region Plan*, Regional Plans across the State, *Future Transport 2056* and regional economic development strategies, this strategy gives the Government for the first time a fully integrated land use and infrastructure plan. This is a landmark achievement. Joined-up planning is essential to encourage and attract private sector investment alongside public investment to build the State's infrastructure momentum.

While a framework for integrated planning across the State now exists, and while some government agencies are well advanced in detailing strategies for the next 20 years and beyond, this strategy recommends that more work be done over the next year or so to bring the State's planning up to the desired level in relation to water, energy, health, justice and tourism. By 2020, the Government should aspire to have in place a comprehensive suite of sectoral strategies that will be fully consistent with and complementary to this 2018 SIS.

In closing, I thank my colleagues at Infrastructure NSW – ably led by CEO Jim Betts – for their preparation of this strategy, as well as the many expert advisors who have contributed to it.

I commend the strategy to the Government.

Yours faithfully,

Graham Bradley AM
Chair
Infrastructure NSW

Overview

Context

NSW has the largest infrastructure program and the strongest economy in Australia. A key factor in the State's recent success has been its focus on infrastructure investment, job creation and accelerated housing supply.

NSW's population is forecast to increase from 7.7 million people today to over 12 million by 2056 – an additional four million people needing two million more homes. NSW will face a tightening fiscal position as its share of Commonwealth Government revenue declines and its ageing population increases the demand for health and other services.

To meet these challenges, this 20-year State Infrastructure Strategy makes recommendations for each of NSW's key infrastructure sectors – transport, energy, water, health, education, justice, social housing, culture, sport and tourism. If accepted, Infrastructure NSW's recommendations would have a substantial, highly positive impact on the State's future: growing the NSW economy by increasing productivity and participation, and generating significant additional employment.

Even greater benefits can be generated if the Government is able to free-up new sources of funding – for instance, from user charges or further asset recycling.

The State Infrastructure Strategy 2018-2038 is about more than big projects. It focuses on continuing to get the basics right, adopting a place-based approach to infrastructure planning and delivery in which resilience,

better asset management and the impact of new technology all play key roles. It also recognises the importance of making the most of existing assets through partnerships and shared uses, innovative service delivery models and the use of digital technologies.

The NSW population will grow from:

2016	**7.7** MILLION
2036	**9.9** MILLION
2056	**12.1** MILLION

Source: NSW Department of Planning and Environment 2016; The Centre for International Economics 2018

Strategic directions

The Strategy sets six cross-sectoral strategic directions, each designed to achieve 'more with less' from the State's large infrastructure program and asset base.

1. **Continuously improve the integration of land and infrastructure planning** so that population growth does not erode the amenity and character of our suburbs, towns and communities. Integrated

planning will ensure that capital investment plans are linked to and keep pace with land use plans for housing and jobs in priority locations.

2. **Plan, prioritise and deliver an infrastructure program that represents the best possible investment and use of public funds.** This includes improvements to major project planning approval processes, considering further asset recycling initiatives and better communicating the Government's intentions so that the business community can invest with confidence.

3. **Optimise the management, performance and use of the State's assets** to strengthen the management of the $300 billion+ of infrastructure assets that NSW already owns, make the most of these assets and ensure they are appropriately maintained, repurposed and upgraded.

4. **Ensure NSW's existing and future infrastructure is resilient to natural hazards and human-related threats** by embedding consideration of risk and resilience into all project business cases, capital asset planning and assurance processes, and requiring agencies to undertake rolling assessments of the vulnerability of assets to natural disasters and human-related threats.

5. **Improve statewide connectivity and realise the benefits of technology**, ensuring that NSW becomes a leader in the adoption and use of digital technology. All new and significantly upgraded assets will be connected or connectable by 2020, a new policy will guide investment in the Internet of Things and a centralised repository of government data will be accessible by everyone under open data provisions.

6. **Drive high quality consumer-centric services and expand innovative service delivery models in infrastructure sectors** by being innovative in buying services and delivering new assets, and harnessing the skills of the public, private and not-for-profit sectors to get best value from public investment.

Geographic directions

This Strategy recognises that different parts of NSW face different opportunities and needs. Infrastructure NSW's recommendations reflect this diversity by setting geographic directions for infrastructure planning, investment and policy:

- **Regional NSW needs** to be supported by good transport links to key markets by leveraging Inland Rail and upgrading east-west links. Better digital connectivity is needed to enable regional business to compete and to improve basic services like health, education and a reliable supply of drinking water.

  Infrastructure NSW supports moving to a 'hub and spoke' model that focuses major investment in regional centres that can then support the communities that surround them.

- **Sydney's long-term future** is a metropolis of three cities – a vision articulated in the *Greater Sydney Region Plan*, which Infrastructure NSW supports.

  Traditionally, investment has focused on Sydney's east. As major infrastructure networks are completed in the Eastern Harbour City, such as WestConnex and Sydney Metro, investment needs to shift westwards: first to the Central River City

around Parramatta and ultimately to the emerging Western Sydney Airport and employment centres of the Western Parkland City.

Infrastructure directions

Infrastructure NSW's overarching message is that good projects come from good plans.

While some sectors – notably transport – have highly developed, prioritised long-term plans, other agencies have some way to go. This deficit in planning needs to be rectified as a matter of urgency if the cross-sectoral and geographic directions in this Strategy are to be implemented effectively.

Independent analysis indicates that, if accepted by the Government, the recommendations in the State Infrastructure Strategy 2018-2038 would increase the size of the NSW economy and generate additional jobs.

Infrastructure NSW's recommendations will boost the NSW economy by

$11B in **2036**   and   **$45B** in **2056**

Source: The Centre for International Economics 2018

Executive summary

Introduction

NSW is changing. The way our infrastructure is planned, delivered, managed and maintained needs to change too. The *State Infrastructure Strategy 2018-2038: Building Momentum* (the 2018 SIS) recommends reforms, policies and projects that respond to NSW's changing economic, social, technological and environmental outlook and build on the benefits already delivered by the largest infrastructure program in Australia.

The 2018 SIS provides the NSW Government with advice about infrastructure policy and investment priorities designed to boost the State's economic prosperity and global competitiveness while meeting the challenges of population growth and ensuring that cities, towns, suburbs and communities across NSW continue to be great places to live and work.

The 2018 SIS endorses and supports the land use directions set out in the *Greater Sydney Region Plan* and the plans for regional NSW prepared by the Department of Planning and Environment. For the first time, NSW has a fully integrated long-term, statewide strategic plan for land use and infrastructure, with a clear focus on investing in the right infrastructure, in the right place and at the right time to deliver maximum value and benefits.

The 2018 SIS contains 122 recommendations spanning NSW's key infrastructure sectors of transport, energy, water, health, education, justice, social housing, culture, sport and tourism. These recommendations identify capital investment, policy initiatives, planning reforms and regulatory changes that are achievable, affordable and evidence-based, and that deliver the highest economic, employment and liveability benefits to the people of NSW.

If accepted, Infrastructure NSW's project and policy recommendations are estimated to increase Gross State Product to over one per cent, or $11 billion in 2036 and by over three per cent, or $45 billion in 2056. If the recommended development of an integrated system wide transport pricing road map proceeds to implementation, the total estimated increase to Gross State Product would be nearly three per cent, or $26 billion, in 2036 and five per cent, or $67 billion, in 2056.

Unlike previous strategies, the benefits of the 2018 SIS recommendations arise largely through improved productivity and the recommendations with the greatest impacts are targeted at getting better outcomes from existing infrastructure.

Implementing the 2018 SIS would make NSW a better place to live with significantly expanded employment opportunities, lower travel times and improved health, education and other services. Across NSW, there would be an additional 26,000 jobs by 2036 and a further 159,000 jobs by 2056.

Infrastructure NSW's recommendations represent independent advice; they do not constitute NSW Government policy. Consistent with the terms of the *Infrastructure NSW Act 2011*, the Government will respond to Infrastructure NSW's advice in a separate, public document.

The 2018 SIS builds on its two predecessors. It recognises that NSW now has an ambitious infrastructure pipeline through to the mid-2020s. There is no immediate need to 're-invent' this pipeline. Rather, the focus of this Strategy is on building the momentum established since 2012 and continuing to strengthen infrastructure planning, procurement, management and performance to ensure the State's assets are flexible, enduring and resilient. The Strategy recognises that government alone cannot afford to build its way out of increasing demand for infrastructure and services: the key is investing in well-targeted infrastructure that is integrated with land use planning, while also extracting more value from existing assets. The Strategy also identifies and prepares for the next wave of investment that will keep NSW in a competitive position within the Asia Pacific region.

Setting the scene

NSW has the largest infrastructure program and the strongest economy in Australia. State-led infrastructure investment has been a key driver of economic and employment growth, and a core contributor to strong investor confidence and rising living standards.

Over the next 40 years, the State will face a series of structural changes, including population growth, an ageing population, a fast-growing young population and changes to the composition of the State's industries and economy.

At the same time, a fiscal gap is emerging where the revenue the NSW Government receives is declining while the demand for services continues to grow. These changes will create challenges and opportunities, with significant implications for the planning, delivery and operation of economic and social infrastructure.

Supporting growth

NSW's population is forecast to grow from about 7.7 million today to over 12 million by 2056. Greater Sydney is expected to accommodate 80 per cent of this population growth. This larger population will require around two million more houses and more supporting infrastructure and services, such as schools, health services, transport, energy and water.

With an ageing population that is living longer, workforce participation is expected to decline significantly (from 64 per cent today to 59 per cent in 2056) and the demand for health services is expected to increase. A fast-growing young population will require more investment in modern education and vocational training infrastructure.

Employment is forecast to grow from 3.8 million jobs today to 5.7 million jobs in 2056, an increase of nearly two million jobs. While there will continue to be job opportunities in sectors like primary exports, services and tourism, increasingly jobs will move to knowledge-based industries like advanced manufacturing, international education and research, creative industries, finance and professional services. These industries will need to be supported by infrastructure that enables them to grow and compete internationally.

The digital economy will continue to grow, with digital technologies transforming almost every aspect of our daily lives and the way businesses and governments operate. Demand for ubiquitous, reliable and fast connectivity will increase. The massive growth in data means that it is becoming a vital infrastructure asset in its own right – one that is critical to developing innovative new services, improving current services and increasing the productivity and performance of assets.

Setting new strategic geographic directions

The NSW Government has set a new vision for growing Greater Sydney based on a metropolis of three cities: the established Eastern Harbour City, the developing Central River City and emerging Western Parkland City centred around the new Western Sydney Airport. Each city will have its own unique identity and endowments, and the infrastructure needed for each must be planned to optimise its liveability, productivity and sustainability.

Infrastructure NSW endorses the concept of the three cities as the foundation for Greater Sydney's future land use. By 2036, over 50 per cent of Sydney's population will live west of Parramatta. People in new and existing suburbs will need access to high quality, infrastructure-enabled public services. As far as possible, jobs will need to be located close to where people live, minimising their need to commute across town.

For regional NSW, the Government has set a new vision for a 'hub and spoke' model, designed to provide equitable, better and more efficient services to communities across the state through a connected network of regional centres. Again, Infrastructure NSW supports these geographic directions as the basis

for optimal and productive land use, economic and infrastructure planning.

Managing the fiscal gap

If current trends continue, the Government will face a major gap between what it receives in tax and other revenues and what it spends on public services and infrastructure. This fiscal gap will be driven in part by NSW's ageing population that will result in lower tax revenues over time as people retire and higher expenses, particularly in the health sector. The NSW Government also has to contend with a declining share of Commonwealth revenues from GST and National Partnership Agreements.

The 2018 SIS identifies steps the Government can take to close this gap, but not all available options are easy. The challenge is to find new and better ways of delivering and paying for the infrastructure and services the community expects, while exercising careful judgement about the major projects in which the Government chooses to invest.

The response

NSW's future prosperity depends on its ability, and willingness, to get the maximum economic and social benefit from existing and new infrastructure assets. To do this, good practices need to be applied to infrastructure planning, assessment, procurement, construction and management:

- to meet rising demand for public services
- to support longer term plans for jobs and housing prepared by the Greater Sydney Commission and the Department of Planning and Environment
- to anticipate and respond to megatrends, including taking advantage of opportunities generated by technological transformation and managing threats such as climate change.

The 2018 SIS sets out six overarching strategic directions, described below, to instil best practice approaches across NSW's infrastructure sectors.

It then sets out the infrastructure needs and priorities for each of NSW's major geographic regions, acknowledging their unique endowments and identifying the priority initiatives and investments that will enable them to meet their goals for liveability and economic development. These geographic directions build on the Government's recently adopted land use plans for jobs and housing.

The cross-cutting strategic and geographic directions then inform Infrastructure NSW's policy and investment recommendations for each infrastructure sector. These recommendations are contained in each of the chapters in the 2018 SIS, and listed again in Appendix 1.

Strategic directions

The following strategic directions will provide long-term value by embedding good practice across the infrastructure lifecycle.

1. Continuously improve the integration of land use and infrastructure planning

Infrastructure planning at the local level will be improved through growth infrastructure compacts and strategic business cases that link population and jobs growth in priority locations to agencies' long-term Capital Investment Plans, as well as acting ahead of time to protect key infrastructure corridors and provide better quality data and information to the housing industry to boost investor confidence. (Chapter 2)

2. Plan, prioritise and deliver an infrastructure program that represents the best possible investment and use of public funds

Further improvements will be made to major project planning approval processes and procurement to get worthwhile infrastructure built more quickly and cost-effectively than in the past. Opportunities will be explored to unlock new or improved sources of funding and the potential for further asset recycling initiatives will be considered over the next five years. (Chapter 3)

3. Optimise the management, performance and use of the State's assets

A revised asset management policy, supported by a new assurance model, will help agencies across NSW's public sector to lift their performance in managing the more than $300 billion of infrastructure assets that NSW already owns, making the most of these assets and ensuring they are appropriately maintained, repurposed and upgraded. (Chapter 4)

4. Ensure NSW's existing and future infrastructure is resilient to natural hazards and human-related threats

The resilience of vital State assets will be improved by better coordination between agencies, sharing of information and infrastructure-specific risk assessment tools and guidance. Resilience considerations will be embedded into project business cases, capital asset planning and assurance processes, and agencies will be required to undertake rolling, periodic assessments of the vulnerability of their assets to natural disasters and human related threats. (Chapter 5)

5. Improve statewide connectivity and realise the benefits of technology

Targets will be set for digital connectivity and existing state-owned telecommunications assets and purchasing power will be harnessed to improve connectivity across NSW. More open approaches to data management will be pursued and risk-based cybersecurity protections for infrastructure adopted. A new policy framework will guide investment in and maximise the benefits delivered by the Internet of Things. All new and significantly upgraded state-owned assets will be connected or connectable by 2020. (Chapter 6)

6. Drive high quality consumer-centric services and expand innovative service delivery models in infrastructure sectors

The best skills in the public, private and not-for-profit sectors will be harnessed by applying the *NSW Commissioning and Contestability Policy* to existing public services, while continuing to innovate in the procurement and delivery of new public assets and services. Government agencies will identify and proactively support opportunities for streamlined regulation to enable new markets and innovative products to develop. (Chapter 7)

Geographic directions

Past infrastructure plans have tended to be divided along sectoral lines – such as transport, health and education – reflecting the 'silos' into which most governments divide themselves.

The 2018 SIS adopts a different approach, considering the infrastructure needs of cities and regions based on their unique characteristics and the likely impact of combined investments across sectoral boundaries. Infrastructure and land use are not the only drivers of economic outcomes.

The regions listed below will only achieve their full potential if infrastructure and land use planning are supported by targeted policies in areas such as skills development and industry attraction.

The key geographic responses are outlined in Chapter 8 and summarised below.

NSW Gateway to Australia and to international markets	• Improve access to NSW's international gateways. • Facilitate investment in all levels of high quality digital infrastructure. • Facilitate investment in secure, reliable, affordable low emissions, energy efficient infrastructure.
Regional NSW Strengthening growing regions with new jobs	• Improve east-west connections to markets and access to international gateways. • Provide connections to and from Inland Rail. • Ensure water supply and wastewater treatment to enable industry and population growth. • Provide health infrastructure upgrades to align with settlement patterns and population. • Ensure education infrastructure and technology are comparable to that in Greater Sydney.
Western Parkland City Developing a new city built on new knowledge industries	• Prioritise intercity road connections to support access and provide a north-south mass transit connection. • Provide a freight network to support a growing city. • Provide health, education and social infrastructure to support population growth. • Facilitate high quality digital connectivity infrastructure as part of all developments. • Protect and enhance the South Creek catchment.
Central River City Supporting an emerging administrative capital	• Improve intercity and intracity transport connections and improve north-south transport connections. • Provide better cultural and recreational infrastructure. • Improve walking and cycling connections. • Facilitate high quality digital connectivity infrastructure as part of all developments. • Provide more education learning spaces.
Eastern Harbour City Strengthening global headquarters for Australia's top businesses	• Improve access to international gateways. • Improve mass transit connections to the CBD, especially from the west and south east. • Improve active transport. • Improve cultural infrastructure and institutions. • Provide more education learning spaces.

Sector-based infrastructure directions

Building on these strategic and geographic directions, Infrastructure NSW has analysed the policy and investment options available to the NSW Government across the key infrastructure sectors. In doing so, it is mindful that the NSW Government has finite resources. Not all worthwhile projects and programs being contemplated by the NSW Government will be affordable, even over the 20-year term of this SIS. The NSW Government has a legislated commitment to maintaining the State's AAA credit rating, which is based in large part on its ability to keep public debt within acceptable parameters.

Accordingly, the 2018 SIS presents the NSW Government with choices as to the priority investments it can make. Infrastructure NSW offers the NSW Government evidence-based advice on the choices it should make, tied to clearly defined economic and social objectives. Not all these choices are straightforward. But the choices the NSW Government faces will be easier, and the list of affordable projects will be longer, if it can unlock extra funding. Potential funding sources include the Commonwealth Government, more widespread user charging, the sale of state-owned assets and greater private sector investment.

Chapters 9 to 15 provide directions for the infrastructure sectors. The table below summarises Infrastructure NSW's key recommendations for each infrastructure sector.

Transport	
Strategic objective: Ensure the transport system creates opportunities for people and businesses to access the services and support they need	**Summary of key recommendations:** • Support the development of a three-city metropolis for Greater Sydney by investing in transport infrastructure that provides high frequency and high-volume access to, and connectivity between, each of the three cities, while enhancing local amenity. • Invest in transport infrastructure that is integrated with land use to create opportunities for agglomeration and enhance productivity, liveability and accessibility, in support of the policy goal of a '30-minute city'. • Support the development of regional hubs by enhancing their accessibility and connectivity via major north-south and east west links. • Encourage travel patterns that are tailored to the capacity of the network and help to manage congestion with mobility pricing reform and demand management initiatives. • Re-allocate road space in key commuter corridors to give priority to the most productive and sustainable transport modes, improve the integration of services across modes, remove network bottlenecks and upgrade operational systems and infrastructure. • Overcome local constraints on the regional road and rail networks that limit the use of high productivity freight vehicles and rail freight. • Further develop the Sydney rail network with new rail links and system-wide upgrades. Develop extensive on-road rapid transit networks and active transport links to support the mass transit system. Plan and deliver critical links in the motorway network that will serve Sydney well into the future and link key centres across Greater Sydney. • In the Western Sydney Parkland City, give priority for the next 20 years to establishing a high quality, on-road rapid transit system and planning and preserving future infrastructure corridors. Investment in rail-based mass transit should commence as a staged investment from 2036 onwards unless co-investment from the Commonwealth Government and the private sector enables it to proceed earlier. • Complete missing links in the regional network, creating travel time savings and safety benefits that increase productivity.

Transport	
	• Equip the transport system for emerging technology with investments in connectivity and digital infrastructure, and establish regulatory and governance settings that will encourage innovation and ensure the benefits of new technology can be fully realised.
	• Develop and protect freight and service networks by improving road and rail access for goods and services to local, national and global markets, leverage the Commonwealth's Inland Rail investment and address existing inefficiencies and pinch points.
	• Improve the resilience of the system to reflect its critical operational role, including during periods of acute and sustained shock.
Energy	
Strategic objective: Encourage private sector investment to deliver secure, reliable, affordable, low emissions energy supply	**Summary of key recommendations:** • Implement the Council of Australian Governments (COAG) Energy Council-endorsed recommendations emerging from the Energy Security Board and the Finkel Review and ensure, through leadership and close monitoring, that energy market actions meet NSW consumers specific needs and circumstances. • Avoid funding new generation capacity or introducing schemes that send distortionary price signals that discourage or prevent private sector investment. • Review the benefits of moving the State transmission and distribution reliability standards to a national framework. • Accelerate the NSW Government's Strategic Release Framework for Coal and Petroleum Exploration, where necessary. • Review local planning rules and the electricity supply regulatory framework to promote new technologies and energy infrastructure. • Accelerate national and state regulations for consumer protection and safety. • Develop regional economic growth programs to support skills development and industries affected by the energy transition. • Promote demand management and nationally harmonised, market-based schemes for energy efficiency. • Strengthen and expand the coverage of national energy efficiency standards for all building and infrastructure developments. • Strengthen and promote the use of the NSW Government Resource Efficiency Policy to drive down Government's energy costs.

Water

Strategic objective:	Summary of key recommendations:
Support the growth, productivity and liveability of metropolitan and regional communities by ensuring that water security, quality and wastewater services protect public health and the environment	• Assess the climate science capability required for water resource management and for infrastructure investment decision-making. • Develop a NSW Water Statement to provide transparency about the management and control of the State's water resources. • Identify investment options in the priority catchments of Gwydir and Macquarie. • Develop regional water strategies for the priority catchments of Richmond and Bega. • Develop a risk-based approach to identify priority infrastructure projects that protect drinking water safety in regional NSW towns. • Finalise the Hunter regional water strategy to achieve longer-term water security for the region, including the Central Coast, and review water sharing arrangements. • Prepare a strategic business case to connect Lostock and Glennies Creek dams. • Prepare a strategic business case for a potable water pipeline connecting Singleton to the Hunter Water network. • Develop a 20-year Strategic Capital Plan for Sydney's water and wastewater systems for consideration by the NSW Government and inclusion in Sydney Water's Pricing Submission to the Independent Pricing and Regulatory Tribunal. • Complete the South Creek Corridor Strategic Business Case. • Develop options for the augmentation of Sydney's water supply, including the findings of the South Creek Strategic Business Case, and provide advice to the NSW Government.

Health

Strategic objective:	Summary of key recommendations:
Plan and deliver world-class health infrastructure that supports a 21st century health system and improved health outcomes for the people of NSW	• Develop a 20-year Health Infrastructure Strategy that incorporates flexibility, enables system integration, innovation and technology, to inform investment in future-focused infrastructure. • Assess ageing health assets to determine whether they are fit-for-purpose, explore the potential to develop greenfield sites and consider divesting assets that are not fit-for-purpose for future care models. • Consider investment in infrastructure for health benefits as part of an integrated health and town planning strategy, such as walking and cycling infrastructure and parks and recreation facilities. • Deliver the current *eHealth Strategy 2016-2026*. • Periodically refresh the eHealth Strategy to support an ongoing investment in technology-enabled health care including: mobile health; cognitive technologies; and virtual healthcare delivery. • Include an assessment of strategic assets and asset management as part of the Health Infrastructure Strategy. • Consider public private partnerships to finance health infrastructure and clinical care delivery, where they deliver value and improved clinical outcomes for the community.

Education	
Strategic objective: Deliver infrastructure to keep pace with student numbers, and provide modern, digitally-enabled learning environments for all students	**Summary of key recommendations:** • Fully fund and implement the *School Assets Strategic Plan*. • Progressively upgrade all existing permanent learning spaces to Future Learning environments over the long term. • Assess the impact of operational policies and procedures on infrastructure requirements. • Identify how the functional limitations of demountable classrooms can be addressed, potentially through modified designs, or a retrofitting or replacement program. • Routinely assess the vulnerability of the Department of Education's assets to the impacts of climate change, natural disasters and human-related threats, and identify cost-effective adaptation and mitigation measures. • Embed consideration of joint and shared used, partnership, and place-making opportunities in Schools Community Planning. • Ensure skilled resources are dedicated to promoting and facilitating joint and shared use opportunities. • Prepare a *School Energy Strategy 2018 – 2030*. • Prepare a *School Digital Transformation Strategy 2018 – 2025*. • Prepare a business case for a *Connecting Metropolitan Schools program*. • Support the non-government school sector to meet its growth challenges and to identify, and where possible, remove barriers to that sector growing its student share. • Prepare and implement a 20-year TAFE NSW Infrastructure Strategy.

Justice	
Strategic objective: Adopt a more integrated approach to strategic asset planning, asset management and service delivery across the Justice Cluster	**Summary of key recommendations:** • Complete a review of asset management across the Justice Cluster by mid-2018. • Drawing on the asset management review, develop a 20-year Justice Infrastructure Strategy by the first quarter of 2019. • Prepare business cases by the end of 2018 to address court capacity in the Sydney CBD, South West Sydney and key locations in regional NSW. • Prepare a business case and undertake site investigations and related community consultation by the end of 2018 to address the requirement for additional long-term prison bed capacity in Greater Sydney.
Culture, sport and tourism	
Strategic objective: Deliver world-class institutions to maintain strong cultural and sporting sectors and support the visitor economy	**Summary of key recommendations:** • Publish and implement a NSW Government response to the recommendations of the 2016 Cultural Infrastructure Strategy. • Develop a Sport Infrastructure Strategy and a whole-of-sector investment framework. • Deliver community sport infrastructure programs and complete final business cases to inform investment in major stadia. • Develop a Tourism Infrastructure Strategy to guide investment that will support the new Regional Economic Development Strategies and visitor economy targets. • Prepare a strategic business case to assess options for providing additional cruise berthing capacity in Sydney. • Encourage the Commonwealth Government to review regulatory settings to improve aviation operations in Sydney.

The context

1. Strategic context

Snapshot

- NSW is changing. The way our infrastructure is planned, delivered, managed and maintained needs to change too. The advice and recommendations in the *State Infrastructure Strategy 2018-2038: Building Momentum* (the 2018 SIS) respond to NSW's changing social, technological, environmental and economic outlook and build on the benefits and achievements already delivered by the largest infrastructure program in Australia.
- The 2018 SIS provides the NSW Government with advice about infrastructure policy and investment priorities, in line with the requirements of the *Infrastructure NSW Act 2011*. Infrastructure NSW delivered the first SIS in 2012, followed by an update in 2014.
- The NSW Government's long-term land use plans for regional NSW and Greater Sydney and *Future Transport 2056* inform the 2018 SIS. Community and business feedback during the development of these plans has been an input to the Strategy.
- The 2018 SIS seeks to answer the question: how can NSW continue to improve its economic prosperity and global competitiveness while meeting the challenges of population growth and remaining a great place to live and work?
- Over the next 20 to 40 years, NSW will face a series of structural challenges, including population growth, an ageing population, a fast-growing young population and changes to the composition of the State's industries and economy. At the same time, a fiscal gap is emerging where the revenue the NSW Government receives is declining while the demand for services continues to grow.
- The recommendations in the 2018 SIS identify investment and policy priorities that are achievable and affordable, based on sound evidence, and that deliver the highest economic, employment and liveability benefits to the people of NSW.
- Should all the 2018 SIS recommendations be accepted, it is estimated that the NSW economy will grow and employment across the State will increase, leaving people in NSW financially better off and enjoying substantial liveability benefits.

1.1 Introduction

Infrastructure is defined for the purposes of the 2018 SIS as a system of physical and digital assets that enable the delivery of the services that are the foundation for a successful economy and society. Infrastructure investment that is well planned, well managed and well delivered lifts productivity and living standards,[1] generating long-term economic and social benefits.

1.1.1 Role of Infrastructure NSW

Infrastructure NSW is an independent statutory agency, established under the *Infrastructure NSW Act 2011* (the Act). Infrastructure NSW is an independent source of expert advice to the NSW Government on its immediate and future infrastructure policy and investment priorities.

A core function of Infrastructure NSW is the preparation and review of 20-year infrastructure strategies every five years. The Act states that the strategy must assess the current state of infrastructure within NSW and the needs and strategic priorities for infrastructure in NSW over the next 20 years.

Since 2011, Infrastructure NSW has prepared two state infrastructure strategies for the NSW Government.

The *State Infrastructure Strategy 2012: First Things First* established Australia's first evidence-based statewide infrastructure strategy. Its recommendations were

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1   Productivity Commission 2015, p. 33

aimed at addressing NSW's long-term infrastructure deficits in roads, public transport, international gateways, water, health, education and justice.

Key investment recommendations made in the 2012 SIS, such as WestConnex and North West Rail Link, are well advanced in their implementation. The International Convention Centre (ICC Sydney) opened in December 2016 and was delivered on time and on budget in partnership with the private sector.

The *State Infrastructure Strategy Update 2014* was developed to guide the Government on the best use of the anticipated proceeds from its asset recycling program, particularly the partial long-term lease of NSW's electricity networks. It provided advice on how to accelerate growth in NSW and contained 83 recommendations, all of which were accepted by the Government. The Strategy Update formed the basis for the Rebuilding NSW initiative, which is well advanced in its implementation. Key city-shaping projects like Sydney Metro City & South West and Parramatta Light Rail Stage One were brought forward as part of Rebuilding NSW.

1.1.2   Scope of the 2018 SIS

The 2018 SIS seeks to answer the question: how can NSW continue to improve its economic prosperity and global competitiveness while meeting the challenges of population growth and remaining a great place to live and work?

The SIS reflects Infrastructure NSW's vision of investing in 'the right infrastructure in the right places', while continuing to get more productive use from existing assets. The strategy's objectives and responses

recognise that government alone cannot build its way out of increasing demand for infrastructure and services: on the one hand, it may not be affordable to do so and, on the other hand, it would cause significant disruption to communities.

The key is investing in well-targeted infrastructure that is integrated with land use planning, while at the same time making the most of the State's assets.

The recommendations in the 2018 SIS identify investment and policy priorities that are achievable and affordable, and that deliver the highest economic, employment and liveability benefits to the people of NSW.

Vision

The right infrastructure, in the right places, that is well managed and put to good use, boosting productivity, global competitiveness, and improving the quality of people's lives.

The 2018 SIS covers the NSW Government's investment in economic infrastructure (transport, communications, energy and water) and social infrastructure (health, education, justice, arts and social housing). The State's investment in these infrastructure sectors is worth $283 billion, with the largest portion, $137 billion, allocated to transport assets such as roads and public transport. The value of NSW transport assets has increased by almost 50 per cent since 2012 due to the State's large transport investment program. A breakdown of the State's infrastructure portfolio and annual capital investment in infrastructure by sector is outlined in Figure 1.

Figure 1 – NSW Government State infrastructure portfolio
State asset value by sector, as at 30 June 2017
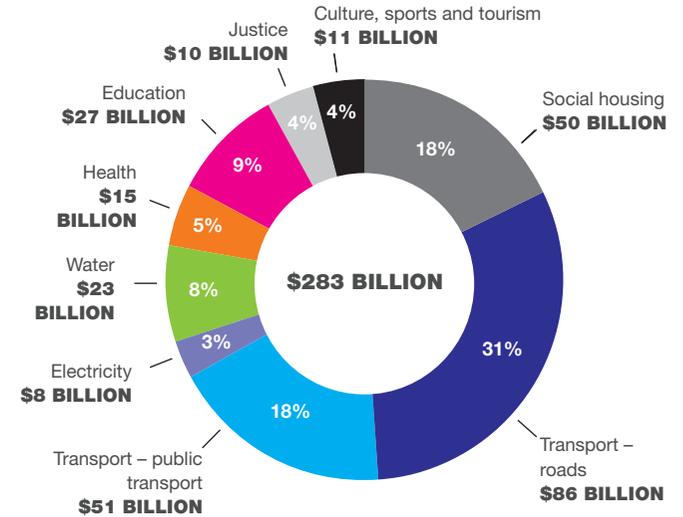
State capital expenditure by sector, 2017-18
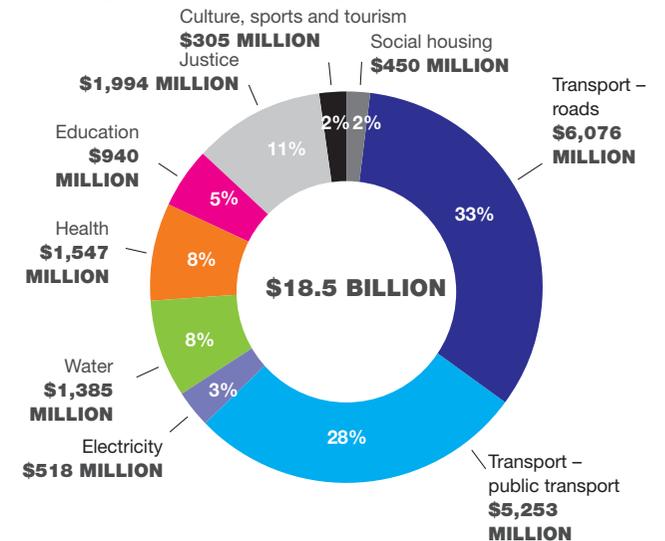
Source: NSW Treasury 2017

The 2018 SIS aligns with the following NSW Government strategies to deliver joined-up policy and investment directions for NSW (see Figure 2):

- long-term land use plans for regional NSW and Greater Sydney, prepared by the Department of Planning and Environment and the Greater Sydney Commission (GSC) respectively
- economic development directions set out in the *Regional Development Framework*, prepared by the Department of Industry
- *Future Transport 2056*, the NSW Government's long-term transport masterplan, prepared by Transport for NSW.

The 2018 SIS also aligns with Infrastructure Australia's *Infrastructure Priority List* (refer to Chapter 2, Figure 8).

Figure 2 – NSW integrated strategic planning framework

Premier's and State Priorities
Vision for NSW

| **Future Transport 2056** | **State Infrastructure Strategy** | **Region Plans** Nine regions of NSW | **Greater Sydney Region Plan and District Plans** |

Common Planning Assumptions

Population, demography, housing, employment, fiscal and economic forecasts
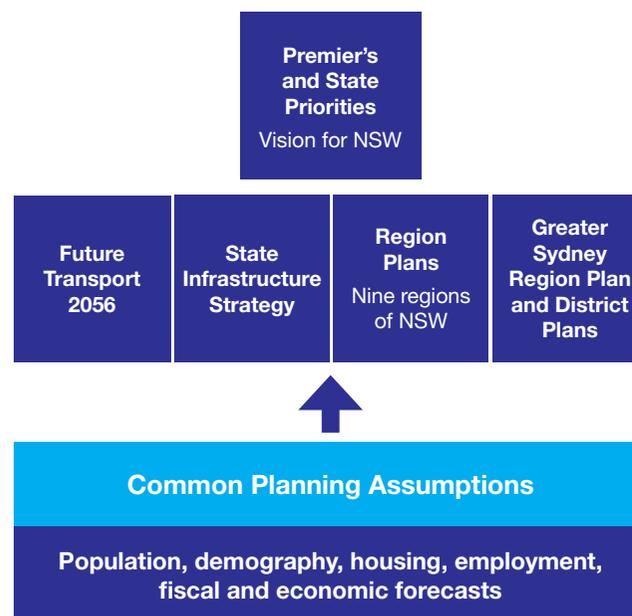
Source: NSW Treasury, adapted by Infrastructure NSW, 2017

1.2 Infrastructure demand

To prepare the 2018 SIS, Infrastructure NSW looked at infrastructure demand over the last five years and the drivers of further change over the next 20 years.

The population of NSW is expected to grow by 28 per cent in the next 20 years, faster than projected in 2012 (27 per cent). This is the result of higher immigration and higher birth rates.[2] Higher population directly affects the demand for social infrastructure services, including the expected number of students entering

the public education system and the expected number of people aged over 70, a key driver of the health demand forecast for 2036.

In transport, changing travel preferences have contributed to higher bus and rail use than forecast in 2012. Demand for rail travel is forecast to more than double over the next 20 years. With growth in car travel forecast to moderate, a greater proportion of travel is expected to be by public transport in the future.

Changing industry structures are leading to slower than expected growth in electricity and freight demand. Electricity consumed from the grid is forecast to grow by only two per cent over the next 20 years, as traditional electricity supply is replaced by distributed energy resources such as solar. Container freight traffic will continue to grow, broadly in line with economic activity (62 per cent over 20 years), but this rate of growth is lower than forecast in 2012. Growth in the volume of coal freight over the next 20 years, which makes up most of the State's freight demand, is expected to be lower than forecast in 2012, reflecting changes in international demand.

Forecasts for demand in the infrastructure sectors considered by the 2018 SIS are shown overleaf.

2   NSW Department of Planning and Environment 2016

Growing population and changing demographics are driving demand for services:

Public school students

2016 – 800,000
2036 – 1m

25%

Nearly 200,000 more students will be enrolled in our public schools in 2036. This growth is **higher** than expected in 2012.

Source: NSW Department of Education 2017

Road – daily car trips

2016 – 9.4m
2036 – 12.1m

30%

2.7 million more daily car trips need to be accommodated on our roads in 2036. This annual growth rate is **higher** than expected in 2012 and in line with population growth.

Source: Transport Performance and Analytics 2017

Population aged 70 years and over

2016 – 853,000
2036 – 1.55m

85%

The increase in the number of people aged 70 years and over will increase the health services demand by more than 50% by 2036.

Source: NSW Department of Planning and Environment 2016, NSW Health 2017

Changing preferences for how we travel are driving transport passenger demand:

Road – daily bus only trips

2016 – 600,000
2036 – 900,000

48%

An extra 300,000 more bus only trips each day need to be accommodated on our roads in 2036. This annual growth rate is **higher** than expected in 2012.

Source: Transport Performance and Analytics 2017

Train trips

2016 – 1.1m
2036 – 2.1m

113%

More than one million extra train trips each day are expected in 2036. This annual growth rate is **higher** than expected in 2012.

Source: Transport Performance and Analytics 2017

Sydney Airport

2016 – 42m
2036 – 90m

114%

An extra 48 million passenger trips are expected to and from Sydney Airport in 2036. This is the **same** annual growth rate as expected in 2012.

Source: Sydney Airport 2017

Changing industry structure is driving changes to demand for electricity and freight:

Electricity

2016 – 69.2 TWh
2036 – 70.7 TWh

2%

Electricity consumption has fallen since 2009 and is only expected to increase by 2% in 2036. This growth rate is **lower** than expected in 2012.

Source: Australian Energy Market Operator 2017

Coal freight

2016 – 189mt
2036 – 210mt

11%

Annual export and domestic coal freight growth rate is expected to slow by 2036. The overall growth rate is **lower** than expected in 2012.

Source: Transport Performance and Analytics 2017

Port Botany – container trade

2016 – 2.36m TEU
2036 – 3.83m TEU

62%

Freight demand is expected to grow in line with GSP. This annual growth rate is **lower** than expected in 2012.

Source: Transport Performance and Analytics 2017

1.3　Challenges and opportunities

NSW is currently in a strong economic position, with a robust infrastructure renewal program. However, over the next 20 to 40 years, the State will face a series of long-term structural changes with significant implications for economic and social infrastructure, as summarised in Table 1.

Table 1 – Implications arising from future structural changes

Structural change	What does it mean for infrastructure?
Emerging fiscal gap	
Current trends indicate that a fiscal gap is emerging between the revenue the NSW Government receives and demand for expenditure on services and infrastructure. Revenue is decreasing due to reducing State duties, a smaller share of GST distribution from the Commonwealth Government, declining Commonwealth partnerships payments and the completion of the current NSW asset recycling initiatives. The ageing of the population is likely to increase expenditure as older people access services more frequently.	The demand for infrastructure to meet housing and jobs growth is increasing, but government alone cannot afford to build its way out of demand. Assessing and prioritising the most cost-effective and efficient means to address the demand for services and supporting infrastructure will be critical to overcoming affordability constraints. Reforms that better manage demand and innovative service delivery models are needed to ensure that the right service outcomes (supported by infrastructure) are delivered at the right time, and at the right price.
Population growth	
The NSW population is set to increase from 7.7 million in 2016 to over 12 million by 2056. Around 80 per cent of this growth is expected to be in Greater Sydney in the next 20 years. Forty per cent of the expected population growth will be due to natural increases and increased longevity, with the balance due to internal and overseas migration, (which is a consequence of Commonwealth migration policy).	NSW's larger population will require more housing and supporting infrastructure and services. To meet the estimated demand, around two million more houses will be needed. Without adequate supporting infrastructure investment, a growing population will place increasing pressure on economic infrastructure (such as transport and water) and social infrastructure (such as schools and health services), as well as on the cost of housing. It is vital that the services necessary to support growing regional communities and Greater Sydney's 'three cities' benefit from well-planned and well-timed infrastructure provision that is integrated with land use.

Structural change	What does it mean for infrastructure?
Demographic change	
With an ageing population that is living longer, workforce participation is expected to decline from 64 per cent today to 59 per cent in 2056. The millennials, people born between 1982 and 2000, are currently the largest generation and will remain the largest proportion of the State's population into the 2030s.	Baby boomers are living longer, with a relatively long period of retirement, leading to an increase in demand for health services. Conversely, millennials are expected to stay in education longer, work differently and demand different kinds of services to meet their individual needs. The fast-growing young population will require more investment in education infrastructure, as well as supporting infrastructure and services for industries needing skilled workers, particularly knowledge-intensive industries.
Changing jobs and digital technology	
It is expected that the number of jobs will grow from 3.8 million today to 5.7 million by 2056. More flexible working hours and part-time jobs are expected as digital platforms accelerate the shift away from single career jobs to the 'gig economy' (freelance workers). Digital technologies will transform the way businesses and governments operate. The jobs market is shifting away from manufacturing and other industrial sectors towards knowledge-based industries. The risk of cybercrime will increase with the growing reliance on digital technologies for the provision of services and the management of infrastructure.	Modern education and TAFE services are needed to support the high-value skills that underpin structural changes to how people work. Demand for ubiquitous, reliable and fast connectivity will increase with the growth of the digital economy. Without appropriate digital connections, economic growth in some areas of NSW may be impeded. Digital technology and automation will improve the productivity of infrastructure, with the introduction of fully automated vehicles and smart motorways set to improve the productivity of existing roads. Data is a new infrastructure asset that is critical to developing new services, improving current services and better managing the performance of assets. Infrastructure will need to be more resilient to cyber and physical attacks as well as unauthorised data breaches.

Structural change	What does it mean for infrastructure?
Economic growth	
The NSW economy is expected to grow from $539 billion to $1.4 trillion over the next 40 years, driven by global economic growth – particularly from fast-growing Asian economies. Export patterns are changing the composition of the State's economy. For example, the demand for high quality food, goods and services, such as education services, is increasing. High growth is also expected in population-serving industries, particularly health and education.	Economic structural change will have significant consequences for infrastructure. Infrastructure that enables greater labour mobility and productivity, such as mass transit systems, will be needed to provide the products and services of the future. The State's freight network will remain critical to ensuring NSW has efficient access to international gateways. Well-targeted communications, energy, water and transport infrastructure will be critical for NSW's trade and population service industries. Health, education, cultural and recreation infrastructure, as well as housing, will be needed to support the State's growing population and attract and retain skilled workers, global business and new industries.
Climate change	
Temperatures in NSW are expected to rise by an average 0.7 degrees in the near future (2020-2039) and by about 2.1 degrees in the longer term (2060-2079). This will result in more hot days and longer heatwaves, and major impacts on human health: heatwaves cause greater mortality than any other form of natural disaster. Rainfall intensity is set to increase in certain areas across NSW, potentially exceeding the capacity of stormwater and wastewater infrastructure. Global sea levels are rising and are expected to continue to rise in the long term. This will directly impact coastal communities. The North Coast Region and the Greater Sydney Region have the greatest exposure to sea level rise and erosion.	An increase in the frequency and/or severity of natural disasters could impact the capacity of all types of infrastructure. For instance, more hot days and increased demand for cooling will place greater stress on energy infrastructure, increasing the possibility of infrastructure system failure. Stormwater drainage is likely to become less effective as sea levels rise, impacting urban areas near coastal rivers, lakes and estuaries. Centrally located, reliable and accessible climate and hazard data, together with appropriate risk assessment tools, will help infrastructure operators to prepare for and mitigate these risks.
Social preferences	
As the NSW population grows and consumption patterns change, the distribution of private and public spending on goods and services will change, with expectations of service quality set to increase as millennials join the workforce. Technology will continue to enable the personalisation of products and services, such as peer-to-peer markets, while society's aggregate consumption patterns are likely to change as wealth increases and a greater proportion of income becomes available for discretionary purchases.	Shifts in social preferences are likely to impact equally on the private and public sectors. Service and infrastructure provision will need to recognise changing consumption patterns and trends around the quality and personalisation of the customer experience. More flexible and innovative service models will be needed to satisfy demand for more efficient, personalised services.

1.4   Strategy methodology

Since the *State Infrastructure Strategy 2012*, Infrastructure NSW has strengthened its framework for identifying, assessing and prioritising infrastructure programs and projects. This includes sharpening our guiding principles, adopting a geographic approach and taking triple bottom line impacts into account. We have improved our modelling approach to better measure the affordability and fiscal impact of our recommendations on the NSW economy.

In addition, Infrastructure NSW has worked with experts who have helped with setting and refining the directions for the 2018 SIS (refer to Appendix 3).

Guiding principles

Infrastructure NSW's recommendations in the 2018 SIS have been guided by three principles to ensure the strategy is sustainable and achievable, and secures social, environmental and economic outcomes for NSW:

- **Investing in competitive jobs and economic development** – Infrastructure responses should be prioritised to support and grow competitive industries and maximise economic development across NSW.
- **A balanced infrastructure program** – Infrastructure responses should include an appropriate balance of reforms and policy initiatives, as well as large and small scale investments, to deliver performance improvements efficiently and cost-effectively.
- **Affordability and fiscal sustainability** – Infrastructure responses should focus on consumer-centric outcomes, be realistic and affordable and be carefully prioritised to deliver maximum community benefit.

Prioritising infrastructure responses

The process for identifying, assessing and prioritising infrastructure responses in the 2018 SIS is set out in Table 2.

Strategy timeframes

Infrastructure responses recommended by Infrastructure NSW have been grouped within the following timeframes:

- **Immediate actions over 0-5 years:** recommendations in this period include planning activity and the development of business cases for the highest priority long-term investments, as well as the investigation of regulatory and policy changes
- **Actions to support planning for growth over 5-10 years:** recommendations in this period generally complement the major infrastructure investments recommended in the 2012 and 2014 State Infrastructure Strategies, and tend to be priorities for shaping land use and economic development in NSW
- **Actions to support the longer-term vision for NSW over 10-20 years:** recommendations in this period are informed by the 40-year outlook and support the formation of economic centres across the State, including the emerging Western Parkland City. Projections for infrastructure service demand for this period are intrinsically uncertain. Infrastructure NSW recommends flexibility and the monitoring of trigger points such as population, demographic, patronage and industry growth rates to inform the timing and development of long-term major infrastructure projects.

Table 2 – Five step assessment process

Step	Description
1. **Problem and gap analysis**	Identifying priority infrastructure policy and investment gaps, through an analysis of: • external trends and policy settings • a high-level condition assessment of NSW's infrastructure • industry development and growth forecasts.
2. **Options development**	Developing options to respond to identified problems and gaps, and to support strategic land use and economic development strategies, including: • investment options for the first 10 years generated by agencies in annual Capital Investment Plans and emerging medium-term projects identified in the project prioritisation process (refer to Chapter 3) • investment and policy options for the long term (10 to 20-year period) generated by agencies, with input from the consultation process described under Step 3.
3 **Consultation**	Analysing infrastructure issues arising from extensive business and community engagement by various government agencies across regional NSW and Greater Sydney over the last three years.
4. **Options assessment**	Assessing investment and policy options based on four key qualitative parameters: • strategic alignment – alignment with the strategic priorities of the NSW Government, including statewide land use plans • triple bottom line impacts – likelihood of generating net benefits • scenario assessment – vulnerability under plausible but extreme scenarios of adverse economic, environmental, technological and social 'shocks' • implementation risk – the likelihood of successful implementation.
5. **Fiscal and economic modelling**	Undertaking fiscal modelling to assess the affordability of proposals over the medium to long term. Undertaking economic modelling to measure the contribution of the infrastructure proposals to productivity, workforce participation and population.

1.5   Strategy benefits

An assessment of the impact of implementing the 2018 SIS recommendations has been undertaken by The Centre for International Economics. The 2018 SIS is expected to grow the NSW economy, increase employment across the State and leave people in NSW financially better off and enjoying substantial non-economic, 'liveability' benefits.

Modelling approach

Improvements have been made to the economic modelling approach since the 2014 SIS, including:

- using the *NSW Common Planning Assumptions*, a central register of shared projections for population, demography, housing, employment and the fiscal environment
- using project-specific evidence about expected benefits, drawing on major project business cases developed over the last three years
- modelling the contribution of the 2018 SIS recommendations on the NSW Government's Regional Plans (including the *Greater Sydney Region Plan*).

Modelling has been undertaken for around 60 per cent of the recommendations in the 2018 SIS, including policies aimed at making better use of existing infrastructure and better integrating infrastructure and land use, and processes designed to make decisions and policies that lead to the more efficient provision of services.

The impact has been measured for two cases:

- policy and project recommendations
- the implementation of an integrated system wide transport pricing road map.

The impacts of the Strategy have been reported for the 20 and 40 year periods to 2036 and 2056 because the assessment relies and builds on NSW Treasury's Intergeneration Report for 2016-2056. Estimating the impacts of the SIS consistently with the time profile in this report and its underlying model provides the most reliable estimates.

Further details on the modelling approach adopted for the 2018 SIS are provided in the report "*Impact of the State Infrastructure Strategy 2018*" by The Centre for International Economics (refer to Appendix 2).

Benefits modelled[3]

- **NSW economy –** The overall impact of recommended policies and projects are estimated to increase the size of the NSW economy by over one per cent, or $11 billion, in 2036 and by over three per cent, or $45 billion, in 2056. If the recommended development of an integrated system wide transport pricing road map proceeds to implementation, the total estimated increase to Gross State Product would be nearly three per cent, or $26 billion, in 2036 and five per cent, or $66 billion, in 2056.
- **Productivity** – Most of the statewide benefits accrue due to higher productivity growth than would otherwise be the case. This improved productivity stems largely from better use of infrastructure (including demand management and integrated transport pricing) and transport investments that support the Government's Regional Plans.
- **Participation** – Labour force participation improves mainly because of improved access and travel times for firms and workers to jobs and services arising from key transport recommendations.
- **Jobs** – An additional 26,000 people would be employed in NSW by 2036 and 159,000 more people would be employed by 2056. Impacts on jobs are more rapid after 2036 when major transport projects and policies are implemented thereby allowing people greater access to job opportunities.
- **NSW households** – People would be $200 per person financially better off per year because of the 2018 SIS recommendations by 2036 and $700 per person better off per year by 2056. If transport pricing road map proceeds to implementation, people would be $1,000 per person financially better off per year because of the 2018 SIS recommendations by 2036 and $1,600 per person better off by 2056.[4] This benefit arises because of productivity and participation growth: the recommendations are expected to improve productivity by lowering the cost of doing business and improve participation in the workforce by older and less advantaged people.

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3   The Centre for International Economics 2018, p. 5-27

4   Measured as the change in per person household consumption. Ibid, p. 6

- **NSW liveability** – The majority of benefits arising from the recommendations relate to improved liveability. The 2018 SIS proposes investments that support population growth without leading to poorer outcomes for residents. The SIS recommends measures that will enhance the quality of people's lives without impairing the character of suburbs and towns. This includes investment in greater capacity and higher quality transport, digital, health, education, recreation and cultural infrastructure. The largest quantified impacts relate to reduced congestion.

- **Regional NSW** – The 2018 SIS proposes investments that will lower business transport costs, improve the attractiveness of regional centres and ensure equality in the standard of digital, education and health services across regional NSW. Regional recommendations that target growth in jobs are expected to reverse historical trends and to encourage working age people to settle in regional NSW. Up to 9,000 more jobs will be in regional NSW by 2036 as a result of these investments in infrastructure and associated regional industry support. Improved digital connectivity, as well as health and education infrastructure, is expected to encourage more than 10,000 additional people to live in regional NSW by 2036.

- **Greater Sydney** –The SIS supports the three city spatial strategy for Greater Sydney and contributes to achieving a '30-minute city' where most Sydney residents can access their metropolitan city centre or city cluster within 30 minutes by public transport. Greater Sydney will benefit from more schools, inter- and intra-city transport, access to international gateways, improved active transport and better recreation, cultural and health facilities. The recommendations will overcome existing barriers to Sydney's competitiveness, connectivity and housing affordability, and boost the city's strengths (higher wages and lower unemployment).

- **Developing Western Sydney Airport** – The 2018 SIS supports the long-term development of new employment centres around the Western Sydney Airport, as well as population growth in Western Sydney. The SIS proposes investments that will support the westward movement of jobs growth over the next forty years. Benefits include over 6,000 more jobs and nearly 9,000 more people in the emerging Western Parkland City, along with the required supporting infrastructure by 2036. The 2018 SIS recommendations will lead to better outcomes for Western Sydney's new and existing residents and will help address inequities in access to services and jobs.

The response

2. Integrating land use and infrastructure planning

STRATEGIC OBJECTIVE   **Continuously improve the integration of land use and infrastructure planning**

SNAPSHOT	
	• Long-term land use plans are a critical foundation for infrastructure planning. Improved, integrated land use and infrastructure planning, and the availability of more extensive and better quality data and information, are vital to collaboration between business, government and the non-profit sector in delivering infrastructure to support jobs and housing growth.
	• While NSW Government agencies have made significant progress towards better integration of land use and infrastructure planning in recent years, more can be done to ensure the Government's land use objectives are met, that current strategic land use planning initiatives are linked more effectively with infrastructure planning and that jobs and housing growth are supported by the right infrastructure at the right time, in the right place and at the right price.
	• Building on the land use planning work being led by the Greater Sydney Commission and the Department of Planning and Environment, there is a need for more robust and focused integration of service and infrastructure planning in priority locations, including Growth Areas and Planned Precincts.
	• Action is also needed to strengthen the NSW Government's strategic planning processes, including undertaking further work to identify and protect major infrastructure corridors and better coordinating and supporting the housing supply pipeline to assist the Government and private infrastructure providers with medium-term infrastructure planning that aligns with Region Plans and the 2018 SIS.

| RESPONSE	Summary of key recommendations
Link integrated strategic land use and infrastructure planning	• Prepare a place-based strategic business case for the pilot growth infrastructure compact in the Greater Parramatta to the Olympic Peninsula area by mid-2018.
	• Subject to the outcomes of the pilot growth infrastructure compact, prepare place-based strategic business cases for future updates to District Plans and Regional Plans.
	• NSW Government agencies to integrate Growth Areas, Planned Precincts and growth infrastructure compacts (subject to the outcomes of the pilot growth infrastructure compact) into asset management plans and capital infrastructure plans from 2019-20.
	• Develop planning rules to integrate telecommunications infrastructure into new developments by the end of 2018.
Support efficient development through shared-use corridors	• Department of Planning and Environment to develop a plan for a 'Collaborate Before You Build' model for co-use of utility assets, including consideration of public and private collaboration, project approval requirements and governance options.
Identify and protect corridors	• Provide funding for the second round of the Corridor Identification and Reservation Fund.
Strengthen government planning processes	• Establish a digitally-based housing and employment supply pipeline by 2020 that includes a 20-year qualitative outlook and analysis of zoning and development application information.

2.1   Recent progress

NSW Government agencies have made significant progress towards better integration of land use and infrastructure planning in recent years.

As noted in Chapter 1, the 2018 SIS and *Future Transport 2056* have been prepared at the same time as the 10 Regional Plans across NSW (Figure 3), allowing both strategies to benefit from a clear view on land use priorities (refer to Chapter 8).

Infrastructure NSW considers that there would be value in refreshing and updating all these documents at least every five years as part of an integrated planning process.

Figure 3 – NSW Regional Plans
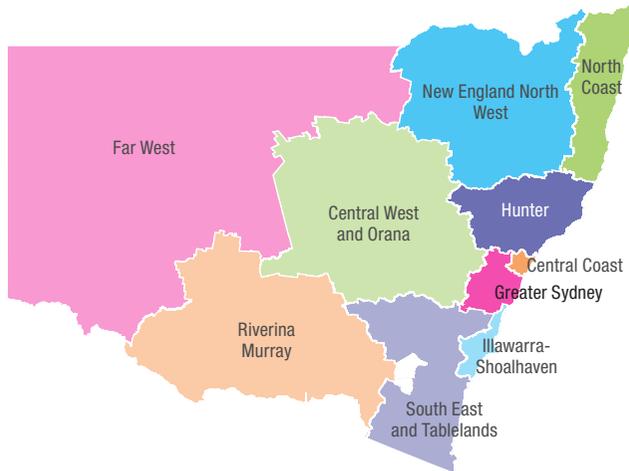
Source: NSW Department of Planning and Environment 2017

2.2   Challenges and opportunities

The NSW Government has set a new vision for growing Greater Sydney based on a metropolitan area of three cities: the established Eastern Harbour City, the developing Central River City and emerging Western Parkland City in and around the new Western Sydney Airport. The Government has also set a new vision for a 'hub and spoke' model for a growing regional NSW to ensure equitable access of services to the community. These geographic land use directions for Greater Sydney and regional NSW will generate their own unique challenges and each must be planned to maximise liveability, productivity and sustainability.

The State's growing population and tightening fiscal position make it imperative that we get the most from our current infrastructure stock and that investment in new infrastructure is targeted effectively to meet and shape demand. Aligning decisions about the provision and use of infrastructure with the three cities vision and the 10 Regional Plans is critical to maximising the effectiveness, efficiency and endurance of both new and existing infrastructure.

2.3   Response

2.3.1   Linking strategic land use and infrastructure planning

Elements of infrastructure planning

An attractive environment, supported by urban infrastructure is fundamental to NSW's continued economic success. As illustrated in Figure 4, the relationships between urban infrastructure are critical and integral to productive, liveable and sustainable places.

The 2018 SIS has used land use and economic development directions as a basis for long-term planning, providing a foundation for future city and regional planning (refer to Chapter 8). The emerging availability of big data provides a more sophisticated evidence base for spatially-informed infrastructure investment decisions.

Figure 4 – Urban infrastructure relationships
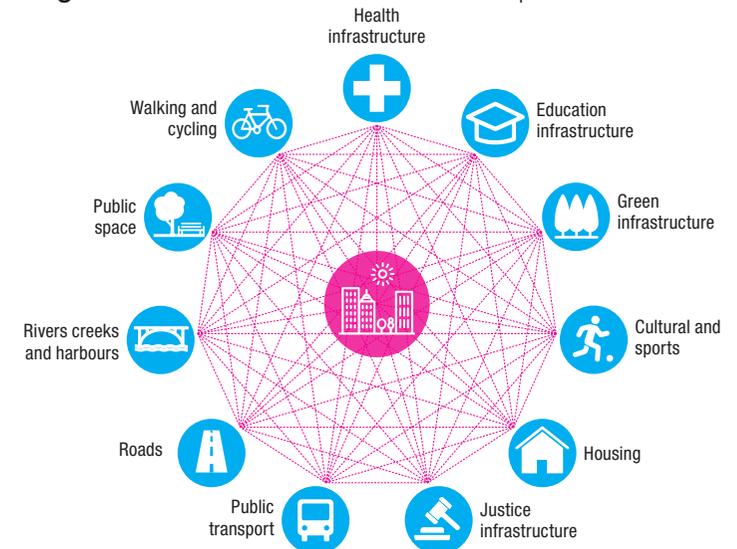
Source: Infrastructure NSW 2017

Infrastructure and the associated costs should be factored in to decisions about whether and where to release or rezone land. This will ensure that the Government understands the full cost of rezoning decisions. It may also result in a more integrated response to population growth if opportunities for the co-location of different services can be identified. Indicative infrastructure and land development lead times are outlined in Figure 5, which demonstrates the advantages of beginning infrastructure planning well ahead of rezoning.

Planning for growth

The Greater Sydney Commission (GSC) has designed the growth infrastructure compact (GIC) to assess the local and regional infrastructure needed to support long-term housing and jobs growth on an area-by-area basis.

The GSC is leading a pilot GIC for the Greater Parramatta to the Olympic Peninsula (GPOP) area, to be completed by the end of 2018. If successful, the pilot will evaluate where the GIC can be applied in other areas of Greater Sydney.

Figure 5 – Timing of infrastructure and development
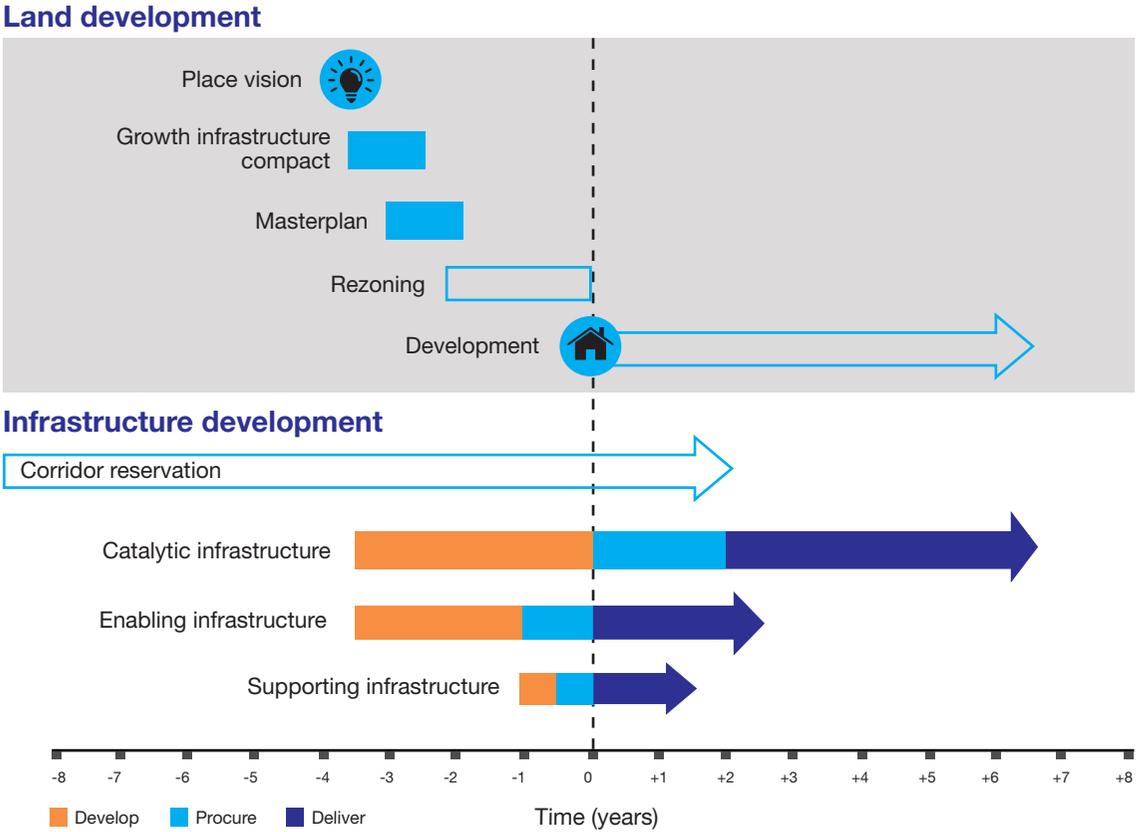
Source: Infrastructure NSW 2017

Growth infrastructure compact

The growth infrastructure compact (GIC) assesses the type, level and timing of infrastructure required for an area, considering different scenarios for housing and employment growth. GICs will be used to identify new growth areas by first understanding infrastructure capacity. Led by the GSC in collaboration with State and local government agencies, the GIC can provide structure planning to identify future updates to District Plans. Refer to Figure 6.

The GIC model seeks to make a step change in the collaborative processes necessary to manage growth in Greater Sydney. The model recognises that many partners – such as industry, local government and the community – need to work together to develop a land use framework supported by funded infrastructure, which then enables the private and not-for-profit sectors to deliver new housing and retail, commercial and industrial developments.

Figure 6 – Greater Sydney Commission's growth infrastructure compact

Develop a vision for growth for an area with 10, 20 & 40 year scenarios

Establish an infrastructure baseline for an identified growth area

Develop a preferred growth scenario including a sequence for growth and infrastructure

Design funding and finance options and an infrastructure delivery sequence

Evaluation by Greater Sydney Commission, Treasury, Infrastructure NSW and Department of Premier & Cabinet

Present preferred scenario to Government as a growth infrastructure compact

If endorsed, Government agencies align their asset management plans to deliver the growth infrastructure compact

Source: Greater Sydney Commission and NSW Department of Planning and Environment 2017

Growth areas and planned precincts

Growth Areas are greenfield locations for new communities. Planned Precincts are generally located around existing transport corridors or strategic centres. These areas and precincts are coordinated by State and local government to deliver jobs, transport and homes.

Led by the Department of Planning and Environment, Growth Areas and Planned Precincts involve master planning to assess housing and employment forecasts, and the type, level and timing of infrastructure required, which in turn leads to establishing a Special Infrastructure Contribution. This supports rezoning and the funding and delivery of key enabling infrastructure.

The GIC process should culminate in the production of a place-based strategic business case, which addresses each location's needs in terms of development feasibility, service and infrastructure costs. The place-based strategic business case can then inform investment decisions where significant State capital investment is required. This will allow an upfront assessment of the best approaches to using existing assets and services, the optimal combination of new infrastructure investments to support future housing and jobs growth, and the most cost-effective sequencing and delivery of infrastructure investment at each location.

The place-based strategic business case can also provide agencies with the guidance and investment parameters they need to coordinate their investment priorities geographically.

Infrastructure NSW considers there is merit in preparing place-based strategic business cases to inform future updates to Regional Plans and District Plans.

Recommendation 1

Infrastructure NSW recommends that the Greater Sydney Commission lead the preparation of a place-based strategic business case for the pilot growth infrastructure compact in the Greater Parramatta to the Olympic Peninsula area by the end of 2018.

Recommendation 2

Infrastructure NSW recommends that, subject to the outcomes of the pilot growth infrastructure compact, the Department of Planning and Environment prepare place-based strategic business cases to inform future updates to Regional Plans and District Plans.

Recommendation 3

Infrastructure NSW recommends that NSW Government agencies integrate the infrastructure priorities necessary to support Growth Areas, Planned Precincts and growth infrastructure compacts (subject to the outcomes of the pilot growth infrastructure compact) into asset management plans and capital infrastructure plans.

2.3.2 Planning infrastructure using 'Movement and Place'

The economic success of our towns and cities depends in part on them being attractive, safe places for people to live, work and raise families. It is important to ensure that considerations of public amenity and good urban design are not sacrificed in addressing major challenges such as road congestion.

Transport for NSW has developed a 'Movement and Place' framework to give decision-makers a better understanding of the trade-offs associated with investing in new transport infrastructure within an established urban context and how to best allocate available road space (Figure 7). The framework establishes strategic planning principles for prioritising the movement of people and goods when developing places for housing and jobs.

By identifying the role and function of a place and its spaces (such as streets and corridors), the framework aims to use the transport system to complement and enhance the function, rather than merely dictate the form, of the place.

The framework can apply to planning new communities and improving existing areas and to health, education and justice precincts. A practitioners' toolkit is needed to help planners implement the framework.

Recommendation 4

Infrastructure NSW recommends that the NSW Government Architect develop a 'Movement and Place' practitioner's toolkit by the end of 2018 to support both *Better Placed – An Integrated Design Policy for NSW* and the *Movement and Place Framework.*

Figure 7 – 'Movement and Place' framework

Source: Transport for NSW 2017

Motorways	Motorways are **strategically significant** roads that move people and goods rapidly over **long distances**.
Movement corridors	Movement corridors provide safe, reliable and efficient **movement of people and goods** between regions and strategic centres.
Vibrant streets	Vibrant streets have a high demand for movement as well as place with a need to **balance different demands** within available road space.
Local streets	Local streets are **part of the fabric of the suburban neighbourhoods** where we live our lives and facilitate local community access.
Places for people	Places for People are streets with high demand for activities and lower levels of vehicle movement. They create places people enjoy, attract visitors, and are **places communities value.**

Revitalising Newcastle

The NSW Government is investing more than $650 million in the Revitalising Newcastle program to transform the city centre by strengthening connections between the city and waterfront, creating job opportunities, providing new housing and delivering attractive public spaces connected to better transport.

The investment reflects the transition of the former heavy rail 'movement corridor' to an urban environment with a high 'place' value. For example, at the Entertainment Precinct by Queens Wharf, the former rail corridor is transitioning towards a 'vibrant street'.

The Revitalising Newcastle program involves:

- the completed Newcastle Interchange, a new multi-modal transport interchange at Wickham in the city's west

- wire-free light rail between Newcastle Interchange and Pacific Park, just 200 metres from Newcastle Beach, reinvigorating Hunter and Scott streets

- revitalised land to provide education and affordable housing, mixed use development, job opportunities, tourist attractions and public open space including the Market Street Lawn.

2.3.3 Using data analytic tools to enhance integrated planning

Traditional planning has been based on ABS Census data, which is limited in scope and timeframe, and is collected only every five years.

Infrastructure planning can be greatly improved through 'data analytics', using a wide range of public and private data sets that relate to specific aspects of the movement of people and business interactions within a location, such as Opal Card, travel survey, Sydney Water connections, school enrolments, property transactions and telecommunications data.

This 'Big Data' can be used to augment Census data, enabling deeper insights and a better understanding of likely trends in population and the use of services. It allows infrastructure providers to make better use of existing assets, optimise services by linking them to the needs of a particular place and tailor infrastructure solutions to match demand.

Data analytics can support the practical application of the 'Movement and Place' framework at the local level and will be an important input to the pilot GPOP GIC. Applying this type of analytics requires a robust data set, drawing on both public and private information. Chapter 6 provides recommendations that will enable data-led infrastructure planning.

Location-based insights in south-east Sydney – Proof of Concept

Infrastructure NSW partnered with the Data Analytics Centre (see Chapter 6) to develop a proof-of-concept based on machine learning and simulating a synthetic population.

Multiple data sources were used to describe and predict what happens when and where in the area between Green Square, Kingsford Smith Airport, Maroubra and Bondi. The results showed that open data, machine learning and predictive analytical techniques are highly suitable for integrated decision-making because they:

- provide insights into a customer's interaction in a place, not just a sector-by-sector view
- allow for a whole-of-government approach to 'what if'-style scenarios
- improve collaboration and co-ordination between agencies in infrastructure planning.

The results allow the simulation of social behaviour (such as transport demand) in response to infrastructure changes. The results showed how small area modelling can be used to consider walkability to primary schools or respond to demand from a catchment. This is particularly useful when an area is undergoing rapid change in a way that could change the population.

This analysis has the potential to complement traditional forms of modelling by providing additional insights to support infrastructure planning.

Recommendation 5

Infrastructure NSW recommends that the Greater Sydney Commission establish a trial program to use predictive analytic tools to support the Greater Parramatta to Olympic Park pilot growth infrastructure compact by the end of 2018.

2.3.4 Supporting efficient development through shared-use corridors

In the context of a growing, denser city, it is important that infrastructure itself is an efficient user of land.

Utility transmission, distribution and 'lead-in' assets, such as land reserves (corridors), towers, trenches, pits and pipes, can serve more than one function and be shared by transport, fuel, energy, water, telecommunications and public spaces for walking and cycling. Ensuring adequate space for supporting infrastructure is vital for growth, particularly in the Sydney CBD area, as sub-ground space is becoming more limited due to existing utilities, tunnels, basements and car parks.[5]

The planning of service infrastructure could be improved through greater coordination between developers and public and private utilities to maximise the co-location of infrastructure services. A 'Collaborate Before You Build' process is recommended for all new utilities provision, extending the 'Dial Before You Dig' system already in place for protecting existing services assets. A review of regulations and incentives will be needed to ensure this model provides fair access and the efficient delivery of integrated infrastructure services.

5   KPMG 2017, p. 51

Recommendation 6

Infrastructure NSW recommends that the Department of Planning and Environment develop a plan by the end of 2018 for a 'Collaborate Before You Build' model for co-use of utility assets.

2.3.5 Integrating telecommunications infrastructure with development

In the last century, it was essential to provide electricity and water to homes. Today, digital connectivity is just as important as these utilities.

Demand for communications infrastructure for industries and in the home is forecast to grow fast[6] to meet demand from population and economic growth. In March 2015, the Commonwealth Government published *Telecommunications Infrastructure in new developments, A new approach to competition policy*, which aimed to give occupants of new developments access to modern telecommunications services.[7] Under the policy, developers are responsible for contracting the provision of telecommunications infrastructure to their developments.

The policy calls on planning departments in the States and Territories to consider changes to legislation to ensure that developers give appropriate consideration to telecommunications so that telecommunications infrastructure is planned and delivered to support the provision of services to homes and businesses.

Recommendation 7

Infrastructure NSW recommends that the Department of Planning and Environment introduce planning rules to integrate telecommunications infrastructure (such as nodes, towers and pit and pipe infrastructure) into new developments by the end of 2018.

2.3.6 Identifying and protecting corridors

Infrastructure corridors determine the shape, economic geography and productivity of a city or region. Planning and protecting the land for infrastructure corridors needed over the next 40 years will give effect to long-term land use and infrastructure strategies. By identifying and protecting these corridors early, the NSW Government can ensure future generations have options to support housing and jobs growth.

Infrastructure corridors can accommodate a range of services, including transport, fuel, energy, water and digital connectivity, as well as green infrastructure. When government agencies are planning for infrastructure corridors, they should coordinate their activities with public and private utilities to explore co-locating other infrastructure services.

Corridor protection in NSW

For many years, it has not been common practice in NSW to progress formal corridor protections. However, several recent major transport projects have been delivered in the absence of prior corridor protection and have opted instead for processes that secure the corridor concurrently with the environmental assessment process during the project's delivery

phase. This has resulted in protracted environmental assessment processes, as issues related to route assessment, environmental considerations and strategic land use have had to be confronted after a commitment has been made to build the project.

This approach risks creating public perceptions that major infrastructure decisions are being made prior to community input. It can also drive up costs for government and lead to inefficient corridor alignments due to the encroachment of urban development, higher costs associated with compulsory acquisition and sub-optimal transport and land use integration.

In 2017, Infrastructure Australia found that protecting and acquiring corridors early could achieve significant cost savings. It is estimated that the additional cost to the Outer Sydney Orbital is at least $2.5 billion if the acquisition of the corridor is deferred until the project is constructed.[8] This corridor passes through regions that are attractive for development, such as areas around the future Western Sydney Airport and some Growth Areas.

The availability of future corridors is at risk unless action is taken to protect them. It is essential to identify these major transport corridors in strategic plans and planning instruments for Sydney's Western Parkland City.

Improving infrastructure corridor protection

Enhanced coordination across the NSW Government is required to support major infrastructure corridor planning.

There is currently no single source of information about planned network expansions that require corridor protection. In 2014, a corridor audit undertaken by

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6   Ibid, p. viii
7   Department of Communications and the Arts 2015

8   Infrastructure Australia 2017, p. 26

Infrastructure NSW and the Department of Planning and Environment found there were 70 publicly identified major infrastructure corridors.

In 2015, the Department of Planning and Environment released the *Planning Guideline for Major Infrastructure Corridors* to assist infrastructure agencies with the corridor planning process. This guideline included a template for agencies to undertake a Strategic Environmental Assessment to identify and reserve the land needed to deliver major infrastructure. It also advised agencies to prepare a management plan that identifies appropriate development and interim uses of land that will not impact the future use of the corridor for infrastructure.

The 2014 SIS Update recommended the reservation of $100 million from the Rebuilding NSW initiative to identify and reserve corridors for strategic projects. So far, about $60 million of this money has been allocated, enabling planning work to proceed across nine corridors. Ongoing funding for corridor planning and protection will deliver significant future cost savings for government, as well as greater certainty for landowners and affected communities. These nine corridors are shown in Figure 8 and include nationally significant priority corridors identified by Infrastructure Australia.

Recommendation 8

Infrastructure NSW recommends that the NSW Government provide funding for a second round of the Corridor Identification and Reservation Fund.

Figure 8 – Nine transport infrastructure corridors awarded funding in 2016

Hunter Orana Fuel Pipeline Corridor – fuel pipeline from the Port of Newcastle to Dubbo

Western Sydney Airport Fuel Pipeline – a fuel pipeline link from port terminals to the Western Sydney Airport

Outer Sydney Orbital Stage 2 – multi-purpose corridor from Hume Motorway and Main South Line to M1 Princes Motorway

Outer Sydney Orbital Stage 3 – multi-purpose corridor from Windsor Road, Vineyard to Central Coast, Kariong

West Metro/West Mass Transit (Parramatta to CBD) – passenger rail link between Greater Parramatta and Sydney, south of Epping Road and north of the T1 Western Line

Bus connectivity – a Gregory Hills connection, parallel to Narellan Road and linking to Badgally Road, and a connection between Rickard Road and Oran Park Drive, both in Western Sydney

South West Rail Link Extension – North – passenger rail link from Bringelly to the T1 Western Line, via the Western Sydney Airport

Cudgegong to St Marys Rail Corridor – passenger rail link from the current Tallawong stabling facility to St Marys Station

Bankstown to Liverpool Metro Extension – passenger rail link north of the M5 between Bankstown and Liverpool

INFRASTRUCTURE AUSTRALIA'S INFRASTRUCTURE PRIORITY LIST

Source: Infrastructure NSW 2017

2.3.7 Making better use of Crown land

The Crown land estate covers 42 per cent of the State, with 580,000 individual land parcels covering some 34 million hectares and with an overall value of $12 billion.

In 2012, the Government initiated a comprehensive review of Crown land management. A key objective of the review was to identify who is best placed to manage Crown land, and to identify and protect Crown land that is important to the State and local communities.

The review found that certain types of Crown land are of state significance and need to be retained by the Government, but decisions about land of local value and interest are best managed locally. It also found that divesting locally used Crown land to local councils would reduce administration time and costs between the local and state governments and make it easier for the local council to manage its overall local land assets.

The expected commencement of the *Crown Land Management Act 2016* in early 2018 will facilitate transfers of local land to local councils on a voluntary basis.

Crown land could also be used to support economic and community development. Infrastructure NSW recommends that, as part of the Government's Land Negotiation Program, a review be undertaken to explore how Crown lands could be better used to activate open space or employment objectives aligned to the Government's Regional Plans and Regional Economic Development strategies currently under development (refer to Chapter 8). This work could be supported by the establishment of Regional Joint Organisations across NSW.

Recommendation 9

Infrastructure NSW recommends that the NSW Government continues the implementation of the reforms to Crown land and that, as part of the Land Negotiation Program, a review is undertaken by mid-2018 of the potential for Crown land to assist in meeting open space or employment objectives outlined in Regional Plans.

2.3.8 Strengthening government decisions

Coordinating housing and employment supply to inform infrastructure planning

The Department of Planning and Environment's housing supply program is a rolling five-year pipeline of zoning capacity to support the demand for housing growth. The program draws on Growth Areas and Planned Precincts to assist the NSW Government and private infrastructure providers with medium-term infrastructure planning.

The housing supply pipeline would benefit from the release by the Department of Planning and Environment of upfront development information (rather than information regarding the completion of developments), and an analysis of zoning and development applications (such as the share of social housing) drawn from the NSW Government's e-Planning Portal. This information will be available once all paper-based applications move to e-Planning over the next three years.

Infrastructure NSW considers that the rolling five-year supply pipeline should contain a qualitative outlook over 20 years to align with NSW Government and business planning horizons. These time profiles will then align with future updates of the Government's asset planning, Regional Plans and the 2018 SIS.

There would be value in including employment land and zoning capacity in the housing supply pipeline so that public and private infrastructure providers can assess the total infrastructure investment required to meet jobs and housing growth.

The annual supply pipeline should be released at the same time each year, ahead of NSW Government Budget decisions, and made publicly available as a digital tool. The pipeline could then inform asset plans and agency Budget bids. This single authoritative source of data will give business and the NSW Government the ability to understand the interdependencies between infrastructure provision and housing and employment supply, and thereby collaborate more efficiently.

The NSW Government should explore whether a housing and employment supply pipeline is needed for other parts of the State, such as Newcastle or Wollongong.

Recommendation 10

Infrastructure NSW recommends that the Department of Planning and Environment establish by 2020 a housing and employment supply pipeline that:

- includes a five-year housing and employment supply forecast with a 20-year qualitative outlook
- is published in the third quarter of each year to support Government asset management plans and Budget bids
- includes analysis of zoning and development pipeline information
- is digitally based and implemented over three years.

Figure 9 – Indicative planning cycle

NSW Budget

NSW common planning assumptions (e.g. population and employment projections)
Housing and Employment Supply Pipeline
Growth infrastructure compact
Planned Precincts
Growth Areas

Capital Prioritisation

Short-medium term planning cycle

UPDATED ANNUALLY

Capital Infrastructure Plans

NSW Intergenerational Report
Region and District Plans
Economic Development Strategies
State Infrastructure Strategy
Sector Strategies (Future Transport 2056 and Cultural Infrastructure Strategy)

Long-term planning cycle

UPDATED EVERY FIVE YEARS

Source: Infrastructure NSW 2017

Aligning data publication

Infrastructure NSW considers that NSW Government agencies, through the annual Budget process, should prioritise their capital spending to align with the needs of GICs and Growth Area and Planned Precinct locations.

To ensure integrated land use and infrastructure planning processes are enduring, data and information need to be provided at a consistent point each year to link to established central government processes. The key information includes population, housing and employment projections, the housing and employment supply program, capital infrastructure plans and the capital prioritisation process (refer to Chapter 3). Indicative timing for key documents is depicted in Figure 9.

Recommendation 11

Infrastructure NSW recommends that NSW Government agencies work together on a common timeframe to publish population and employment projections, the housing and employment supply pipeline and agency infrastructure planning actions to coordinate the availability of key information to support Capital Infrastructure Plans and annual Budget decisions. This new common timeframe should commence in preparation for the 2019-20 Budget cycle.

2.3.9   Meeting housing and jobs growth

With NSW facing significant demand for a mix of new housing products to match different price points and provide access to diverse job opportunities, it is critical that appropriate delivery arrangements are in place to meet the priorities identified in Regional and District Plans. The recent split of the former Urban Growth NSW into Landcom (a State-owned corporation) and the Urban Growth NSW Development Corporation (UGDC) addresses this need.

Landcom – the NSW Government's land and property development corporation – is now well-placed to meet the Government's commitment to increase housing supply, choice and affordability through a pipeline of new development opportunities for Greater Sydney and regional NSW (including the Sydney Metro North West Urban Transformation Program).

While Landcom's focus will be largely on greenfield housing development, particularly in Sydney's west and regional NSW, UGDC will drive urban renewal in major, complex brownfield areas of the Eastern Harbour City and the Central River City. Its portfolio of major projects includes urban development in strategic corridors such as Parramatta North, Waterloo and, most critically, the Bays Precinct.

UGDC is well positioned to act as the NSW Government's source of expert advice on the delivery of commercially feasible, high quality urban development, balancing housing supply against considerations of urban design and place-making. It can also play a key role in ensuring that the land use outcomes of key transport projects are optimised.

Infrastructure NSW supports these initiatives.

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3. Infrastructure planning, prioritisation and delivery

STRATEGIC OBJECTIVE **Plan, prioritise and deliver an infrastructure program that represents the best possible investment and use of public funds**

SNAPSHOT	
	• There are limits to the NSW Government's ability to sustain its current record level of infrastructure investment while continuing to meet fiscal targets. NSW needs to optimise its use of existing assets and, where new investment is warranted, select the right projects so that available funding is used as productively as possible.
	• The large number of projects, and the increasing number of mega-projects, will place pressure on the planning system to assess projects efficiently. The construction industry will face resourcing constraints in key areas and the NSW Government will face challenges in building and sustaining its own capability to manage the growing complexity and volume of work.

RESPONSE	Summary of key recommendations
Continue major project approval reforms	Pursue further reforms to improve major project planning approval processes.
Explore further asset recycling	Explore the potential for further asset recycling initiatives.
Ensure construction sector capability and capacity	Establish a whole-of-government process, led by Infrastructure NSW and in partnership with industry, to identify and deliver major project procurement reforms by mid-2019.

3.1   Recent progress

In May 2015, the NSW Audit Office reviewed the effectiveness of the NSW Government's assurance processes for major construction projects. The review found that while independent assurance processes had evolved, they were not as effective as they could be. It concluded that assurance needed to be more independent and compliance needed to be more consistent.[9]

In June 2016, the NSW Government adopted the Infrastructure Investor Assurance Framework (IIAF), a tiered, risk-based external assurance framework for projects with a capital value above $10 million. The IIAF, which builds on the Major Projects Assurance process detailed in the *State Infrastructure Strategy 2012*, identifies whether the State's capital projects are being effectively developed and delivered. It incorporates project monitoring, regular project reporting and expert and independent Gateway

Reviews and health checks to ensure that projects are on-track.

Infrastructure NSW, which oversees the IIAF, completed 255 assurance reviews across 131 projects between May 2015 and December 2017. Evaluation of the IIAF by Infrastructure NSW shows that the assurance process is improving the planning and delivery of projects. In many cases, projects that have been subjected to reviews and health checks have shown signs of significant improvement. Infrastructure

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9   Audit Office of NSW 2015

NSW is undertaking regular six-monthly performance reviews of the IIAF to identify areas for ongoing improvement.

In addition to the IIAF, NSW Government agencies are improving their capability to develop and deliver major capital programs. Some agencies, such as Transport for NSW and the Ministry for Health – through Health Infrastructure – are well advanced. Other agencies, such as the NSW Department of Justice and the NSW Department of Education, are bringing a new focus and capability to infrastructure delivery, having recently established Justice Infrastructure and School Infrastructure NSW respectively.

3.2   Challenges and opportunities

There are limits to the NSW Government's ability to sustain its record level of infrastructure investment while continuing to meet fiscal targets. The State needs to ensure that it is getting the most out of existing assets and, where new investment is warranted, that it is selecting the right projects so that available funding is used as productively as possible.

In a constrained fiscal environment, business cases must demonstrate that proposed projects address an identified need and that a full range of options, including non-build solutions, have been considered and thoroughly evaluated. Project planning must allow for rapid societal changes, including the impacts of climate change, and enable the NSW Government to make informed investment decisions as areas of uncertainty become clearer.

The number of infrastructure projects, and the increasing number of mega-projects, will place pressure on the planning system to assess these projects in a streamlined and timely manner.

The NSW construction industry will face resourcing constraints in key areas, and NSW will need to focus on attracting and retaining these scarce resources to support its infrastructure pipeline in the face of competition from other jurisdictions. Similarly, the NSW Government will face challenges in building and maintaining its own capability to manage the growing complexity and volume of work.

3.3   Response

3.3.1   Improving project identification, options development and evaluation

Infrastructure projects must be subject to thorough investigation and evaluation before being funded or announced. Premature project announcements can put at risk service delivery outcomes and can lead to project delays and higher costs to government.

A range of project options must be considered and evaluated so that the best option is selected on appropriately justified grounds. Too often in the past, agencies sought to respond to an identified need by building new, expensive infrastructure. In many cases, that infrastructure was selected without adequate consideration of alternatives. NSW Treasury's *Business Case Guidelines* require infrastructure agencies to fully assess a range of options in completing strategic business cases.

Alternative strategies that may reduce or delay the need for new infrastructure include asset utilisation measures, such as contra flow lanes on existing roads, initiatives to reduce demand or change customer behaviour, such as user pricing, and procuring services competitively from the private sector. For further discussion on asset utilisation see Chapter 4. Discussion of new service delivery models appears in Chapter 7.

To support stronger options development and evaluation, the NSW Government has adopted *Common Planning Assumptions* and is updating its *Business Case Guidelines*. The updated Guidelines will reinforce the need for project proponents to consider alternatives to new or upgraded infrastructure, including non-build solutions. The NSW Government is also exploring the development of an Infrastructure Data Management Framework to capture and share new sources of data.

Broadening cost-benefit analysis

The ability of cost-benefit analysis to capture the full range of social, economic and environmental impacts of projects is still developing. In 2017, NSW Treasury updated the NSW Government's *Guide to Cost-Benefit Analysis*[10] to better integrate social, economic and environmental impacts, reflecting developments in analytical tools that strengthen the estimation of economic, social and environmental costs and benefits.

Other jurisdictions are also looking to broaden cost-benefit analysis. Infrastructure Victoria released updated guidance for project appraisal as part of its ongoing work on how to better value economic, social

10   NSW Treasury 2017

Figure 10 – Conventional vs adaptive management
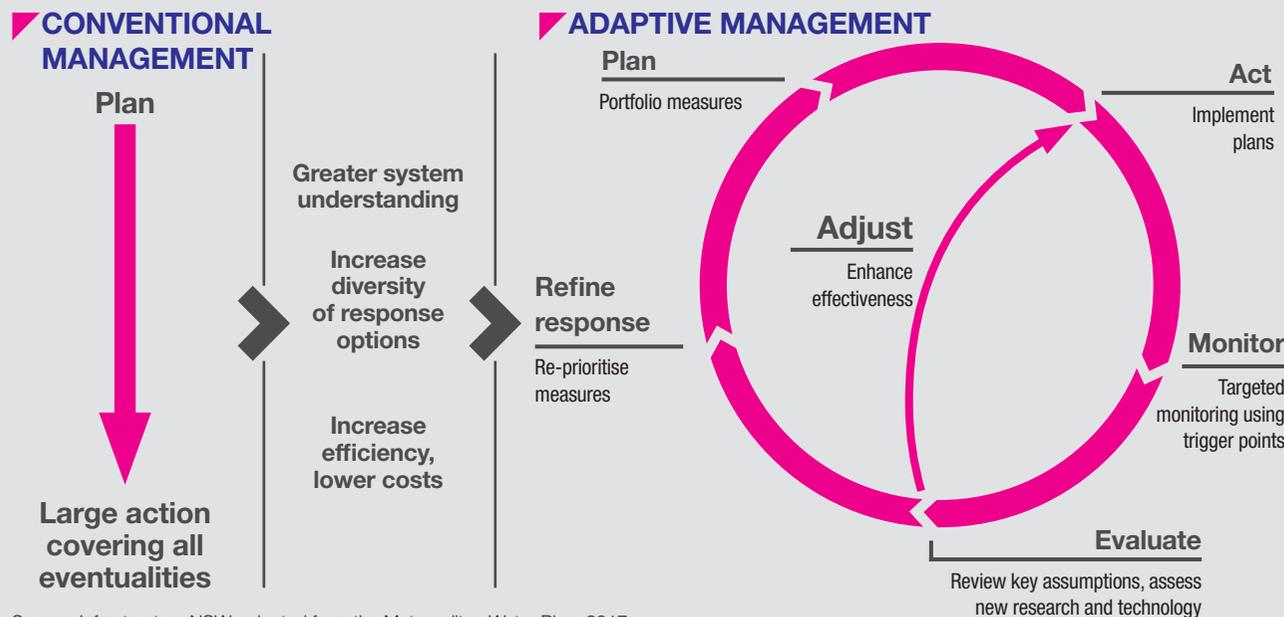
Source: Infrastructure NSW, adapted from the Metropolitan Water Plan, 2017

Dealing with uncertainty

Adaptive management is an increasingly mainstream approach to managing the environmental and economic costs and risks associated with change. Tools such as scenario planning and real options analysis allow exploration of a range of options or pathways for future action. They allow demand and supply options to be explored, identifying trigger points that can be used to determine when future actions are taken.

As an example, lower than expected rainfall may constrain water availability. Using an adaptive management approach, trigger points can be used to identify when response measures should be implemented. Interventions, from lowest to highest cost, might include:

- reducing demand through low flow devices, such as shower heads and taps
- a water restrictions regime
- extracting water from ground sources to provide additional capacity
- recycling initiatives
- capital investment in a desalination facility.

Greater use should be made of adaptive management techniques in long-term land use and infrastructure planning to better manage significant uncertainties.

and environmental impacts.[11] New Zealand Treasury has developed a cost-benefit analysis tool called CBAx, which contains a common database to help agencies monetise impacts and undertake 'return on investment' analysis.

Separate to quantifying benefits, there are behavioural influences on the application of cost-benefit analysis tools that may affect the rigour of project appraisals. In 2015, the United Kingdom's HM Treasury updated its guidance for appraising and evaluating public projects – The Green Book – to better account for 'optimism bias': a tendency for project appraisers to be overly optimistic regarding the performance of the project. This guidance suggests explicit, empirical adjustments should be made to mitigate the effects of optimism bias in evaluating a project's benefits.

Infrastructure NSW considers that NSW Treasury should continue to explore options to improve the quantification of social and environmental factors in cost-benefit analysis and manage optimism bias, consistent with best practice in other jurisdictions.

3.3.2 Prioritising projects

In December 2016, the NSW Government endorsed an enhanced process for prioritising capital infrastructure. Under this process, Infrastructure NSW, in consultation with the Department of Premier and Cabinet and NSW Treasury, prioritises all emerging projects as an input to the NSW Government's Budget deliberations. The process promotes transparency around the State's fiscal capacity, promotes informed decision-making and allows priorities to be assessed consistently between sectors.

11 Infrastructure Victoria 2016, p. 2

3.3.3   Improving major project planning approvals

Assessing major projects through the statutory planning system can take too long, be too costly and result in unpredictable outcomes. The Productivity Commission has estimated that the cost of a one-year delay in approvals for an average major project is up to $59 million and for a large project, up to $2 billion.[12] In 2016, the Business Council of Australia recommended reforms to improve the global competitiveness of Australia's major project planning approvals process.[13]

In 2017, the NSW Government consulted on reforms to improve major project approval processes and timeframes. Proposed reforms included:

- earlier and better engagement with affected communities
- improving the quality and consistency of Environmental Impact Assessment (EIA) documents
- developing a standard approach for applying conditions to projects
- providing greater certainty and efficiency around decision-making, including assessment timeframes
- strengthening monitoring and reporting on project compliance
- improving the accountability of EIA professionals
- improving concurrence and referrals for local development through new reserve powers for the Secretary of the Department of Planning and Environment to prevent delays and resolve conflicts.

These reforms align with the recommendations made by the Business Council of Australia and the Productivity Commission and move the State to a best practice model. Notwithstanding these improvements, there is merit in continuously reviewing and improving the competitiveness of major project planning approval processes to support decisions for investment in NSW. Key prospective areas for reform are outlined below.

Strengthening major projects assessment through strategic planning

District Plans, which support the *Greater Sydney Region Plan*, integrate land use with future major projects, such as major transport projects and health and education precincts. Regional Plans and District Plans should include associated environmental targets for key corridors so that the cumulative impacts of all development in the area can be considered. This upfront recognition of place-based environmental goals will help with subsequent planning for major infrastructure projects.

Performance-based major project approval

Since 2005, NSW has had the most integrated major project assessment in Australia, removing the need to obtain many separate approvals for each project and providing a streamlined and consistent approach to approvals.

The NSW Government has also implemented reforms to address delays in its own processes. This led to reductions in processing timelines from 298 days in 2014 to 163 days in 2016-17. However, there is an opportunity to assist project proponents by providing

more upfront information for key industry sectors and on key environmental impacts. While the Department of Planning and Environment has established this practice for some industry sectors, such as windfarms, it is not applied across the board.

Key improvements to the existing process for determining major projects could include:

- a separate, dedicated assessment pathway for major projects
- standardised risk-based performance requirements by industry sector
- providing key environmental information – including species information, government and private sector monitoring, environmental studies and approvals, and scientific research – on a spatially enabled open data system (leveraging systems such as the NSW Environmental Data Portal or the NSW Planning Portal).

Recommendation 12

Infrastructure NSW recommends that the Department of Planning and Environment pursue further reforms to improve major project planning approval processes. Initial reforms should include:

- providing key environmental information – including species information, government and private sector monitoring, environmental studies and approvals, and scientific research
- preparing standardised risk-based performance requirements for each industry sector.

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12   Productivity Commission 2014, p. 8
13   Business Council of Australia 2016, p. 6

3.3.4   Exploring funding and financing options

'Infrastructure financing' is the supply of capital, such as debt and equity, used to meet the upfront cost of an infrastructure project. 'Infrastructure funding' is the cash used to pay back the money raised through the initial financing.[14] In recent years, the NSW Government has unlocked significant funding for infrastructure projects through:

- a tighter focus on core budget discipline
- the retirement of debt
- securing Commonwealth funding for infrastructure investment
- dedicating proceeds from asset sales to new infrastructure.

Not all these funding streams are enduring. Proceeds from asset sales are one-off. If the property market was to cool, there would likely be a reduction in government revenues from housing transactions. In addition, the Commonwealth Government has stated that it will no longer 'act as an ATM' for the States' infrastructure programs.

In this context, the NSW Government needs to get the most out of existing assets and, where new investment is warranted, select and prioritise the right projects so that available funding is used as productively as possible. The Government also needs to explore opportunities to unlock new or improved sources of infrastructure funding over the medium and long term. However, many potential new sources of funding are likely to prove complex and often politically unattractive. Some of these funding sources are discussed below.

Value capture

Value capture seeks to recover the economic productivity and land value benefits created from government planning decisions and infrastructure investments.

Views on value capture vary across Australian jurisdictions, with differing opinions on what mechanisms constitute value capture and how they should be applied. There are also differing views on the extent to which value capture can make a meaningful contribution to addressing infrastructure funding gaps. For instance, the Victorian Government's *Value Creation and Value Capture Framework* makes it clear that its focus is on creating value, rather than taxing beneficiaries. It argues that the role of government is to invest in better communities without charging those communities for it.[15]

In NSW, opportunities for value capture are routinely examined as part of the development of project business cases. In undertaking value capture assessments for major infrastructure projects, it has become apparent that, while value sharing may provide a useful contribution to project funding, in most cases it will not have a transformational impact on the funding equation.

In most cases, the value created for businesses and households directly affected by a project is unlikely to cover the full costs of that project. Even if a government sought to capture all the value created by taxing households and businesses, the size of the funding contribution, in real terms, would be eroded if captured over time – for instance, as property is brought to market and value crystallised.

Although value capture is not a panacea for infrastructure, it should continue to be assessed as an option in the development of major infrastructure projects.

Asset recycling

Asset recycling is the lease or sale of government assets to free-up capital to invest in new assets or revitalise existing assets. It involves government reinvesting the proceeds of asset sales into new, economically productive assets. As noted by the Productivity Commission, in considering asset recycling, governments must ensure that the decision to divest and the decision to invest are assessed separately within a transparent decision-making environment where a robust cost–benefit analysis is undertaken.[16] The two decisions must be justifiable on a stand-alone basis. Infrastructure NSW agrees with this assessment.

The priority for the sale of government-owned assets is to ensure that:

- economic efficiency is achieved
- the risks to consumers and other public interests are managed
- the market structure is amenable to asset recycling
- the sale is conducted efficiently, ethically and transparently.[17]

Having justified the asset sale on its merits in accordance with these criteria, governments then face separate decisions about the optimal use of the resulting proceeds.

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14   Infrastructure Partnerships Australia 2017

15   Victoria State Government 2017, p. 49

16   Productivity Commission 2014, p. 262
17   Ibid, p. 18

The significant increase in infrastructure investment in NSW in recent years would not have been possible without the asset recycling initiatives pursued by the NSW Government. Asset divestments have included Port Botany, Port Kembla, the Port of Newcastle, a share of the State's electricity networks (see breakout box at right), public housing assets and the Land and Property Information Service.

Asset recycling funds have been directed to the Restart NSW Fund which was established by legislation in 2011. Infrastructure NSW is statutorily responsible for making recommendations to the Government for use of the Restart NSW Fund. By convention, 30 per cent of Restart funds must be directed to regional NSW.

As at June 2017, an estimated $24.8 billion in proceeds from asset recycling had been directed to Restart NSW, providing funds to invest in new public transport, new roads, new schools, new health facilities, upgraded cultural attractions and water security. The successful completion of the electricity network transactions also allowed the NSW Government to accelerate delivery of major infrastructure projects. The Sydney Metro City & South West project was accelerated by up to seven years; the Pinch Point and Clearways program by up to five years; and Northern Beaches B-Line by up to five years.

Electricity network transactions

The NSW Government leased 49 per cent of the NSW network businesses. The transaction included the leases of:

- 100 per cent of TransGrid, the statewide transmission business. Completed in December 2015, the transaction netted proceeds of $6.6 billion
- 50.4 per cent of Ausgrid. Completed in December 2016, the transaction netted proceeds of $5.6 billion
- 50.4 per cent of Endeavour Energy. Completed in June 2017, this transaction netted proceeds of $2.8 billion.

These proceeds will be augmented by an estimated $2.2 billion in Commonwealth Government Asset Recycling Initiative incentive payments and accrued investment earnings.

On completion of the initial Sydney Motorway Corporation sale, Infrastructure NSW recommends that, where possible, the NSW Government explore further asset recycling initiatives. Subject to a review of feasibility, candidates for asset recycling include the NSW Government's remaining share in Sydney Motorway Corporation and its shareholding in Snowy Hydro Ltd.

If the NSW Government wishes to maximise its investment options over the term of the 2018 SIS, it should consider the suitability of recycling these and other assets. Conversely, if the Government is unwilling or unable to recycle assets, it will face real choices as to which of these investments it can afford over the next 10-20 years.

Recommendation 13

Infrastructure NSW recommends that the NSW Government, where possible, explore the potential for further asset recycling initiatives.

3.3.5 Ensuring construction sector capability and capacity

In 2016, Infrastructure NSW undertook research to assess the capability and capacity of the NSW construction sector and identify any issues that could impact the timely and cost-effective delivery of the NSW Government's infrastructure program.[18] The key capacity and capability challenges identified revolve around securing access to quality skills and construction materials, boosting construction industry productivity and meeting the transport and logistical challenges associated with an increasing construction task. Some of the critical issues identified, and proposed responses, are detailed below.

Developing and communicating an infrastructure pipeline

There will be many opportunities for the private sector to engage in NSW's large infrastructure program, including in the design, financing, development, operations and maintenance of projects, as well as in advisory roles throughout asset lifecycles. As NSW is in a national market, it is competing with other jurisdictions to get the best people to fulfil these roles.

To give industry the best chance of responding to these opportunities, the NSW Government needs to

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18   BIS Oxford Economics 2017

provide a clear and coherent whole-of-government long-term project pipeline. A visible pipeline facilitates forward planning – by industry and government – and enables industry to plan the physical and human capital to meet projected demand.[19]

To this end, Infrastructure NSW has produced the *NSW Infrastructure Pipeline*. The NSW Infrastructure Pipeline details proposals with a minimum capital value of $100 million that are expected to come to market over the next three to five years. Proposals in the *NSW Infrastructure Pipeline* are in various stages of development, with some of the projects yet to be approved by the NSW Government. The document will be reviewed every six months, giving industry the most up-to-date information on NSW opportunities. Insight into the planned infrastructure program beyond the next five years is provided in the 2018 SIS.

Infrastructure NSW will continue to examine project and program sequencing on a whole-of-government basis. It will work with other jurisdictions to ensure that the *NSW Infrastructure Pipeline* is informed by developments across the national infrastructure sector.

Optimising project procurement

Projects can be procured using a variety of different approaches related to choices of contracting model, the tender process and the criteria used to select the winning bids. Decisions on the right procurement method for a project can affect value for money, risks, costs and time.[20]

Various assessments of the NSW Government's major project procurement processes have identified that further improvements are required to avoid increasing project risk and cost.[21] The NSW Government's ability to deliver on its pipeline is dependent upon reforms to its procurement methodology.

Several key initiatives have been implemented to improve the approach to Public Private Partnership (PPP) procurement, including:

- development of the NSW Procurement Policy Framework
- establishment of the NSW Procurement Board's Construction Leadership Group
- release of updated PPP Guidelines, most recently in 2017[22]
- a new PPP contracting model to be used across all NSW PPP projects.

While these PPP reforms are positive, reform is needed in relation to all forms of contracting models. There is a need to bring about long-term, embedded behavioural change across all NSW Government agencies that will lead to best practice, world class procurement.

A whole-of-government approach to procurement reform is required to ensure that the NSW Government takes a consistent and efficient approach to procurement across projects, agencies and sectors. A broad procurement reform initiative should be undertaken in partnership with industry to simplify procurement processes, reduce bid costs and

encourage and reward innovation. This initiative should also aim to improve capabilities in procurement agencies and provide a consistent and efficient interface with industry across government.

Construction Industry Leadership Forum

The Construction Industry Leadership Forum has been established to promote collaboration between the public and private sectors and improve infrastructure procurement and delivery. Held every six months, the Forum is attended by representatives from the construction industry and the NSW and Victorian public sectors. The Forum focuses on:

- developing capability and skills to ensure projects are delivered effectively
- creating more streamlined and efficient bid processes
- ensuring projects are delivered on time and on budget.

Ensuring the availability of essential construction skills

Securing the necessary construction-related skills is likely to be one of the biggest challenges to NSW's construction capacity and capability. Growing construction activity means that there is rising demand for construction and professional skills, with the greatest risks likely to revolve around securing critical on-site skills, including high quality supervisors, site managers and project engineers. Meeting demand for

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19 Ibid, p. 49
20 Ibid, p. 55

21 Legislative Assembly Committee on Transport and Infrastructure 2017; Legislative Assembly of New South Wales 2017; BIS Oxford Economics 2017; Australian Government Productivity Commission 2014
22 NSW Treasury 2017

high quality skills in tunnelling is likely to be particularly challenging given the size of the approaching boom in tunnelling work.

There is a range of constraints to the 'transferability' and 'mobility' of labour.[23] 'Transferability' is the ability of skills to be applied equally in different contexts; for example, between resources and infrastructure sectors. 'Mobility' is the ability of skills to move geographically.

Emerging skills gaps will not be closed through simply hiring labour from other regions, sectors or even from other parts of the construction industry. It will be essential to boost workforce development to meet demand for key onsite skills. This should include expanding the coverage of the NSW Infrastructure Skills Legacy Program and removing existing constraints to workforce development initiatives at the procurement phase. The NSW Government will need to ensure that it is an informed client by continuing to improve its technical capability to handle the growing complexity and volume of work.

Driving construction industry productivity and innovation

The Australian construction industry has generally lagged behind other industries in terms of productivity growth. The challenge for industry and government is to find ways in which productivity can be improved, including by securing higher quality supervision and project management, harnessing new technologies and processes, and adopting a more innovation-friendly culture.

The Productivity Commission identified new technologies emerging in the construction sector with the potential to deliver a step-change in productivity improvements:

- prefabrication and modularisation
- robotics and automation
- use of advanced materials or processes
- digital technologies, including Building Information Modelling.[24]

Industry and government need to foster innovation to ensure that inefficient construction practices are reformed and new productivity-enhancing technologies are adopted.

Recommendation 14

Infrastructure NSW recommends that the NSW Government establish a whole-of-government process, led by Infrastructure NSW and in partnership with industry, to identify and deliver major project procurement reforms by mid-2019. The reforms should focus on driving innovation, reducing bid costs and promoting competition.

3.3.6   Building public sector capacity

Currently, NSW Government infrastructure planning and delivery agencies do not have structured learning programs in place to foster knowledge-sharing between agencies and project teams. Opportunities to promote good practice, and to avoid past mistakes, are being missed. While Infrastructure NSW identifies trends and analysis through the IIAF, there is a need for a more structured approach across government to sharing project knowledge. Project innovation could be captured and shared in a structured and systemic manner, particularly in major projects like Sydney Metro and WestConnex.

NSW could be guided by other jurisdictions' approaches to building sector capacity. The UK Government's Major Projects Leadership Academy (MPLA) offers a useful model for improving leadership of major projects. Through this program, 'Senior Responsible Owners' appointed to lead major projects pass through the MPLA to ensure they have the necessary leadership capability, including technical and commercial know-how.

Infrastructure planning and delivery agencies should implement structured learning programs and transfer of knowledge from project to project and across sectors to strengthen public sector infrastructure planning and delivery capability.

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23   BIS Oxford Economics 2017, p. 62

24   Ibid, p. 100

4. Asset management – assurance and utilisation

STRATEGIC OBJECTIVE   **Optimise the management, performance and use of the State's assets**

SNAPSHOT	
SNAPSHOT	• The NSW Government currently manages assets worth more than $300 billion. In 2016-17, the NSW Government's maintenance expenditure was approximately $4.1 billion. This is expected to increase due to a growing and ageing asset base.[25]
	• Population growth, climate change, expectations of improvements in the level of service offered by infrastructure and the age profile of assets are placing upward pressure on maintenance requirements and expenditure. As it is not always feasible to build new assets, it is essential for NSW agencies to make the most of existing assets.
	• Asset management has focused primarily on individual infrastructure sectors to date, with an emphasis on inputs and outputs. This needs to be broadened to consider environmental, social and economic outcomes as well as interdependencies between sectors. The management and use of assets must become smarter, more productive and more efficient to avoid infrastructure spending increasing unsustainably.

RESPONSE	Summary of key recommendations
Improve asset management across government	• Introduce a revised asset management policy by the end of 2018, including an Infrastructure NSW assurance model and updated supporting policy and guidance materials, which require infrastructure agencies to:
	– make the most of their installed asset capacity
	– use clear and consistent definitions and methodologies to report to the Government each year on the size of any maintenance backlog in their sector and identify measures to address it, such that it becomes an input into the Budget process
	– broaden assessments of asset performance to take into consideration economic, social and environmental benefits
	– develop a 'system-of-systems' approach across interconnected infrastructure networks to drive an integrated vision of infrastructure provision and management, and create value, reduce costs, manage risks and improve the resilience of assets
	– adopt innovative, contemporary technologies to improve the operations and maintenance of infrastructure
	– use quality data for decision-making to balance cost, risk and asset performance.

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25   NSW Treasury 2017, pp. 1-20

4.1　Recent progress

The major NSW infrastructure agencies, including transport, health, education and social housing, have developed and refined standardised asset management frameworks and systems. These frameworks and systems are underpinned by an asset strategy for each agency that comprises:

- renewal capital works identified through the application of an asset maintenance plan, which is based on 'asset condition' key performance indicators (KPIs) – for example, Transport for NSW has a Pavement Health Index and other intervention conditions

- improvement and enhancement of assets through capital works identified in a services and operations plan, which is driven by 'performance' KPIs (such as traffic congestion) or 'improved customer outcomes' KPIs (such as improved service safety, improved service reliability, more timely and accurate information, air quality or lighting levels)

- additional or new infrastructure capital works, identified through a growth and improvement process, which is driven by increased demand due to population growth, demographic change, economic growth, land use changes, environmental imperatives, technology, government policy or legislative change.

Some NSW agencies use asset management frameworks, supported by recently developed technologies, that capture and assess significant amounts of data. For example, NSW Health has established Asset and Facilities Management Online, a web-based integrated workplace management system for 'whole-of-life-cycle' asset management. This online system improves the management of assets and facilities

by ensuring they are available in the right condition, at the right time and in the right location for optimal patient care. Another example is the Department of Education's Asset Management System, which holds relevant data about the Department's buildings and sites. This system interfaces with a life-cycle costing system to support the management of assets. A similar capability has recently been established in the Department of Justice.

Some agencies have established stand-alone bodies, such as Transport for NSW's Asset Standards Authority (see breakout box at right), which is responsible for the network design and standards for all NSW transport assets, and Health Infrastructure, which is responsible for the delivery of the NSW Government's major hospital building program. School Infrastructure NSW is a new unit within the Department of Education charged with the planning and delivery of new schools, upgrading existing schools, optimising existing resources and improving utilisation across schools in specific geographic locations.

Asset management frameworks form the foundation of NSW Treasury's Capital Investment Planning (CIP) policy, which seeks to ensure that the NSW Government's physical assets best support its service delivery responsibilities within the limits of available resources. CIP submissions from agencies are a key input to the annual NSW Budget process. NSW Treasury uses CIP submissions to:

- evaluate an agency's planned capital expenditure for the Budget year and Forward Estimates

- ensure that the State's capital program aligns with its priorities and service delivery levels

- assess each agency's capital programs against capital planning limits, where applicable

- identify and advise the NSW Cabinet's Expenditure Review Committee of potential risks to the implementation of agencies' infrastructure strategies by comparing proposed capital expenditure in CIPs against NSW Treasury's 10-year affordability projections

- provide advice to the NSW Government and agencies on capital strategy, asset management planning and related financial risks.

Infrastructure NSW considers the CIP policy to be an effective mechanism for planning specific infrastructure investments in a sector. However, the process does not consider asset performance (such as whether assets are well managed) or geographic outcomes (such as whether the assets improve a region or town); nor does it identify the contribution infrastructure makes to key outcomes such as the Premier's Priorities and State Priorities. A new approach is required where indicators are based on a prior definition by the NSW Government of its desired outcomes.

Transport for NSW's Asset Standards Authority

The Asset Standards Authority (ASA) is an independent unit established within Transport for NSW. It is the network design and standards authority for NSW transport assets. The ASA is responsible for developing engineering governance and frameworks to support the design, safety, integrity, construction and commissioning of transport assets for the asset 'whole-of-life-cycle'. The ASA is also responsible for providing the standards for NSW transport assets, which industry organisations can use to deliver projects and manage assets in an innovative, safe and efficient manner.

4.2 Challenges and opportunities

A key challenge for NSW is to extend the life of existing infrastructure assets for as long as possible to support continued service delivery. Infrastructure deteriorates due to natural ageing, wear and tear and external factors such as natural disasters. Without adequate asset maintenance practices and investment, there is a risk that the NSW Government will incur unforeseen and avoidable future costs associated with the renewal or replacement of infrastructure.

Asset maintenance was identified as a critical area for reform in the 2012 NSW Commission of Audit Interim Report.[26] That report made several important recommendations to improve asset maintenance, including preparation by the NSW Government of an asset management policy statement with a clear set of objectives and undertaking a rolling series of collaborative asset management evaluations for capital-intensive and large capital spending agencies in the general government and non-commercial Public Trading Enterprises. The report also recommended that NSW Treasury work with asset-intensive and large capital spending agencies to establish maintenance-related KPIs for incorporation into annual investment planning submissions to the annual NSW Budget process (now made under the CIP policy).

Only limited whole-of-government action has been taken since the release of the report.

In 2016, the NSW Audit Office examined the maintenance backlog for the three largest capital-intensive infrastructure sectors (transport, education and health) and found that:

- At 30 June 2015, Roads and Maritime Services, the Department of Education and NSW Health had estimated maintenance backlogs of $5.3 billion, $732 million and $323 million respectively.

- At 30 June 2016, Roads and Maritime Services reported a maintenance backlog of $3.4 billion, $1.9 billion lower than the $5.3 billion reported at 30 June 2015 due to the adoption of a refined methodology for calculating the backlog.

- The Department of Education is working to address a backlog in maintenance estimated at $775 million at 30 June 2016, an increase of $43 million from 2014-15. The Department will receive funding of $330 million over 2016–17 and 2017–18 to address maintenance needs in schools.

- NSW Health did not quantify its total backlog maintenance in 2015-16. However, NSW Health is refining its methodology and systems for identifying and reporting maintenance works following the implementation of a statewide asset management system (AFM Online). NSW Health's estimated backlog maintenance was $323 million at 30 June 2015.[27]

The 2016 reports of the NSW Audit Office did not define the concept of 'maintenance backlogs' or how they are measured. There is no single definition of the term within the NSW Government. In accounting terms, maintenance expenditure is either capitalised or incorporated into general operational expenses, which means that it is difficult to determine actual levels of maintenance expenditure or its relationship to asset management.

The Grattan Institute noted that Australia's transport investment level is the highest of all Organisation for Economic Co-operation and Development (OECD) countries, but that maintenance levels are among the lowest. This disparity can reduce the effectiveness of the infrastructure for users and lead to avoidable extra expenditure on remedial works and the premature replacement of assets.[28]

There is no clear and consistent reporting on the size of the maintenance backlog for agencies, their maintenance effort undertaken each year or their spending patterns (recurrent or capitalised). While some agencies have good systems in place, these do not feed through in terms of reliable reporting to the NSW Budget process.

Infrastructure NSW considers that current whole-of-government practices are inadequate and represent a risk to making the most out of the State's assets over the long term.

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26   NSW Government 2012, pp. 101-140

27   Audit Office of NSW 2016, pp. 9-16

28   Terrill, M et al 2016, p. 8

4.3   Response

4.3.1   Meeting demand by making better use of existing assets

Many existing infrastructure assets in NSW are under stress because demand has risen beyond forecast levels. Examples of assets struggling to meet increasing demand include:

- NSW's rail network, which will find it hard to meet punctuality targets after 2019, based on forecast patronage increases, unless its capacity is increased significantly. If higher than forecast patronage growth continues, the network may even struggle to maintain its punctuality before 2019[29]

- Sydney's major roads, with some key arterial roads showing marked slumps in peak hour speeds. Peak hour speeds have declined by up to 25km/h in the past two years, meaning drivers are stuck in rush hour traffic for longer. The largest fall in peak hour speeds was on the M2 Hills Motorway from North Ryde to Carlingford, where the average speed fell by 25km/h to 46km/h[30]

- NSW hospitals, which are facing record numbers of emergency department presentations, admissions and elective surgeries.[31]

Other infrastructure assets in NSW are less productive than they could be because demand is 'peaky', meaning that while infrastructure must be available during occasional peaks, it is under-utilised most of the time. For example, NSW peak electricity demand in the evening of the hottest day of 2017 was 14.7 GW – nearly 50 per cent higher than the average daily peak demand in summer of 10 GW. The electricity system is expected to meet high security and reliability standards and be available 99.998 per cent of the time.

Given that it is not always feasible to build new assets, it is essential for NSW agencies to continue to make the most of their installed asset capacity by:

- enhancing peak capacity and throughput

- seeking to spread demand to reduce the peaks

- optimising the availability of assets by minimising downtime.[32]

4.3.2   Enhancing infrastructure capacity

Infrastructure assets often have reserve capacity that is not being used. This spare capacity, if made available, could ease bottlenecks. Some past examples of changes to NSW infrastructure to enhance capacity include:

- RMS implementing contraflow lanes on several key roads including the Sydney Harbour Bridge, Military Road and the Pacific Highway to increase throughput

- the then Sydney Catchment Authority accessing a body of water in dams known as 'deep storage', which had previously been inaccessible for water supply. In 2006, new pipes and pumps were built to reach deeper into Warragamba and Nepean Dams.[33] This increased the annual average amount of water available over the long term by 40 billion litres a year, or about seven per cent of Sydney's water needs[34]

- RMS upgrading the Sydney Harbour Bridge and Sydney Harbour Tunnel in 2016 with new technology to provide multi-lane free-flowing tolling to maximise capacity at choke points[35]

- the Department of Education improving the use of school sites by building larger schools on smaller sites, increasing the use of modular classroom blocks and building vertical schools where appropriate (refer to Chapter 13).

4.3.3   Getting more out of infrastructure through demand management

Strategies that redistribute demand in time, space or mode are also important in making the most of existing capacity. Examples of demand side management optimising the use of infrastructure capacity include:

- public behaviour programs aimed at increasing water conservation during the Millennium Drought from 1997-2009, which combined public education, target-setting, water restrictions, efficiency labelling, rebates and water pricing. Trends in Sydney Water's customer water use show that people have permanently adopted water efficiency programs, with water use remaining at record lows since 2008[36]

- changes to the management and treatment of patients in the NSW health system that enable patients to take advantage of in-home care and rehabilitation, increasing the number of hospital beds available for managing acute care cases. This can also contribute to lower average costs per patient.

29   Audit Office of NSW 2017
30   Roads & Maritime Services 2017
31   Bureau of Health Information 2017

32   World Economic Forum, in collaboration with The Boston Consulting Group 2014, p. 9
33   'Deep water project expands Warragamba Dam', 15 April 2006
34   Metropolitan Water Plan 2010

35   Roads & Maritime Services 2016
36   Sydney Water Corporation 2010

Figure 11 – Maximising the use of infrastructure

1 Enhance peak capacity and effective throughput

- Enhance peak capacity by
  – unlocking backup capacity
  – targeted capacity enhancement
  – incentivising users to optimally use capacity
- Increase effective throughput by
  – reducing headways and technical losses
  – reducing commercial losses

2 Apply demand management

- Employ static or dynamic time-based charges
- Promote self-regulation via user education/ information
- Increase operations control
- Shift demand across mode and space

3 Optimise availability / reduce downtime

- Reduce the number of scheduled downtimes
- Reduce the risk of unscheduled breakdowns
- Reduce the downtime of each outage
- Integrate operations & maintenance planning
- Keep the system running during maintenance
- Improve incident management

—— Theoretical peak capacity

– – – Availability limit

- - - - Effective throughput

■ Demand

Source: World Economic Forum and the Boston Consulting Group 2014, *Strategic Infrastructure – Steps to Operate and Maintain Infrastructure Efficiently and Effectively*

Price signals have also been employed to assist with demand management. Examples include:

- electricity networks offering cheaper prices during off-peak times and introducing 'time of use' tariffs. The Ausgrid peak 'time of use' tariff is more than four times the price of the off-peak tariff. Smart meters can also provide half-hourly data on consumption, allowing users to pinpoint how much energy certain activities use[37]

- 'time of day' tolling for vehicles using the Sydney Harbour Bridge and Tunnel – assets that are used by over 43 million vehicles each year, making them two of the busiest roads in NSW. Time of day tolling was introduced in 2009 to help ease traffic congestion and to encourage motorists to travel outside peak hours where possible.

Pricing reform directions are outlined in Chapters 9.3.3 (Transport), 10.3.5 (Energy) and 11.3.5 (Water).

In addition to public behaviour programs, demand management and price signals, the provision of information and technology to help manage demand is proving effective. Customers with solar generators can avoid using power from the grid at peak periods if they have battery storage. Transport for NSW's CBD Coordination Office has implemented a Travel Choices program, which advises CBD employers on how they can help their workforce and business partners adapt to a changing CBD during the construction of Sydney Light Rail. The program has helped about 150,000 workers from more than 450 organisations to shift to more sustainable ways of moving into, out of and around the CBD.

37   Ausgrid 2017, p. 15

4.3.4 Optimising the time taken to maintain infrastructure

Long lead times to repair or replace an asset can result in significant downtime and service interruption. Asset downtime is an expensive challenge for infrastructure operators and reduces reliability for users. Operators are always seeking to maintain infrastructure in a way that minimises downtime. For example, early leak detection and repair is one of the main ways Sydney Water, with a network of over 21,000 kilometres of water pipes, can reduce water loss and downtime. Sydney Water uses acoustic devices to pick up the noise that water makes as it leaks from pipes. This helps the utility to quickly identify and repair hidden leaks before they become major incidents that have a system-wide impact.[38]

Similarly, Roads and Maritime Services uses preventative maintenance to minimise the cost of maintaining road pavement over the life of the asset. Timely and regular small-scale interventions reduce the need for more costly and disruptive road rebuilding activities.

Sydney Trains is constructing a new Rail Operations Centre that will modernise the control of Sydney's rail network by incorporating dozens of different systems into a single location. This will minimise delays and ensure incidents on the rail network are resolved quickly.

Although many NSW infrastructure agencies are taking steps to maximise the use of their installed asset bases, there is scope to do much more. It is critical that agencies make better use of existing assets before they spend funds on new capital projects. This responsibility should be embedded in the CIP policy, requiring agencies to provide evidence of how their assets are being used.

4.3.5 Delivering outcomes for the overall economy, society and the environment

The current planning and appraisal processes used by agencies focus on discrete, sector-specific assets and on inputs and outputs, not outcomes.

Many agencies simply focus on the estimated cost of delivering infrastructure to meet projected demand. For example, Roads and Maritime Services will construct a road at the lowest cost to meet projected use. A range of measures are used to manage and monitor performance to ensure the project and operations are on track. These include travel time, reliability and safety. However, there may be little consideration on whether the road itself achieves beneficial economic, social or environmental outcomes at its origin and destination.

This 'inputs and outputs' approach is being challenged by an alternative approach that assesses higher-level objectives in terms of the asset's contribution to the economy, society and the environment. A focus on outcomes provides more freedom in selecting solutions to identified problems, as performance is not locked into a particular type of infrastructure or technology.[39]

For example, contemporary developments in energy and nutrient recovery are increasing the value of sewage treatment processes and infrastructure. Wastewater treatment works are now becoming producers of energy and agricultural fertiliser rather than simply pollution remediators. Sydney Water is using food waste to power the Cronulla wastewater treatment plant. In other words, outcomes are valued over outputs.[40]

4.3.6 Taking a 'systems-based' approach

Current planning and appraisal processes in NSW can fail to identify and exploit potentially valuable interdependencies, due to a misplaced emphasis on discrete, sector-specific planning. Silo-based planning and appraisal processes may also be unable to identify potentially hazardous and costly interdependencies.[41]

A governance framework that ensures resilience measures are applied across critical infrastructure sectors is essential. Damage to one asset, for example electricity distribution infrastructure, can result in downstream disruptions to various sectors such as water purification and rail services.

The NSW Government should develop close partnerships with the private operators and owners of critical infrastructure, particularly in the energy and communications sectors, including a much greater exchange of information and potentially cost sharing.[42]

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38 Sydney Water 2016, https://www.sydneywater.com.au/SW/water-the-environment/what-we-re-doing/current-projects/maintaining-our-water-supply/leak-detection-program/index.htm

39 World Economic Forum in collaboration with The Boston Consulting Group 2014, p. 32

40 Edkins, A et al 2016, p. 5
41 Rosenberg, G & Carhart, N 2014, pp. 15-24; International Symposium for Next Generation Infrastructure 2013
42 The Organisation for Economic Co-Operation and Development (OECD) 2016, pp. 13-14

Efforts are underway in NSW to develop and apply tools to assess the vulnerability of critical infrastructure to existing and future climate risks and compare the costs and benefits of adaptation measures. AdaptInfrastructure, a tool developed for this purpose, is being trialled for the Sydney metropolitan region by the NSW Office of Environment and Heritage (refer to Chapter 5.3.3).

Hurricane Sandy

Hurricane Sandy provides valuable lessons for managing interdependencies during emergencies.

Hurricane Sandy struck the east coast of the United States in October 2012, causing enormous economic damage because of the interdependent infrastructure systems in New York City.

Direct damages from the hurricane were estimated to be USD$78-97 billion. The indirect damages – that is, damage to areas that were not inundated but were affected by Sandy through interconnected infrastructure – are estimated to have cost USD$10-16 billion. Damage to the electricity sector and associated outages impacted other infrastructure such as water, communications, transportation, food supply and private sector supply chains.

New York City introduced initiatives to increase the resilience of critical infrastructure after the hurricane. These initiatives focused primarily on building hard infrastructure to decrease direct damages. For example, New York City's building sector has adopted methods to construct new buildings and retrofit old buildings in the floodplain to the highest resiliency standards. However, as indirect damages to the building sector as a result of Hurricane Sandy were larger than direct damages, future disaster risk reduction strategies also need to consider interdependent infrastructure to reduce indirect damages.

To reduce indirect damages due to business interruption, Con-Edison, which provides electricity services in New York City, is making sure that its system is less susceptible to similar storms. Con-Edison has embarked on a long-term plan focusing on the following areas:

- fortifying the electric, gas and steam systems against future storms
- decreasing the time needed to restore power in the event of an outage
- enhancing storm planning and restoration processes
- improving the flow of information to customers and other stakeholders.[43]

4.3.7 Using new technology to improve operating and maintenance practices

Infrastructure could soon experience a major productivity gain from innovative technologies that promise new operating and maintenance (O&M) solutions. Recent innovations in digital technology – such as remote sensing, advanced analytics, autonomous operations, Building Information Modelling (BIM) and integrated scheduling and control – mean that traditional 'bricks and mortar' infrastructure can now be used more effectively, and operated and maintained more efficiently (also refer to Chapter 6.3.3).

Innovative O&M solutions are often relatively affordable and cost-effective in otherwise capital-intensive industries. Even small O&M improvements can make a big impact. For example, water utilities in the UK use an advanced pressure management system, with software, sensors and controllers to detect leakages as soon as they occur. This has reduced water loss by 1.5 million litres per day.[44] The infrastructure sector has sometimes been slow to adopt new technology given its massive existing asset base and entrenched processes and systems. But many examples of O&M best practice exist in various infrastructure sectors and other heavy industries around the world. Best practice O&M, illustrated in Figure 12, needs to be explored more widely in NSW.

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43 Haraguchi, M & Kim, S 2015

44 *"i2O Water helps Veolia water save 1.5 million litres of water a day"* (January 2012)

Figure 12 – Innovative O&M solutions can potentially make a big impact

Smart Transport	Smart Energy	Smart Water, Waste and Social
Intelligent transport systems	**Smart electricity meters**	**Smart water meters**
Hong Kong: Large-scale traffic management system	**California:** Roll-out of smart meters since 2006, with >90% of households accepting	**Toronto:** Large roll-out of smart water meters improving metering accuracy and billing efficiency
Congesting charging	**Electric vehicle infrastructure**	**Distribution network control**
Singapore: Time – based urban road pricing	**France:** Staged introduction of obligatory charging stations in new-builds and offices	**Sao Paulo:** Digital water management, real-time system control, automatic leaks warning
Smart parking	**Demand – response**	**Remote social infrastructure**
San Francisco: Sensors report free parking spaces and prices are adjusted based on demand	**Ontario:** "Peaksaver" programme to switch off home devices during peak hours	**Boston:** Telepresence robots, observing out-patient recovery after discharge from hospital
Public transport information – sharing	**Distributed generation integration**	**City safety & security**
Singapore: Inter-modal journey planners and real-time information systems	**Lower Saxony:** Piloting of dynamic distribution transformers	**Rio de Janeiro:** Real-time city monitoring and control of municipal services

Source: World Economic Forum and the Boston Consulting Group 2014, *Strategic Infrastructure Steps to Operate and Maintain Infrastructure Efficiently and Effectively*

Smart solutions, although effective, are not a panacea. O&M innovations can be difficult to integrate into legacy systems and the investment required for acquiring and installing them might not be justified by the benefits. Many of the promised benefits of the smart energy meter project in Victoria failed to materialise.[45]

Despite this uncertainty, many technologies that appear prohibitively expensive today will become cheaper and more cost-effective when implemented at scale, and will further enhance the effectiveness and efficiency of infrastructure assets.

4.3.8 Using data to improve infrastructure management and utilisation

Today's world produces a vast amount of digital data. The proliferation of low-cost sensor technology is providing many new information sources, including transactions, social media, sensors, cameras and global positioning systems (GPS), which can be harnessed by infrastructure operators.

New opportunities to improve asset management and use arise not just from the soaring volume of data but also from its increasing variety (which can now be mined even from unstructured data sources) and velocity (the speed at which data can be collected, processed and used for decision-making and automatic system responses).

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45   Victorian Auditor-General's Office 2015

Data applications are becoming increasingly affordable, with rapid advances in processing power, storage density and connection speed. New applications present a major opportunity for improving productivity and efficiency in infrastructure, enabling operators to improve market research, enhance O&M decision-making and boost customer relationships and satisfaction.

In addition to productivity improvements, data can make infrastructure operations more efficient. For example, Stockholm's road authorities collect real-time traffic data from a variety of sources, including vehicle GPS, radar sensors, congestion charging and weather reports, and process it via algorithms to advise motorists on optimal travel routes.[46] This helps to ease congestion without the need for costly and disruptive capital works on the road system.

To take full advantage of data, infrastructure operators need to define open and interoperable interfaces and industry standards to enable data interchange. New York City's 'Midtown in Motion' congestion management system provides such an interface for app developers.[47] Infrastructure operators can publish data through application programming interfaces that enable entrepreneurs to unlock the value of the data, connect to other data and develop new user solutions. This improves the efficient operation of infrastructure and encourages innovative and collaborative uses of existing assets (also refer to Chapter 6.3.3)

Predictive maintenance on Sydney Harbour Bridge

A structural health monitoring system, developed and implemented by Data61, has been applied to the Sydney Harbour Bridge, which is now over 80 years old. The system incorporates over 2,400 sensors to monitor around 800 structural components of the bridge. The network of sensors can provide infrastructure planners with early warning signs about physical damage and potential weaknesses. The use of sensors for structural health monitoring can reduce maintenance costs through preventive maintenance, limit disruption to road users and extend asset life without drastically increasing expenditure.[48]

4.3.9   A new asset management policy and assurance model

Asset management has focused primarily on individual infrastructure sectors to date, with an emphasis on inputs and outputs. This should be broadened to consider environmental, social and economic outcomes as well as interdependencies between sectors. The new approach should focus on long-term directions, as well as immediate operational matters that cut across infrastructure sectors.

Agencies should continue to expand and harness productivity gains from innovative technologies that promise new operating and maintenance solutions, as well as using appropriate, good quality data to improve productivity and efficiency in infrastructure.

A new assurance model should be developed, allowing Infrastructure NSW, together with NSW Treasury, to lead an overall assessment of asset management maturity across infrastructure sectors. Such an approach will:

- enable cross-fertilisation between agencies and sectors
- overcome differences in maturity across sectoral agencies
- ensure more systemic and transparent metrics for the NSW Government
- ensure an outcomes-based approach is used, including consideration of interdependencies
- increase transparency for the NSW Government regarding operations and maintenance
- improve public confidence in the management of assets
- ensure the current asset base is appropriately maintained to deliver the intended customer outcomes.

The assurance process for the State's major asset systems should include the following features:

- a single point of accountability for independent assurance across the State's major asset systems
- a risk-based assurance process tied to outcomes based and financial performance
- escalating the levels of scrutiny applied to asset management systems when emerging risks are reported
- improved reporting and data collection through a fit-for-purpose reporting tool

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46   World Economic Forum 2015
47   New York City Department of Transportation 2012

48   Data 61 2015

- aligning asset management systems against the ISO 55000 series for asset management and include a NSW Government Asset Management Community of Practice.

NSW Treasury should impose additional data requirements for asset management as part of the CIP policy so that:

- agencies provide digital asset management strategies linked to digitised asset registers and data management systems

- agencies provide evidence of how the use of assets is being maximised

- agencies use a consistent and standardised approach to develop systems and processes for assessing the performance of their assets

- agencies use clear and consistent definitions and methodologies to report on the size of maintenance backlogs, determine appropriate benchmarks and propose measures to address their backlogs

- agencies demonstrate that they have adopted and are using innovative technologies to improve the operation and maintenance of infrastructure

- agencies use data and other information in decisions to make infrastructure operations more efficient

- agencies clearly and consistently report to the Government each year on the size of their maintenance backlogs and measures to address these backlogs

- agencies report to the Government each year on their proposed expenditure for asset maintenance

- agencies broaden their assessments of asset performance to take into consideration the economic, social and environmental benefits

- a 'system-of-systems' view on interconnected infrastructure networks is developed to derive an integrated vision on infrastructure provision and management and ensure that infrastructure is effectively managed, maintained and optimised

- agencies undertake rolling, periodic assessments of the resilience and vulnerability of their assets to the impacts of climate change (such as rising sea levels), natural disasters (such as floods, bushfires, heatwaves and storms) and human-related threats (such as cyberthreats)

- an operations and maintenance budget for whole of life is defined and provisioned at the time an asset is acquired.

Recommendation 15

Infrastructure NSW recommends that the NSW Government introduce a revised asset management policy that includes a new assurance model managed by Infrastructure NSW, including updated supporting policy and guidance materials, by the end of 2018.

Recommendation 16

Infrastructure NSW recommends that NSW Treasury update by the end of 2018 the data requirements for asset management plans prepared by agencies as inputs into NSW Treasury's Capital Investment Planning policy.

5. Resilience

STRATEGIC OBJECTIVE **Ensure that existing and future infrastructure is resilient to natural hazards and human-related threats**

SNAPSHOT	
	• The State's existing and future infrastructure must be 'resilient'. That is, it should be able withstand disruption, operate in crisis and deal with and adapt to shocks and stresses.
	• Shocks to infrastructure can include natural disasters (floods, bushfires and storms) and human-related risks such as cyberthreats. Stresses, which can increase the impact of shocks, include existing risks (such as the vulnerability of ageing infrastructure) and emerging risks (such as those which arise from the increasing connectivity and interdependence of infrastructure).
	• The NSW Government has taken steps towards improving the management of infrastructure resilience. However, preparedness across agencies varies, with some having only limited understanding of the vulnerability of their assets and limited ability to assess effective mitigation or adaptation measures.
	• To effectively manage resilience risks, decision-makers need access to accurate information on the hazards facing existing and future infrastructure. The nature and type of natural hazard information currently available in NSW, particularly flooding information, varies in its quality, availability and accessibility. Responsibility for the collection of natural hazard information is spread across a range of state and local government authorities. This means there is no comprehensive understanding of the potential impact of natural hazards on infrastructure and of the risks that should be prioritised for mitigation. The patchiness of information and limited guidance available to assess risk also makes it difficult to embed risk and resilience in strategic land use planning and infrastructure investment decisions.

RESPONSE	Summary of key recommendations
Improve the collection of natural hazard information	• Invest in the collection of natural hazard information and complete the NSW Flood Data Access Program by 2020. • Nominate an agency to assume central accountability for the collection and coordination of statewide natural hazard information.
Embed resilience in strategic land use planning	• Develop a Natural Hazard Policy, supported by a broader strategic process to embed resilience in land use planning, by the end of 2019.
Make infrastructure resilience central to investment decisions	• Develop infrastructure-specific risk assessment tools and guidance by mid-2019 to support government agencies, the private and not-for profit sectors, and local government to better assess the vulnerabilities of new and existing infrastructure, and to identify cost-effective adaption and mitigation measures. • Require consideration of resilience risks and outcomes for new and upgraded infrastructure in all project business cases, capital asset planning and assurance processes as a matter of course.
Invest to reduce risks	• Prepare business cases for evacuation road upgrade packages in the Hawkesbury-Nepean Valley by the end of 2019.

5.1   Recent progress

The *State Infrastructure Strategy 2012* highlighted the importance of resilient public and private infrastructure, defining resilience as the capacity to withstand disruption, absorb disturbances, act effectively in crisis and deal with climatic variability. The NSW Government has taken steps to improve the management of infrastructure risk and resilience, including completing the:

- *Hawkesbury-Nepean Flood Risk Management Strategy (2016)* (see breakout box at right)
- *NSW Climate Change Policy Framework (2016),* which includes the objective to make NSW more resilient to a changing climate
- *Emergency Risk Management Framework (2017),* which aims to strengthen and integrate emergency risk management
- *State Level Emergency Risk Assessment (2017),* which identifies and assesses key hazards and risks across NSW
- *NSW Critical Infrastructure Resilience Strategy Discussion Paper (2017),* which seeks to identify and address risks to critical infrastructure (see section 5.3.4).

The Hawkesbury–Nepean Valley Flood Risk Management Strategy

In 2016, the NSW Government adopted the Hawkesbury-Nepean Flood Risk Management Strategy to manage the risk posed by regional floods in the Hawkesbury-Nepean Valley. This strategy, the first of its kind in NSW, includes infrastructure and non-infrastructure responses across the emergency management spectrum of prevention, preparedness, response and recovery. Key issues addressed by the strategy include:

- risk mitigation through raising Warragamba Dam
- the integration of regional land and emergency planning to manage development exposure
- raising community awareness of risk
- improving emergency response and recovery activities.

5.2   Challenges and opportunities

Existing natural disaster risks (in some cases exacerbated by climate change), a growing population and increasing interdependencies between infrastructure systems highlight the need to improve the resilience of infrastructure across NSW, particularly infrastructure that supports the essential needs of communities. Failure to adequately address infrastructure resilience puts existing and future assets at risk, potentially increasing the costs to government of repairing or replacing damaged assets. It will also strain the capacity of infrastructure service providers to meet expected levels of service.

Climate change is expected to increase temperatures and alter the frequency and intensity of extreme weather events such as heatwaves and flooding. This is likely to increase the vulnerability of NSW's infrastructure to natural disaster risks.

As digital connectivity increases, so does the risk of cyberattack against the public and businesses: as infrastructure systems become more reliant on technology, this vulnerability will increase.

In an increasingly interconnected world, damage to one asset may generate impacts that 'ripple out' to other assets, affecting their capacity to provide services even if they are not damaged themselves or are in a different location (refer to Chapter 4 for further discussion on the interconnected nature of infrastructure sectors).

While natural disaster and climate hazards such as bushfires, heatwaves, storms and floods are well known, not all hazard information is well documented or easily accessible. This limits the Government's ability to effectively embed risk and resilience into strategic land use planning and infrastructure investment decisions.

In a constrained fiscal environment, it is vital that the NSW Government has a clear understanding of the vulnerability of its infrastructure and the priority risks that it needs to address. Preparedness amongst agencies varies, with some having only limited understanding of the vulnerability of their assets and limited ability to assess effective mitigation or adaptation measures. While some initiatives are underway, NSW is not as far advanced as other jurisdictions in addressing infrastructure resilience risks.

5.3   Response

5.3.1   Improve the collection of natural hazard information

To effectively manage risk, decision-makers need access to accurate and up-to-date information on the natural hazards facing existing and future infrastructure.

The nature and type of natural hazard information available varies in its quality, availability and accessibility. Responsibility for the collection of natural hazard information is spread across a range of state and local government authorities. As a result, there is no efficient, coordinated approach to its collection, use and dissemination suitable for assessing risk. There

is also no clear, comprehensive understanding of the potential impact of natural hazards on infrastructure or of the risks that should be prioritised.

In particular, variability in the quality, availability and accessibility of flood hazard information has precluded consistent assessment of flood risks. Primary responsibility for the management of flood-prone land and the provision of flood hazard information rests with local councils. Local councils generate flood hazard information and mapping either with grant funding and technical support from the NSW Government or independently of government.

Flood risk studies are typically location- or catchment-based and do not always present a consolidated view of the risk to communities or infrastructure across council boundaries. Existing flood studies vary in the detail they provide about hazard profiles. Improved access to flood hazard information at suitable scales is needed to assess the exposure and vulnerability of infrastructure and communities. Compounding these issues, many past flood studies have been subject to copyright restrictions, which restricts their release and use outside government.

Possible initiatives that could improve the collection of natural hazard information include:

- producing statewide hazard maps and reports for key hazards such as flood, bushfire, drought and heat
- undertaking research on the impact of climate change on extreme climatic events
- updating the NSW / ACT Regional Climate Modelling project (NARCliM).

The NSW Office of Environment and Heritage and the NSW State Emergency Service are implementing a NSW Flood Data Access Program, which includes:

- the launch of a *NSW Flood Data Portal* to enable flood hazard data owners (generally local councils) to share their flood information across government and with industry stakeholders such as insurers, infrastructure providers and the community
- requiring all flood studies undertaken with NSW Government funding to be made available in a 'creative commons' (open data) environment through the *NSW Flood Data Portal*
- investigating the establishment of a public-facing web service to enable councils to display their flood information in a consistent manner to the public.

Infrastructure NSW supports these initiatives. However, given the critical importance of natural hazard information to assessing community and infrastructure vulnerability, it is recommended that the NSW Government prioritise and coordinate this work. Infrastructure NSW recommends investment in natural hazard information collection and that the *NSW Flood Data Access Program* be funded and completed by 2020.

The 2017 NSW State Level Emergency Risk Assessment[49] proposed establishing a central point of accountability within the NSW Government to manage spatial and related risk data and modelling. Infrastructure NSW supports this approach and recommends that accountability for coordinating the collection of natural hazard information be centralised within a nominated agency, potentially the NSW Office of Environment and Heritage. State and local entities

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49   NSW Office of Emergency Management 2017a, p. 14

with existing responsibilities for the collection of natural hazard information will retain that responsibility. The nominated agency should have an oversight role and overall accountability for ensuring the necessary information is collected at appropriate standards.

Building on the recommendations in the *2017 State Level Emergency Risk Assessment,*[50] the work priorities of the nominated agency should include initiatives to improve the collection of natural hazard information and completion of the *NSW Flood Data Access Program*. The ongoing work program should incorporate:

- coordinating the collation of statewide spatial information on current and future natural hazards necessary to inform decision-making
- coordinating a review of existing hazard modelling across all hazards at local, regional and state levels
- investigating the standardisation of hazard data through common criteria for all hazards
- investigating the consolidation of hazard information databases and portals to ensure that information is accessible.

Recommendation 17

Infrastructure NSW recommends that the NSW Government invest in initiatives to improve the collection of natural hazard information and complete the NSW Flood Data Access Program by 2020.

Recommendation 18

Infrastructure NSW recommends that the NSW Government nominate an agency to assume central accountability for coordinating the collection of statewide natural hazard information.

5.3.2 Embedding resilience in strategic land use planning

The *National Land Use Planning Guidelines for Disaster Resilient Communities* (published by the Planning Institute of Australia together with the Commonwealth Attorney-General's Department) notes that land use planning has consistently been identified as one of the key means to reduce natural disaster hazards and help build long-term community resilience.[51]

In 2015, the Productivity Commission argued that land use planning was perhaps the most potent policy lever for influencing the level of future natural disaster risk. Despite growing awareness of the need to integrate natural disaster risk management into all aspects of the land use planning process, the Commission noted that this is not always achieved in practice. It highlighted the difficulty associated with uninformed and opaque decision-making, concluding that land use planning systems need to be transparent.[52] Infrastructure NSW agrees with these assessments.

Hazard information must be transparently considered at the outset of strategic land use planning. Integrating risk and resilience considerations into strategic land use planning will involve:

- balancing housing and jobs growth needs against the risk of development in areas subject to natural hazards
- providing guidance on acceptable levels of exposure to risk across government and the community
- consulting with the community and key stakeholders to understand risks and their consequences
- coordinating planning across multiple local and state governments.

Current strategic land use planning processes, such as land rezoning, use Ministerial Directions and State Environmental Planning Policies (SEPPs) to inform the way in which natural hazards are considered. However, the absence of a natural hazards policy and process to guide the management of natural hazards and resilience has resulted in an inconsistent and at times inadequate approach to identifying and responding to hazards. For example, existing Ministerial Directions for flood management do not encourage an appropriate risk-based approach to flood hazard. This has limited the land use responses in areas exposed to significant flood hazard.

It is recommended that the Department of Planning and Environment develop a Natural Hazard Policy, supported by a broader strategic process to embed resilience into land use planning. The new policy and supporting process should:

50   NSW Office of Emergency Management 2017b

51   Planning Institute Australia 2015
52   Productivity Commission 2014, p. 29

- ensure more transparency in the assessments undertaken, including the assessment of different natural hazard scenarios to inform land use plans
- improve the quality of hazard information considered
- include risk assessments in strategic land use planning.

Recommendation 19

Infrastructure NSW recommends that the Department of Planning and Environment develop a Natural Hazard Policy, supported by a broader strategic process to embed resilience considerations into land use planning, by the end of 2019.

5.3.3   Make risk and resilience considerations central to investment decisions

Infrastructure owners and operators are responsible for the safety and security of their assets. Ownership and operational responsibilities are held variously by local, state and federal governments, and the private sector.

The World Economic Forum argues that governments need to mainstream disaster risk management into all stages of the infrastructure lifecycle – from planning and construction to operations and maintenance.[53] Doing so enables infrastructure to withstand threats and hazards, to recover quickly after disruption and to be ready for long-term stresses such as climate change.[54]

Considerations of risk and resilience should have a material impact on infrastructure design. In the case of Sydney Metro North West, for example, resilience considerations resulted in changes to standard station and embankment designs to address climate risks.

New Zealand's Civil Defence Emergency Management (CDEM) Act (2002) requires a comprehensive risk management-based approach to hazard management, comprising risk reduction, readiness, response and recovery.[55] The CDEM framework requires that 'lifeline utilities', such as electricity distributors, should be directly involved in CDEM hazard and risk management through regional CDEM Groups. Section 60 of the CDEM Act places obligations on lifeline infrastructure providers to ensure that they can function, if necessary at a reduced level, during and after an emergency and to participate in CDEM planning.

Orion, a lifeline utility company, adopted the CDEM framework. Drawing on lifeline and resilience reports from Christchurch and Edgecombe conducted during the 1990s, as well as engineering and geo-technological assessments, Orion invested $6 million in seismic strengthening of its critical infrastructure. As a result, following the Canterbury Earthquakes of 2010 and 2011, Orion saved between $30 and $50 million in direct asset replacement costs.[56]

Similarly, several Canadian provinces have incorporated climate change resilience into their provincial infrastructure plans. Ontario's 10-year infrastructure plan, *Building Together*, requires the preparation of asset management plans that consider

climate change adaptation in project design.[57] Alberta's *Provincial Recovery Framework* details key government functions, including developing policy to restrict development in floodplains and instituting mandatory standards for infrastructure.[58] In British Columbia, the government provides a one-stop online service on the tools and resources available to support climate adaption measures[59], including infrastructure vulnerability assessments and associated training[60].

NSW Climate Change Policy Framework

A key policy direction in the NSW Climate Change Policy Framework is to reduce risk and damage to public and private assets and services arising from climate change. This framework seeks to reduce the impact of climate change on key assets and services by embedding climate change considerations into asset and risk management.[61]

To deliver on this commitment, the NSW Government:

- is preparing comprehensive guidance material for agencies on how to consider climate risks at all stages of decision-making
- is proposing to develop a NSW Government *Climate Change Preparedness* Program to support government agencies to undertake climate risk assessments and then manage the risks
- has updated the NSW Common Planning Assumptions to include climate projections.

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53   World Economic Forum 2014, p. 49
54   NSW Office of Emergency Management 2017, p. 9

55   *Civil Defence Emergency Management Act 2002*
56   Kestrel Group 2011, pp. 8-9

57   Ministry of Infrastructure (Ontario, Canada) 2017, p. 6
58   Ministerial Flood Recovery Task Force (Alberta Canada) 2013, pp. 4-6
59   Ministry of Environment, Fraser Basin Council (Vancouver BC, Canada) 2017
60   Ibid.
61   NSW Office of Environment and Heritage 2016, p. 1

AdaptInfrastructure

AdaptInfrastructure, currently being trialled in Sydney by the Office of Environment and Heritage, analyses extreme weather and climate change risks and annual average damage costs. It then supports the analysis of resilience investments options, comparing the cost of investment with saved operational and other costs through losses or insurance.

Coordinate infrastructure risk information and assessment

It is recommended that the NSW Government coordinate efforts across the *NSW Climate Change Policy Framework, NSW Critical Infrastructure Resilience Strategy* and *NSW Government Cyber Security Strategy* (see 'Enhance critical infrastructure resilience' section below) to develop a set of infrastructure-specific risk assessment tools and guidance. These tools and guidance should help government agencies, local government and the private sector to better assess the vulnerabilities of new and existing infrastructure and identify cost-effective adaption and mitigation measures. The risk assessment tools and guidance should be completed by mid-2019.

To ensure whole-of-life assessment of infrastructure risk and resilience issues, it is recommended that:

- consideration of risk and resilience outcomes for new and upgraded infrastructure be embedded in project business case guidelines, capital asset planning and assurance processes as a matter of course

- as part of the new asset management assurance framework (see Chapter 4), agencies be required to undertake rolling, periodic assessments of the vulnerability of their assets to the impacts of climate change (such as sea level rise), natural disasters (such as floods, bushfires, heatwaves and storms) and human-related threats (such as cyberattacks).

As noted in Chapter 6, it is proposed the NSW Government develop an *Infrastructure Data Management Framework* by 2020 to ensure NSW has a coordinated, shared and trusted framework to harness infrastructure data to better plan and operate the State's infrastructure systems. The *Infrastructure Data Management Framework* should provide governance for the continuous collection, curation and sharing of infrastructure data. All information related to infrastructure risk and resilience should be collected in a consistent manner to allow it to be collated and centrally accessed from the *Infrastructure Data Management Framework*.

Treatment of risk mitigation and adaption measures in business cases

The benefits of risk mitigation and adaptation investments (such as a raised Warragamba Dam) often extend beyond the usual period for assessing costs and benefits in business cases (generally 20-30 years). As a result, the standard discount rates applied in cost-benefit analysis guidelines may understate the benefits of those investments.[62]

The *NSW Government Guide to Cost-Benefit Analysis*[63] notes that the longer the appraisal period, the more difficult it becomes to forecast costs and benefits, and the less sensitive the quantum of costs and benefits becomes in later years. This guide raises the possibility of longer analysis periods (and specifically mentions assessing climate changes issues), but notes that decisions on extending the analysis period will depend upon the plausibility of the data and assumptions over this period.

In the absence of longer analysis periods, cost-benefit analyses should undertake sensitivity testing of the costs and benefits using lower discount rates, consistent with the rates specified in the *NSW Government Guide to Cost-Benefit Analysis.* While the benefits may be realised far into the future, failure to consider them in the planning and construction of long lived assets could result in recovery costs many times larger than the cost of the upfront resilience upgrade.

Recommendation 20

Infrastructure NSW recommends that the Office of Environment and Heritage and Office of Emergency Management jointly lead the development of infrastructure-specific risk assessment tools and guidance by mid-2019 to support government agencies, the private and not-for profit sectors, and local government to better assess the vulnerabilities of new and existing infrastructure and to identify cost-effective adaption and mitigation measures.

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62   Organisation for Economic Cooperation and Development 2006, pp. 23-25

63   NSW Treasury 2017, p. 55

Recommendation 21

Infrastructure NSW recommends that NSW Treasury and Infrastructure NSW require consideration of risk to natural hazards and human-related threats and resilience outcomes for new and upgraded infrastructure in project business cases, capital asset planning and assurance processes as a matter of course.

5.3.4 Enhance critical infrastructure resilience

Certain infrastructure is critical to supporting the resilience of communities. 'Critical infrastructure' includes the assets, systems and networks required to maintain the security, health and safety, and social and economic prosperity of a community.[64] It includes the energy, water, communications, transport and health infrastructure supporting communities across NSW.

As part of an ongoing Emergency Management and Disaster Resilience Review, the NSW Government is developing a NSW Critical Infrastructure Resilience Strategy. To inform the development of this strategy, the Office of Emergency Management released the NSW Critical Infrastructure Resilience Strategy Discussion Paper in September 2017.[65]

The NSW Critical Infrastructure Resilience Strategy is intended to foster collaborative partnerships and put in place a framework to identify and address risks to critical infrastructure, and outline a plan to deliver, monitor and evaluate critical infrastructure initiatives.

It will involve the private sector and local, State and Commonwealth Government owners or operators of critical infrastructure working together to consider responses to natural and human-related risks. It will include work to:

- develop a detailed understanding of critical infrastructure risks and interdependencies from natural and other hazards
- foster the collection and sharing of critical infrastructure risk information
- develop guidelines to use that information to inform decision-making
- consolidate the multiple asset registers in NSW, so that there is a centralised source of information.

Recognising the increasing risk of cyberattacks as infrastructure becomes more connected and reliant on technology, the NSW Government is proposing to develop a *NSW Government Cyber Security Strategy.* This work will need to be coordinated with the development of the *Critical Infrastructure Resilience Strategy*, which is scheduled to be finalised by mid-2018.

5.3.5 Invest in infrastructure that reduces risks

Physical infrastructure (such as dams and levees) and natural infrastructure (such as wetlands and forestation) can be used to reduce risks, improve infrastructure and community resilience, and reduce disaster recovery costs.

In 2011, the Productivity Commission suggested that more should be done to invest in risk reduction to minimise disaster recovery costs[66]. It noted that the Australian Government's resilience spending had been only three per cent of disaster recovery spending in the preceding years, a trend mirrored in the NSW spend.[67] Economic analyses of recent major disasters have estimated that the cost of recovery from disasters is between double to four times the cost of action to reduce risk.[68]

Given the potential to reduce infrastructure costs associated with disaster recovery, it is important that the NSW Government maintain oversight of statewide and regional risk information to assess the merits of investing in regional risk reduction infrastructure. For instance, it is important that Government has a coordinated view of the impacts of sea level rise on its infrastructure and considers potential mitigation strategies. As risks often cross multiple government boundaries, agencies and tiers of government will need to collaborate to identify risks and assess the benefits of options to reduce these risks. This will require a coordinated approach to assess possible economic and social losses from failing to address risks, and the benefits of taking a more proactive and coordinated approach to risk reduction through infrastructure.

In a recent example of a coordinated approach to this issue, Infrastructure NSW oversaw the development of the NSW Government's *Hawkesbury-Nepean*

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64   NSW Office of Emergency Management 2017, p. 10
65   Ibid.

66   Productivity Commission 2014, p. 9
67   Ibid.
68   Kelman I 2014, p. 4; International Federation of Red Cross and Red Crescent Societies 2007, p. 2; McClelland R 2011; SGS Economic and Planning 2016, p. 6

Flood Risk Management Strategy. This strategy is the first phase of a program of infrastructure and non-infrastructure actions to reduce flood risk in the Hawkesbury-Nepean Valley (the Valley). The NSW Government allocated $58 million to support the implementation of Phase One (2016-2020) actions, including:

- work to complete a final business case and obtain planning approvals for the raising of Warragamba Dam (refer to Figure 13)

- programs to increase community flood risk awareness

- new evacuation signage

- improved flood forecasting

- integrating flood risk management with regional land use planning.

Notwithstanding the proposed dam raising, low level and localised floods caused by rainfall outside the Warragamba Catchment will still occur in the Valley.

Evacuating people from flood-affected areas is the primary method of reducing the risk to life during a flood. In the Valley, evacuation by car is the most effective evacuation method, as other transport options are either highly vulnerable to floods or have limited capacity. However, 40 high priority local evacuation roads have been identified as having access constraints that pose a risk during flooding events. Subject to the impending completion of a business case, it is recommended that the NSW Government invest in local evacuation road upgrades in the Valley.

Recommendation 22

Infrastructure NSW recommends that Roads and Maritime Services prepare business cases for evacuation road upgrade packages in the Hawkesbury-Nepean Valley by the end of 2019.

Figure 13 – Aerial photo of Warragamba Dam 2012
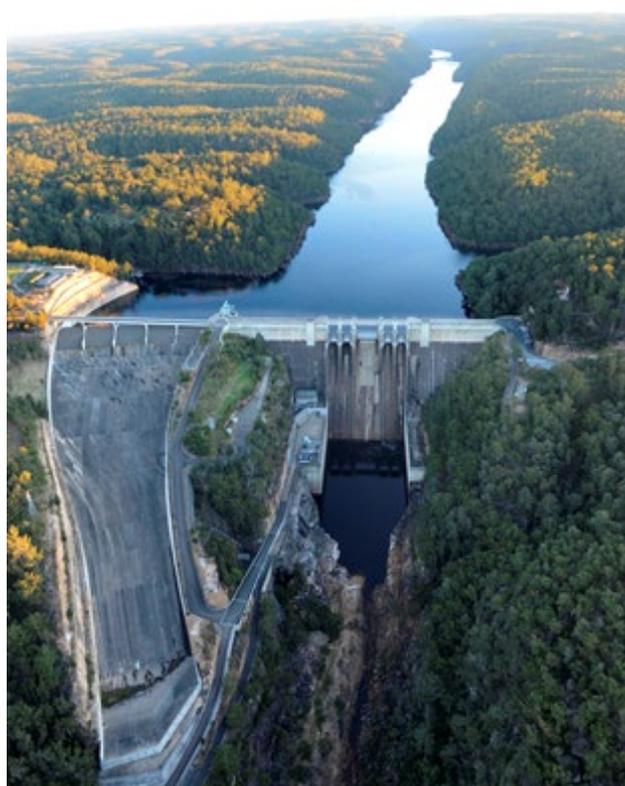
Source: A Hollingworth © WaterNSW

6. Digital connectivity and technology

STRATEGIC OBJECTIVE   **Improve statewide connectivity and realise the benefits of technology**

SNAPSHOT	- The NSW Government has opportunities to realise the benefits of digital connectivity and technological innovation, and ensure that NSW becomes a leader in the adoption and use of digital technology. - Demand for high speed, reliable digital connectivity is increasing, as businesses, government and households become more reliant on connected assets and processes. However, there is inconsistent access to digital connectivity across NSW and gaps in the affordability, quality and reliability of connectivity. As improved digital connectivity is vital to NSW's economic prosperity, opportunities should be pursued to deliver the required infrastructure and levels of service across the State. - The way in which infrastructure is used, managed, maintained and developed through technology will be determined in the future by the availability of data for analysis, decision-making, policy setting and strategic investment. We must use more data more effectively and treat data as a critical asset in its own right. Efficient collection of and access to government-held data, including the enabling spatial data infrastructure, are the keys that will unlock the benefits of technology. - Infrastructure NSW supports the development of a centralised data repository that is accessible to everyone under open data provisions, searchable in real time and spatially enabled. - The NSW Government's involvement in digital connectivity and technology is significant, as an owner of assets and a purchaser of around $500 million worth of telecommunications services a year. The Government should ensure that all new and significantly upgraded infrastructure is connected or connectable by 2020 by planning for and embedding smart technology during its development. - With technology expected to continue to disrupt most infrastructure sectors, government decision-making needs to keep up with rapid change. In particular, as the future productivity of infrastructure is likely to be greatly enhanced by the Internet of Things (IoT), a whole-of-government policy framework should be developed to guide investment in the IoT and ensure that NSW has the right systems, processes and infrastructure in place to maximise the benefits delivered by the IoT. - Protecting assets from cyberthreats and maintaining information security are critical for the NSW Government. Risk-based approaches to cybersecurity should be strengthened and supported with the required investment. Cybersecurity risk assessments should be included as part of the assurance process for all information and communications technology (ICT) and connected infrastructure investments from 2018.

RESPONSE	Summary of key recommendations
Improve connectivity across NSW	• Seize opportunities to improve connectivity across the State to support statewide access to uncontended 25Mbps download and 5Mbps upload capacity by 2020 and 50Mbps download and 10Mbps upload capacity by 2025. • Conduct a stock-take of fibre optic cable networks owned or leased by NSW Government agencies. • Complete the delivery of the Critical Communications Enhancement Program (CCEP). • Leverage existing NSW telecommunications assets to support the statewide connectivity goals.
Invest in technology that improves productivity and social outcomes	• Develop policies for adopting the IoT and connected infrastructure to achieve interoperability. • Ensure all new and significantly upgraded infrastructure is connected or connectable, where appropriate, by 2020 through embedding smart technology during its development.
Treat data as an asset	• Increase the use of big data and metadata to improve how infrastructure is planned, delivered, managed and operated. • Develop and deliver the data ecosystem including the spatial data framework. • Implement an Infrastructure Data Management Framework.
Ensure appropriate cybersecurity	• Strengthen risk-based approaches to information and cyber security and support this with the required investment. • Adopt a 'secure-by-design' approach for new initiatives and development, including the IoT and infrastructure.

6.1 Recent progress

The NSW Government has established a platform for improving service quality and efficiency through more connected infrastructure, more available data and investment in technology. Various sectors have adopted strategies for more connected digital infrastructure, including:

- NSW Digital Government Strategy
- NSW e-health Strategy
- Transport for NSW Future Technology Roadmap
- NSW Telecommunications Strategy
- NSW Government Operational Communications Strategy

- NSW Government Open Data Policy
- creation of the NSW Data Analytics Centre (DAC)
- establishment of the Government Chief Information Security Officer (GCISO) role
- ICT Strategy
- Digital Economy Industry Action Plan.

The focus of these strategies has been on improving service quality, facilitating technological innovation, enabling business and community partnerships and providing open access to State-owned infrastructure. A whole-of-government approach to connected infrastructure has not been developed.

6.2 Challenges and opportunities

6.2.1 Uncertain futures

It is hard to predict how digital connectivity and technology will develop in the future. There is uncertainty around how technology will evolve, how prevalent it will be and how trends in technology will intersect with other megatrends shaping the future of NSW.

Four possible scenarios for digital connectivity and technology in NSW

In research prepared to inform the 2018 SIS,[69] four potential future scenarios were identified. The level of connectivity required under each scenario varies, as do the benefits in terms of reduced costs of delivering services and maintaining and operating infrastructure. The four scenarios are:

1. **Heritage** – In this scenario, digital technology has advanced but the results have only been incremental. The pathway to adoption is slow and uneven. This scenario involves the lowest level of digital impact on infrastructure planning.

2. **Restructured** – In this scenario, technology gains have been modest but there have been considerable changes to lifestyles. A substantial number of NSW residents and visitors have opted for teleworking, online retail, telehealth and other digital services, leading to changes in mobility patterns in the near term (next five to 10 years) and eventually to changes in land use and settlement patterns.

3. **Enabled** – In this scenario, people in NSW maintain their current mobility and settlement patterns over the coming 20 years. Today's more desirable postcodes remain attractive and people continue to endure commuter stress for trips into cities and town centres. Infrastructure is much more technologically enabled, with sensory systems, predictive analytics, automation and other digital technologies deeply embedded into infrastructure.

4. **Renaissance** – In this scenario, infrastructure is completely reinvented and the opportunities provided by enhanced connectivity are widely adopted. Settlement patterns have been transformed, with people living in different places with different lifestyles demanding different services. At the same time, digital technologies have proven highly capable of reducing costs and improving the quality of services.[70]

Infrastructure planning needs to be flexible enough to respond to each of these scenarios. The NSW Government must seek to maximise the uptake and benefits of technology. Investments in technology and service delivery should be treated in an integrated manner to take full advantage of the available opportunities.

6.2.2   Differing connectivity levels across NSW

High connectivity across NSW is fundamental to maximising the efficiencies and benefits of technology. The vast geographic area and dispersed population of NSW will be the key challenge to ensuring universal and reliable connectivity.[71] The mix of connective technology across NSW includes fibre optic, copper, wireless and satellite (see Figure 14).

Some regional areas within NSW fall below the national and regional standards for digital inclusion and connectivity, as measured by the Australian Digital Inclusion Index (ADII). The ADII measures three vital dimensions of digital inclusion – access, affordability and digital ability – and shows their development over time, across social and economic circumstances and geographic locations.[72] Sydney scores above the national average of 56.5, with a score of 60, but rural NSW has an average score of just 51.4. Some regions have an ADII score far below the national average, such as the Murray and Murrumbidgee (50.9) and north-west NSW (51.7).[73]

There is also evidence of increasing unmet demand for digital connectivity and dissatisfaction with current service levels across NSW. In 2017, the Telecommunications Industry Ombudsman (TIO) received over 50,000 new complaints about internet services from NSW, over 40 per cent more than in 2016.[74]

6.2.3   Economic and social impacts of digital connectivity

Economic benefits of connectivity

Analysis undertaken by the OECD has identified a correlation between economic income (GDP per capita) and broadband internet speeds.[75]

Without action, there is a risk that NSW's patchy connectivity will make it unattractive for investment. Australia slipped from 16th to 18th in the world on the World Economic Forum's Information Technology ranking between 2015 and 2016 (on an aggregate of 53 related indicators). This decline was partly due to the lack of affordability, with Australia ranked 57th in the world against this measure. The low levels of business adoption of ICT also impacted the country's ranking.

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69   Hajkowicz et al 2017, p. 3

70   Ibid.
71   Ibid, p. 6

72   Thomas et al 2016, p. 6
73   Thomas et al 2017, p. 24
74   Telecommunications Industry Ombudsman 2017, p. 32
75   Hajkowicz et al 2017, p. 18 (citing OECD statistics)

Figure 14 – NSW connectivity[76]

Fibre optic cable

HFC

Copper

Fixed Wireless

Satellite
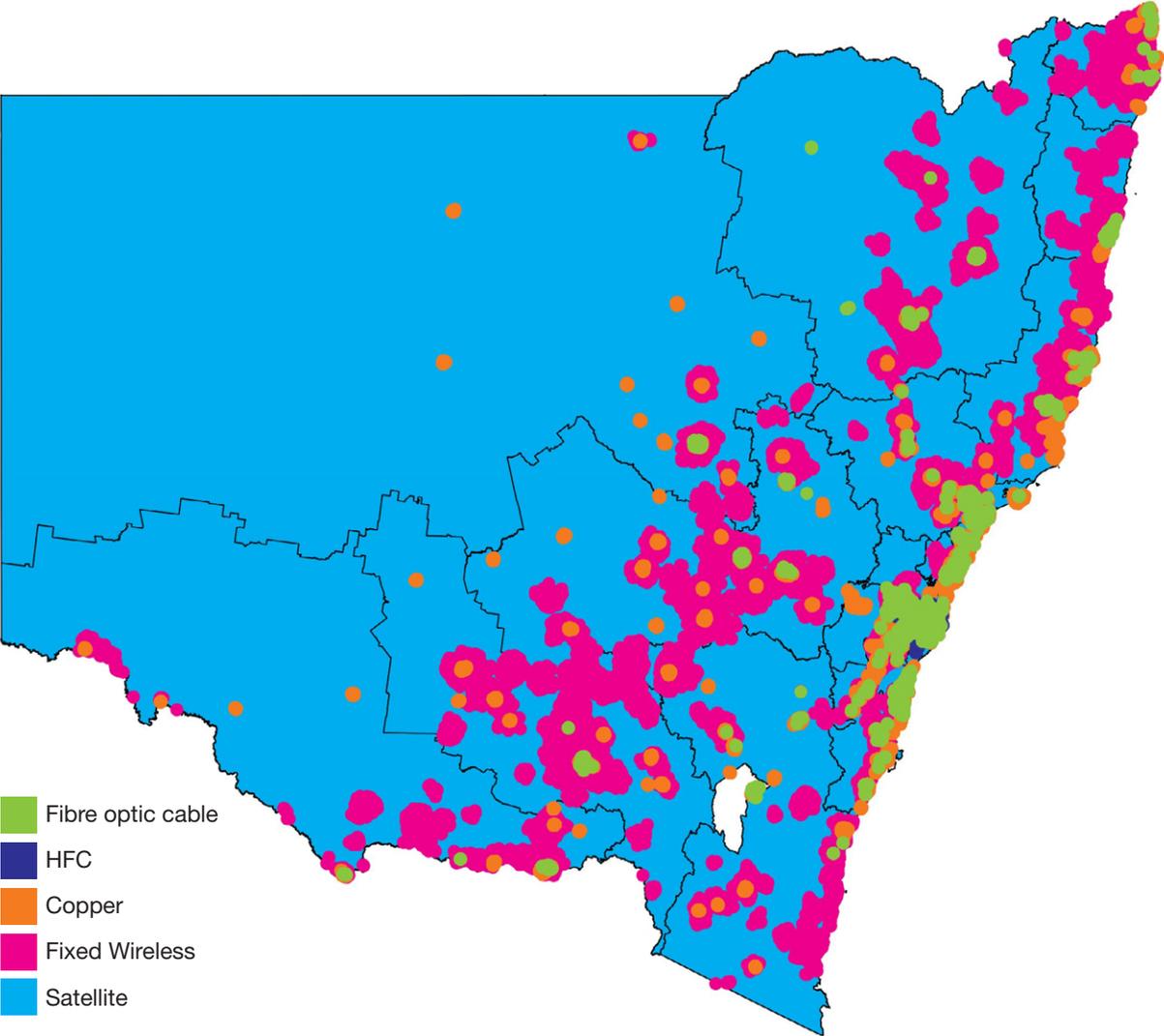
Source: The Grex Group 2017, *NSW Infrastructure Digital Connectivity*

Singapore is the top-ranking country, followed by Finland, Sweden, Norway and the United States.[76]

Slow and unreliable internet access may hinder regional economic growth and job creation. A study of OECD countries during 1996-2007 found a 10 per cent rise in broadband penetration led to 0.9-1.5 per cent growth in annual income per capita. Another study of OECD countries during 2008-2010 found that doubling internet broadband speed increased economic growth by 0.3 per cent. Research from the United States similarly concluded that expanding broadband deployment and adoption can have a positive effect on the economy, but noted a time-lag for business benefits. While cause and effect need to be better understood, the evidence is increasing that fast and reliable internet is associated with higher rates of economic growth.[77] Improving digital connectivity is an urgent priority and is relevant to all levels of government and industry, warranting further policy development and innovative investment models.[78]

Social benefits of connectivity

Investment in digital connectivity improvements in NSW, especially in areas that currently score below the ADII average, would contribute to the realisation of broader social objectives.

In 2016, the United Nations identified that the link between access to the internet, as well as ICT literacy, improved overall global education levels and social equity.[79] There is evidence that a lack of access to high-speed broadband reinforces socio-economic

76   Ibid (citing World Economic Forum 2016)
77   Ibid, p. 21; (citing Amelung & Nicholls 2014; BOM 2017; Muresan 2016, p. 19; McKinsey & Co 2015)
78   Ibid, p. 8 (citing McKinsey & Co 2015)
79   Office of the United Nations High Commissioner for Human Rights (OHCHR), Oral Revisions (30 June 2016), pp. 2-4

disadvantage, with some of the most disadvantaged areas of Australia having relatively poor connectivity.[80]

Improved connectivity can support increased labour force participation rates across groups such as parents with young and school-aged children, as well as people with disabilities. High quality connectivity helps to save time and supports practices such as teleworking and flexible work.[81]

The Internet of Things

The Internet of Things (IoT) is made up of sensors and other devices that are connected to computing systems.[83] It is the global network of physical devices, home appliances, vehicles and other objects that are embedded with electronics, software, sensors and actuators, enabling these 'things' to share and exchange data to perform their functions more efficiently and effectively.

Connectivity requirements are not being met

The Productivity Commission has found that the combination of the National Broadband Network (NBN) and mobile networks is likely to meet or exceed minimum standards for universal service delivery in the short to medium term.[83] Analysis prepared for Infrastructure NSW indicates that over the next five to 10 years, most digital connectivity demand will be met by the market through NBN Co. and other telco providers. However, there are currently gaps in

the affordability, quality and reliability of connectivity. These gaps will widen over time and be exacerbated by expected increases in the demand for and use of data-intensive applications[84] (see Figure 15).

Areas in regional NSW served exclusively by satellite connectivity will be unable to access the same voice and high-volume data connectivity as metropolitan customers for key services such as video conferencing. Over the next five to 10 years, the demand for connectivity is expected to increase as High Definition (HD) video conferencing becomes increasingly 'business as usual' for remote working, distance education and eHealth.

Other applications that will drive the need for faster and more reliable connectivity include the large numbers of connected devices – the IOT and Machine to Machine (M2M) – as well as virtual and augmented reality to support remote working and training, distance education and eHealth. Residents and businesses may find that the connectivity required to receive basic services is unaffordable.

The digital connectivity needed to support demand for residential, business and government uses is estimated to require bandwidth beyond that provided under the NBN rollout. This means that further investment in digital connectivity infrastructure will be required beyond the rollout of the NBN rollout to meet future needs.

Fragmented procurement processes and differing agency requirements

NSW Government ICT expenditure, as a portion of total expenditure, increased from 3.23 per cent to 3.72 per cent between 2010/11 and 2015/16. According to the Department of Finance, Services and Innovation, this increase in expenditure is consistent with international benchmarks.[85] Such significant expenditure, and the market power that accompanies it, can be used more effectively to secure better outcomes for government, communities and business in NSW.

Purchasing and management of ICT services is currently undertaken on a sector and agency basis, with different levels of value being achieved by agencies. The Department of Finance, Services and Innovation is working to improve how the NSW Government purchases telecommunications services and mobile radio services, focusing on aggregating service demand and improving commercial terms for services.

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80 *'Three Charts on: NBN and Australia's digital divide'* (21 June 2017). https://theconversation.com/three-charts-on-the-nbn-and-australias-digital-divide-78911
81 Hajkowicz et al 2017, pp. 19-21
82 Ibid, McKinsey & Co 2015, p. 17
83 Productivity Commission 2017a, p. 2

84 The Grex Group 2017, p. 5

85 Department of Finances, Services and Innovation 2016, p. 29

Figure 15 – Connectivity demands – residential and business

Residential bandwidth demand (up to Mbps)					
% of premises	**2013**	**2018**	**2023**	**2030 (estimate)**	**2035 (estimate)**
70%	10	16	38	76	125
15%	17	31	40		
10%	23	34	42		
5%	25+	35+	43+	76+	125+

Business bandwidth demand (up to Mbps)				
% of premises	**2015**	**2025**	**2030 (estimate)**	**2035 (estimate)**
70-75%	8	35	50-75	100+
12-16%	18	45	60-85	120+
4-8%	30	85	100-140	150+
1%	70+	100+	150+	180+

Source: Communications Chambers 2015, *The Broadband Requirements of Small Businesses in the UK; Communications Chambers 2014, Domestic Bandwidth Requirements in Australia, A forecast for the period 2013-2023*

Enterprise Telecommunications Optimisation Program

The Enterprise Telecommunications Optimisation Program (ETOP) has been developed to take advantage of new and emerging disruptive technologies and exploit the contestability available from more competitive supplier markets and NBN connectivity. It also embraces the fixed-mobile convergence that enables flexible and mobile working for employees.

This program builds on work already undertaken across the NSW Government to share network assets, use government buying power to achieve better unit prices, improve connectivity between government offices and increase the use of collaboration services. This program will apply across the whole-of-government and cover fixed voice, fixed data Wide Area Network (WAN) and mobile services (voice and data).

The roll-out of ETOP will:

- reduce duplication of fixed data links
- achieve commercial reform and increase value for money
- facilitate the migration away from legacy services.[86]

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86 NSW Government 2015, www.finance.nsw.gov.au/ict/enterprise-telecommuications-optimisation-program-etop-faqs

The ETOP initiative does not extend to all the assets held by NSW agencies. Key exclusions include fibre optic cable in rail corridors and there is currently no NSW Government asset register of high-value digital connectivity assets such as fibre optic cable networks, spectrum and tower networks.

This issue is not unique to NSW: the Productivity Commission has recommended a national audit of existing networks, including fibre networks. A lack of publicly accessible information about these networks leads to a duplication of assets and higher costs. The Productivity Commission has noted that the extent of this problem is difficult to assess in the absence of a comprehensive telecommunications infrastructure audit.[87]

Using more data, more effectively

The Productivity Commission has identified data as both an input to and an output of new technology, and as a growing resource of significant importance. Estimates of the rate of growth of data vary, although the forecast growth rate is consistently high. Lack of access to data for data-hungry businesses and government agencies looking to improve efficiency is a key barrier to technological progress. Extensive restrictions on access due to information security and privacy concerns may also be barriers to technological advances.

The Productivity Commission has argued that despite progress in states such as NSW, open access to public sector data is outstripped by developments in the United States, the UK and New Zealand, and that fundamental reform is needed to ensure that Australia is not left behind.[88]

Restrictions on access to public sector data will become increasingly debilitating as the number of connected devices increases and as the IoT becomes more prevalent. Vast amounts of data exist but are not accessed or fully exploited, sacrificing opportunities to drive value through increasingly sophisticated applications.[89]

In a business climate where data is a competitive currency, resources such as the unstructured and unexplored data available through the web may create new business and economic opportunities if these sources can be harnessed to develop marketable products or service offerings.[90]

Information security and cybersecurity is critically important

As infrastructure becomes more connected, and as more services are delivered digitally and our reliance on analytics and data increases, cybersecurity and the protection of data assets will require an increased focus. Cyberattacks against Australia are most likely to be directed at high-value targets including critical infrastructure.[91]

The national Computer Emergency Response Team (CERT) is the main point of contact for cybersecurity issues affecting major Australian businesses, including the owners and operators of Australia's critical infrastructure and other systems of national interest.[92] CERT has found that the energy and communication sectors were the most frequent targets of cyberattacks in 2016. Given that ownership of infrastructure in

Australia is divided between the public and private sector, and many networks, such as communication, transport and electricity infrastructure, span state boundaries, NSW's response will need to coordinate with national approaches. Appropriate governance and investment in cybersecurity will be required to achieve the benefits of technology and connectivity.[93]

6.3   Response

The NSW Government will have a role in:

- building infrastructure to support connectivity
- setting appropriate standards and policies for the use of technology
- making data more open and available
- efficiently purchasing telecommunications services
- ensuring high cybersecurity and information security standards.

The NSW Government's role should be to enable the benefits of increased connectivity to be realised, while mitigating the risks that may accompany new technology.[94]

6.3.1   Improve connectivity across NSW

In Infrastructure NSW's view, the NSW Government should set connectivity targets for the State that will support economic development and digital access to services. These targets should reflect the data demands of the applications needed to support the modern economy and the needs of businesses, government and residential users. Access at all

87   Productivity Commission 2017b, p. 120
88   Productivity Commission 2016, pp. 12-33

89   McKinsey Global Institute 2015, p. 4
90   Deloitte 2017, pp. 21-22
91   Hajkowicz et al 2017; Australian Cyber Security Centre 2016
92   Computer Emergency Response Team (CERT) Australia 2017

93   Hajkowicz et al 2017, pp. 32-37; Centre for International Futures 2015
94   Ibid, pp. 32-34

times (peak and off peak) to connectivity of 25Mbps download and 5Mbps upload capacity by 2020 and 50Mbps download and 10Mbps upload by 2025 can help to position NSW as a leader for business and the delivery of government services.

Given NSW's size, and the cost of digital connectivity infrastructure,[95] the most cost-effective approach will be to leverage assets from the NSW and Commonwealth Governments to support overall improvements to connectivity. The Commonwealth Government has provided $29.5 billion in equity and a loan on commercial terms of up to $19.5 billion to NBN Co. for the delivery of the NBN.[96] This scale of investment underlines the magnitude of the challenge of providing high-speed connectivity to Australian residencies and businesses via fixed and wireless broadband technologies. Countries such as Singapore and the Netherlands have been able to achieve high global rankings on digital connectivity due to their small size and high population densities. Countries such as Australia and Canada struggle by comparison.[97]

Infrastructure NSW has identified opportunities for government agencies to partner with telcos to pursue connectivity improvements. These partnerships will build on current expenditure and existing programs including the ETOP and the Critical Communications Enhancement Program (CCEP) (see breakout box).

Given the statewide reach of these programs and the extensive asset base held by the NSW Telco Authority, these assets can be harnessed to improve

digital connectivity in some regional areas by adding fixed wireless connectivity to existing and new Telco Authority towers.

Connectivity standards are also being considered as part of the overall regulatory system for communications as part of the Commonwealth Government's Telecommunications Reform Package. The service standard proposed in these reforms requires peak speeds of 25Mbps download and 5Mbps upload capacity from broadband connectivity providers.[98]

The NSW Government has established the $50 million Connecting Country Communities program to invest in communications infrastructure and deliver improved regional voice and data connectivity. This fund will be used to build and upgrade mobile base stations and connect businesses to global markets and schools with innovative learning resources.[100]

Infrastructure NSW's recommendations propose a better coordinated approach that will leverage existing investments, assets and purchasing power to improve connectivity, especially in regional NSW.

Critical Communications Enhancement Program

The Critical Communications Enhancement Program (CCEP) is delivering an enhanced Government Radio Network (GRN) to improve emergency and day-to-day operational communications for NSW Government agencies, including public safety, law enforcement and essential services.

The CCEP will consolidate the large number of radio assets owned and operated by government agencies to enhance the NSW Telco Authority's existing network. It will increase the level of shared coverage available to NSW Government agencies and essential services from less than 35 per cent at present to over 80 per cent of the state. Coverage in urban areas will also improve from 96 per cent to close to 100 per cent. Emergency and day-to-day operational communications will benefit from the network capacity improvements.

The enhanced network will support network users to more easily share information – interoperability – and coordinate responses to critical incidents, leading to better outcomes for frontline personnel and the NSW community.

The shared vision for the future of operational communications is for seamless, robust communication to be available to NSW Government agencies and essential services. Moving from many independent agency networks to one single, shared platform for operational communications (as delivered by the CCEP) is key to achieving this outcome. It also paves the way for the adoption of new technologies such as public safety mobile broadband.[99]

95   Ibid.
96   Commonwealth Treasury 2017, pp. 3-18
97   Hajkowicz et al 2017, pp. 20-21

98   NSW Telco Authority, http://telco.nsw.gov.au/ccep/ccep-home
99   NSW Telco Authority
100 NSW Department of Premier and Cabinet 2017

Recommendation 23

Infrastructure NSW recommends that the Connecting Country Communities program be used to improve connectivity in regional NSW and support access to uncontended 25Mbps download and 5Mbps upload capacity by 2020 and 50Mbps download and 10Mbps upload by 2025.

Recommendation 24

Infrastructure NSW recommends that the Department of Finance, Services and Innovation lead a stock-take of all fibre networks owned or managed by the NSW Government during 2018 and establish a fibre optic cable network database.

Recommendation 25

Infrastructure NSW recommends that the Department of Finance, Services and Innovation identify opportunities to leverage NSW Government-owned telecommunications assets to improve statewide connectivity in partnership with the telecommunications industry. These assets include towers, fibre optic cable networks and buildings, as well as expenditure on telecommunications services.

Recommendation 26

Infrastructure NSW recommends that the rollout of the Critical Communications Enhancement Program be completed and funding provided to the NSW Telco Authority to deliver the required infrastructure.

6.3.2   Recognising the role of data in the digital future

Policy on infrastructure data should be focused on achieving the right balance between protecting critical infrastructure and safeguarding privacy, and facilitating access to and management of data. Consistent with the recommendations of the NSW Chief Scientist and Engineer in a review of coal seam gas activities in NSW, Infrastructure NSW supports the development of a centralised data system that is accessible by everyone under open data provisions, searchable in real-time and spatially enabled.[101]

The NSW Government's Digital Strategy recognises that usable, accessible data that enables insights and informs government decisions is a critically important asset.[102]

Using and managing data

Increasingly, smart ICT is being used in the infrastructure sector, with a proliferation of new ways to plan and operate infrastructure improving how services are delivered.

Smart ICT, such as sensors, provides information on the performance of infrastructure systems. As smart ICT is deployed across the State's infrastructure network, infrastructure-related data will be almost as important as the infrastructure asset itself. It will contain real-time performance information, including data on customer use. This rich information can be used to build evidence-based, data-driven models to better plan infrastructure for regional NSW and Greater Sydney and to operate infrastructure more efficiently and effectively.

An Infrastructure Data Management Framework would ensure that NSW has a coordinated, shared, standardised and trusted framework to harness infrastructure data to better plan and operate the State's infrastructure systems. It would provide governance for the continuous collection, curation and sharing of the State's infrastructure data. It would need to align with the Bureau of Infrastructure's National Data Collection and Dissemination Plan, which was prepared for the Commonwealth Government and focuses on transport data.

Established legislative and policy settings enable open access to government information and data.[103] Once infrastructure-related data is collected, it should be made open to the private sector, enabling deeper analytics to improve the function and operation of infrastructure and services, and alternative uses that can create business development and growth opportunities.

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101 NSW Chief Scientist and Engineer 2014, p. 13
102 NSW Data Analytics Centre 2016, https://www.finance.nsw.gov.au/ict/
      nsw-data-analytics-centre
103 Department of Finance, Services and Innovation 2016

Establishing the Data Analytics Centre

The creation of the NSW Data Analytics Centre (DAC) and the passing of the *Data Sharing (Government Sector) Act 2015*, created a central point for coordinating data sharing initiatives within the NSW Government. It identifies a group to coordinate activities to provide a whole-of-government view of service delivery and overcome the challenges faced by individual cross-agency data sharing projects.

The ongoing success of the DAC will require appropriate use and interpretation of data, managing unintended consequences of sharing data or accidental release of sensitive data, as well as adhering to privacy legislation. Frameworks for trusted data sharing will be needed.

Recommendation 27

Infrastructure NSW recommends that by the end of 2020 the Department of Finance, Services and Innovation develop and implement an Infrastructure Data Management Framework that incorporates access to open data, is searchable in real time and is spatially enabled to support market innovation and smart asset management with sector infrastructure experts.

6.3.3   Considering data as an asset

Digital connectivity and future technological advances can improve how we build infrastructure as well as improving asset utilisation and efficiency. The NSW Government needs to consider data as an asset, and invest in spatial data and management as the supporting framework to optimise infrastructure networks.

Increasingly, infrastructure will be planned, delivered or operated using digital models. The development of a digital model containing 3D data sources and detailed specific information about sites (such as maintenance requirements, and accurate condition assessments) can help inform planning for future infrastructure and maintenance of current infrastructure.

The physical underpinning for digital modelling includes the sensors that collect information, the devices that process it, the internet that communicates it and autonomous devices that act on it.

The digital model will also require policies to govern, manage, distribute and organise data. These policies should recognise the importance of accurate, consistent and available data. Spatial data should include location coordinates of infrastructure assets and places, the measurement of distance and calculation of area. The spatial data should also cover the physical environment, including property, roads, addresses, administrative boundaries, hydrography, elevation, land cover, imagery, place names and positioning. Without a foundational spatial data framework in place, access to the benefits of digital engineering will be limited. Ongoing investment in further developing this framework is necessary to underpin future advances toward virtual 3D modelling and the increasing importance of access to Digital Engineering (DE).

As the NSW Government invests in building new infrastructure, it has opportunities to create legacy assets from information resources. Increasing and standardising the use of DE techniques, including BIM, can reduce the cost of construction. BIM is an intelligent 3D model-based process that gives architects, engineers and construction professionals the tools to best plan, design, construct and manage buildings and infrastructure.[104]

Foundational Spatial Data Framework

Foundational spatial data is the 'authoritative geographic information' that underpins, or can add significant value to, any other information. It supports evidence-based decisions across government, industry and the community.[105]

The NSW Government has a Foundation Spatial Data Framework (FSDF) that, along with standards for time, currency and the alphabet, provides the basis for a common evidence base that enables society to function.

The FSDF is not as well-embedded as the other units of measurement and is less regulated and reliable. However, measuring and describing the physical world is more complex than measuring or describing time or currency. Considerable resources are required to standardise spatial measurement and locations to bring the FSDF to the same standard as time and currency.

As we move toward an increasingly online and connected world, it will become even more important that places, distances or areas are described using a clear framework.[106]

104 Autodesk 2017, https://www.autodesk.com/solutions/bim
105 The Australian and New Zealand Foundation Spatial Data Framework (FNZFSDF) 2015, p. 1
106 NSW Foundation Spatial Data Framework 2015

DE has made it possible to create detailed, data-rich, virtual models of everything surveyed, designed and delivered. These models can be re-used and leveraged to unlock benefits in areas such as infrastructure operations and maintenance, drawing on advanced information systems, automated systems, surveillance drones and real-time monitoring.

Given the range of infrastructure the NSW Government owns and is currently building, investing in DE now will improve asset management in the near term as well as for future investments. DE has been used for a number of projects in NSW and elsewhere, including the development of Barangaroo and Wynyard Walk, the Royal Adelaide Hospital Project, Regional Rail Link in Victoria and the Perth Children's Hospital and Perth Stadium.

The UK is leading the world in the adoption of DE, having run campaigns to ensure greater awareness and use of DE among government agencies. The adoption of DE in the UK has coincided with cost reductions. Some estimates value the potential worldwide benefits of digitisation in the non-residential construction sector to be over a trillion dollars annually during the construction phase and half a trillion dollars in the operations phase.[107]

Recommendation 28

Infrastructure NSW recommends that the Department of Finance, Services and Innovation lead the development of a data infrastructure ecosystem, starting with the Foundation Spatial Data Framework, to access the future benefits of digital mapping and modelling of infrastructure.

Recommendation 29

Infrastructure NSW recommends that the Department of Finance, Services and Innovation prepare a business case for upgrading the Foundation Spatial Data Framework from a map to a model (a real-time 3D model of the physical environment).

Virtual Singapore

Digital twin technology is an option being used in Singapore, with the completion of Virtual Singapore expected in 2018. This model is expected to enable sophisticated analysis and coordination amongst many industries, particularly through its ability to help planners test concepts and prospective services before implementation.

Ultimately, the model will allow planners to digitally trial their ideas and pre-empt any problems before the implementation stage. This digital technology can improve real-time asset management, enable stress testing of infrastructure decisions and better integrate infrastructure networks.[108]

Virtual Singapore will enable:

- virtual experimentation
- validation of concepts for service improvements
- more detailed assessment of demand and movement for transport and parks
- future research applications.[109]

6.3.4 Enabling connected infrastructure networks

The NSW Government can help to create an environment that is conducive to technological innovation and connected infrastructure networks by developing policies for connected infrastructure and the IoT. In doing so, the Government should aim to encourage and support innovation through effective and proportionate regulation.

Connected infrastructure

Where possible, new infrastructure should incorporate device connectivity, sensors and computing power. Large increases in M2M connectivity are forecast as the availability of connected infrastructure increases and the cost of enabling infrastructure such as sensors falls. The NSW Government's role, as an infrastructure owner, is to set the framework that allows the benefits of this infrastructure to be realised. For example, governments can facilitate the development of smart cities through integrated planning that embeds connectivity into new infrastructure. The proliferation of smart devices means that the contemporary city is now a data generator. By 2020, cities globally will include 10 billion 'smart objects'. Consumer demand for smart home devices will also be a major driver: the European Commission expects that by 2020, 72 per cent of European Union consumers will have smart electricity meters installed in their homes and 40 per cent will have smart gas meters. As the volume of data generated by cities increases, so too does the importance of data in city planning frameworks. For instance, transport planning decisions are increasingly able to draw on the data collected by smart ticketing systems such as Opal.[110]

107 The Boston Consulting Group 2016, p. 3

108 National Research Foundation (Singapore) 2017
109 Ibid.

110 Hajkowicz et al 2017 (citing Rathore, Ahmad, Paul, & Rho 2016, p. 12)

Smart cities

A city is smart when investments in human and social capital, traditional infrastructure and disruptive technologies fuel sustainable economic growth and a high quality of life, with wise management of natural resources, through participatory governance.[111]

'Smart cities' use innovative solutions to address challenges related to urbanisation and sustainability. Smart city initiatives fall broadly into two categories:

- those that reduce resource use and improve and maximise efficient use of resources
- those that add context and a user experience that helps cities or towns do something new or better.[112]

Within NSW, local governments are adopting smart city strategies to improve liveability and sustainability. For example, the *Newcastle Smart City Strategy 2017-2021* aims to improve operational efficiency,

better service local community needs and stimulate economic development activity. Projects underway in the city centre include smart parking, free public Wi-Fi, transport network upgrades, including on-demand buses, and public domain upgrades.[113]

The Committee for Sydney suggests that "put simply, promoting open data, effective data governance and uniform standards to promote interoperability and value creation…are the building blocks of a smart city".[114]

Digital technologies may reduce, or even remove, the need for some types of infrastructure: teleworking, online education and online retail could reduce commuter pressure on roads at peak times.

The ability of government to access and use sensors will increase as these become smaller, smarter, self-powering and cheaper. As sensors and related systems develop, they will better detect, capture and transfer masses of information.[115] Cheaper, more powerful technologies are likely to create new opportunities for innovation and digital business[116] and to enable the control and automation of infrastructure at a more granular level.

Smart city opportunities for the NSW Government to explore include DE, incorporating smart technology into new infrastructure and setting governance and policy frameworks that encourage collaboration to realise the full benefits of interoperability. The benefits

of data sharing, digital connectivity requirements in urban design and planning, and applying smart cities principles to natural resource management should also be areas of focus across NSW. Regional areas are likely to be ideal test zones and locations for pilot initiatives and trial sites.

Recommendation 30

Infrastructure NSW recommends that the NSW Government develop a Smart Cities Strategy and program business case during 2018 to identify opportunities to deliver better services through collaboration and embracing the benefits of technology for infrastructure and public services.

6.3.5   Enabling the IoT

The future productivity of infrastructure will be greatly enhanced by the IoT. A survey of 1,100 Australian businesses by Vodafone in 2016 reported that 63 per cent of businesses are seeing a positive return on investment from IoT projects, up from 59 per cent in

2015. Another report by General Electric estimates that over the coming 15 years the 'industrial internet' could generate savings of US$30 billion for aviation, US$63 billion in healthcare cost reductions, US$27 billion via more efficient rail freight movements and US$90 billion through reductions in capital expenditure in the oil and gas sector globally. Numerous technology companies are investing heavily in IoT capabilities and have expectations of a growing marketplace.

It will be important to ensure that the right systems, processes and policies are in place to support adoption of the IoT. The McKinsey Global Institute argues that the benefits of the IoT could be more than US$11 billion by 2025, and that interoperability accounts for an average of 40 per cent of the potential benefits. Similarly, the Productivity Commission argues that standards will play an important role in facilitating the adoption of new technologies and that this is particularly relevant for digital technologies. The Productivity Commission recommends that standards should be outcomes-focused and not overly complex or prescriptive. Given these trends, NSW needs to ensure that appropriate standards exist to 'future proof' the infrastructure it owns.

111 Deloitte 2015, p. 14
112 Committee for Sydney 2017, p. 13
113 Newcastle City Council 2017, p. 19
114 Committee for Sydney, 2017, p. 11
115 Ibid, p. 21, (citing Goldman Sachs 2014)
116 Ibid.

Figure 16 – The declining average costs of sensors deployed onto the IoT
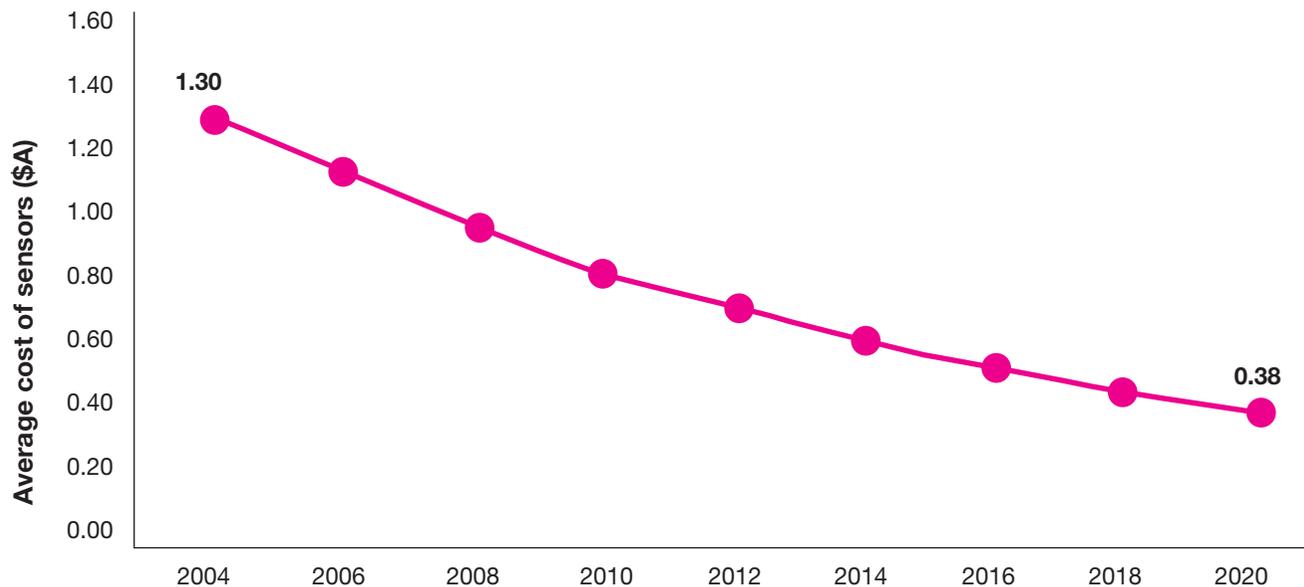
Source: Goldman Sachs 2014, *The Internet of Things: Making Sense of the Next Megatrend (as cited by Hajkowicz et. al 2017, Digital futures – exploring the future impacts of digital technology on the New South Wales infrastructure system)*

Recommendation 31

Infrastructure NSW recommends that the Department of Finance, Services and Innovation lead the development of a whole-of-government policy framework to guide investment in the Internet of Things (IoT) and connected infrastructure to maximise the benefits and manage the potential risks of connected infrastructure.

Recommendation 32

Infrastructure NSW recommends that the Department of Finance, Services and Innovation leads the development of a whole-of-government policy that sets the requirements for smart technology to be embedded in all new and significantly upgraded infrastructure from 2020 onwards.

6.3.6 Managing the risks of cybersecurity and information security

The NSW Government should continue to adopt a risk-based approach to information and cybersecurity connected to global best practice and national policy directions. It should invest in ensuring that there is an appropriate focus on information and cybersecurity in all projects, as well as in education and training, to increase the security awareness of infrastructure owners and operators.

A risk-based approach is consistent with recommendations of the Productivity Commission. Public confidence in the security of online systems is essential to realising the potential of the digital economy, but public cybersecurity investment will need to be proportionate and deliver a net benefit to the community.[117]

The NSW Government is increasing its cybersecurity capability with the appointment of a Government Chief Information Security Officer (GCISO) to work across agencies and consult with industry leaders and research groups to ensure an effective and collaborative approach to cybersecurity. The GCISO will need to consider a wide range of issues, including preparedness, prevention, detection, response and recovery, and coordinate an agreed position on these. The GCISO's scope of work will include managing relationships with the State-Owned Corporations that manage much of NSW's infrastructure and overseeing the development of information and cybersecurity management and governance arrangements for NSW's infrastructure networks.

117 Ibid, pp. 112-120

As investments are made in more connected and enabled infrastructure, the Government's capital decision-making process must start to incorporate information and cybersecurity at all stages. Such safeguards will ensure that appropriate public safety, data integrity and privacy standards are being maintained.

Recommendation 33

Infrastructure NSW recommends that the existing risk-based approach to information and cyber security and support is strengthened under the direction of the Government Chief Information Security Officer in 2018, with appropriate investment including whole-of-government governance and coordination.

Recommendation 34

Infrastructure NSW recommends that from 2018, cybersecurity risk assessments be included as part of the assurance process for all ICT and connected infrastructure investments, in accordance with the risk framework developed by the Department of Finance, Services and Innovation.

Recommendation 35

Infrastructure NSW recommends that a secure-by-design approach for new initiatives and development be adopted in accordance with standards set by the Government Chief Information Security Officer, including the IoT and connected infrastructure, and that this be included in the connected infrastructure policy framework by 2020.

7. Innovative service delivery models

STRATEGIC OBJECTIVE **Drive high quality consumer-centric services and promote innovative service delivery models in infrastructure sectors**

SNAPSHOT	
	• Technological innovation is changing how customers choose and use services, and driving a growing expectation by consumers that services will be simpler, convenient and personalised. Infrastructure and related services no longer need to be procured exclusively by the NSW Government; consumer demand is driving the creation of new markets led by the private sector and non-government organisations.
	• Some new business models, particularly those that use digital technology, may not fit neatly within existing regulatory regimes. It is crucial that the NSW Government provides regulatory settings that allow new business models to develop and proactively identify and support infrastructure and services where flexible, risk-based regulation can enable new markets and products to develop.
	• Increasing data availability can facilitate the development of new products and services, enhance consumer and business outcomes, and encourage greater efficiency and innovation in the economy. Additional reforms should be considered to maximise market access to government-owned data within appropriate privacy frameworks.
	• The NSW and Commonwealth governments have committed, through the *Intergovernmental Agreement on Competition and Productivity Enhancing Reforms*, to pursue greater efficiency and effectiveness in the infrastructure sector through renewed microeconomic reform. Infrastructure NSW supports these reform directions.
	• The *NSW and Contestability Policy and Practice Guide*, adopted in 2016, demands a more structured approach and rigorous analysis in the design and funding of service delivery, including contesting services where this will deliver better outcomes. While good progress has been made by some agencies in adopting commissioning and contestability as part of their service delivery planning, there are further opportunities to consider how services can be provided and who should provide them.
	• In the context of growing fiscal constraints, it is imperative that the NSW Government should continue to explore innovative service delivery models where these can deliver better value for money and improved service delivery.

RESPONSE	Summary of key recommendations
Expand the use of innovative service models	• NSW Government agencies (with NSW Treasury) should assess their ability to respond to the *Commissioning and Contestability Policy* and implement steps to separate purchaser and provider roles. • Continue to proactively identify and support infrastructure or related services where streamlined regulation can enable new markets and products to develop. • Apply the *Commissioning and Contestability Policy* to the development of long-term infrastructure strategies to enhance customer outcomes and enable closer collaboration, particularly in health, education, TAFE and justice.

7.1   Recent progress

In the *State Infrastructure Strategy 2012* and *State Infrastructure Strategy Update 2014*, Infrastructure NSW identified opportunities to leverage private sector expertise using the Public Private Partnerships (PPP) delivery model. PPPs include core service provisions and customer outcomes to drive the effective design of infrastructure, assets and services, with payment regimes tied to performance.

Major projects in NSW being delivered using variations of the PPP delivery model include the transformation of Darling Harbour, the Sydney Metro North West (SMNW) and Sydney Light Rail (SLR) projects, the Northern Beaches Hospital (NBH), the New Grafton Correctional Centre (NGCC) and the NorthConnex motorway.

More recently, the learnings from these service-enabling infrastructure projects have been used to develop innovative service delivery models, including:

- establishing a dedicated fund to invest in financial markets to generate capital for social housing and implementing a variety of models to deliver more social housing (such as the Social and Affordable Housing Fund)
- entering into an integrated services franchise to combine three modes of public transport (bus, ferry and light rail in Newcastle), with a private operator given incentives to improve customer satisfaction, increase patronage and improve services planning.

7.2   Challenges and opportunities

7.2.1   Consumer expectations and choice

As highlighted in Chapter 1, as incomes rise and people spend more on discretionary services, consumers' expectations of service levels and quality will grow. NSW's ageing population is likely to increase public expenditure as people access health and other services more frequently.

7.2.2   Consumer-centric services

Technological innovation is increasing consumer choice. People want simple, convenient and personalised services that are readily, and in some cases instantly, available. This market change is forcing service providers to shift away from traditional models, where consumers are told where, when and how to purchase services, to more tailored services that match consumers' expectations for service availability, quality and customer experience.[118] In other words, consumers now expect to be at the centre of the services they receive.

This trend is already affecting infrastructure-enabled services. Digital devices now allow transport consumers to choose and combine services such as bike-sharing, car-sharing, ride-sharing, taxis and mass transit services to meet their travel needs. In human services, patient access to health records, tele-health care and the rise of connected wearable technologies that transmit human activity and vital signs to

consumers and service providers will allow consumers to better manage their own health in their own time.

7.2.3   National commitment to competition policy

In the 1990s, national competition policy reforms in the infrastructure sectors (utilities, telecommunications and parts of the transport sector) resulted in strong productivity growth, which is estimated to have increased national Gross Domestic Product (GDP) by around 2.5 per cent.[119] These reforms included separating regulatory and commercial functions within public monopolies and introducing opportunities for contestable service provision.

NSW's annual productivity growth in the 2000s slowed, averaging only 1.1 per cent. Over the last five years, it has averaged 1.3 per cent.[120] NSW Treasury estimates that annual productivity growth of 1.5 per cent is required to sustain economic growth and living standards at current levels. Serious micro-economic reform and innovation are needed to achieve this, and the infrastructure sector can play a key role in this regard.

In 2016, the NSW and Commonwealth governments signed the *Intergovernmental Agreement on Competition and Productivity Enhancing Reforms* (the Competition and Productivity IGA) as part of a shared commitment to pursue greater efficiency and effectiveness in the infrastructure sector, and to renew broader microeconomic reform. Infrastructure NSW supports the implementation of key reform directions from the Competition and Productivity IGA, which include:

118 World Economic Forum 2017, p. 16

119 Productivity Commission 2005, p. XVII
120 NSW Treasury 2016, p. 36

- providing greater consumer choice and adopting commissioning and contestability to drive innovation and value for money in the delivery of human services (described in this chapter)
- accelerating heavy vehicle road pricing reform and investigating options for broader road user pricing reform, aided by new technologies (refer to Chapter 9.3.3)
- transferring responsibility for electricity and gas reliability standards to a national framework (refer to Chapter 10.3.1)
- improving governance, economic regulation and using competition consistent with the National Water Initiative
- improving procurement and tendering, focusing on outcomes rather than outputs to allow for innovation, and promote choice and diversity of providers (refer to Chapter 3.3.5 and this Chapter).[121]

7.3   Response

At the broadest level, the key roles of government in the provision of infrastructure and related services include:

- purchasing and/or providing infrastructure and related services – ensuring services are cost-effectively delivered to a high standard
- regulating services – protecting the public interest whilst ensuring regulation does not unnecessarily hinder innovation
- providing data – appropriately sharing information that enables service providers to better meet customer needs.

In each of these areas, there are opportunities for the NSW Government to explore innovative service delivery models.

## 7.3.1   Purchasing and providing infrastructure and related services

New infrastructure assets are almost always delivered by the private sector. Various well-established procurement models exist for government to purchase assets, ranging from traditional fixed-price design and construct arrangements and PPPs, through to more collaborative arrangements like early contractor involvement and alliancing. There is no single best procurement model: the choice of model should be based on each project's unique characteristics and a rigorous assessment of its risk profile – all with a view to achieving value for money.

Increasingly, customer-facing services that have traditionally been delivered by government, including those enabled by infrastructure, are being delivered by the private sector. But selection of the most appropriate model for service delivery is not always subject to the same level of analysis as it is for asset procurement. To this end, the NSW Government adopted a *Commissioning and Contestability Policy* and *Practice Guide* in 2016, which requires a more structured and thorough approach to the design and funding of service delivery.

Under a commissioning approach, governments define service outcomes by considering customer needs and then adopt delivery models (particularly open and contestable models) that make the best use of

available government resources. Contestability is the process of evaluating and benchmarking services against credible alternatives.

Figure 17 – Customer outcomes driving service delivery
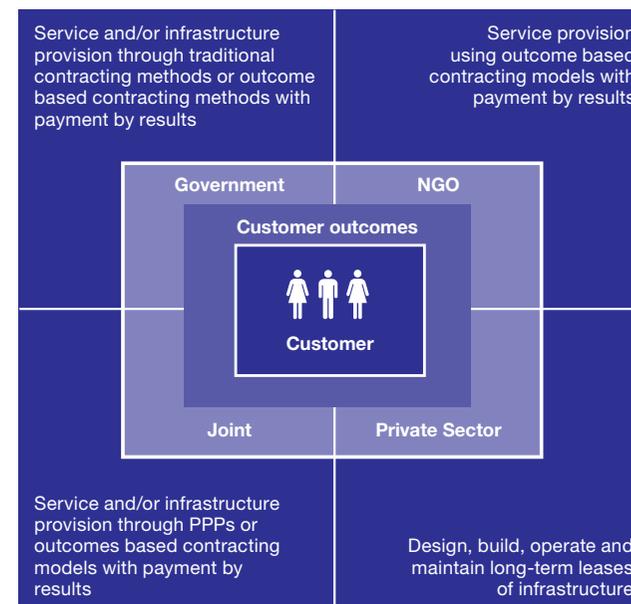
Source: Infrastructure NSW 2017

Substantial progress has been made in adopting contestability in agencies such as Transport for NSW, the Ministry of Health, the Department of Justice and the Department of Family and Community Services. These agencies are now routinely considering commissioning and contestability opportunities as part of their service delivery planning. However, broader and ongoing application of the policy and guidelines across the NSW Government is warranted.

Implementation of the *Commissioning and Contestability Policy and Practice Guide* is the first step towards a fundamental change in the way government thinks about public services. Embedding commissioning and contestability within NSW Government infrastructure and service planning will require the NSW Government to clarify the highest level outcomes it is aiming to achieve. This discipline will require the Government to be more disciplined and transparent in specifying the services it buys on behalf of the community. Some of the outcomes, particularly those relating to social issues (such as reducing prisoner recidivism in the justice sector or social housing) may require coordination of various 'wrap-around' services delivered by multiple government agencies, non-government organisations and/or private providers.

7.3.2 Regulating services

Some new business models, particularly those that use digital technology, may not fit neatly within existing regulatory regimes. It is therefore important for governments to provide regulatory settings that allow new business models to develop. The Productivity Commission has argued that, rather than extending existing regulations, governments should

use technology-led disruption as an opportunity to reassess risk and adjust regulation.[122] This reflects the approach taken by the NSW Government to address new business models in relation to ride-sharing.

Ride-sharing regulation

When UberX entered the NSW market, Roads and Maritime Services initially enforced existing taxi and hire car legislation. However, this legislation was focused on drivers and operators and did not directly regulate companies that provide booking services. To determine the best regulatory approach to this new ride-sharing business model, the NSW Government commissioned an independent review of point-to-point transport services regulation.

Following the review, the NSW Government pursued key reforms through the Point to Point Transport (Taxis and Hire Vehicles) Act 2016 including:

- the removal of restrictive requirements for booked services, such as license requirements and restrictions on vehicle types

- introducing an outcomes-focused regulatory regime, which included a general duty safety framework

- removing the regulation of service quality, with businesses being responsible for customer service and other quality issues.

Source: Transport for NSW

In 2016, in response to an Audit Office of NSW performance audit of red tape reduction initiatives in NSW,[123] the NSW Government commissioned an independent review of the NSW regulatory policy framework (the Independent Review) to develop recommendations for enhancing the policies, institutions and tools that underpin regulatory quality in NSW.[124]

The Independent Review report, which was finalised in 2017, found that the emergence of new business models was at risk of being stifled by existing regulation and explored the use of regulatory trials and 'sandboxes' to support adaptive responses co-designed by government and stakeholders. Sandboxes are targeted regulatory exemptions granted for a limited period to reduce uncertainty and help firms to manage regulatory risks during the testing stage of their products. Such arrangements have been used in the financial technology (FinTech) industry with success.[125]

The report recommended that regulatory frameworks should be customer centric and outcomes focused, supported by a regulatory culture that is open to alternative approaches to achieve desired outcomes.[126] Infrastructure NSW supports the Independent Review's recommendations in this regard.[127]

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122 Productivity Commission 2016, p. 98

123 Audit Office of NSW 2016
124 Regulatory Policy Framework Review Panel 2017
125 Ibid, p. 99
126 Ibid, p. 7
127 Ibid, p. 34

Regulatory sandboxes

The Department of Finance, Services and Innovation launched the NSW Regulatory Sandboxes pilot program as a key initiative of the NSW Innovation Strategy, released on 30 November 2016. The program is designed to create opportunities for business to test new products and services that are currently not accommodated under NSW regulatory frameworks. This is intended to enable innovative products and services that deliver clear benefits for the people of NSW to reach market faster. The pilot program is currently in progress.

7.3.3   Providing data

Data-sharing can facilitate the development of new products and services, enhance consumer and business outcomes, and encourage greater efficiency and innovation in the economy. According to the World Economic Forum, the rate at which data is being produced is increasing dramatically, with 90 per cent of the data in the world today created just in the past two years. But most of this data lies dormant, with only 0.5 per cent of it having been analysed.[128]

Data provided by and collected from consumers can be used to develop new and improved products and services, and generates significant opportunities for innovative and competitive responses. Government-generated data is at least as valuable as data generated by the free market.

Transport for NSW Open Data Hub

Launched in 2016, the Open Data Hub and Developer portal is where Transport for NSW provides open transport data (such as static timetable information, as well as live and real-time information) to give the private sector the capacity to create innovative solutions for customers. There are currently over 5,000 registered users and over 1,500 applications have been created from the data that has been made available.

Through releasing data and collaborating with developers directly through innovation challenges, Transport for NSW can encourage the creation of customer-focused products such as real-time customer apps and the digital learner driver log book.

Source: Transport for NSW, https://opendata.transport.nsw.gov.au/

NSW has strong legislative and policy settings for open data. The *Data Sharing (Government Sector) Act 2015* and *Government Information (Public Access) Act 2009 (NSW)* place the onus on government agencies to make a wide range of data and other information available for use by other agencies, businesses and the community.

While NSW Government agencies are releasing data year-on-year, the Independent Review reported that more data could be shared to achieve better policy or regulatory outcomes. Infrastructure NSW considers that additional policy and procedural reforms should be considered to maximise appropriate data-sharing to enable innovation and strategic service delivery.

Recommendations relating to the provision of NSW Government infrastructure-related data are outlined in Chapter 6.

7.3.4   Expanding innovative service delivery models

The private sector already provides a wide range of infrastructure-related services. National competition reforms over the last two decades have led to the privatisation of telecommunications, ports, airports and most energy services, with consumers paying for services based on regulated prices and service standards.

The private sector also delivers:

- human services – across Australia, most primary healthcare is delivered by private providers: 40 per cent of patients are admitted to not-for-profit or private hospitals for secondary health care; 30 per cent of students attend a non-government school; and 20 per cent of prisoners are held in privately operated correctional facilities[129]
- transport services –18 per cent of total Opal trips were made on privately operated services[130]
- water services – for Sydney Water's operations, 100 per cent of mechanical and electrical maintenance is undertaken by private providers.[131]

There is scope for the NSW Government to trial or introduce further competitively driven innovative service delivery models. Some of these opportunities are set out below.

129 Sturgess, G L 2015a
130 Transport for NSW 2017
131 Sturgess, G L 2015b, p. 4

128 World Economic Forum 2016

Transport

The transport sector has established new models for service delivery through the franchising of Sydney Ferries, some metropolitan bus contracts and, more recently, the integration of bus, ferry and light rail services in Newcastle.

Over the next five years, there are opportunities to:

- re-tender the Sydney Ferries Network franchise when it expires
- investigate tendering the bus regions operated by the State Transit Authority following an assessment of the outcomes achieved from the Region 6 tender process
- assess other opportunities for private sector involvement as infrastructure and service investments are completed.

Future Transport 2056 outlines a move to a 'Mobility as a Service' model (MaaS), where customers access combined public and private transport services through a digital platform such as a mobile app. This would enable travel planning and payments to be part of a single service.

Sydney Ferries Network franchise

Sydney Ferries Network (SFN) is a franchise model of transport operated by a PPP venture between Transdev and Broadspectrum under the title 'Harbour City Ferries' (HCF).[132] Transdev has acquired 100 per cent of Harbour City Ferries from 8 December 2016. Prior to this, SFN was operated by Sydney Ferry Corporation (SFC). SFC's contract was terminated after a 2007 inquiry found its operation to be ineffective.[133]

In July 2012, the NSW Government awarded HCF a seven-year franchise arrangement contract for responsibility of the operation, care and maintenance of all ferry vessels and facilities. Transport for NSW retains fare revenue and control over fare structure, routes and timetables, and ownership of original Sydney Ferry vessels and shipyard maintenance facilities, which are leased to HCF to maintain and operate.[134]

In 2016, a NSW Audit Office found that franchising was justified, with HCF being generally effective in providing ferry services against the ferry system contract KPI targets and comparable to those achieved by its predecessor, SFC, over the 27 months prior to its contract being terminated.[135] The franchise had a total saving of around $100 million, approximately 12 per cent per annum below that of HCF's predecessor[136] and risk had been effectively transferred from public to private sector, absorbing any additional costs above the agreed contract price.[137]

Integrated service delivery – Newcastle Integrated Services

Newcastle Integrated Services is an Australian-first integrated model of transport with a single operator running multiple modes – bus, ferry and light rail – to meet the needs of end-users.

The new model delivers improvements to all modes, including increased operating hours and higher frequency ferry and light rail services. Early in 2018, Keolis Downer will introduce a revised bus network that aims to optimise services, reduce journey times and offer an on-demand service. A new 'night owl' bus service will support the weekend night-time economy. This model facilitates integrated and seamless travel between different modes of transport.

132 Audit Office of NSW 2016, p. 1
133 Ibid, p. 2
134 Ibid, p. 2
135 Ibid, p. 8
136 Ibid.
137 Ibid, p. 11

Health

Several not-for-profit and private health providers deliver primary and secondary health care services across NSW. The Ministry for Health has progressively introduced innovative service delivery models, including the procurement and delivery of the Northern Beaches Hospital. This hospital will open in 2018; its performance should be assessed over time as a model that could be applied more widely across the health sector.

Education

Service delivery models that could be adopted to deliver education outcomes include:

- packaging the delivery of multiple new and upgraded schools
- combining new school builds with maintenance and refurbishment
- providing modular, portable classrooms through sale and lease back arrangements
- providing air conditioning to schools where the private sector invests in the necessary assets and the Department pays a service fee.

Justice

Correctional centres in Parklea and Junee are currently operated by the private sector. In June 2017, a PPP contract was awarded to the private sector to design, deliver, operate, maintain and finance a new 1,700 bed facility in Grafton. Operational payments for the NGCC are linked to agreed outcomes relating to rehabilitation and reintegration, safety and security, decency and respect, professionalism and accountability and health. Corrective Services NSW also recently benchmarked and then market tested the operation of the John

Morony Correctional Centre (near South Windsor), applying the same outcomes.

Building on this work, there is an opportunity to rollout more contemporary, outcomes-focused approaches to prison operations, including through private sector operations, where these would achieve better value for money. A review of courts and tribunals services is under way, which may lead to opportunities to contest some court services.

Family and Community Services

Social and affordable rental housing is an important part of the State's infrastructure, providing disadvantaged people and those on low incomes with a secure foundation from which they can access other services and opportunities to improve their circumstances. The Land and Housing Corporation owns nearly $50 billion of assets, second in value to that of the transport portfolio.

Demand for social housing in NSW is growing. As at June 2016, about 59,907 households were on the social housing waitlist – an increase of almost 15,000 since June 2007.[138]

Current social and affordable housing infrastructure is unable to meet existing or future demand,[139] with an estimated 31,000 to 51,000 additional affordable rental homes needed in Sydney by 2026.

The social housing sector faces challenges in meeting the needs of its tenants. These include an insufficient number of dwellings, ageing and deteriorating assets,

a two-tiered scheme of financial assistance for renting social housing or in the private market, poorly located housing stock and underutilisation of assets (for example, some tenants are in properties that have more bedrooms than they require).[140]

Social housing stock has not kept pace with demographic changes and the needs of tenants. In 2015, three bedroom detached homes made up more than one third of total asset stock. While one bedroom apartments are the housing type most in demand, these comprise only 25 per cent of public housing dwellings.[141]

The National Disability Insurance Scheme (NDIS) has led to changes in Family and Community Services' (FACS) operating model. Several commissioning and contestability opportunities have been pursued in recent years, including:

- in 2017, through the Social and Affordable Housing Fund (SAHF), FACS entered into several contracts with not-for-profit organisations and community housing providers to provide 2,200 new dwellings through a tenancy arrangement and support services, with flexibility to convert to outcomes-based programs. A further phase of this program is currently underway
- the Communities Plus program – a new model for delivering a $22 billion, social, affordable and private housing building program aimed at increasing housing supply by 63,500 homes as part of integrated developments across NSW. For example, the Ivanhoe Estate will deliver at least 950 new social houses in an integrated community of approximately 3,000 homes.

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138 Family and Community Services (FACS) 2017
139 Ibid.

140 Productivity Commission 2017, p. 146
141 Infrastructure Partnerships Australia 2015, p. 30

Social and Affordable Housing Fund

The Social and Affordable Housing Fund (SAHF) is an innovative approach to delivering social and affordable housing in NSW. SAHF Phase 1 will deliver up to 2,200 additional social and affordable homes in metro and regional NSW, together with access to integrated support services through Tenant Support Coordination. The SAHF was established under legislation for the purposes of investing in the financial markets to generate funding for social housing. The investment proceeds are used to pay providers under the SAHF contract. The contract leverages existing PPP principles, recognising that the State does not own the asset – different to most situations where the State retains ownership of the asset throughout the contract term.

Source: NSW Treasury

The NSW Government is also currently undertaking a Social Housing Management Transfers program across selected areas of NSW. Under this program, tenancy management and wrap-around services will be delivered by community housing providers.

Noting the range of delivery models being used to deliver social and affordable housing, and the results of the Independent Pricing and Regulatory Tribunal (IPART) review and the recent Productivity Commission report, Infrastructure NSW's considers that the NSW Government should continue to review the best ways to improve the sustainability of the social housing system to arrest the ongoing inequity gap. This should include leveraging state infrastructure to facilitate the delivery of more affordable and social housing into new communities close to transport, education, community facilities, shopping and other services.

Infrastructure NSW considers that a review could be undertaken to identify lessons learned, optimise existing models and inform an options paper to identify new or improved delivery models for the provision of family and community services. The review should involve developers, financiers, investors and the not-for-profit sectors.

Recommendation 36

Infrastructure NSW recommends that NSW Government agencies (with NSW Treasury) assess their ability and capability to respond to the *Commissioning and Contestability Policy* and implement steps to separate purchaser and provider roles.

Recommendation 37

Infrastructure NSW recommends that the NSW Government continue to proactively identify and support infrastructure or related services where regulation can enable new markets and products to develop.

Recommendation 38

Infrastructure NSW recommends that NSW Government agencies apply the *Commissioning and Contestability Policy* to the development of long-term infrastructure strategies to enhance customer outcomes and enable closer collaboration, particularly in health, education, TAFE and justice.

Recommendation 39

Infrastructure NSW recommends that the Department of Family and Community Services continue to work with NSW Government agencies to explore opportunities to embed social and affordable housing into future infrastructure projects, noting the benefits delivered by increasing the supply of social and affordable housing close to services, transport and community facilities. A 'lessons learned' review of existing models should be undertaken in the first quarter of 2018 and an options paper prepared for government by the end of 2018.

8. Geographic infrastructure directions

STRATEGIC OBJECTIVE   Adopt an area-based approach to infrastructure planning and investment decisions

SNAPSHOT
- The 2018 SIS adopts a geographic (or spatial) planning approach to guide infrastructure investment towards meeting the needs and supporting the potential of individual cities, towns, precincts and other locations.
- This approach recognises that infrastructure networks (such as transport, energy and water) are the foundation of a successful economy, that investment in the right infrastructure in the right places drives industry competitiveness and business and jobs growth, and that a diverse range of urban infrastructure (from schools and health services to open spaces and recreational facilities) is essential for creating productive, liveable and sustainable places.
- To prepare the 2018 SIS, Infrastructure NSW has undertaken a location-based assessment of industry strengths, labour patterns, socio-demographic trends, current infrastructure challenges and future visions for jobs and growth. This assessment draws on land use plans and economic development strategies developed by other NSW Government agencies. Infrastructure recommendations in the SIS are aligned with these spatial directions.
- In regional NSW, the focus is on infrastructure investment that enables access to markets for regional industries, along with more equitable access to key services, especially in the context of an ageing population and growing regional centres.
- Economic activity is growing in and around Newcastle and Wollongong. Infrastructure priorities in Newcastle focus on supporting the city's competitive strengths, including improved transport and digital connectivity, and maintaining access to the Hunter region and global gateways. In Wollongong, the focus is on providing jobs and housing, growing the capacity of Port Kembla and driving greater economic diversity in priority sectors.
- Infrastructure investment across Greater Sydney will support the three cities vision, protecting the strengths and attributes of the Eastern Harbour City, but shifting medium- and long-term investment priorities decisively towards the Central River City and Western Parkland City where significant population and employment growth are forecast over the next 40 years.

8.1 Defining geographic infrastructure planning

Previous State Infrastructure Strategies have focused on policy and investment priorities for infrastructure to meet demand within discrete sectors. The 2018 SIS adopts a new geographic (or spatial) planning approach to help ensure that the recommendations in the SIS reflect strategic regional and metropolitan planning priorities, support enduring economic growth across NSW and secure the State's global competitiveness.

The OECD argues that the key task in any infrastructure strategy is to identify the factors that will shape the economic, social, political and environmental quality of an area.[142] To achieve this, geographic infrastructure planning seeks to identify critical relationships between overarching government plans, the current and future economy of an area, the environment and the community.

8.1.1 Geographic infrastructure directions for NSW

This chapter outlines geographic infrastructure planning directions, first for the whole state, then for regional NSW and Greater Sydney. Newcastle and Wollongong are recognised as major cities, key international gateways and significant economic activity centres.

For each location, Infrastructure NSW has completed an assessment of its competitive industry strengths, labour patterns, socio-demographics, current infrastructure challenges and future visions for jobs and growth – as set out in statewide land use plans and economic development strategies. Recommended infrastructure responses have been formed based on these spatial considerations.

While they are not discussed in this chapter, Canberra and the Gold Coast area are recognised as major centres of economic activity with important links to NSW, given their size and proximity. The NSW

Government has agreements in place with the Queensland and ACT Governments, which include actions to support future cross-border developments and key services across State and Territory boundaries.

Infrastructure NSW recognises that infrastructure is an enabler of economic growth and social wellbeing, but that investment in infrastructure must be supported by various non-infrastructure levers to achieve enduring economic growth. These include:

- removing barriers to the growth of competitive industries
- ensuring people and businesses have access to skills development to enable jobs growth
- unlocking residential land for the supply of a diverse range of housing in liveable communities
- protecting and enhancing the natural environment
- supporting a culturally and educationally rich environment that will attract people and businesses.

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142   OECD 2006, p. 135

8.1.2 Infrastructure networks are the foundation of the economy

Economic infrastructure, including energy, water, telecommunications and transport networks, is the foundation of the economy and one of the keys to the State's global competitiveness.

Effective transport networks facilitate production, link businesses to their customers and support employment opportunities. If transport networks operate efficiently, they can lower input costs, deepen markets and facilitate competition. Efficient electricity, gas and water networks facilitate the reliable and economical supply of key services to businesses and households. Digital infrastructure plays a vital role in connecting citizens and business to local and global opportunities, while improving public services.

Maintaining, optimising and ensuring access to efficient major economic infrastructure networks (outlined in Figure 18) are prerequisites for economic growth.

Figure 18 – NSW major economic infrastructure networks
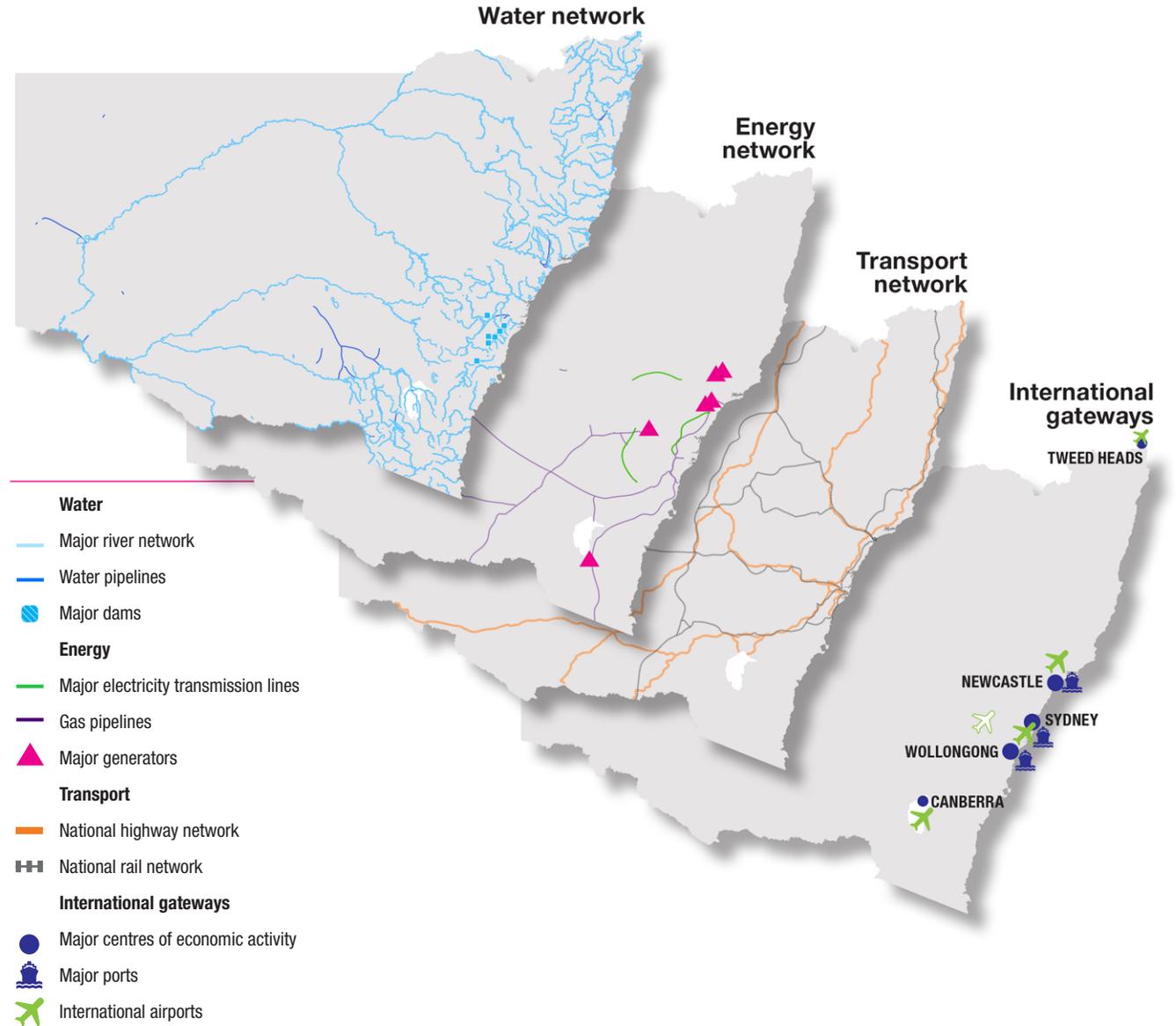
Source: Road, Rail, Rivers, Pipeline Network, Bioregional Assessment Programme licensed under CC BY 3.0; Transmission Lines, Power Stations, Dams Publisher Geoscience Australia licensed under CC BY 4.0

8.1.3   Infrastructure drives competitiveness and growth

Infrastructure is a direct input to the production processes of the economy – the quality, cost and reliability of infrastructure can impact the viability of production, the costs to consumers and the competitiveness of goods and services at a local and national level.

Investment in the right infrastructure can enhance industry competitiveness, efficiency, productivity and access to labour markets. Combined with non-infrastructure interventions, it can also change the way industries operate and interface with each other. In some cases, it can create new industries.[143]

Investment should therefore be targeted at infrastructure that aligns with existing industries and enables new or emerging business sectors to grow. The relative strengths of traded industry sectors across NSW regions are outlined in Figure 19.

Driving growth in competitive industries will also require non-infrastructure interventions, including:

- industry policy that appropriately encourages innovation, commercialisation and internationalisation
- regulatory settings that do not unnecessarily hinder competition
- land use plans that enable industry and economic development strategies and priorities
- collaboration between industry and educational institutions to provide relevant and accessible education and training – such as on-site-learning.

Figure 19 – Percentage of traded industry Gross Value Add (GVA) by Region

Total GVA Traded Industries ($, billion)

Region	Total GVA Traded Industries ($, billion)
Greater Sydney	146
Hunter	21
Central West & Orana	10
North Coast	8
Riverina–Murray	7
Illawarra–Shoalhaven	7
New England North West	5
South East and Tablelands	5
Central Coast	4
Far West	1

Legend:
- Finance and professional services
- Other traded services
- Transport and communications
- Other manufacturing
- Primary
- Agriculture
- Advanced manufacturing
- Traded health and education

Source: Adapted by Infrastructure NSW, DPE and DPC based on NSW Industry Development and Growth, KPMG 2017, analysis of NSW Regional Plans.
Note: Analysis is based on 2011 ABS data. Traded Industries are those that are concentrated in specific subsets of geographic areas and that sell their products or services nationally and internationally.

8.2 New South Wales

Figure 20 – New South Wales overview
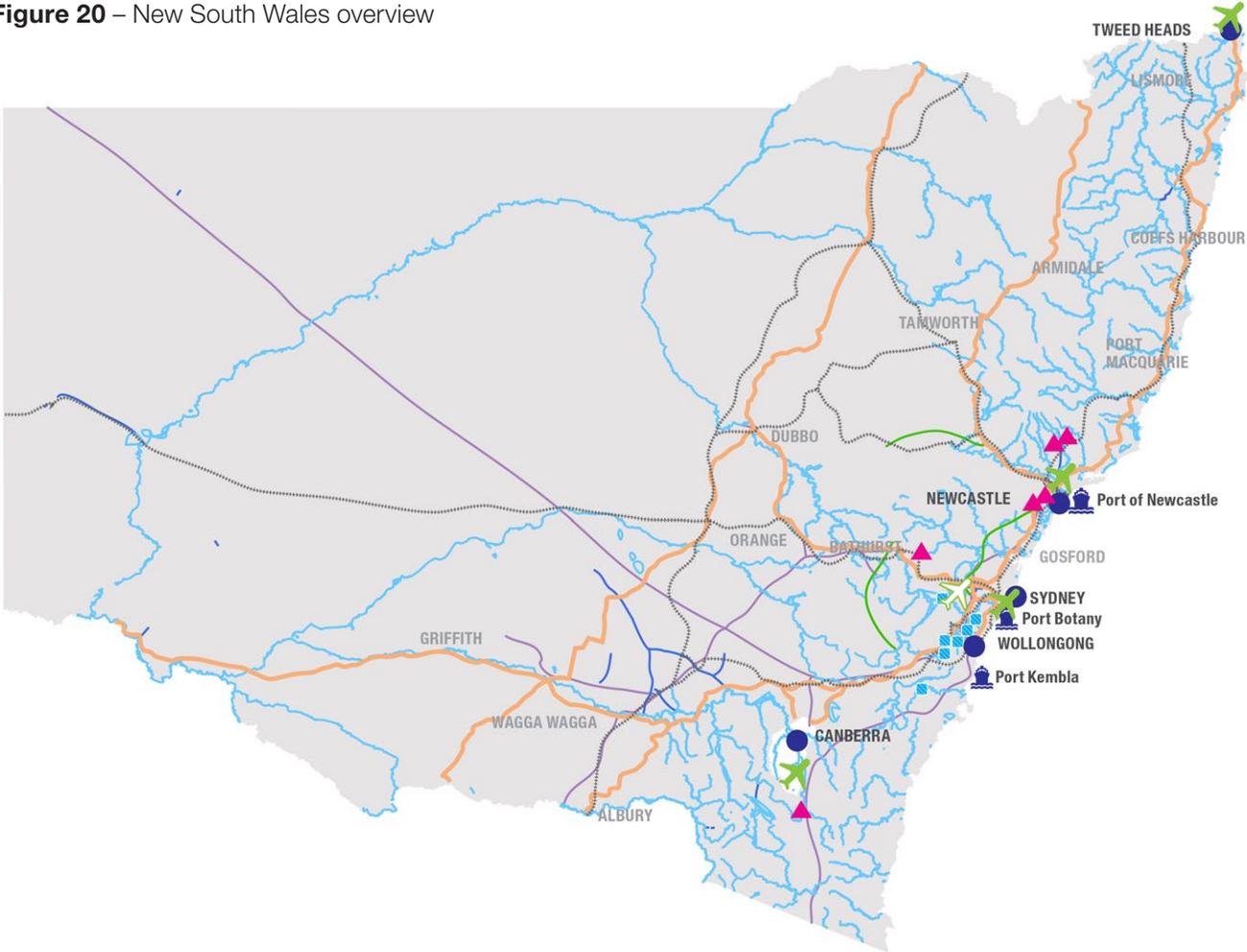
Now (2016)		Future (2036)
$539 billion	**Economy**	$ 907 billion
7.7 million	**Population**	9.9 million
3.3 million	**Dwellings**	4.3 million
3.8 million	**Employment**	4.8 million

Source: NSW Common Planning Assumptions 2017

International gateways

- ● Major centres of economic activity
- ⚓ Major ports
- ✈ International airports

Transport

- ▬ National highway network
- ⊢⊢ National rail network

Water

- ▬ Major river network
- ▬ Water pipelines
- ▨ Major dams

Energy

- ▬ Major electricity transmission lines
- ▬ Gas pipelines
- ▲ Major generators

Source: Road, Rail, Rivers, Pipeline Network, Bioregional Assessment Programme licensed under CC BY 3.0; Transmission Lines, Sub Stations, Power Stations, Publisher Geoscience Australia licensed under CC BY 4.0

8.2.1   New South Wales geographic directions

NSW offers an internationally competitive and compelling location to live and do business. The State enjoys the benefits of abundant natural resources and attractions, well-established economic corridors connecting businesses to national and international markets – particularly Asia, a young, highly-skilled and multicultural workforce, and a strong pipeline of government investment.

These endowments support a strong and growing economy and globally competitive industries, including:

- finance and professional services, which has moved its international ranking from 16 in 2011 to 11 today[144]
- mineral resources (coal), with around 163 million tonnes (Mt) exported to international markets in 2015-16[145]
- international education, which is the State's second largest export, behind coal, contributing over $6.7 billion in exports in 2014-15[146]
- agriculture, with the value of NSW agribusiness exports estimated at $5.7 billion in 2015–16[147]
- other traded services like construction, tourism and the performing arts.

There is potential for growth in health and advanced manufacturing, with the latter driven by technology and increasing labour costs in other countries.[148]

The State is highly urbanised, with 90 per cent of people living in cities concentrated along the coast. Over the next 20 to 40 years, continued growth in knowledge-intensive industries, and the benefits of agglomeration generally, will drive even greater concentration of economic activity around major economic centres across the State.[149] Jobs for NSW has set a goal of having over 2.8 million knowledge-intensive jobs by 2036 making up 60 per cent of total jobs. This compares to 48 per cent, or 1.8 million knowledge-intensive jobs, in 2016.[150]

Historically, major infrastructure investment has been Sydney-centric, but increased regional infrastructure investment in recent times has delivered strong economic returns, including through significant investment made in north to south connections in regional NSW, such as the Hume, Pacific, Great Western and Princes Highways.

Providing equitable access to services is more challenging west of the Great Dividing Range – driven by topography and population – and in parts of Greater Sydney where growth has outpaced infrastructure investment. In turn, this has led to higher relative levels of socio-economic disadvantage in these areas.

To drive ongoing productivity and improved access to services, future investment will need to be distributed across major economic and strategic centres throughout the State to support economic growth and social inclusion.

Maintaining connectivity to and from international gateways, enhancing digital connectivity and securing access to economic infrastructure networks including energy and water, will be critical to enhancing global competitiveness. Social infrastructure, including increased social housing supply, will also require government investment.

### Infrastructure response — New South Wales

- Improve access to and prepare international gateways for growth.
- Facilitate investment in education infrastructure that supports skills development and industry growth.
- Facilitate investment in accessible high quality digital infrastructure.
- Facilitate private sector investment in secure, reliable, affordable, low-emission, energy infrastructure.
- Ensure water supply and wastewater treatment to enable growth.
- Provide necessary social infrastructure to support the population.
- Optimise existing infrastructure networks to provide greater capacity for better services.
- Provide internationally competitive cultural and sporting infrastructure to meet contemporary expectations.
- Support the visitor economy, including overseas tourism.

144 Financial Centres Future Group 2016, p. 4
145 Transport for NSW 2017, pp. 21-22
146 Department of Premier and Cabinet 2016, p. 6
147 Department of Primary Industries 2016, p. 2
148 KPMG 2017, p. 32

149 Ibid. p. 31
150 Jobs for NSW 2016, p. 27

8.3   Regional New South Wales

Figure 21 – Regional New South Wales overview

Regional hub and spoke model

Major centres of economic activity
Regional city hub
City to city links
City to regional centre links
Great Dividing Range
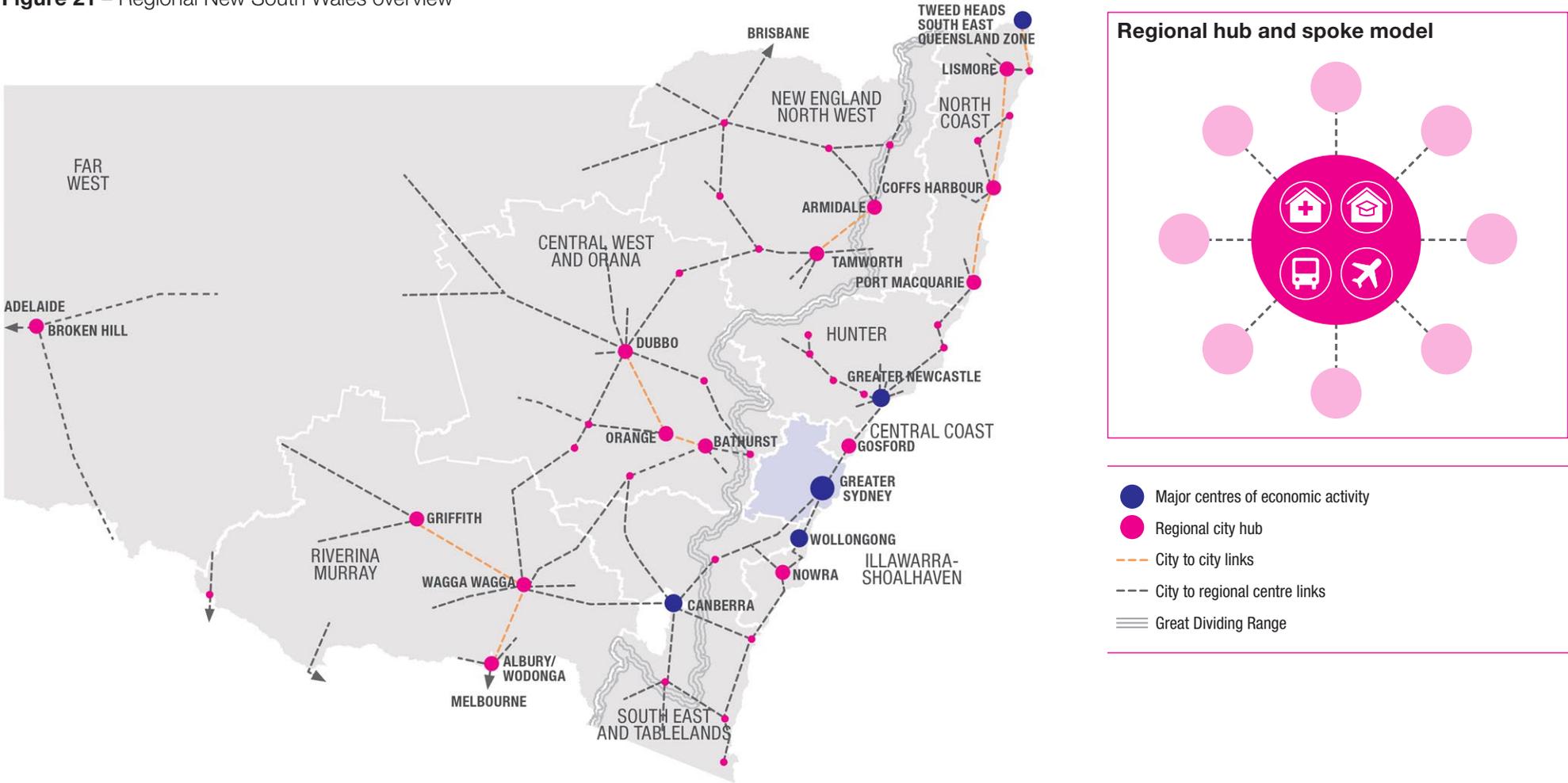
8.3.1 Regional New South Wales geographic directions

Regional NSW has a $157 billion economy, the second largest regional economy in Australia behind regional Queensland. It has grown strongly in the past five years, driven by primary commodity export growth and favourable seasonal conditions, as well as the investment of over $1.9 billion in infrastructure from the Restart NSW fund.

Development patterns across regional NSW have historically been influenced by the distribution of natural and locational endowments, such as agricultural land, mineral resources, high amenity landscapes and proximity to ports and trade routes. Infrastructure investment decisions – for instance, in relation to highway alignments and the establishment of universities or major health institutions – have also tended to focus growth in particular locations.

Functional Economic Regions

The economy of regional NSW is made up of several sub-economies that do not fit neatly into land use planning or local government boundaries. Each regional sub-economy is distinct and can claim its own natural or man-made endowments. Strategic investment can increase a region's endowments and/ or its ability to exploit them to drive economic growth.

In general, over time the State's regions can expect to host fewer, larger industries that are networked into global supply chains. Skills availability, infrastructure and digital connectivity will be vital to maximising regional productivity and competitiveness.

Over the next 20 years, the trend of internal migration to larger, growing centres will continue and is likely to accelerate.

To reflect the diversity of the State's regional economies, the NSW Government has identified 37 Functional Economic Regions (FERs). These economic regions, some of which extend beyond NSW's borders, typically have a large town at their centre (a 'hub') and several interconnected 'spokes' to smaller centres. Some FERs are residential satellites to large metropolitan cities, but all rely on their connections to markets and suppliers through key freight and service exchange routes. Most of these routes lead to Sydney and other port cities, with some leading to interstate capitals and regions like Canberra, Melbourne and Brisbane.

ABS data shows that 29 FERs (78 per cent) have grown in population over the last five years, with 10 experiencing growth in excess of one per cent per annum. Eight FERs (22 per cent) have experienced declining populations. While population increases generally indicate future economic growth, a stable or declining population is not always an indicator of future decline: some FERs will grow if appropriate investments and interventions are made to reinforce their strategic endowments.

To ensure that local communities and all levels of government have a detailed and consistent understanding of each regional economy, the NSW Department of Premier and Cabinet, in consultation with local councils, is developing Regional Economic Development Strategies (REDS) for each FER. Each strategy will identify the region's economic strengths and endowments, articulate an economic vision for the future based on its competitive advantages and outline the strategies and supporting infrastructure needed to achieve the vision.

Key competitive advantages across regional NSW include:

- agriculture, which is strong in most regions, supported by productive land and a suitable climate, contributed $10.6 billion (1.85 per cent) towards the NSW economy in 2016-17[151]

- mining, which is a key industry in several regions, including the Hunter region and around Broken Hill, Cobar, Orange and Parkes, contributed $16.8 billion (2.91 per cent) towards the NSW economy in 2016-17[152]

- manufacturing closely connected with primary resources and transport, for example, food product manufacturing in Griffith, Leeton and the Central Coast, and wood and paper product manufacturing around Albury, Bathurst, Tumut and the Clarence Valley

- recreational facilities and destinations that attract tourists; for example, at Bega, Coffs Harbour and the Snowy Mountains – regional tourism contributed $11.4 billion towards the NSW economy in 2015-16, representing around 38 per cent of the total tourism contribution for NSW[153]

- a combination of amenity and high level medical and associated institutions that attract retirees; for example, at Port Macquarie

151 Australian Bureau of Statistics 2017
152 Ibid.
153 Destination NSW 2016

- specialised freight transport in regions where major road and rail routes intersect; for example, at Dubbo and Moree
- elite training facilities for police and defence forces, such as those at Goulburn and Wagga Wagga
- education and research clusters; for example, at Armidale, Bathurst, Lismore and Wagga Wagga.

Port of Eden upgrade

At the junction of the Bega and Brogo rivers, Bega is the rural centre of the Sapphire Coast and part of the South East and Tablelands Region.

Tourism is one of the region's largest direct and indirect economic contributors, with over 400,000 people visiting the Bega Valley each year to take advantage of its proximity to surrounding natural endowments like beaches and national parks, and local amenities.[154]

In 2017, the NSW Government confirmed its approval of a $44 million upgrade to the Port of Eden, with funding contributions from all three levels of government.

Once complete, the new wharf will be a major tourist attraction for the area that can accommodate larger cruise ships, and is expected to attract significantly more visitors to the area, as well as providing local jobs during and after its construction.

Wagga Wagga elite defence training facilities

With a presence of the army, air force and navy, Wagga Wagga in the Riverina Murray Region is one of Australia's major Defence Force locations, and the heart of military training in NSW. Facilities include:

- the Army Recruit Training Centre Kapooka, which provides training for around 3,500 recruits and 1,750 army reservists each year
- the Royal Australian Air Force (RAAF) Base Wagga, which provides aviation training to all three military services and with around 4,500 trainees graduating each year
- the Royal Australian Navy training facilities.

Servicemen and women are all based in the city.

The presence of these facilities makes defence a core industry and economic driver for Wagga Wagga and the Murrumbidgee region, contributing around $350 million annually in economic output.[155]

Armidale education and research city

Armidale, located in the New England North West region, is recognised as one of regional NSW's premier education cities, providing excellence in education from kindergarten to post-graduate level.

The University of New England, located on the outskirts of the city of Armidale, was the first university established in regional NSW. It is home to six national Cooperative Research Centres (CRCs) for industry-focused research in the cotton, poultry and sheep industries, and beef genetic technologies.

The University also conducts joint research ventures with industry partners in the fields of primary industry and animal genetics, and has a range of research centres in areas as diverse as social science, management and policy, language and cognition, and agricultural law.

With more than 80,000 people holding qualifications from the university, it contributes to regional, state, national and international development through its provision of higher education opportunities, support and leadership in various intellectual and cultural issues, and access to research.[156]

154 Bega Valley Shire Council 2015, p. 21

155 Regional Australia Institute 2017
156 Armidale Dumaresq Council 2017

Regional Development Framework

The NSW Government's approach to regional investment is underpinned by its *Regional Development Framework*, released in 2016, which aims to:

- provide quality services and infrastructure in regional NSW – ensuring equitable service levels across the state
- align efforts to support growing regional centres, acknowledging the needs of areas with strong growth in population, jobs or both
- identify and activate economic potential by looking across regional NSW for opportunities to change the economic outlook and activate local economies.

The *Regional Development Framework* acknowledges that regional investment decisions need to be customised and that, particularly in small and/or remote localities, they may need to be based on factors other than cost-benefit analysis, including the achievement of minimum equity-based service standards.

Access to digital technology and networks is emerging as critical to business success as value chains fragment and competition becomes global in many regional industries. The benefits of improved digital connectivity for regional communities are illustrated in the following Walla Walla case study.

Walla Walla internet connectivity

In 2015, the Commonwealth and NSW governments supported investment into business-grade internet to unlock the potential of Walla Walla in southern NSW.

Kotzur Silos, a bulk handling and silo manufacturer operating in Walla Walla, is experiencing significant growth in its bulk handling projects. But this growth was being restricted by a slow and unreliable internet service that struggled to support basic online services.

Similarly, St Paul's College, a co-educational day and boarding secondary school specialising in equine and agricultural studies, was unable to deliver education using digital content, a service that is available to most other schools across NSW.

As well as supporting the continued growth of Kotzur Silos, including increased employment, the investment has improved the basic amenity of the town for students and residents by providing access to data and Voice Over Internet Protocol capabilities (such as Skype) at up to 200 megabytes per second.

Guyra tomatoes

Guyra and surrounding communities have benefited from one of the largest tomato greenhouse facilities in the Southern Hemisphere. Costa is a major Australian grower, packer and marketer of fresh produce and supplies to Australian supermarkets and wholesale markets, and exports to Asia, North America and Europe.

Costa recently expanded its existing 20-hectare facilities in Guyra, building two new five-hectare, hi-tech glasshouses, adjacent to the New England Highway north of Guyra. The State Government funded roadworks and the construction of a new entrance from the New England Highway to the new glasshouses, providing easier and safer access for employees.

The expansion created more than 170 new jobs, with Costa Group's operations at Guyra now employing over 500 people and producing around 14.5 million kilograms of tomatoes each year.

Restart NSW

Over the last six years, regional economic growth has been supported through significant infrastructure investment from the Restart NSW fund. Since the fund was established in 2011, around $9.1 billion has been committed or reserved for programs and projects in regional NSW.

Restart NSW funds have been allocated to specific projects such as upgrades to the Pacific and Princes Highways, Grafton Bridge and various freight pinch

points across regional NSW. Funds have also been channelled into submissions-based funding programs such as Resources for Regions and Fixing Country Roads. These programs involve local councils and other organisations submitting proposals for Restart funding of local projects, which are then evaluated on a transparent, competitive basis by Infrastructure NSW.

To date, over 400 individual projects have been funded from Restart NSW, many of which are supported by co-funding from local councils or the Commonwealth Government.

Infrastructure NSW requires that, to be eligible for Restart NSW funding, a project must demonstrate a benefit cost ratio of greater than 1.0.

Where submissions-based programs have been offered, they have been consistently oversubscribed, with successful projects demonstrating benefit cost ratios significantly in excess of 1.0. This suggests there is significant scope for further, economically beneficial investment in regional NSW, particularly if it is strategically guided by the REDS.

Infrastructure response – Regional New South Wales

- Improve transport connections to key markets, especially east-west.
- Improve access to international gateways and manage them for future growth.
- Provide connections to and from proposed Inland Rail.
- Facilitate private sector investment in secure, reliable, affordable energy.
- Improve access to digital connectivity.
- Ensure water supply and wastewater treatment to enable growth.
- Upgrade hospitals and other social infrastructure in regional hubs, including social housing.
- Provide additional and improved cultural infrastructure and attractions.
- Support regional hubs to act as effective centres serving their surrounding regional populations.

Greater Newcastle

Greater Newcastle is the major centre of the Hunter region. It is home to around 560,000 people but is expected to grow to around 700,000 over the next 20 years,[157] generating an additional 48,000 jobs.[158] Newcastle Port is a key international gateway, handling over $15 billion in (predominantly coal) trade annually.[159]

Newcastle's endowments include its port and airport, strong education, health and manufacturing sectors, strong connections to primary industry via the Hunter Valley Coal Chain and a vibrant waterfront and heritage. Drawing on these endowments, and the diverse competitive strengths and labour markets within the surrounding region, including the Central Coast, Newcastle is well positioned to grow as one of NSW's major cities.

Delivery of new infrastructure including light rail, road upgrades and an expanded port, as well as urban renewal along strategic corridors, will secure the competitiveness of Greater Newcastle and the Hunter region. Maintaining access to global gateways will be important as the city continues to grow. The Hunter Regional Plan has set a target of 95 per cent of residents living within 30 minutes of a strategic centre.[160] Better telecommunications infrastructure will be required to ensure that digital connectivity for residents and businesses supports continued growth.

The expanding University of Newcastle and the John Hunter Hospital will provide health and research facilities of an international standard. Targeted government investment to support these facilities will provide enhanced productivity benefits.


157 Department of Planning and Environment 2017, p. 9
158 Department of Planning and Environment 2016a, p. 14
159 Port of Newcastle 2014, p. 9

160 Department of Planning and Environment 2016a, p. 8

Figure 22 – Greater Newcastle and City overview
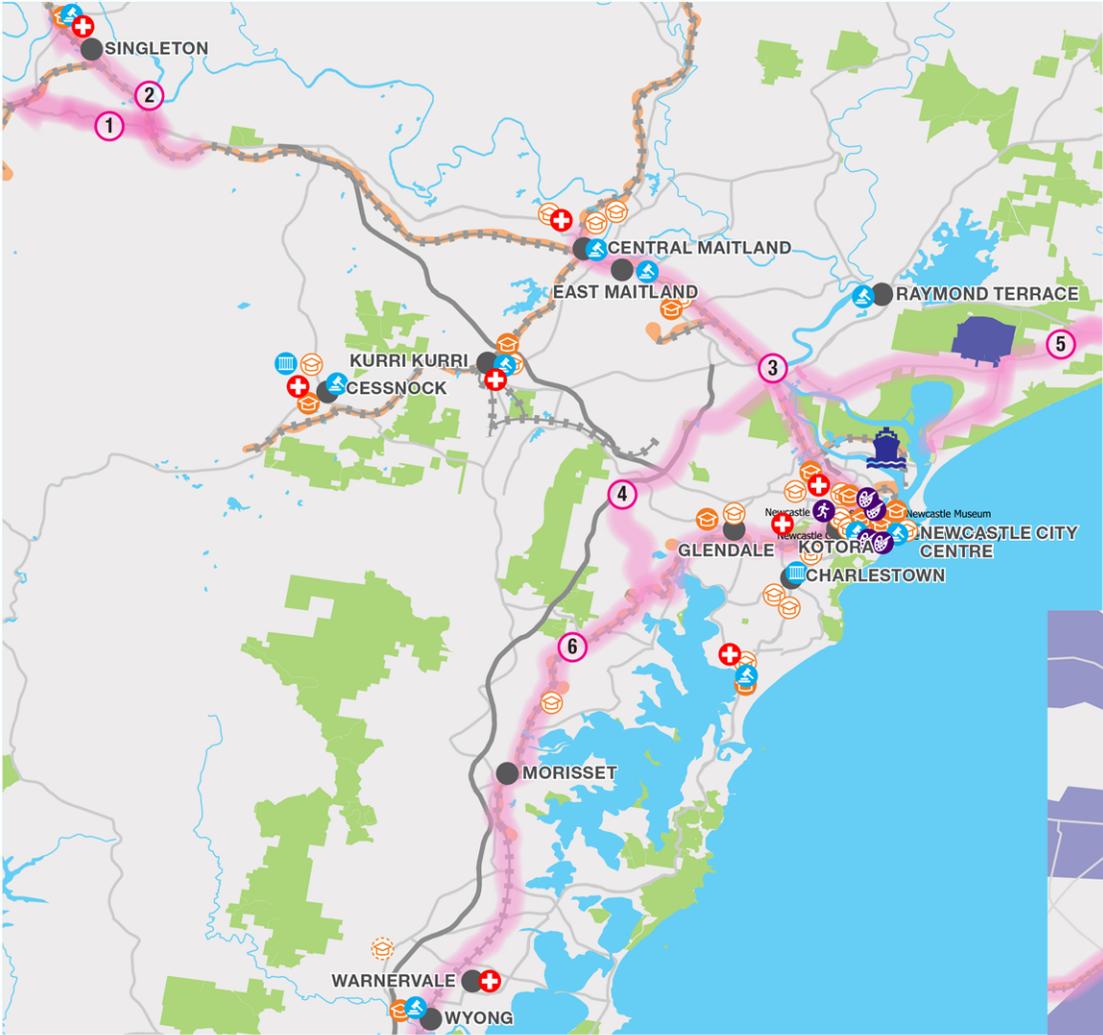
Legend:
- Newcastle City Centre
- Strategic centres
- Major parks and reserves
- Waterways
- Priority growth areas
- Urban renewal corridors
- Newcastle Airport
- Port of Newcastle
- Cruise ship terminal
- Newcastle Interchange
- Hunter Valley Coal Chain corridor
- Railway (existing)
- Motorways and freeways (existing)
- Arterial roads (existing)
- Selected major sports venues
- Selected major cultural venues
- New schools (proposed)
- Upgraded schools (proposed)
- Universities and TAFE NSW colleges
- Hospitals
- Correctional facilities
- Courts
- Transport projects proposed for the future (possible alignments)
  1. Golden Highway improvements
  2. Main Northern Line improvements
  3. Electrification of the Hunter Line to Telarah
  4. Lower Hunter Freight Corridor
  5. Nelson Bay road improvements
  6. Sydney-Central Coast-Newcastle rail improvements
- Transport projects in delivery
  7. Newcastle Light Rail

(See Chapter 9 for details on transport recommendations.)

NEWCASTLE CITY INSET
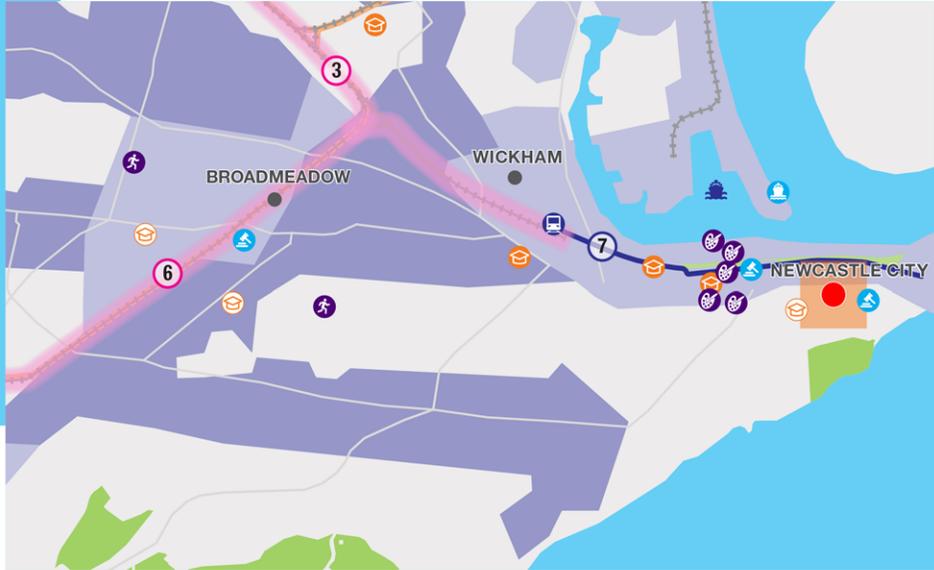
Source: Road, Rail, Reservoirs, Lakes, Rivers Publisher Bioregional Assessment Programme licensed under CC BY 3.0; Openstreetmap, Publisher Open Street Map licensed under CC BY 2.0; School Infrastructure, NSW Department of Education 2018; Hospitals, NSW Health 2017; Transport projects, Transport for NSW 2017; adapted by Infrastructure NSW 2018

8.4 Greater Sydney and the outer metropolitan area

Figure 23 – Greater Sydney

8.4.1 Greater Sydney geographic directions

Greater Sydney is Australia's global economic gateway and financial capital. It is a regional hub for global financial markets and hosts a majority of Australia's top 50 ASX-listed companies. It is home to 4.7 million people and has the highest concentration of managers and professionals of any capital city in Australia.[161] The region is set to grow to 8.3 million people, with a trillion-dollar economy by 2056, up from $382 billion in 2016.[162]

Sydney's globally competitive strengths lie in financial and professional services, higher education, health, manufacturing and international tourism. Advanced electronic and medical devices, and advanced manufacturing sectors, are growing strongly.[163]

Greater Sydney's main economic attractors, high-end jobs and recent infrastructure investments are skewed to the established Eastern Harbour City. To strengthen the region's competitive sectors and manage the pressures of population growth, the Greater Sydney Commission has set out a vision to reshape and rebalance the city's structure, creating a metropolis of three cities.

To achieve this vision for growth and a new economic geography for Sydney, the balance of infrastructure investment will need to shift over time. More new infrastructure will be required in the outer western, north-western and south-western areas to support

Source: Transport for NSW 2017 and Greater Sydney Commission; Australian Bureau of Statistics 2011, *Index of Relative Socioeconomic Advantage and Disadvantage,* adapted by Infrastructure NSW

161 Department of Industry 2013
162 The Centre for International Economics 2017, p. 6
163 Greater Sydney Commission 2017, p. 67

connectivity, services and amenity for the expanding Central River City and Western Parkland City.

Efficient trade gateways and freight and logistics networks within Greater Sydney will continue to be critical to NSW's global competitiveness. New gateways like the Western Sydney Airport and intermodal terminals will help to support the growing freight task across Greater Sydney.

Early identification and protection of future infrastructure corridors and space for vital social infrastructure, including public and green spaces, will be critical, particularly to ensure the success of the Western Parkland City.

Greater Sydney also benefits from people commuting from the Central Coast (particularly south of Wyong) and Illawarra to jobs in Sydney. Both Gosford and Wollongong also play significant roles in supporting the needs of their broader regions.

Eastern Harbour City

Eastern Sydney is Australia's global economic gateway and most concentrated area of economic activity, jobs and investment. The eastern economic corridor between Macquarie Park and Sydney Airport alone accounted for 24 per cent of Australia's growth in GDP in the 2015-16 financial year.[164]

Competitive industries include finance and professional services (including FinTech), ICT, health and education, tourism and creative industries. These are boosted by endowments such as internationally renowned tourist attractions and being the global headquarters of Australia's top businesses.

The Eastern Harbour City is well established and developed, with limited space for new developments compared to other cities within Greater Sydney. The challenge is to drive and accommodate growth and density, balanced with smart infrastructure investments and the optimised use of existing assets.

Given its location on the harbour and surrounding parklands, the Harbour CBD (encompassing Sydney CBD and North Sydney CBD) is constrained in terms of opportunities for growth. Urban renewal will occur to the south and west of the city – in the Central to Eveleigh and Bays precincts – and will benefit from the clustering of businesses in the emerging innovation precinct, anchored by health and education assets, on the south-western edge of the CBD.

Maintaining the efficiency of infrastructure networks and access to the international trade gateways of Sydney Airport and Port Botany will be critical to support the ongoing competitiveness of the city and of NSW.

Infrastructure response – Eastern Harbour City

- Improve access to international gateways.
- Improve intercity and intracity transport connectivity.
- Improve intracity walking and cycling infrastructure.
- Improve mass transit connections to the Harbour CBD, especially from the west and south east of the Eastern Harbour City.
- Invest in improvements in cultural infrastructure and institutions.
- Support the population with social infrastructure investments.
- Provide more school education facilities, exploring joint and shared use.

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164 Ibid, p. 67

Figure 24 – Eastern Harbour City (movement)
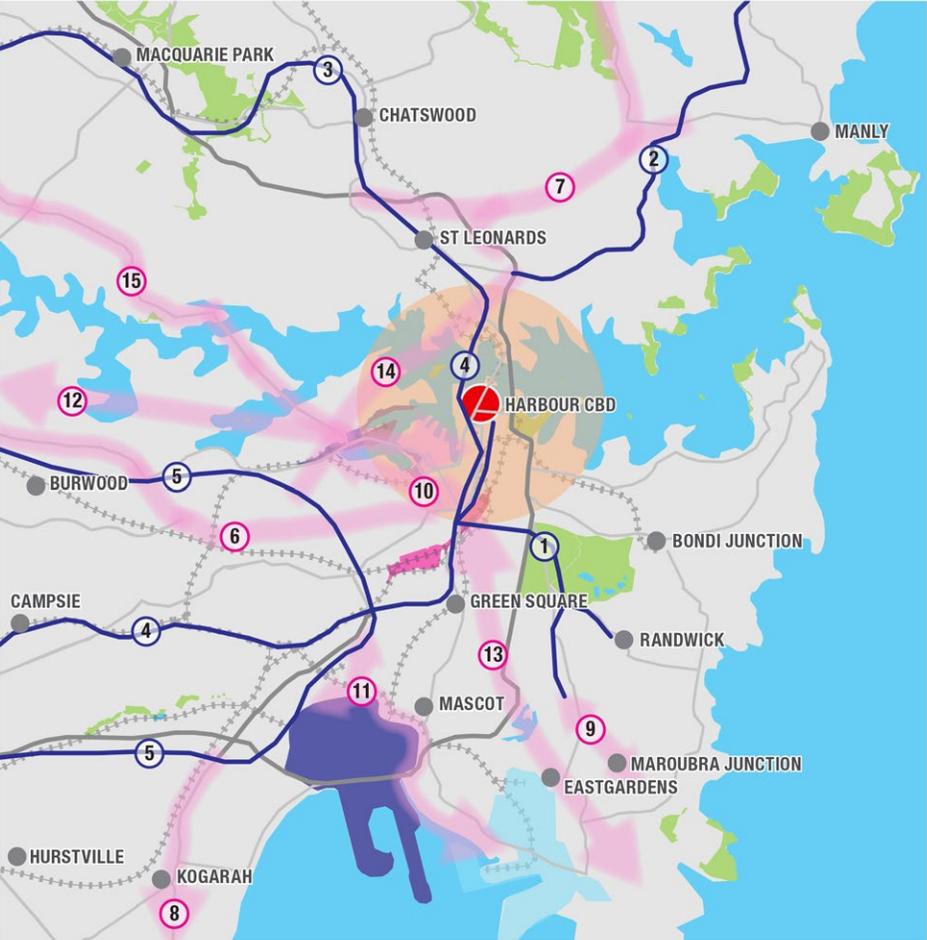
- Metropolitian centre
- Strategic centres
- Major parks and reserves
- Waterways
- Bays Precinct
- Central to Eveleigh Precinct
- Sydney Airport
- Port Botany
- Railway (existing)
- Motorways and freeways (existing)
- Arterial roads (existing)

Transport projects in delivery
1 CBD & SE Light Rail
2 Northern Beaches B-Line
3 Sydney Metro Northwest
4 Sydney Metro City & Southwest
5 WestConnex

Transport projects proposed for the future (possible alignments)
6 Parramatta Road public transport improvements
7 Beaches Link
8 F6 Extension
9 Light Rail to Maroubra Junction
10 Light Rail to Bays Precinct
11 Sydney Gateway
12 Sydney Metro West
13 Mass transit to South East
14 Western Harbour Tunnel
15 Victoria Road public transport improvements

(See Chapter 9 for details on transport recommendations.)

Source: Road, Rail, Reservoirs, Lakes, Rivers Publisher Bioregional Assessment Programme licensed under CC BY 3.0; Transport projects, Transport for NSW 2017

Figure 25 – Eastern Harbour City (place)
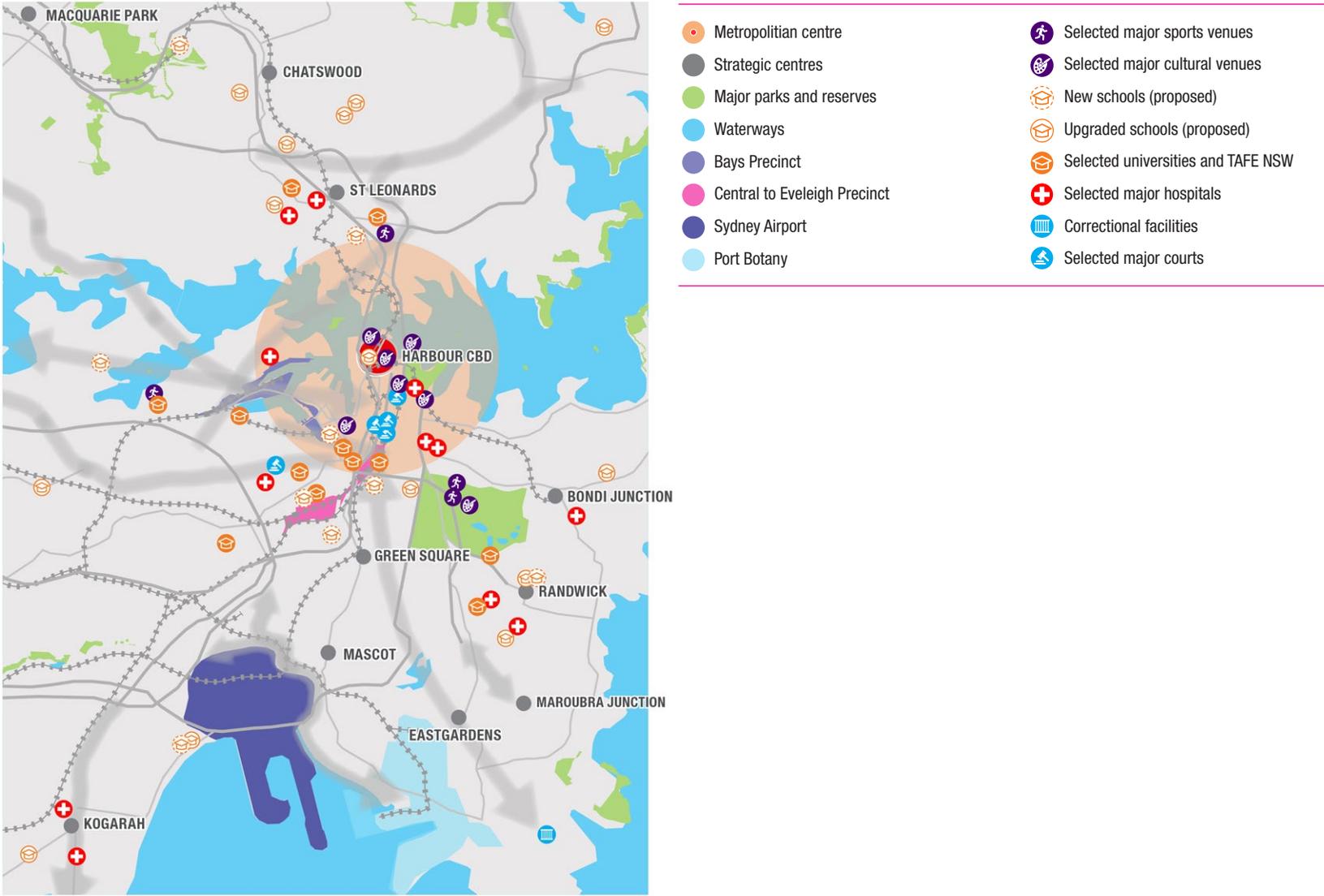
Legend:
- Metropolitian centre
- Strategic centres
- Major parks and reserves
- Waterways
- Bays Precinct
- Central to Eveleigh Precinct
- Sydney Airport
- Port Botany
- Selected major sports venues
- Selected major cultural venues
- New schools (proposed)
- Upgraded schools (proposed)
- Selected universities and TAFE NSW
- Selected major hospitals
- Correctional facilities
- Selected major courts

Map labels: MACQUARIE PARK, CHATSWOOD, ST LEONARDS, HARBOUR CBD, BONDI JUNCTION, GREEN SQUARE, RANDWICK, MASCOT, MAROUBRA JUNCTION, EASTGARDENS, KOGARAH

Source: Road, Rail, Reservoirs, Lakes, Rivers Publisher Bioregional Assessment Programme licensed under CC BY 3.0; School Infrastructure, NSW Department of Education 2018; Hospitals, NSW Health 2017; adapted by Infrastructure NSW 2018

Central River City

The Central River City has grown strongly as a retail and service centre in the last 10 years, and now hosts 85,000 jobs in Greater Parramatta – a similar number to Macquarie Park.[165] Economic growth and productivity are being driven by the NSW Government's $10 billion investments in city-scale assets in Parramatta and potential new transport connections.[166]

Home to information technology, public administration, construction, manufacturing and logistics centres, the Central River City's competitive and growing industries include finance and professional services, health, international education and advanced manufacturing (requiring smaller, highly automated production).

While it is the geographic centre of Greater Sydney, the Greater Parramatta area and the Greater Parramatta to Olympic Park Corridor are poorly connected to areas to their north and south, and would benefit from a faster high capacity connection to the Harbour CBD. Within the central city corridor, Sydney Olympic Park is a major recreation and events destination, but is poorly connected to the rest of the city.

An innovation precinct is emerging around Westmead, driven by significant government investment in the hospital redevelopment and the presence of major universities. Good connections within the precinct, and appropriate zoning and land uses that enable cross-industry collaboration, will be prerequisites for the precinct's success.

In recognition of the strategic significance of Greater Parramatta and the Olympic Peninsula, the Greater Sydney Commission has set out a vision for renewal within the corridor in which it becomes the connected unifying heart of Greater Sydney. Work is underway on a pilot growth infrastructure compact for the area to ensure it is supported by the right infrastructure and policy settings to accommodate and drive growth in a coordinated way.

Infrastructure response – Central River City

- Improve intercity and intracity transport connections.
- Improve intracity walking and cycling connections.
- Improve north-south transport connections, for example Greater Parramatta to Epping and Greater Parramatta to Kogarah via Bankstown.
- Provide additional cultural and recreational infrastructure.
- Facilitate high quality digital connectivity infrastructure as part of all development.
- Support growth in population and housing, including social and affordable housing options.
- Provide more school education facilities, exploring joint and shared use.

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165 Ibid, p. 88
166 Ibid, p. 70

Figure 26 – Central River City (movement)
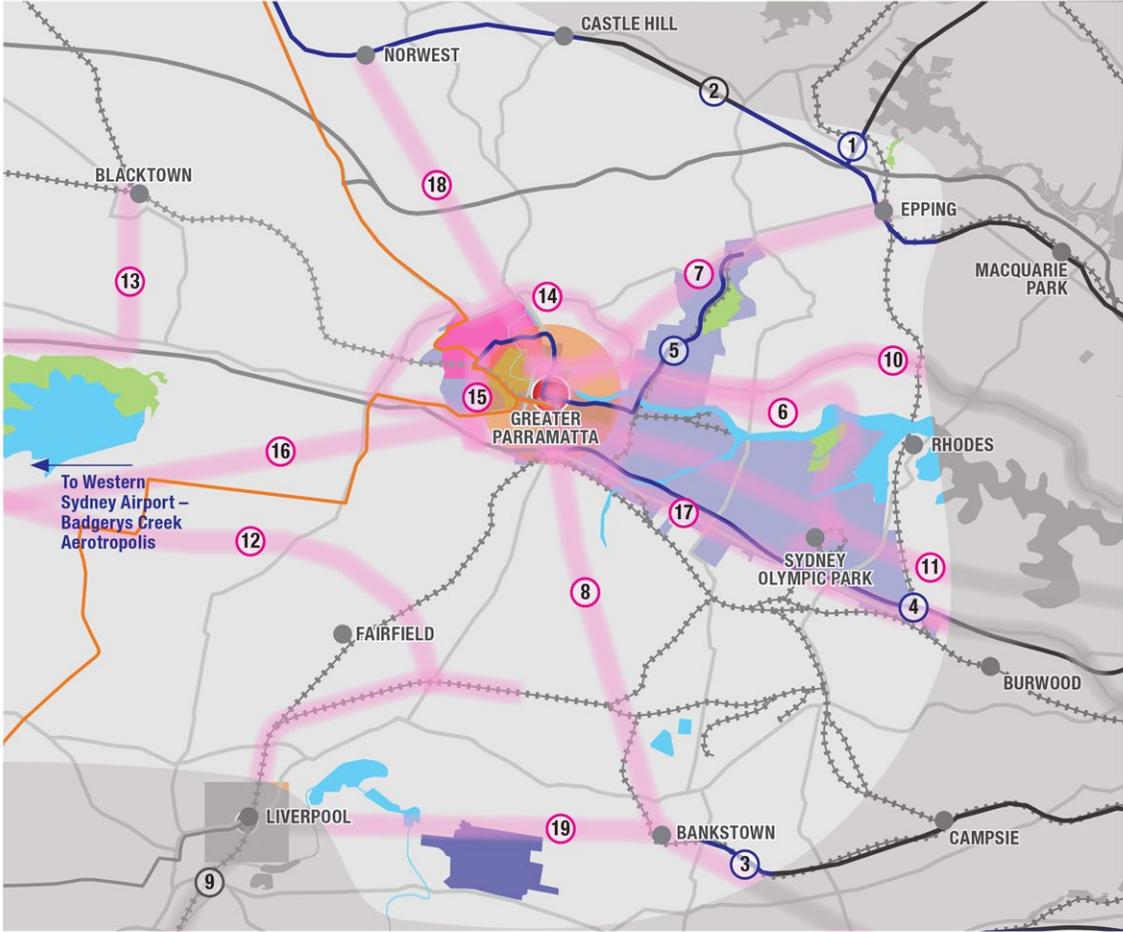
Legend:

- Metropolitian centre
- Strategic centres
- Major parks and reserves
- Waterways
- Greater Parramatta and Olympic Peninsula
- Westmead Innovation Precinct
- Bankstown Airport
- Railway (existing)
- Motorways and freeways (existing)
- Arterial roads (existing)
- Area outside of Central River City
- T-Way (Exisiting Rapid Bus Network)

Transport projects in delivery
1   NorthConnex
2   Sydney Metro North West
3   Sydney Metro South West
4   WestConnex
5   Parramatta Light Rail Stage 1

Transport projects proposed for the future (possible alignments)
6   Parramatta Light Rail Stage 2
7   Parramatta to Epping Mass Transit
8   Parramatta to Kogarah Mass Transit
9   Southern Sydney Freight Line (additional capacity)
10 Victoria Road public transport improvements
11 Sydney Metro West
12 Western Sydney Freight Line corridor protection
13 Rapid bus connection to Western Sydney Airport
14 Parramatta Outer Ring Road
15 T-way to T-way Link
16 WSA to Parramatta train link
17 Parramatta Road public transport improvements
18 Parramatta to Norwest Mass Transit
19 Sydney Metro City & Southwest extension to Liverpool corridor protection

(See Chapter 9 for details on transport recommendations.)

Source: Road, Rail, Reservoirs, Lakes, Rivers Publisher Bioregional Assessment Programme licensed under CC BY 3.0; Transport projects, Transport for NSW 2017

Figure 27 – Central River City (place)
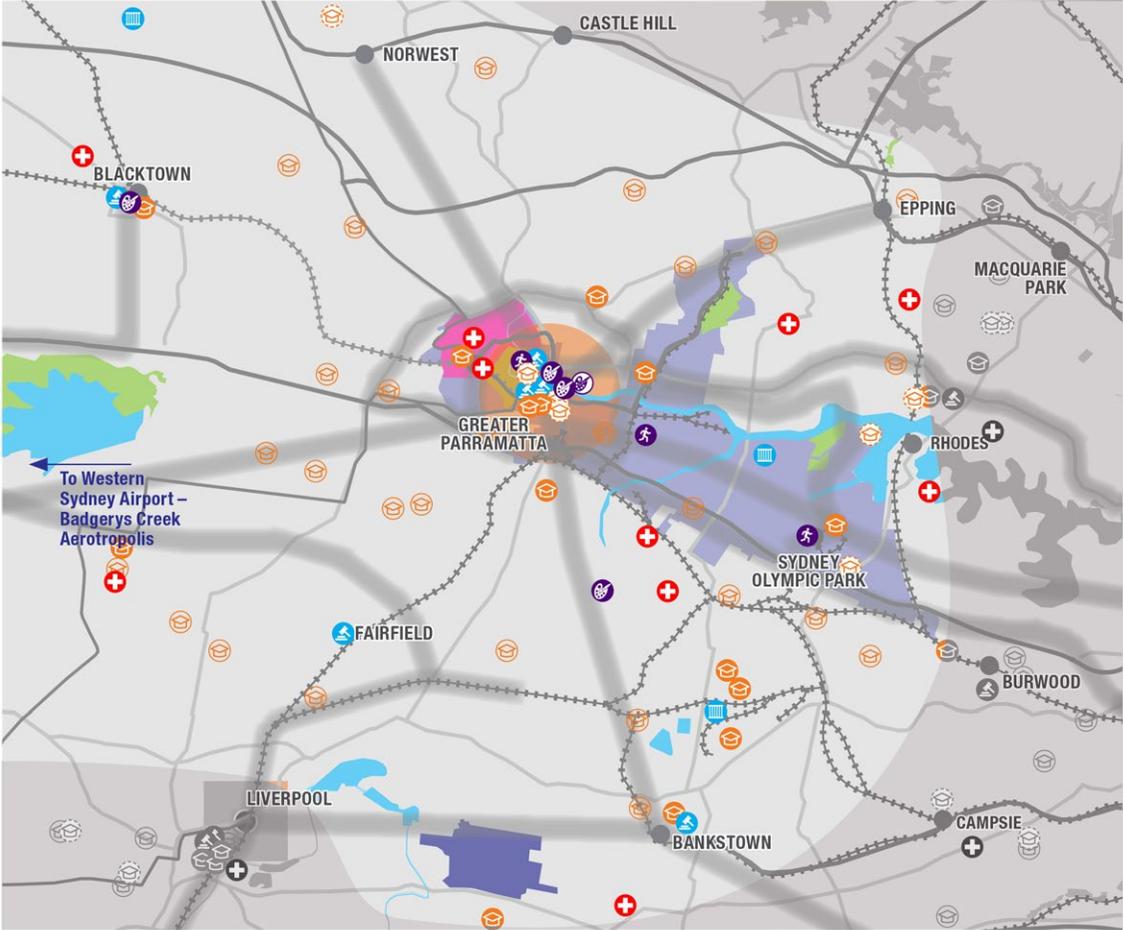
Legend:
- Metropolitian centre
- Strategic centres
- Major parks and reserves
- Waterways
- Greater Parramatta and Olympic Peninsula
- Westmead Innovation Precinct
- Bankstown Airport
- Area outside of Central River City
- Major sports venues
- Major cultural venues
- Major cultural venues (proposed)
- New schools (proposed)
- Upgraded schools (proposed)
- Universities and TAFE NSW colleges
- Hospitals
- Correctional facilities
- Courts

Source: Road, Rail, Reservoirs, Lakes, Rivers Publisher Bioregional Assessment Programme licensed under CC BY 3.0; School Infrastructure, NSW Department of Education 2018; Hospitals, NSW Health 2017; adapted by Infrastructure NSW 2018

Western Parkland City

By 2056, nearly two million people will live in the Western Parkland City.[167] Currently, the Western Parkland City comprises large areas of light industrial and urban agricultural land, as well as large developable land parcels, with greenfield development underway within the Greater Macarthur Growth Area, North West Growth Area and South West Growth Area.

South Creek is planned to be preserved and enhanced as a parkland and creek lands corridor to support the western parkland urban form, while enabling delivery of housing supply and employment opportunities through water supply and management. All infrastructure and land-use planning decisions in the Western Parkland City will need to be oriented to support this important asset.

The development of an economic city in the heart of the western corridor will be fundamental to realising the potential of the new Western Sydney Airport, accommodating population growth and providing opportunities to overcome the socio-economic disadvantage that characterises parts of south-western Sydney. Creating a lifestyle and culture that attracts people and businesses to the city will also be crucial.

The largely greenfield nature of the new city requires early action by the NSW Government to develop a strategic plan for the city that brings together infrastructure needs, identifies areas and corridors for protection, identifies the cultural infrastructure necessary to support a thriving community, balances development of industry and housing, encourages and stimulates private sector investment and maintains flexibility to accommodate future uncertainties around technology and development.

If planned and executed correctly, the city will attract defence and aerospace activities. It will also have significant warehousing, freight and logistics activity. Planning will need to include major transport connections to the north and south, and to surrounding established centres at Campbelltown-Macarthur, Greater Penrith and Liverpool, Blacktown, and Greater Parramatta in the Central River City.

The proposed Western Sydney City Deal, a collaboration across three tiers of government to drive the delivery of the Western Sydney Airport and Badgerys Creek Aerotropolis, aims to unlock public and private investment in key infrastructure.

Infrastructure response – Western Parkland City

- Prioritise intercity road connections to support access from all directions.
- Provide a north-south mass transit connection, for example the T1 Western Line to Western Sydney Airport
- Prioritise sustainable transport connections, particularly walking and cycling infrastructure within the city.
- Facilitate high quality digital connectivity infrastructure as part of all development.
- Provide social infrastructure, such as schools, social housing and hospitals, to support population growth.
- Provide additional cultural and recreational infrastructure.
- Encourage local council and private investment in recreation infrastructure.
- Facilitate South Creek catchment to become an enabler of world class water management, urban greening and climate control.
- Deliver a freight network to support a growing city, and the next tranche of container imports into Sydney.

167 The Centre for International Economics 2017, p. 6

Figure 28 – Western Parkland City (movement)
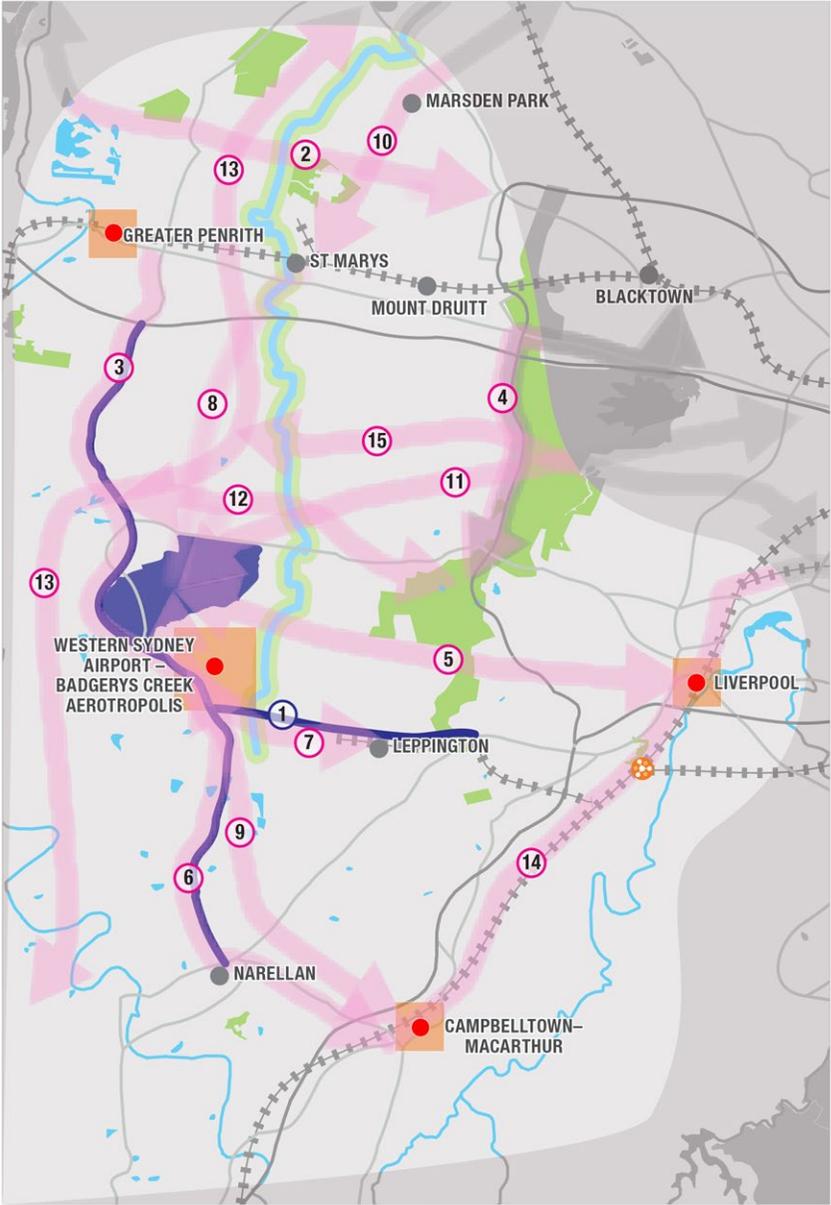
Legend:

- Metropolitan clusters
- Strategic centres
- Major parks and reserves
- Waterways
- South Creek / riparian corridor
- Western Sydney Airport
- Moorebank Intermodal Terminal
- Railway (existing)
- Area outside of Western Parkland City
- Motorways and freeways (existing)
- Arterial roads (existing)

Transport projects in delivery
1   Western Sydney Infrastructure Plan (WSIP)

Transport projects proposed for the future (possible alignments)
2   Bells Line of Road Castlereagh Connection corridor protection
3   Penrith rapid bus connection to WSA
4   Blacktown rapid bus connection to WSA
5   Liverpool Rapid Bus connection to WSA
6   Campbelltown rapid bus connection to WSA
7   Leppington to WSA train link
8   North – South train link (St Marys to WSA)
9   North – South train link (WSA to Campbelltown-Macarthur)
10   North – South train link (St Marys to Cudgegong Road)
11   WSA to Parramatta train link
12   M12 motorway (part of WSIP)
13   Outer Sydney Orbital corridor protection
14   Southern Sydney Freight Line (additional capacity)
15   Western Sydney Freight Line corridor protection

(See Chapter 9 for details on transport recommendations.)

Source: Road, Rail, Reservoirs, Lakes, Rivers Publisher Bioregional Assessment Programme licensed under CC BY 3.0; Transport projects, Transport for NSW 2017

Figure 29 – Western Parkland City (place)
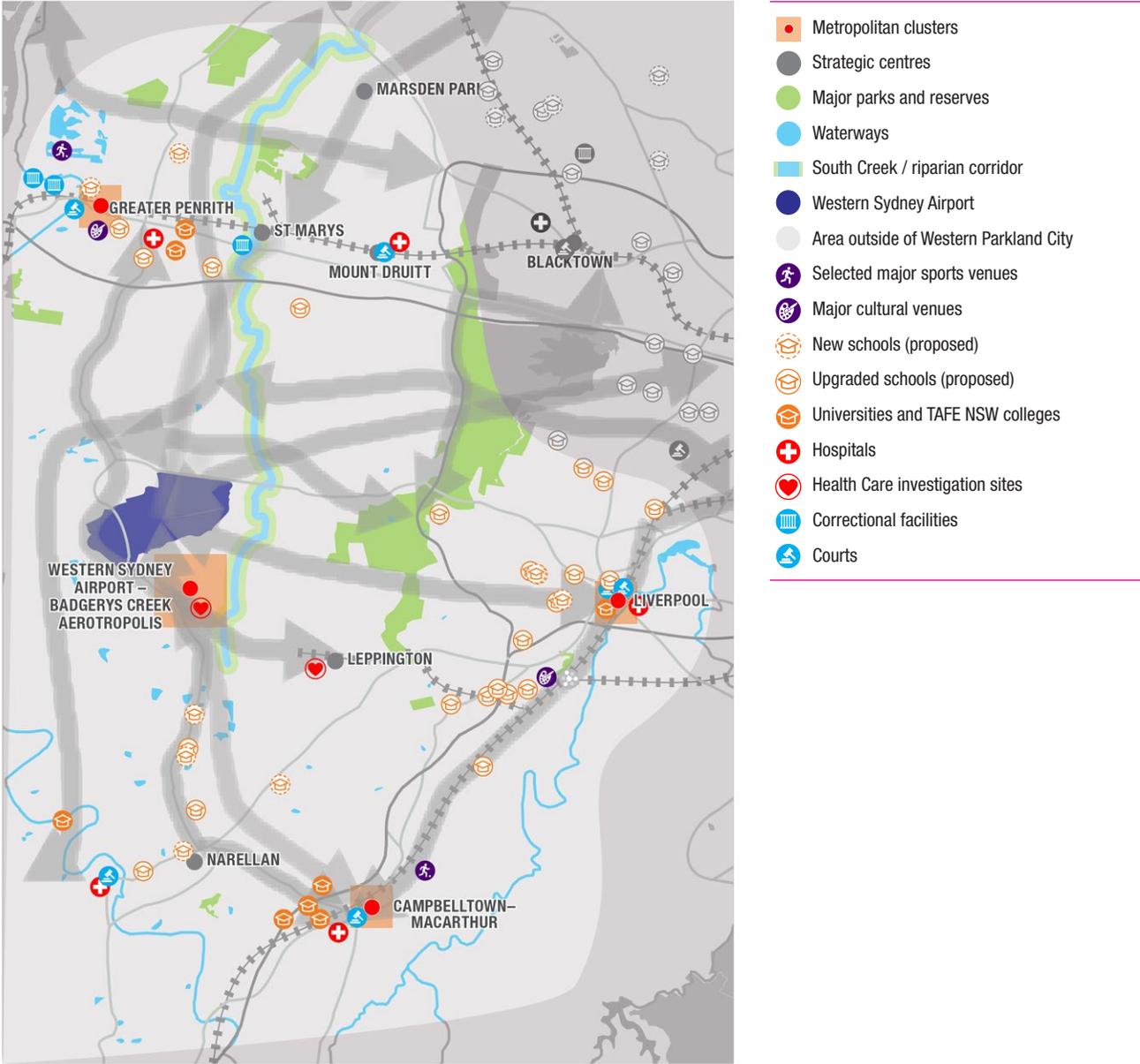
Legend:
- Metropolitan clusters
- Strategic centres
- Major parks and reserves
- Waterways
- South Creek / riparian corridor
- Western Sydney Airport
- Area outside of Western Parkland City
- Selected major sports venues
- Major cultural venues
- New schools (proposed)
- Upgraded schools (proposed)
- Universities and TAFE NSW colleges
- Hospitals
- Health Care investigation sites
- Correctional facilities
- Courts

Source: Road, Rail, Reservoirs, Lakes, Rivers Publisher Bioregional Assessment Programme licensed under CC BY 3.0; School Infrastructure, NSW Department of Education 2018; Hospitals, NSW Health 2017; adapted by Infrastructure NSW 2018

Wollongong

The Wollongong and Shellharbour area is likely to be home to more than half a million people by 2036.[168] The area will drive the economic growth, employment and diversification of the broader Illawarra-Shoalhaven region, while also contributing to Greater Sydney's economy and labour force.

The regional city of Wollongong will become increasingly connected to Greater Sydney by 2056, enabled by its proximity to Greater Sydney's jobs and services and improved road and rail connections. Improved connectivity between Wollongong and Port Kembla, the National Land Transport Network, the Western Sydney Airport and intermodal terminals in the Western Parkland City will also be important for the city's ongoing economic growth.

A high environmental value, as well as access to public amenities, make the Wollongong-Shoalhaven area an attractive place to live and work. Wollongong Metro supports 34,000 jobs in diverse sectors including tertiary health and education, business, the public sector, innovation and research and development.[169]

Port Kembla's importance as an international trade gateway will increase as it progressively serves as an overflow facility for Port Botany (with Port Botany expected to reach operational capacity after 2040).

Various NSW Government and private investments will enhance Wollongong over the coming years, including an expansion of the Wollongong Hospital. Future investments should be focused on:

- growing the amenity of Wollongong by providing good transport connections and local services
- growing the capacity of the port at Port Kembla as an international trade gateway, enabled by dedicated rail connections
- strengthening links between Wollongong, Port Kembla and Greater Sydney, with extra capacity for rail services and improved road connections across the Illawarra Escarpment and to the Western Parkland City
- building on existing strengths and supporting economic diversity through growth in priority sectors including tourism, health, disability and aged care, ICT/knowledge services, education and training, and freight and logistics.[170]

168 Department of Planning and Environment 2016b
169 Ibid, p. 15

170 Ibid.

Figure 30 – Illawarra overview

Legend:

- ● Metro Wollongong
- ● Strategic centres
- Major parks and reserves
- Waterways
- Industrial areas
- Regionally significant release area
- ◆ Illawarra Regional Airport
- ⚓ Port Kembla
- ┼┼┼ Railway (Existing)
- ━━ Motorways and freeways (existing)
- ━━ Arterial roads (existing)
- Transport projects proposed for the future (possible alignments)
    1. Hume Motorway improvements
    2. Electrification of intercity connection to Goulburn
    3. Maldon-Dombarton Freight Rail Link
    4. Appin Road improvements
    5. Picton Road improvements
    6. Moss Vale-Unanderra-Coniston Junction rail improvements
    7. Electrification of intercity connection to Bombaderry /Nowra
    8. Sydney-Wollongong rail improvements
    9. Improved bus connections with South West Sydney
    10. Outer Sydney Orbital corridor protection

    (See Chapter 9 for details on transport recommendations.)

- 🏃 Major sports venues
- 🎭 Major cultural venues
- 🏫 New schools (proposed)
- 🏫 Upgraded schools (proposed)
- 🎓 Universities and TAFE NSW colleges
- ✚ Hospitals
- ⚖ Courts

Source: Road, Rail, Reservoirs, Lakes, Rivers Publisher Bioregional Assessment Programme licensed under CC BY 3.0; School Infrastructure, NSW Department of Education 2018; Hospitals, NSW Health 2017; Transport projects, Transport for NSW 2017; adapted by Infrastructure NSW 2018

Central Coast

The Central Coast is located at the centre of the State's fastest growing corridor – between Sydney and Newcastle – where the population is estimated to grow to 1.1 million by 2036.[171]

The region's Southern Growth Corridor, which extends from Somersby to Erina, and the Northern Growth Corridor, which extends from Tuggerah to Warnervale, provide major infrastructure and services and contain 48 per cent of the region's jobs.[172] These areas will remain priority locations for future investment, jobs, services and business growth.

Warehousing and logistics are economic strengths for the Central Coast with capacity for growth. The region benefits from its proximity to Greater Sydney and the Hunter with connections to both via the M1 Pacific Motorway, the Pacific Highway and the Main Northern rail line.

Construction of transport infrastructure outside the region, such as NorthConnex and the M2, will drive demand for accessible employment land on the Central Coast. Clustering freight and logistics businesses around interchanges at Somersby, Tuggerah and Warnervale will maximise these opportunities.

The region's unique and productive natural environment, including its coastline, will support growth in the tourism, lifestyle housing, agriculture and resource sectors.

Gosford will flourish as the region's capital and centre of administrative, civic and commercial services. Improvements to health, transport, education, sporting and civic infrastructure will bolster its expanding cultural, residential and employment functions. Good building design will capitalise on its attractive waterfront setting.

Improving passenger rail services, and reliability and efficiency of the M1 between Sydney and Newcastle, will allow residents to access a wider variety of jobs and business opportunities in both cities.

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171 Department of Planning and Environment 2016c, p. 4
172 Ibid, p. 18

Figure 31 – Central Coast overview
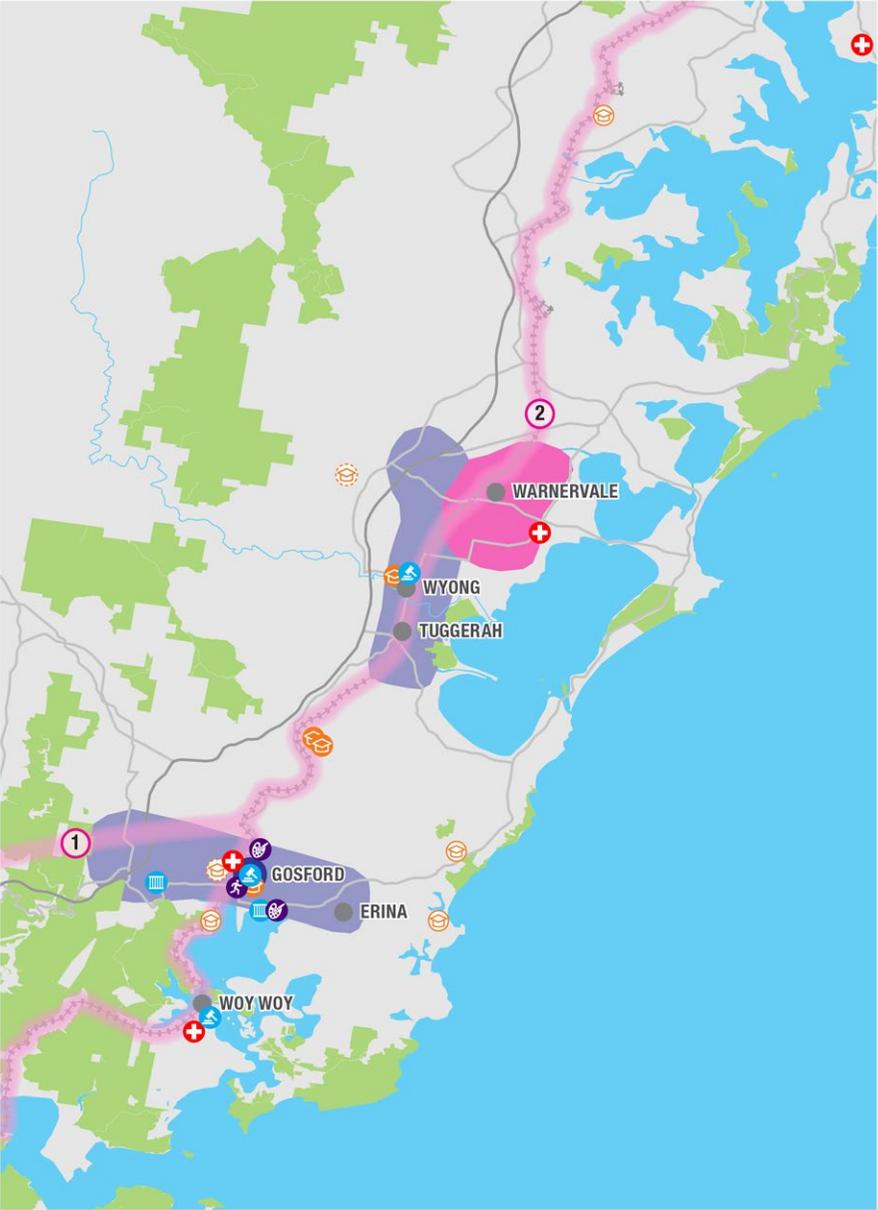
Regional city

Strategic centres

Major parks and reserves

Waterways

Warnervale Wadalba land release area

Regional growth corridors

Railway (Existing)

Motorways and freeways (existing)

Arterial roads (existing)

Transport projects proposed for the future
(possible alignments)
1   Outer Sydney Orbital corridor protection
2   Sydney–Central Coast–Newcastle rail
improvement

(See Chapter 9 for details on transport
recommendations.)

Selected major sports venues

Selected major cultural venues

New schools (proposed)

Upgraded schools (proposed)

Universities and TAFE NSW
colleges

Hospitals

Correctional facilities

Courts

Source: Road, Rail, Reservoirs, Lakes, Rivers Publisher Bioregional Assessment Programme licensed under CC BY 3.0; School Infrastructure, NSW Department of Education 2018; Hospitals, NSW Health 2017; Transport projects, Transport for NSW 2017; adapted by Infrastructure NSW 2018

9. Transport

The recommendations in the 2018 SIS for the transport sector need to be read in the context of *Future Transport 2056* and the *Greater Sydney Region Plan*. Both documents have been key inputs to this strategy. Infrastructure NSW supports the land use directions set out in the *Greater Sydney Region Plan* and, in this chapter, seeks to assess the relative priority of the major investments within *Future Transport 2056*. It does so by considering both the guiding vision in the *Greater Sydney Region Plan* and its own strategic directions set out in Chapters 2 to 7.

STRATEGIC OBJECTIVE   Ensure the transport system creates opportunities for people and businesses to access the services and support they need

SNAPSHOT	
	• From providing access to essential services in the bush, connecting valuable goods and services to markets and moving millions of people each day across our cities and regions, transport is an integral part of our lives and is crucial to helping NSW function.
	• Unprecedented levels of investment are being made in the State's transport network, but more targeted investment will be needed, and more efficient use made of existing transport assets, to cater for growing personal, business and freight transport needs over the next 20 to 40 years.
	• Infrastructure NSW's recommendations acknowledge the directions set by *Future Transport 2056* and the *Greater Sydney Region Plan*, and are generally supportive of the investments and approaches proposed by these plans.
	• In regional NSW, Infrastructure NSW endorses Transport for NSW's vision for a 'hub and spoke' transport network model that improves connectivity to strategic centres from surrounding communities and improves access to key markets and international gateways. In the regions, reducing road trauma and protecting transport assets from natural disasters and extreme weather must be a priority.
	• In Greater Sydney, catering for the extra 1.7 million people that will live there by 2036 will require better integration of land use with transport, managing travel demand, making better use of scarce road space (including delivering bus priority and bus rapid transit infrastructure on major road projects and to connect strategic centres), continuing to improve and extend the city's rail network, upgrading major public transport interchanges and modernising the city's motorway network.
	• With the freight task in NSW over the next 20 years growing from 443 Mt to 569 Mt per year, strategically important ports, airports, industrial lands, freight precincts and key corridors must be protected from incompatible uses to ensure the efficient movement of freight in Sydney and NSW, now and into the future.

RESPONSE	Summary of key recommendations
Integrate transport with land use	• Support the development of a three-city metropolis for Greater Sydney by investing in transport infrastructure that provides high frequency and high-volume access to, and connectivity between, each of the three cities, while enhancing local amenity. • Invest in transport infrastructure that is integrated with land use to create opportunities for agglomeration and enhance productivity, liveability and accessibility, in support of the policy goal of a '30-minute city'. • Support the development of regional hubs by enhancing their accessibility and connectivity via major north-south and east west links.
Manage travel demand	• Encourage travel patterns that are tailored to the capacity of the network and help to manage congestion with mobility pricing reform and demand management initiatives.
Unlock capacity in existing assets	• Re-allocate road space in key commuter corridors to give priority to the most productive and sustainable transport modes, improve the integration of services across modes, remove network bottlenecks and upgrade operational systems and infrastructure. • Overcome local constraints on the regional road and rail networks that limit the use of high productivity freight vehicles and rail freight.
Continue to invest in new network links	• Further develop the Sydney rail network with new rail links and system-wide upgrades. Develop extensive on-road rapid transit networks and active transport links to support the mass transit system and link key centres across Greater Sydney. Plan and deliver critical links in the motorway network that will serve Sydney well into the future. • In the Western Sydney Parkland City, give priority for the next 20 years to establishing a high quality, on-road rapid transit system and planning and preserving future infrastructure corridors. Commence investment in rail-based mass transit as a staged investment from 2036 onwards, unless co-investment from the Commonwealth Government and the private sector enables it to proceed earlier. • Complete missing links in the regional network, creating travel time savings and safety benefits that increase productivity.
Capitalise on new technology	• Equip the transport system for emerging technology with investments in connectivity and digital infrastructure, and establish regulatory and governance settings that will encourage innovation and ensure the benefits of new technology can be fully realised.
Improve regional and metropolitan freight productivity	• Develop and protect freight and service networks by improving road and rail access for goods and services to local, national and global markets, leverage the Commonwealth's Inland Rail investment and address existing inefficiencies and pinch points. • Improve the resilience of the system to reflect its critical operational role, including during periods of acute and sustained shock.

9.1 Recent progress

The recommendations for transport investment in the *State Infrastructure Strategy 2012* and *State Infrastructure Strategy Update 2014* are being progressively implemented by the NSW Government, which has invested nearly $60 billion in transport infrastructure since 2012.

The *State Infrastructure Strategy Update 2014* recommended delivering 16 major transport passenger and freight projects and programs across the state. Four years into implementation, Infrastructure NSW finds these projects are now progressing through planning and delivery. Significant milestones include:

- **Sydney Metro City & South West:** the NSW Government has committed $7 billion from Restart NSW to this project, accelerating its delivery by five to seven years. Planning approvals for Metro City from Chatswood to Sydenham were obtained in January 2017, with early works already underway. The planning approval process for Metro South West has started and, subject to approval, construction work will commence in early 2018.

- **Parramatta Light Rail:** currently in its planning and development stage. Stage 1 is fully funded and construction is expected to begin in late 2018, to be completed by 2023.

- **WestConnex:** the centrepiece of the *State Infrastructure Strategy 2012*. In 2017, the first stage of the M4 upgrade was opened, as was the King Georges Road / M5 interchange. Delivery of Stages 1 and 2 are well progressed, with planning well underway for Stage 3.

- **M4 Smart Motorway:** using intelligent technology to improve the safety, reliability and efficiency of the M4 Motorway. Construction of Stage 1 has begun and is scheduled to be completed by 2019.

- **Fixing Country Rail Program:** a $400 million program to fund rail infrastructure enhancements that eliminate connectivity constraints and reduce the costs of moving freight on the regional rail network. A pilot, run in 2016, allocated $14 million in funding to six projects across NSW. The total reservation of $150 million for the first round of the program is expected to be fully allocated to projects by early 2018.

- **Bridges for the Bush Program:** announced in 2012 and extended in 2014, the program improves road freight productivity by replacing or upgrading bridges across NSW. Seven bridges have been completed and planning or delivery of works at other key locations in regional NSW is underway.

- **Fixing Country Roads Program:** providing targeted funding to local councils to repair and upgrade regional NSW roads. As at the end of 2017 a total of 210 projects valued at $319 million have received $195 million in Restart NSW funds.

9.2 Challenges and opportunities

NSW is in the midst of an unprecedented infrastructure investment boom, with $41 billion to be spent on transport alone over the next four years. This transformative investment will bolster NSW's rich stock of transport infrastructure assets, and help to address the following key challenges and opportunities over the coming decades:

- **Addressing capacity constraints:** NSW's road, public transport and freight networks are affected by system-wide and interdependent capacity constraints, particularly on radial routes into and out of major centres.

- **Improving productivity:** Across the road, rail and freight networks, local pinch points, bottlenecks, missing links and inefficient management of freight movements hamper productivity.

- **Shaping our regions and cities:** The transport network plays an important role in shaping our regions and cities by establishing the mass movement patterns that create the structure of cities.

- **Improving road safety:** With 380 fatalities and a further 12,000 serious injuries in NSW in 2016,[173] road trauma is the largest contributor to transport-related social and economic costs in Australia.[174]

- **Addressing socio-economic disadvantage:** Parts of Sydney and regional NSW have relatively poor accessibility to services, jobs and

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173 Transport for NSW 2017a, p. 4
174 Bureau of Infrastructure, Transport and Regional Economics (BITRE) 2014, p. 1

opportunities and higher levels of disadvantage than the rest of NSW.

- **Catering for demographic changes:** An ageing population means that travel needs will change. There is also evidence of a gradual reduction in average car travel per capita since 2004.[175]
- **Embracing technological changes:** The rapid emergence of new technology can improve personal mobility, as well as freight supply chains, by making journeys safer, more efficient and more productive.
- **Resilience and climate change:** Reducing greenhouse gas emissions from the transport sector and adaptation to climate change are crucial to meeting Australia's commitments to the *Paris Agreement* and the NSW Government's target of net zero emissions by 2050 as part of the *NSW Climate Change Policy Framework.*
- **Leveraging health benefits:** A well-designed transport system can reduce health system costs by increasing walking and cycling.[176]

9.3   Response

9.3.1   Regional NSW

NSW is blessed with diverse regions, each with unique capabilities, resources and cultural heritage. The Department of Planning and Environment's *Regional Plans*, Transport for *NSW's Future Transport 2056* and the 2018 SIS recognise that each region has its own infrastructure and service needs and seek to acknowledge that diversity. Infrastructure NSW

recommends investments in the transport sector in regional NSW that:

- support Transport for NSW's vision for a 'hub and spoke' regional transport network model that improves connectivity to global gateways and strategic centres from surrounding communities, capitalising on their role as hubs for services and employment
- support regional development with reliable and efficient access to key markets, including improved access to international gateways and the National Land Transport Network
- support sustainable jobs growth in traditional and emerging industries by facilitating access between and within regional centres
- reduce the levels of accident trauma on the regional transport network
- protect regional communities and physical infrastructure from the impacts of extreme weather and mitigate climate change.

Hub and spoke model of regional service delivery

Transport in regional NSW is transitioning to a 'hub and spoke' model: a transport service and network model that recognises the importance of regional strategic centres in the provision of essential services and jobs (refer to Chapter 8.3). This is characterised by links that radiate to connect to surrounding towns and communities (spokes) from strategic centres and cities (hubs).

The NSW and Commonwealth Governments have invested substantial funds in north-south routes that comprise the National Land Transport Network, such as the Hume and Pacific Highways, and the NSW Government is leading major improvement programs on the Princes and the Newell Highways. The final sections of the Pacific Highway are being upgraded to dual carriageway, although two significant pinch points at Coffs Harbour and Hexham/Heatherbrae remain and should be addressed as a priority in partnership with the Commonwealth Government. As the north-south routes are completed, east-west connectivity on corridors such as the Barrier, Bruxner, Great Western, Kings, Oxley and Snowy Mountains Highways will become even more important as (see Figure 32 showing annual regional road freight movements). Roads and Maritime Services is undertaking a progressive corridor planning program to identify ways of overcoming physical challenges and network restrictions such as:

- a lack of overtaking lanes, which increases travel times and the risk of crashes
- restricted access for High Productivity Freight Vehicles due to road design constraints
- recurring road and rail closures in flood-prone areas
- a shortfall of facilities to manage driver fatigue for heavy vehicle operators
- rail level crossings without boom gates that increase the safety risk for road and rail users
- narrow bridges, road shoulders and clear zones that increase the risk of vehicle crashes.

175 Bureau of Infrastructure 2012, p. 71
176 Reiner et al 2013

Aviation also has a role to play in the 'hub and spoke' model. Global gateways at Sydney Airport, Newcastle and Canberra, as well as regional aviation hubs, can be made more productive prior to the development of Western Sydney Airport with more effective regulation, accommodating day-return trips and better integrating landside transport connections.

Figure 32 – Annual road freight movement in NSW

Centres of major economic activity

Regional city hubs

Road Freight (per annum)

▬▬	>10 Mt
▬▬	5-10 Mt
▬▬	1-5 Mt
▬▬	<1 Mt
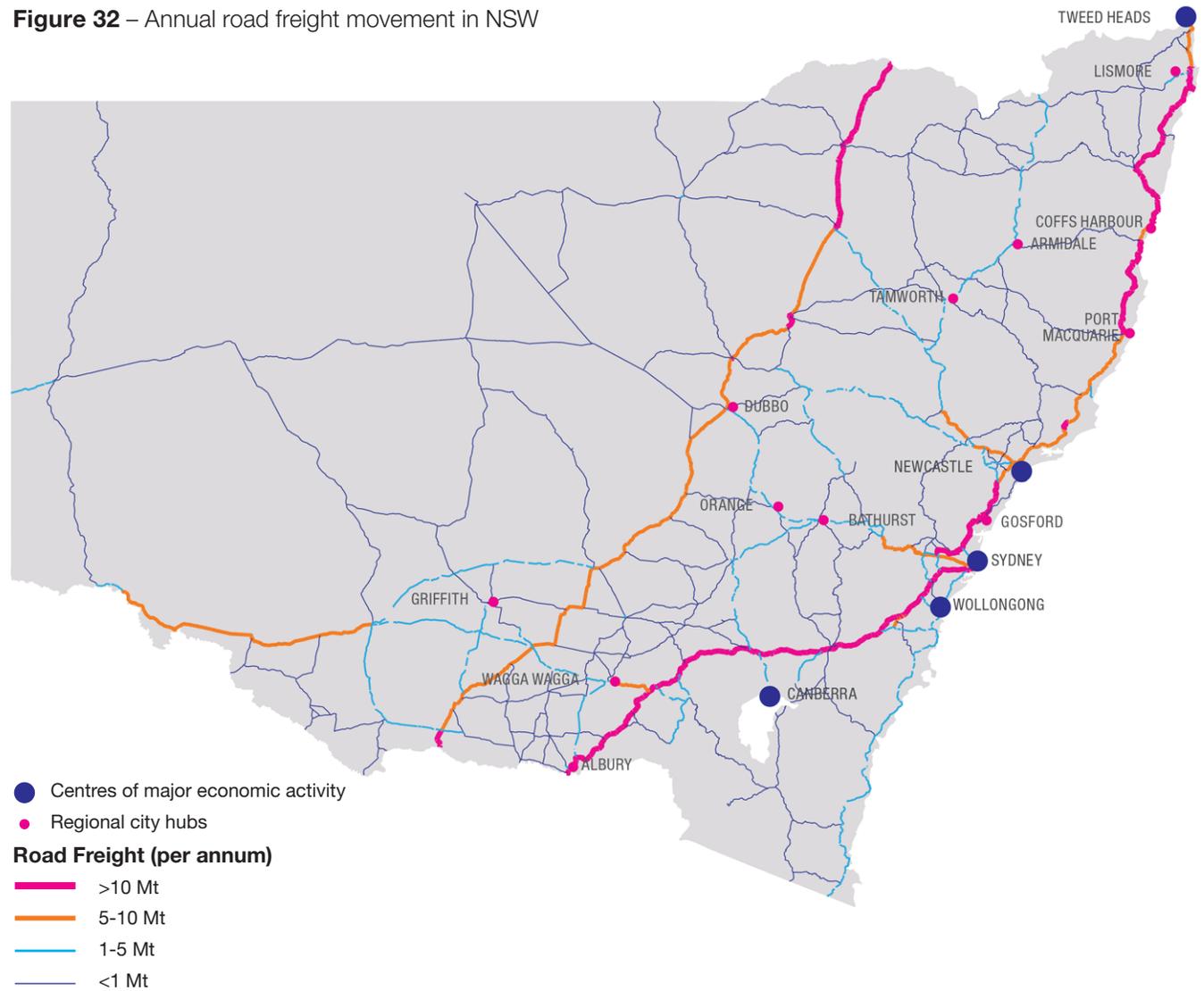
Source: Transport for NSW 2017

Embedding safety and resilience

Regional NSW is significantly over-represented in the NSW road toll. The combination of high private vehicle use, long distances to travel and the condition of some physical infrastructure increases exposure to risk and contributes to the road toll. Despite being home to just over 20 per cent of the NSW population, country areas represent two thirds of all fatalities and one third of serious injuries.[177] Infrastructure investments are a critical part of the Safe System approach in Transport for NSW's *Road Safety Plan 2021*. Bringing higher volume routes up to four- and five-star standard creates safer roads that – together with safer speed limits, safer vehicles with new technology and changes in driver behaviour and enforcement that create safer users – will help to reduce the regional road toll and move NSW closer the 'Towards Zero' road toll target.

Inland and remote areas are already prone to extreme weather conditions and natural hazards, including floods, droughts and fires. These conditions will be exacerbated by a changing climate. Regional NSW's transport infrastructure needs to be able to better withstand extreme weather conditions and natural disasters and provide reliable emergency evacuation routes for people living in vulnerable areas.

Infrastructure NSW recognises the importance of investing in safe and resilient infrastructure (refer to Chapter 5) and recommends that considerations of safety and network resilience be factored into all of NSW's future transport investments and policies.

As Corridor Strategies are completed, these will provide a framework to guide subsequent investment decisions in regional Rebuild NSW programs, including the Regional *Road Freight Corridor Fund*, *Fixing Country Roads* and *Bridges for the Bush* programs. Consequently, these strategies should recognise the strategic importance of east-west connectivity, the high standards of safety required to move closer to the 'Towards Zero' target and the role these play in increasing the resilience of regional NSW.

Recommendation 40

Infrastructure NSW recommends that the Corridor Strategies and guidelines for submissions to the *Regional Road Freight Corridor Fund, Fixing Country Roads* and *Bridges for the Bush* programs adopt an increased focus on achieving goals related to road safety and network resilience.

Improving regional productivity

Despite the NSW and Commonwealth Governments' investments to increase regional freight capacity, including the main north-south routes and the future Inland Rail project, freight productivity will continue to be hampered by local constraints (such as the physical challenges outlined above). In addition, network restrictions on key corridors (particularly in an east-west direction), as well as 'last-mile' challenges and access restrictions on local roads, compounded by fragmented road ownership across state and local governments, remain barriers to regional freight productivity.

Existing funding mechanisms, which are a mix of Commonwealth, state and local funding sources, tend to entrench underinvestment in the road network, with road managers unable to recover the full costs for repairing and maintaining roads. Revenue-raising mechanisms such as fuel excise and vehicle registration fees are mismatched to road use and the wear and tear it brings with it. The proposed National Heavy Vehicle Pricing and Investment Reform would establish equitable 'user pays' arrangements and help set prices that reflect the long-run cost of road provision.

Recommendation 41

Infrastructure NSW recommends that the NSW Government continue the *Regional Road Freight Corridor Fund* for a further 10 years once the current Rebuilding NSW reservation is exhausted around 2025 to overcome physical challenges and network restrictions. Investment should target freight productivity upgrades on key east-west routes linking the National Land Transport Network via a 'top down' strategic approach, supported by completed Corridor Strategies and business cases.

Recommendation 42

Infrastructure NSW recommends that the NSW Government continue the *Fixing Country Roads and Bridges for the Bush* programs for a further 10years once the current Rebuilding NSW reservation is exhausted around 2025 to overcome physical challenges and network restrictions. Investment should occur via a 'top down' strategic approach to target safety and productivity upgrades to the road network to unlock High Productivity Freight Vehicle network capacity.

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177 Transport for NSW 2017a, p. 11

Regional freight markets in NSW

The total regional NSW freight task is forecast to grow from 208 Mt in 2016 to 235 Mt by 2036 and 260 Mt by 2056 – a 25 per cent increase.

The freight sector is dominated by the movement of coal destined for export markets via rail through the Hunter to the Port of Newcastle and from the Central West to Newcastle and through the Illawarra to Port Kembla. The demand for coal in 2016 was approximately 189 Mt. Even with a changing international energy market, it is expected to grow to 230 Mt by 2056, an increase of 21 per cent.

Demand for other freight sectors is generally correlated with population and economic growth. Food and agricultural products destined for local and overseas consumption represent the next largest components of the freight market in NSW. Where economies of scale occur and rail access exists, freight flows are aggregated and moved to capital cities via rail for export or consumption. Road freight remains important for the transport of these commodities, particularly for shorter journeys and for access to railheads.

Imported goods and general freight are de-containerised in capital cities and distributed to the regions primarily via road. These movements represent the quickest growing segment of the freight market, being more closely linked to consumer demand. While road freight will continue to play a crucial role in the freight task, it is notable that both the NSW Government and Commonwealth Government are aiming to increase the proportion of freight moved by rail.

Figure 33 – Composition of regional NSW freight task

	Annual growth rate (2016-56)
Coal	0.5%
Grains	1.1%
Forestry supply	0%
Horticulture	1%
Steel	1.3%
Livestock	2.6%
Meat	2.6%
Cotton	1%
Total NSW Regional Freight	**0.56%**
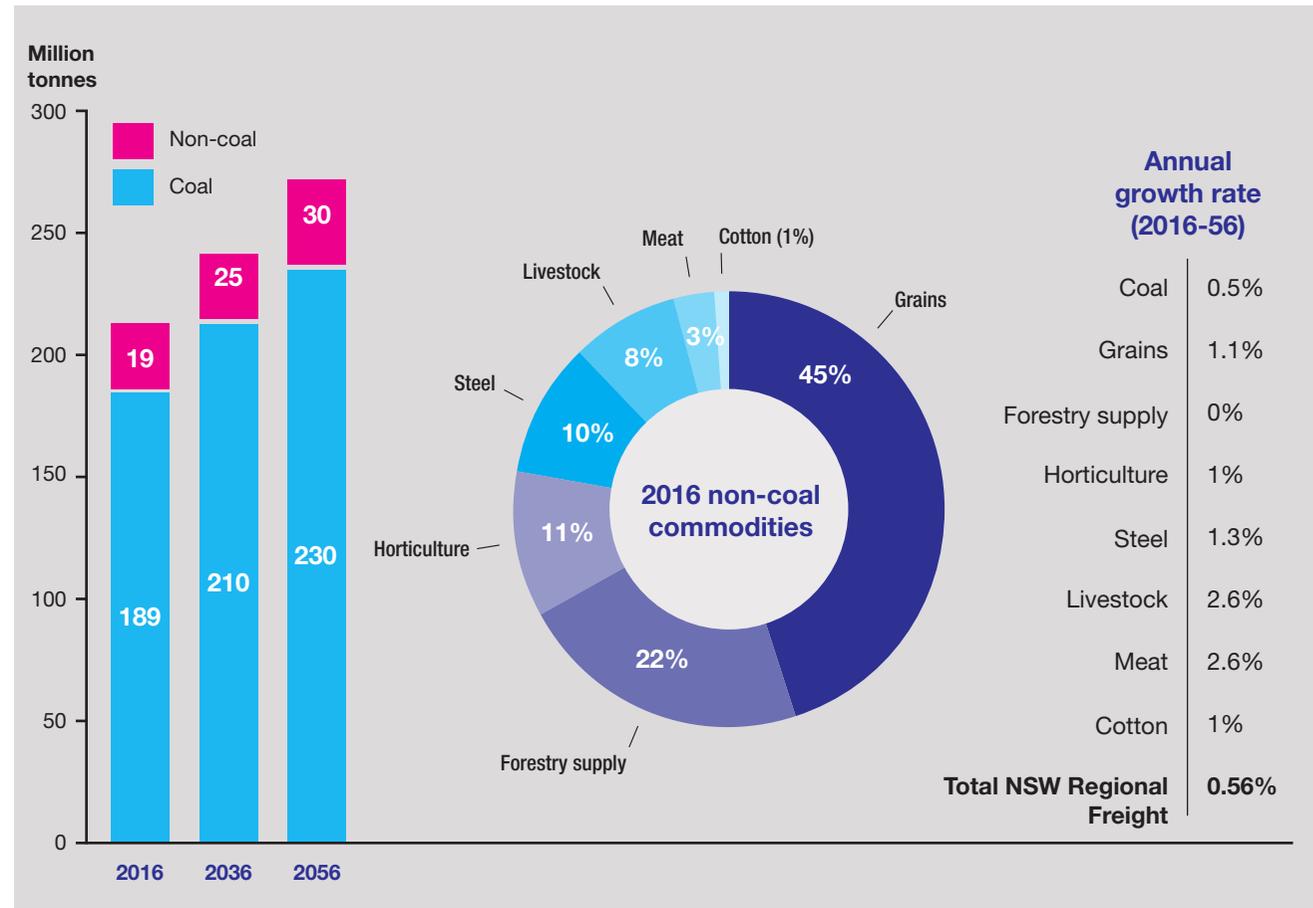
Source: Transport Performance and Analytics 2017

Leverage Inland Rail and resolve local access constraints

The NSW Government is working with the Commonwealth Government to develop the Inland Rail project, which provides an opportunity to reshape the regional freight rail network and the economic geography of the regions it serves. A key focus for NSW is to ensure that Inland Rail supports the State's primary industries by optimising the movement of freight in regional NSW to ports and gateways, regardless of whether those gateways are in NSW, Victoria or Queensland. Inland Rail seeks to deliver efficient links to these gateways and develop economically sustainable freight hubs – operated by the private sector – at appropriate locations along the route.

Key parts of the broader rail network beyond the mainline tracks suffer from significant constraints, including low axle weight capacity, low track speeds and insufficient siding lengths. While addressing these issues has been a focus of previous State Infrastructure Strategies, many constraints remain, impairing productivity and resulting in freight inefficiencies and/or goods being transferred to road transport.

To get the best value, investments to upgrade the regional rail freight network should be underpinned by a high-level network strategy that reflects the Commonwealth Government's proposed *National Freight and Supply Chain Strategy* and leverages the development of Inland Rail.

Recommendation 43

Infrastructure NSW recommends that the NSW Government continue the *Fixing Country Rail* program for a further 10 years once the Rebuilding NSW reservation is exhausted around 2025 to overcome local rail system constraints. Investment should occur via a 'top down' strategic approach underpinned by a high-level network strategy.

9.3.2 Central Coast and Illawarra-Shoalhaven

Infrastructure NSW recognises the need to invest in the Central Coast and Illawarra-Shoalhaven as stand-alone, self-contained administrative and business centres, and to support the increasingly important connectivity between the Illawarra-Shoalhaven and south-western Sydney. Infrastructure NSW supports the Department of Planning and Environment's Regional Plans for the Central Coast and Illawarra-Shoalhaven and the vision of *Future Transport 2056* that recommend investments in the transport sector to:

- provide for improved connectivity between the Illawarra-Shoalhaven and south-western Sydney, and between Sydney, the Central Coast and Newcastle

- support population growth and changing demographics in the Central Coast and Illawarra-Shoalhaven, as the total population of these areas grow to over one million people

- support self-sustaining local employment in traditional and emerging industries (health, education) through an integrated, connected public transport network

- support import/export industries with connections between international gateways and the National Land Transport Network and recognise the increasing importance of Port Kembla.

Improving connectivity to south-western Sydney

Over the next 40 years, the Illawarra-Shoalhaven will become more closely integrated with the economy of Greater Sydney. Major economic growth opportunities stem from the region's proximity to the growth areas of south-western Sydney, the Illawarra's port and logistics infrastructure and its education, health and innovation facilities. Reliable access between the Illawarra-Shoalhaven, the Greater Sydney Region, the Hume Motorway and the broader National Land Transport Network is crucial to realising these opportunities. This means addressing congestion in and around Wollongong and the Illawarra Escarpment, as well as resolving conflicts between passenger and freight train movements on the rail network.

Picton Road provides the main vehicle and freight access from the Illawarra-Shoalhaven to the M31 Hume Motorway, the Greater Macarthur Growth Area in the Western Parkland City and beyond. To achieve the road's full potential, further safety and design improvements will be needed, building on the success of the $53 million Picton Road upgrade program (2009-2013) and the $2.5 million Hume Highway and Picton Road interchange safety improvements (2016).

Road links into and out of the Illawarra are challenged by steep grades and tight turns on the Illawarra escarpment, which create safety, noise and access problems. Roads and Maritime Services is planning an upgrade to the M1 Princes Motorway between Picton Road and Bulli Tops

and an upgrade to the M1 Princes Motorway / Mount Ousley interchange. When completed, these projects will improve safety, capacity and efficiency for the 44,000 vehicles that use these routes each day.

In addition, the NSW Government has committed to upgrading the Princes Highway at Albion Park Rail and the section between Berry to Bombaderry. This investment will improve access between the Shoalhaven and Wollongong and Sydney.

Recommendation 44

Infrastructure NSW recommends that the NSW Government improve strategic connectivity between the Illawarra-Shoalhaven and the Western Parkland City by investing, subject to business cases, in the following projects over the next five to 10 years:

- upgrades to road access into the Illawarra via the M1 Princes Motorway, including the Mount Ousley interchange and M1 Princes Motorway between Bulli Tops and Mount Ousley
- freight and safety upgrades to Picton Road in recognition of its role as the primary connector between the M31 Hume Motorway and the M1 Princes Motorway.

Figure 34 – Road and rail network upgrades to support the Illawarra-Shoalhaven

Source: Infrastructure NSW 2017
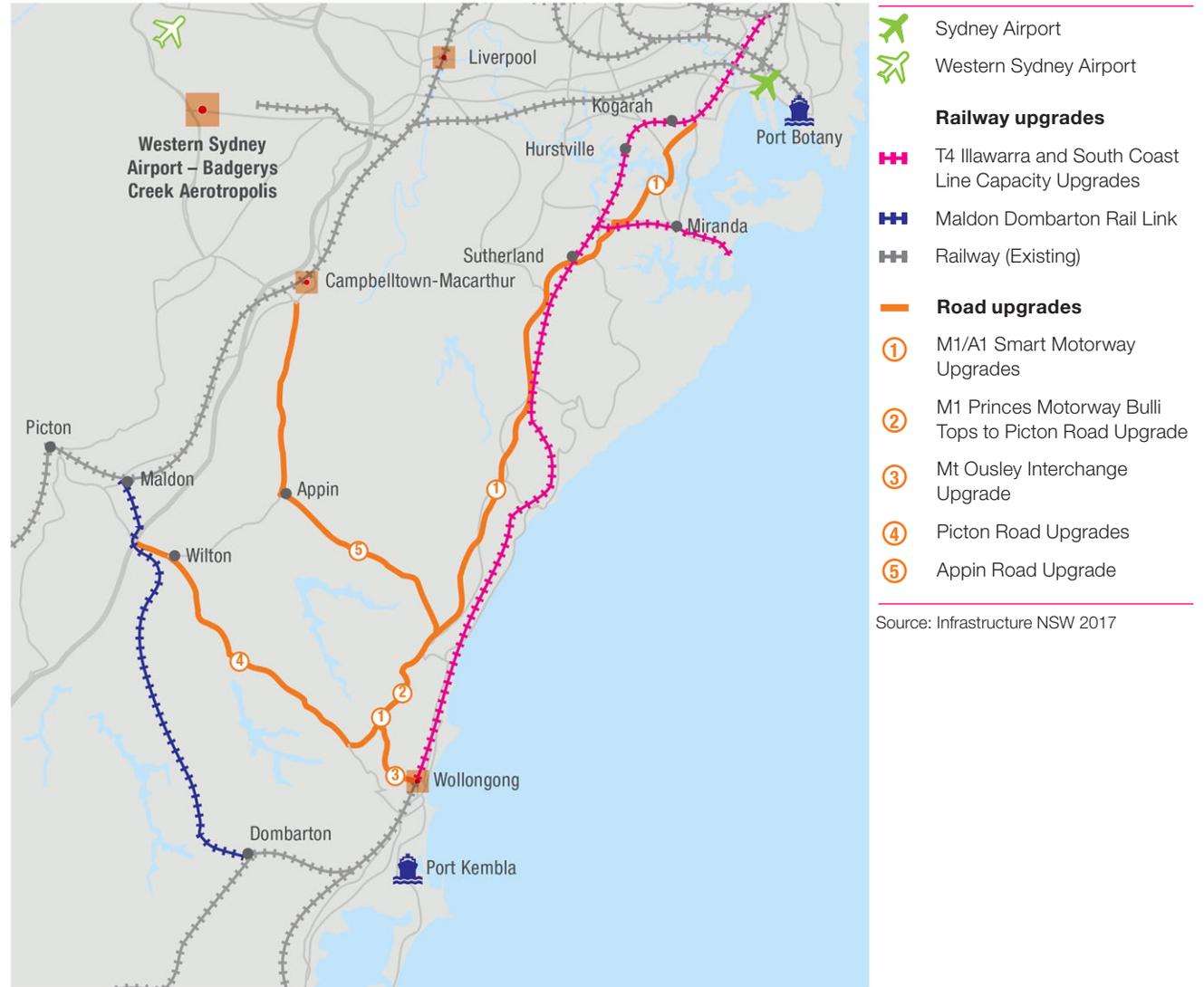
As demand for passenger travel between Sydney and the Illawarra-Shoalhaven grows, competition between passenger and freight movements on the T4 Illawarra and South Coast line will intensify. Forecasts suggest that, by around 2030, freight movements will be displaced entirely from the rail network between Sydney and the Illawarra-Shoalhaven to make way for passenger services. It is strategically critical to maintain long-term rail freight connectivity between Sydney and the Illawarra-Shoalhaven. When Port Botany reaches capacity, Port Kembla will need to support servicing the containerised freight needs of Greater Sydney.

Building on recommendations from the *State Infrastructure Strategy Update 2014,* Infrastructure NSW considers that the Maldon-Dombarton rail link is the most appropriate rail freight connection between Sydney and Port Kembla, although it is unlikely to be needed until 2030. This link will connect Port Kembla to intermodal facilities in the Western Parkland City via the Southern Sydney Freight Line and future Western Sydney Freight Line, as well as improving travel times and reliability for the 60-65 per cent of freight that currently enters or leaves Port Kembla by rail.

While the need for this investment is some time in the future, Transport for NSW should be prepared for its eventuality. Infrastructure NSW suggests that in the next five to 10 years, Transport for NSW should prepare an updated business case for the project that incorporates updated land use, transport and freight forecasts that reflect planned growth in the Western

Parkland City and passenger rail demands on the T4 Illawarra and South Coast line. Overall strategic investment for the region is shown in Figure 34.

Alternatives to fast rail

Future Transport 2056 envisages that track straightening and new fleet will improve the rail connection between the Sydney CBD, the Illawarra-Shoalhaven and the Central Coast and Newcastle. However, significant improvements in passenger rail travel time between the Sydney CBD, the Illawarra-Shoalhaven and the Central Coast and Newcastle are difficult to achieve given the region's challenging terrain, such as steep gorges, river crossings and geotechnical conditions affected by mining activity. Studies into improving travel times between Sydney CBD and Wollongong and Sydney CBD and Newcastle have consistently found that only very modest improvements are likely to be feasible without immense cost.

Around 17,000 workers, or 14 per cent of the Illawarra-Shoalhaven workforce, commute to Sydney, most of them living north of Wollongong. Over time, the proportion of people living in the Illawarra who work locally will increase, but the connection to Sydney will remain important as the number working in Greater Sydney will also grow.[178]

Illawarra-Shoalhaven workforce commute to Sydney

14% or around **17,000** workers commuting to Sydney

Source: Transport for NSW 2017

Passenger rail capacity constraints to and from the Illawarra-Shoalhaven can be overcome with progressive investment in the SmartRail program (refer to section 9.3.3) and, in the long term, by the diversion of freight services from the T4 Illawarra Line. However, as the Western Parkland City takes shape, and its economic connection to the Illawarra-Shoalhaven grows, the case for a direct passenger rail connection between western Sydney and the Illawarra may become stronger. Such an investment is unlikely to be feasible within the timeframe of the 2018 SIS, but should be canvassed as part of the business case for the Maldon-Dombarton freight line.

The M1 Princes Motorway is the major road connecting Sydney and the Illawarra-Shoalhaven. Traffic incidents and congestion on the route can significantly affect travel times, and these challenges are expected to worsen over time. Smart motorway technology can smooth traffic flows and control entry

178 Transport for NSW 2016a, p. 58

and exit points, help to manage congestion and decrease the impact of incidents, as well as equipping motorways to harness the productivity benefits of advanced vehicle technologies. Smart motorways have proven to be a very worthwhile investment both in Australia and overseas; they have similar potential to improve operations on the corridor between Sydney and the Illawarra-Shoalhaven.

In the Central Coast, 22 per cent, or 22,000 people, commute to Sydney every day and six per cent, or 6,000, commute to the Hunter region.[179] In the long term, large numbers of commuters will continue to travel from the Central Coast to Sydney and the Hunter.

Central Coast workforce commute to Sydney and the Hunter

22% or **22,000** workers commuting to **Sydney**

6% or **6,000** workers commuting to the **Hunter**
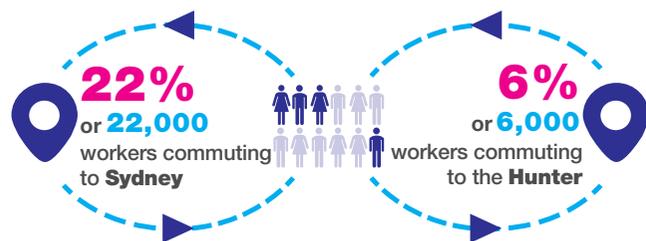
Source: Transport for NSW 2017

Like the Illawarra-Shoalhaven, options for materially improving capacity and travel times on the rail network between the Central Coast and Sydney are unlikely to be economically feasible, even in the long term.

Road access between the Central Coast, Sydney and Newcastle is provided primarily by the M1 Pacific Motorway. As with road connectivity between Sydney and the Illawarra, reliance on one primary link means traffic incidents and congestion can significantly affect travel times. Smart motorways also have similar potential to improve operation on the corridor between Sydney, the Central Coast and Newcastle.

Recommendation 45

Infrastructure NSW recommends that Transport for NSW develop business cases by the end of 2020 for the deployment of Smart motorway technology along the M1 Princes Motorway between Sydney and Wollongong and the M1 Pacific Motorway between Sydney and Newcastle to help manage congestion, improve network resilience and capitalise on future vehicle technologies.

9.3.3   Greater Sydney

The 2018 SIS supports the guiding principle of the '30-minute' city vision and the metropolis of three cities that underpins the *Greater Sydney Region Plan* and *Future Transport 2056*.

By 2036, 6.4 million people will live in Greater Sydney, 1.7 million more people than today, resulting in an estimated increase of 6.2 million journeys each day: up from 16 million now to over 22 million. These daily journeys will generate strong additional demand on

important links into and out of the Eastern Harbour and Central River cities, as well as strong growth in the northern and southern parts of the Western Parkland City.

Future Transport 2056 recognises that catering for this additional demand and maintaining and expanding the '30-minute' catchments within each of Sydney's three cities will require a mobility system that improves people's access to jobs and services without compromising the liveability and amenity of Sydney's suburbs and centres. Infrastructure NSW supports this strategic direction.

Recommendations for Greater Sydney as a whole are presented in this section. Further recommendations for each of the three cities are set out in sections 9.3.4 to 9.3.6.

The NSW Government is investing across Greater Sydney in transformational mass transit projects like Sydney Metro and Sydney Light Rail, as well as in major motorways like WestConnex and NorthConnex, which will improve travel times and increase network capacity. Major investments like these have established the backbone of the citywide transport system and will continue to be critically important in increasing the '30-minute' catchments of each city.

However, even with this investment, Transport for NSW has forecast that rising congestion on parts of the road network and crowding on sections of the rail network will increase travel times and affect the reliability of the system. These trends will impair the productivity of the city, with congestion alone expected to cost over

179 Transport for NSW 2016b, p. 59

$12 billion per annum by 2030.[180] If current levels of private vehicle use persist, they will reduce the '30-minute' catchments across the city.

As shown in Figure 35, major road links in all three cities will experience severe congestion, with an extra 500,000 car trips during each morning peak.

To respond to this, like *Future Transport 2056*, the 2018 SIS recommends a response that will shift demand towards more efficient modes of transport, reduce, re-time or re-route movements and unlock the capacity of current assets by modernising systems and addressing bottlenecks. Both strategies seek to identify transport investments that will support the land use directions in the *Greater Sydney Region Plan*. In this context, Infrastructure NSW recommends investments in the transport sector for Greater Sydney that:

- support and shape the structure of Greater Sydney with major transport infrastructure

- preserve the high levels of amenity that contribute to Sydney's existing competitive advantages

- sustainably manage transport demand by integrating land use with transport

- efficiently move people across an integrated, connected network by using mass movement corridors to their highest potential, improving local accessibility, facilitating ease of interchange and enhancing public and private supply of services

Figure 35 – Road network performance across Greater Sydney in 2036 morning peak

Greater Parramatta

Harbour CBD

Western Sydney Airport – Badgerys Creek Aerotropolis

Volume / Capacity ratio
— 0.8-1.0 (at capacity)
— >1.0 (above capacity)
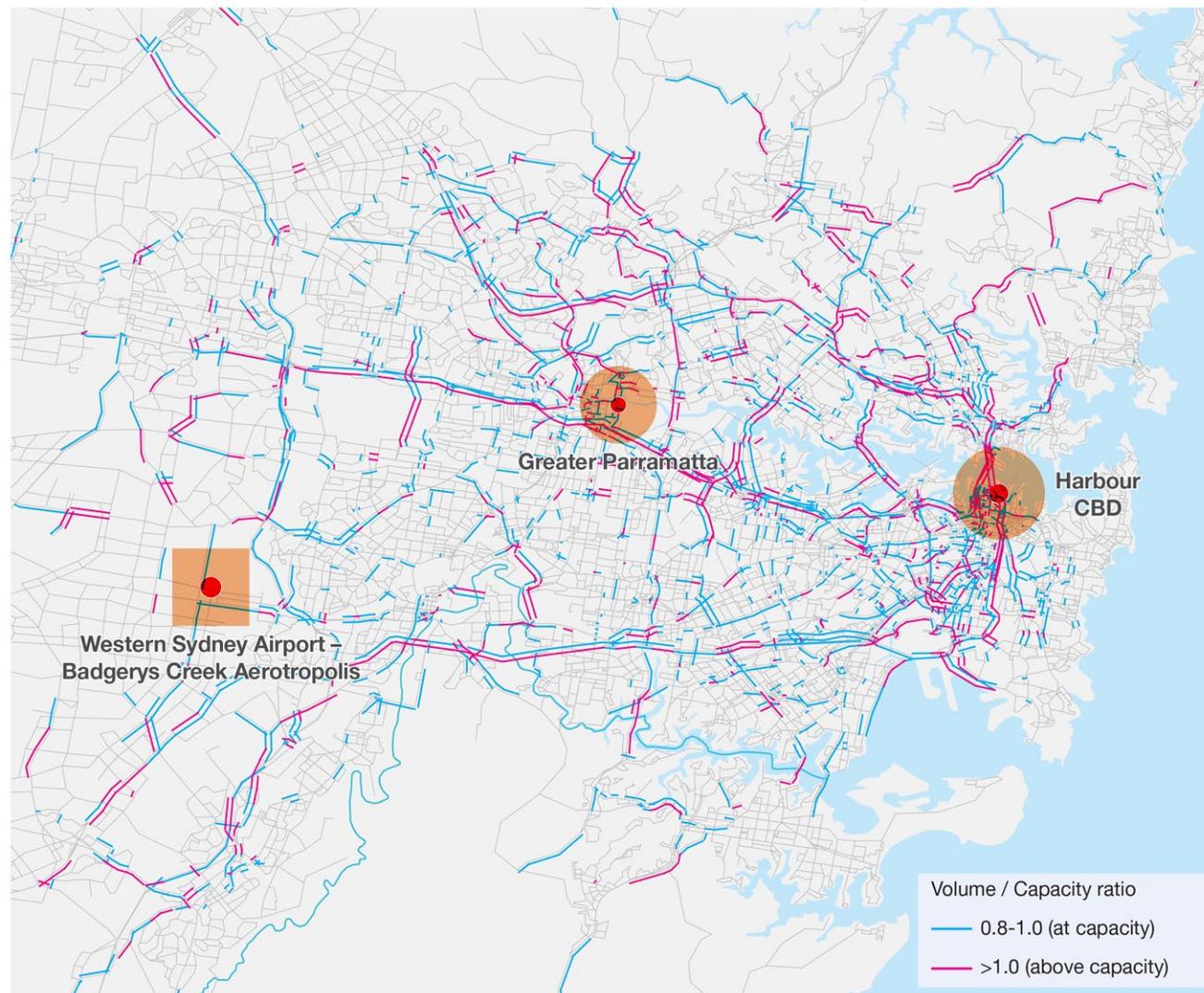
Source: Transport for NSW 2017

180 Bureau of Infrastructure, Transport and Regional Economics (BITRE) 2015, p. 1

- reduce the incidence of accident trauma on the metropolitan transport network
- mitigate emissions and adapt to the impacts of climate change.

Demand management

Congestion brings with it considerable social and economic costs, including increased travel times, lost productivity, health impacts from stress and increased air pollution, and increased vehicle operating costs. These affect Sydney's economic productivity and liveability.

Analysis of global cities (refer to Figure 36) suggests that cities with higher congestion levels than Sydney have a materially lower quality of life. Sydney may have reached a point of inflection, beyond which further increases in congestion may significantly reduce its high quality of life and global competitiveness.[181]

In addition, reducing congestion will reduce emissions in line with Australia's commitments to the *Paris Agreement* and NSW's Net Zero Emissions objective. In NSW, the transport sector contributes 20 per cent of all greenhouse gas emissions, with road based transport – cars, commercial vehicles and buses – contributing over 85 per cent, as shown in Figure 37. Further details on the transition toward electric vehicles and charging infrastructure are outlined in Chapter 10.

Figure 36 – City congestion and quality of living rankings
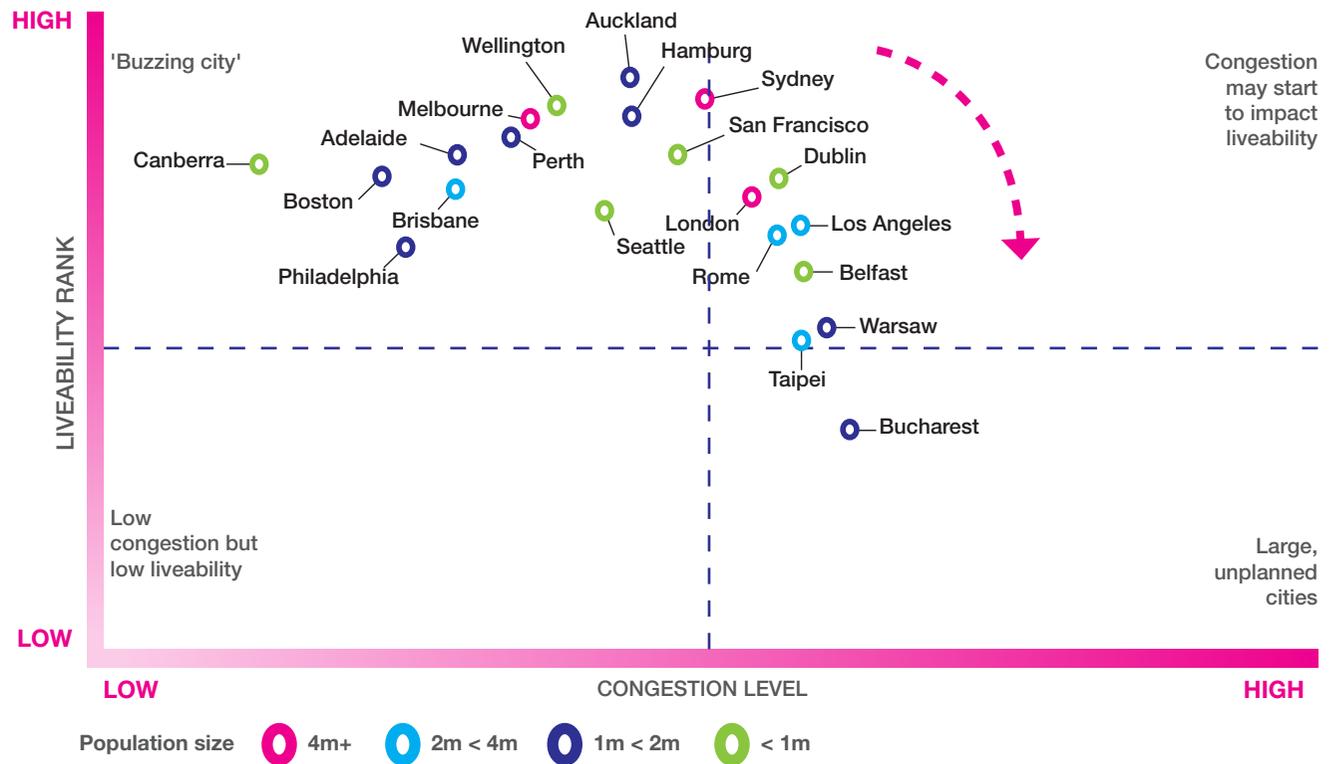
Source: Austroads 2016, *Congestion and Reliability Review*

Figure 37 – NSW transport related greenhouse gas emissions
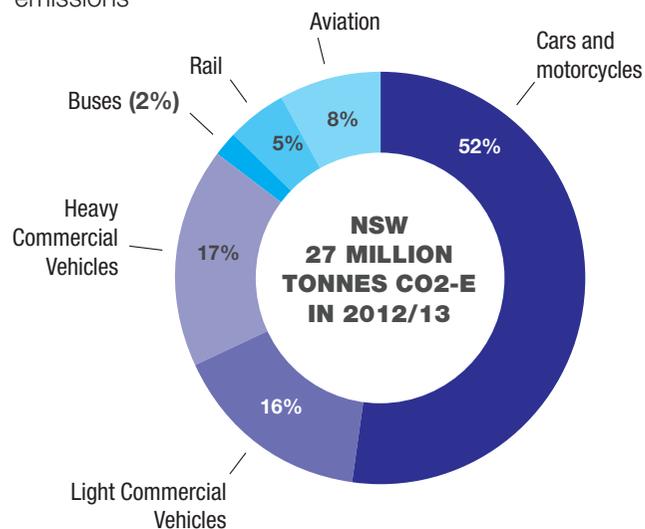
Source: Centre for Transport, Energy and Environment and Pekol Traffic and Transport 2015, *NSW Transport Facts*

As new major links like WestConnex, NorthConnex and the planned Western Harbour Tunnel are established, the necessary functional links that have been missing from the urban motorway network will be completed, particularly in the eastern and central regions of metropolitan Sydney. However, over the term of this strategy, further investment in expanding the road network in established parts of Sydney will become harder to justify given:

- the high cost of major road projects
- the decreasing amount of land available to accommodate new roads
- the negative impacts of traffic on the amenity of neighbourhoods.

Integrated system-wide pricing

While transport is crucial to economic prosperity and the quality of people's lives, it comes with a cost. Part of this cost is recovered from users through public transport fares, fuel excise, vehicle registration fees and tolls.

In addition, transport activities impose societal costs from congestion, crowding, air pollution and noise, which impact people's quality of life, health and productivity. These costs are not reflected in the prices road users pay and are ultimately borne by others and society in general. This results in an inefficient transport system as the choices made by drivers, passengers and freight operators regarding when to travel and their mode, route and vehicle type do not consider the external costs they cause.

The introduction of a system-wide user pricing system for the Sydney metropolitan area and for heavy vehicles across NSW would represent a means to more fairly recover costs to provide mobility, relieve congestion, improve road safety and reduce other costs to society.

Pricing reform in the transport sector has been considered by governments for at least two decades, albeit with little change in institutional arrangements – as found by the 2015 Harper Competition Review. In response to this review, the reform process was refreshed as Heavy Vehicle Road Reform in 2015, with heavy vehicle user pricing at its core, and has since been endorsed by the Commonwealth, state, territory and local governments.

In December 2016, as part of the *Intergovernmental Agreement on Competition and Productivity Enhancing Reforms*, state and territory governments (including NSW) and the Commonwealth Government committed to accelerate the Heavy Vehicle Road Reform, including identifying steps to introduce pricing regulation by 2017-18 and developing cost-reflective road pricing for all users.

In 2017, the Commonwealth Government (in response to Infrastructure Australia's recommendation to introduce road pricing for all vehicles within 10 years) commissioned a study to investigate its costs and benefits for the community, noting that its introduction would hinge on a positive net benefit.

Current reform discussions are focused on providing a direct link between users and the cost of transport provision. Infrastructure NSW supports this approach.

Reform of road user charging has proven very challenging for governments, not just in NSW but globally. However, the advent of electric and autonomous vehicles will inevitably transform people's use of the road network and will require changes to funding and charging arrangements. In anticipation of these developments, Infrastructure NSW considers it would be prudent for the NSW Government to begin to assess the options for reform of road user charging.

It will become increasingly important to ensure that the use of scarce road space is optimised. Pricing can play a role, with economic modelling undertaken as part of the 2018 SIS suggesting that it leads to fairer charging for users of the system, decongestion of the network and overall economic benefits. Any reforms to road user charging will require careful consideration given current community sentiment on the issue.

Recommendation 46

Infrastructure NSW recommends that it partner with NSW Government agencies to develop a 'road map' by the end of 2020 that examines the merits of, and outlines a pathway to, an integrated, system-wide user pricing regime across the Sydney metropolitan road and transport network that contemplates the impacts of electric and autonomous vehicle technology.

Using the road network more efficiently

As Sydney's population grows, competition for scarce road space between users, modes and sectors will increase. A more efficient way of moving increasing numbers of people and goods on existing, constrained networks will need to be found. Particularly in the commuter segment of the travel market, private vehicle traffic with low vehicle occupancy rates is far less efficient at moving people than public transport.

Relative efficiency of transport modes

1 **Waratah train carriage**

is equivalent to

1.4 Sydney buses

or about

22 full cars
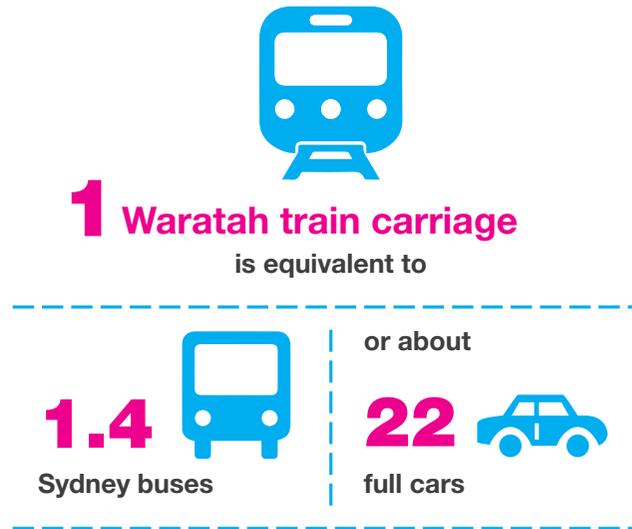
Source: Transport for NSW 2017

The NSW Government has provided record funding to upgrade and extend Sydney's road and public transport networks over the next decade. This means that parts of Sydney, including the Eastern Harbour City, will maintain a very high standard of amenity and public transport accessibility and connectivity. These parts of the city should play a key role in accommodating population and jobs growth.

Population growth will complement the already high density, mixed use areas in the Eastern Harbour City and strengthen established patterns of high volume, concentrated flows of people and goods throughout the day, not just in peak times.

However, as indicated in Figure 35, even with the major investments committed or underway, unless private

vehicle use can be reduced, population growth will result in severe congestion on a majority of roads in the Eastern Harbour City by 2036.

To protect the amenity that Sydneysiders prize so highly, available road space will need to be used more efficiently. Reallocating road space in key corridors to more efficient and sustainable modes is critical – modes such as light rail, buses and active transport that will maintain high patronage levels throughout the day.

Recommendation 47

Infrastructure NSW recommends that Transport for NSW develop a program to reallocate and prioritise road space for on-road rapid transport links for buses and high-efficiency vehicles on major routes into the Sydney CBD as major projects like WestConnex, Sydney Metro and SmartRail are completed progressively over the next five to 10 years.

In the Western Parkland City, the NSW and Commonwealth Governments have co-invested in the Western Sydney Infrastructure Plan, which provides key road infrastructure to support the early development of the city. This program aims to improve connectivity between the main centres of Greater Penrith, Liverpool, Campbelltown and the Western Sydney Airport, and complements other major infrastructure like the Liverpool and North West T-Ways, as well as major arterial roads linking growth areas.

While rail networks will be important over the long term, the arterial road network provides an opportunity

to introduce a high quality rapid bus network to serve the airport and the metropolitan centres of Liverpool, Penrith and Campbelltown as the Western Parkland City takes shape.

Establishing this network should leverage investment in the Western Sydney Infrastructure Plan by reallocating road space, extend the Liverpool T-Way to Western Sydney Airport and include the necessary bus priority infrastructure and complementary supporting infrastructure to provide high user amenity and accessibility (such as stops, shelters and weather protection, and signage).

Recommendation 48

Infrastructure NSW recommends that Transport for NSW develop business cases by the end of 2019 for the progressive delivery of a bus rapid transit network connecting the centres of Liverpool, Campbelltown, Greater Penrith, Blacktown and Western Sydney Airport over the next 10 years.

Notwithstanding the Government's major investment in public transport, the road network will continue to be crucial to the movement of people and goods. Pinch points, bottlenecks and reliability problems on the existing road network were highlighted in the *State Infrastructure Strategy Update 2014*, with recommendations for investment in targeted upgrades as part of the Easing Sydney's Congestion program. Projects implemented as part of this program, such as the Pinch Points Program and upgrades to Sydney Coordinated Adaptive Traffic System, have consistently demonstrated large benefits relative to their costs.

Further targeted investments to remove pinch points, improve public transport priority and upgrade traffic management systems should remain a priority.

Recommendation 49

Infrastructure NSW recommends that the NSW Government continue the *Easing Sydney's Congestion* program over the next 10 years with further progressive investment in targeted, small scale, high impact network management programs (such as pinch points, clearways and bus priority programs) and Co-operative Intelligent Transport Systems (such as upgrades to the Sydney Coordinated Adaptive Traffic System and Transport Management Centre).

Walking and cycling provide people with flexible point-to-point mobility for short trips and make neighbourhoods more liveable by reducing noise and pollution from through-traffic. They can easily coexist with public open spaces where people like to relax. Walking and cycling trips help to reduce ill-health and health-related expenditure, and ensuring they are safe and protected from traffic is proven to increase their use.

Within high density areas, such as major retail districts and employment centres, walking is by far the most efficient means to travel, given the relatively short distances involved and volumes of traffic on the road network. Ninety per cent of trips in Sydney's CBD are made on foot[182] and the introduction of Sydney Light Rail and the pedestrianisation of George Street will transform walking in the CBD. However, pedestrians

182 Transport for NSW 2013, p. 10

in other parts of the CBD face high levels of crowding and long wait times at intersections. Improvements targeted at reducing wait times, widening kerbside areas and increasing accessibility would have a significantly positive impact on productivity and amenity.

Walking and cycling should be encouraged in the established Eastern Harbour and Central River cities, and integrated into planning for the new growth areas in the Western Parkland City.

Recommendation 50

Infrastructure NSW recommends that by the end of 2018, Transport for NSW develop business cases on a city-by-city basis for an annual program of investment in a network of protected cycleways linking major strategic centres across the three cities. This should be delivered in partnership with local government and be integrated with the Greater Sydney Commission Green Grid.

Recommendation 51

Infrastructure NSW recommends that Transport for NSW, in partnership with local government, develop a 10-year rolling program that prioritises active transport at high volume and high profile locations in the Sydney CBD and other strategic centres.

Greater Sydney rail strategy

Future Transport 2056 acknowledges the rail network will play a pivotal role in realising the vision of a three-city metropolis with connected housing, jobs and services outlined in the *Greater Sydney Region Plan*. To achieve this, the Greater Sydney rail network will need to transition from its predominantly radial pattern and focus on the Eastern Harbour City to service an interconnected system of cities and centres with accessible 30-minute catchments.

Rail trips are expected to more than double over the next 20 years, growing from 386 million trips per year in 2016 to 817 million by 2036 and to over 1.1 billion by 2056. As shown in Figure 38, without further investment in parts of the network as Sydney grows, beyond 2021, the main routes into the Eastern Harbour City and the Central River City will suffer from levels of crowding that will impair the performance of the system.

To address these pressures, in the near term, Transport for NSW has developed the SmartRail program, a series of network-wide investments that will deliver additional capacity, reduce the complexity of rail operations and better connect the network. SmartRail will transform the rail network by utilising world-class technology to enable automated high-capacity turn-up-and-go services. The first three stages should be delivered over the next 10 years, with targeted investments to remove bottlenecks, automate train control, improve signalling systems and capitalise on the benefits of new rolling stock and infrastructure.

Stage 1 would deliver extra capacity across the network by upgrading rail infrastructure to unlock capacity in central Sydney. It includes the development

Figure 38 – Rail network demand and capacity on key lines to 2026
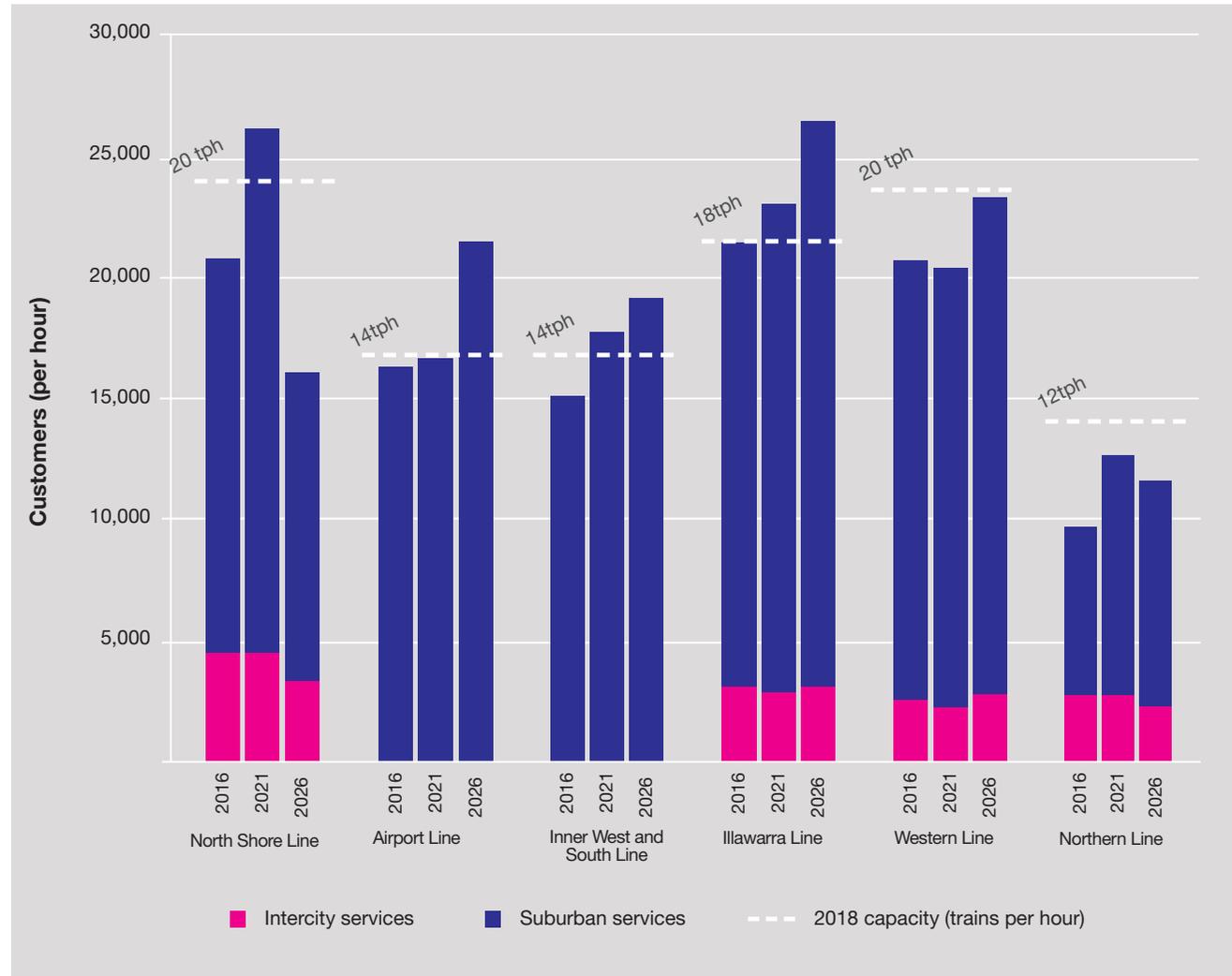
Source: Transport for NSW 2017

of new automated systems to cost-effectively improve train control. Stage 1 would deliver capacity upgrades on the T4 Eastern Suburbs and Illawarra line and the T8 Airport line.

Stage 2 would continue to upgrade the T4 Eastern Suburbs and Illawarra line and improve the T8 Airport line, providing an uplift of capacity, as well as delivering further upgrades in central Sydney to provide a network-wide benefit. Stages 1 and 2 include the deployment of new suburban trains and coincide with the introduction of the New Intercity Fleet, further improving services across the network.

Stage 3 would complete the reconfiguration of the network in central Sydney, deploying automation and providing the transformative programs needed to separate inner urban and intercity services on the T1 Western and Northern line and the T4 Eastern Suburbs and Illawarra line.

These investments would deliver significant customer benefits by transforming the network into a more efficient and reliable rail system that allows more trains to run per hour in peak times and helps separate longer distance intercity, suburban and freight services from suburban operations. SmartRail will allow the independent operation of rail lines across the system, improving the capacity, frequency and reliability of the network and permitting the conversion of lines to provide high-frequency all-day services in the future, with the T4 Illawarra Line as the top priority for transformation.

While SmartRail will benefit the entire network, the most constrained parts of Sydney's heavy rail system will realise the most significant benefit of the initial stages, particularly services in the south of Sydney on the T4 Illawarra Line and the T8 Airport Line.

The State Infrastructure Strategy Update 2014 allocated $1 billion towards the More Trains More Services program, and SmartRail should continue to be a priority for funding to ensure that existing rail assets are used to their full potential.

Recommendation 52

Infrastructure NSW recommends that Transport for NSW complete business cases for Stage 1 and Stage 2 of the SmartRail program by the end of 2018 and 2019 respectively to enable progressive delivery of this program as a priority to provide capacity needed beyond 2021.

Sydney Metro is at the heart of the Government's agenda for the rail system. New links being procured and built, including Sydney Metro North West and Sydney Metro City & South West, will increase coverage of 30-minute rail catchments across Sydney and provide high frequency connections between the three cities.

Beyond these new links, Transport for NSW has identified further extensions to the rail network to relieve capacity pressures, increase 30-minute catchments and facilitate the evolution from a predominantly radial to an interconnected network that is no longer reliant on travel through Sydney CBD to access other parts of the city.

With the SmartRail program addressing capacity constraints in the south of Sydney, Transport for NSW's top priority for a new rail link is the Sydney Metro West project, which will connect the Eastern Harbour City to the Central River City and double capacity between Parramatta and the Eastern City's CBD. The business case for this project is in development and – assuming that the project proves to be affordable in the near and medium term – it could be delivered by around 2027.

Other network extensions will become important in the longer term. Transport for NSW has identified potential new links that radiate from Parramatta, establishing it as the centre of the long-term rail network and reinforcing its role as the second city in the Greater Sydney metropolis.

New links from Parramatta to Kogarah, Parramatta to Epping and Parramatta to Norwest, and an extension of Sydney Metro South West to Liverpool, would considerably increase the catchment that can easily access the Central River City. A link between Kogarah and Parramatta would mean that an extra 324,000 people would be able to access the Parramatta CBD within 30 minutes by public transport. A link from Epping would increase this catchment by an extra 276,000 people, and a link from Norwest would contribute an additional 264,000 people.[183] Focusing these new links on Parramatta significantly strengthens the network overall – providing direct connections between strategic centres without having to travel via the Sydney CBD.

183 Transport for NSW 2017b

The development of a sustainable and compact urban form in the Western Parkland City will ultimately require the provision of mass public transport services. Transport for NSW has identified the backbone of this network, involving a new north-south link between the North West Growth Area, T1 Western Line and the new Western Sydney Airport that will ultimately continue south to Campbelltown and beyond, as well as new links to Parramatta, and to Leppington.

As these projects are developed, it is crucial that they contribute to achieving higher population densities, integrating land use with transport. Combining new or updated stations with pedestrian-friendly environments, public spaces, on-road rapid transit networks and active transport will help to reduce traffic congestion.

Early investment in the north-south corridor through Western Sydney Airport to Campbelltown has the potential to shape development in a way that favours mixed use, high density patterns and supports employment precincts around the new airport. However, the significant cost of this link means that without co-investment from the Commonwealth Government and the private sector, the NSW Government will need to weigh its relative priority against more pressing needs, especially those in the Central River City as outlined above.

Infrastructure NSW considers that the Sydney Metro West project should be the priority for rail network extensions, followed by the new links necessary to service the Central River City. Beyond this, rail connections to the Western Parkland City, integrated with land use, via the Western Sydney Airport should

only be a priority once they are justified by patronage at the airport having reached a critical mass. This is unlikely to be the case before 2036, unless investment form the Commonwealth Government and the private sector significantly offsets the contribution of the NSW Government.

Recommendation 53

Infrastructure NSW recommends that Transport for NSW complete the Sydney Metro West business case before the end of 2018 and continue to progress corridor planning and protection activities for future links in the Central River City and Western Parkland City.

As the rail network is augmented and upgraded, the role of interchanges will become paramount as users switch between services to get to their destinations. Given their size and location, major transport interchanges have place-making functions that go beyond enabling a smooth interchange between services. Integrating a mix of uses (including high density residential uses) with interchanges will create vibrant places where people live and shop, local businesses prosper and people want to spend time.

Transport for NSW has identified Central station, Redfern, Circular Quay, and other locations in the Metropolitan Interchange Program as priorities in the existing network for upgrades. In addition, as major transport projects like the Metro and light rail networks are delivered, new interchanges will be established.

Opportunities to partner with the private sector to integrate land use with transport, and help fund

development, should be pursued for both existing and new interchanges.

Recommendation 54

Infrastructure NSW recommends that by the end of 2018, Transport for NSW complete business cases and planning for the upgrade of major public transport interchanges at Central, Redfern and Circular Quay, and develop a program for the progressive upgrade of other major interchanges across Greater Sydney.

Greater Sydney's strategic road network

Future Transport 2056 sets out a long-term vision in which Sydney's motorway network evolves to connect important economic precincts and gateways such as Western Sydney Airport and to capitalise on advanced vehicle technology. Infrastructure NSW supports the vision of *Future Transport 2056* for smart, digitally connected and efficient motorways that service the city's key economic assets and enable the mass movement of people and goods without compromising Sydney's prized amenity.

The NSW Government's investment in WestConnex and NorthConnex, combined with existing links such as the M2, M7 and the M31 in the Central River and Western Parkland cities, establishes the backbone for vehicular movement into and around Sydney. When complete, this network will provide much-needed connectivity between the three cities of Sydney, the main economic precincts of Sydney's service-based economy in the Global Economic Corridor, international gateways (such as the port and airports)

and important freight and logistics precincts (such as Moorebank Intermodal Terminal).

Modernising the motorway network

Investment into Sydney's motorway network will serve generations to come, not least because advanced technology has the potential to improve the capacity and efficiency of the network by allowing traffic to flow more smoothly with fewer disruptive incidents and less congestion. Sydney's motorway network needs to be ready to take advantage of these technology-driven opportunities, using Co-operative Intelligent Transport Systems (C-ITS) that will enable Vehicle to Infrastructure communication (V2X) within regulatory settings that will foster the introduction of high-efficiency Connected and Autonomous Vehicles (CAVs) to the network.

Recent investment in Smart motorway technology is a good starting point, as is the upgrade of the Sydney Coordinated Adaptive Traffic System – a traffic signalling detection, analysis and signalling system developed by Roads and Maritime Services that is used in over 150 cities around the world. These investments have consistently demonstrated high returns relative to their costs and will significantly improve the capacity, reliability and safety of the network, potentially deferring the need for further investment in motorway widening and freeing up funds for other uses.

Rolling out Smart motorway technology across the network will ensure that existing assets are operating to their full potential and the benefits of new motorway investments are maximised. The network wide roll-out of Smart motorway technology should be staged

to complement the opening of NorthConnex and WestConnex to leverage the benefits of these links, and ultimately be in place prior to the opening of the Western Harbour Tunnel.

Recommendation 55

Infrastructure NSW recommends that Transport for NSW develop business cases to complete the deployment of Smart motorway technology and digital infrastructure across the network in time for the expected opening of the Western Harbour Tunnel.

Future Transport 2056 envisages further extensions to the strategic road and motorway network through projects such as the Western Harbour Tunnel, Beaches Link, the F6 Extension, new motorways to connect the Western Parkland City into the Sydney motorway network and longer-term connections such as a new Central River City motorway linking the M2 and M5, as well as the full development of the Outer Sydney Orbital.

These projects will provide crucial functions for the strategic road network such as improving its resilience, extending the network to major growth areas and connecting key freight precincts.

Sydney's inner urban motorway network

With the completion of WestConnex Stage 3: M4-M5 Link and the Western Harbour Tunnel, a western bypass of the CBD will be created. This completed bypass will establish an inner urban motorway network enclosed by the M1, the M2, the M5 and the M7 and connected by cross-town routes via the

M4, WestConnex, Western Harbour Tunnel and the Cross City Tunnel, as shown in Figure 39. Future Transport 2056 estimates that gains from advanced vehicle technology could significantly improve freeway capacity as CAVs are taken up. An integrated, cross-town, inner urban motorway network that is free of 'missing links' will serve Sydney well into the future.

Infrastructure NSW recognises that the Western Harbour Tunnel will considerably strengthen the capacity and resilience of the Sydney motorway network. Crucially, the western bypass of the CBD provides the opportunity to remove through traffic from sensitive residential and commercial precincts, improving public amenity and enabling the allocation of more surface road space to public transport, walking and cycling.

It is important to complete the business case for Western Harbour Tunnel as a priority, enabling the NSW Government to take an investment decision on this critical project.

Recommendation 56

Infrastructure NSW recommends that subject to completion of the business case in 2018, the NSW Government invest in the Western Harbour Tunnel to complete a Western CBD Bypass and inner urban motorway network.

Figure 39 – Sydney motorway network

Motorways in delivery | Planned motorways | Existing motorways

1. Northconnex
2. Westconnex
3. Sydney Gateway
4. Western Harbour Tunnel
5. Beaches Link
6. F6 Extension
7. M12

Freight activity precincts
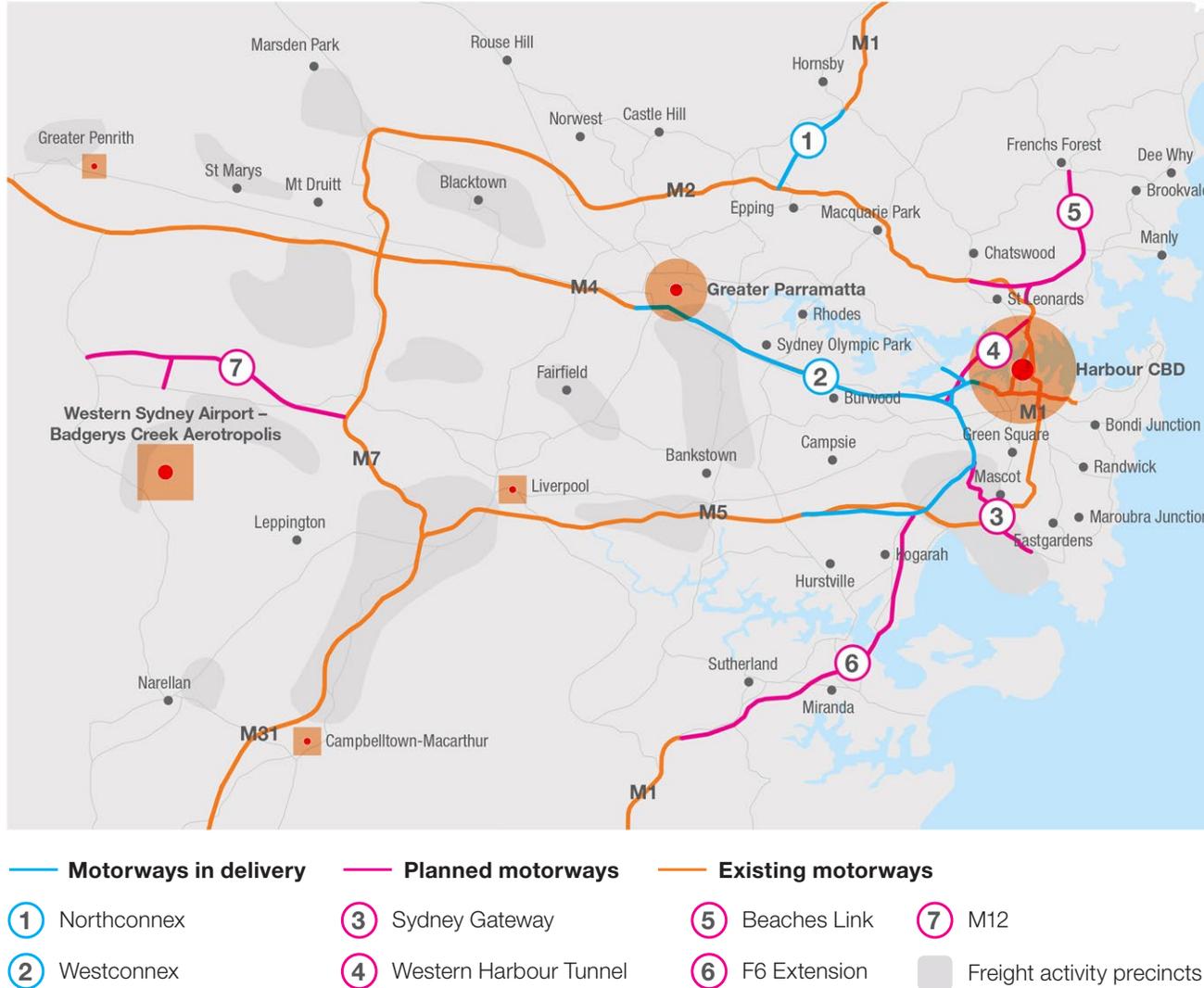
Source: Infrastructure NSW 2017

Connecting key economic precincts

Sydney Gateway will provide a valuable connection between WestConnex and the key international gateways of Sydney Airport and Port Botany. Planning for this link has consistently demonstrated that it returns a high benefit relative to its cost, commensurate with the high value of the productive traffic that is expected to use it. At this stage, the link remains only partially funded. Infrastructure NSW recommends that, subject to a business case, the NSW Government and Commonwealth Government partner to prioritise its delivery.

By 2036, the Western Parkland City will have grown by an additional 500,000 people to over 1.4 million people. Developing a strategic road network that can cater for the mass movement of people and valuable freight is crucial to support connectivity to Western Sydney Airport and the surrounding employment lands. Infrastructure NSW recommends that Transport for NSW continue to develop its plans for the Western Sydney Airport motorway in partnership with the Commonwealth Government, enabling the link to be available at the time of the airport opening in the mid 2020's.

As the Western Parkland City evolves, the Outer Sydney Orbital will provide an important long-term north-south link that connects the Illawarra-Shoalhaven and the National Land Transport Network to the Western Parkland City and the south via the M31.

Recommendation 57

Infrastructure NSW recommends that Transport for NSW complete the business case for the Western Sydney Airport motorway for delivery in time for opening of the Western Sydney Airport. Corridor planning and protection for future strategic road links in the Western Parkland City and to the Illawarra-Shoalhaven should continue to be progressed.

Potential future network expansions

In the Central River City, consistent with *Future Transport 2056*, Infrastructure NSW recommends upgrades to the strategic road network that connects Parramatta to surrounding strategic centres. Along with investments in WestConnex and Smart motorway technology on the M4, these upgrades will reinforce Parramatta's position at the geographic centre of the inner urban motorway and establish a strategic road network to service the Central River City well into the future, at least until a Central City motorway is needed – beyond 20 years from now.

In other parts of Sydney, *Future Transport 2056* envisages the delivery of new motorway projects in the near term. In the South District in the Eastern Harbour City, the F6 Extension has been identified as a priority. The South District has a mature road network that is the target of a $300 million investment from the Pinch Points program and a well-developed mass transit network, with the T8 Airport and South Line and T4 Illawarra Line set to realise significant improvements from the SmartRail program and a new rail link between Parramatta and Kogarah in the longer term.

The F6 Extension would provide a link between the M1 Princes Motorway and the Sydney motorway network near Sydney Airport. The project is currently in the planning phase, with Stage 1 (providing a link between the New M5 and President Avenue at Kogarah) identified as the initial priority. Any decision to invest in Stage 1 should be made subject to a completed business case demonstrating a positive economic return from the investment.

In a similar vein, *Future Transport 2056* considers Beaches Link as a near-term priority for the Sydney motorway network. This project would primarily benefit the eastern parts of the lower North Shore and the Northern Beaches, providing an alternative to the Military Road / Spit Road corridor and bypass the Spit Bridge, which still opens.

Both of these projects provide connections to areas that were expanded over the last four decades and significant congestion has built up over this time.

Infrastructure NSW considers that the F6 Extension and Beaches Link both need to be weighed carefully against other potential government sector investments. In a constrained fiscal environment, a near term decision to invest in these new motorway connections serving the Eastern Harbour City may mean deferral of projects elsewhere in Greater Sydney which may have greater city-shaping impacts. Infrastructure NSW supports an increased focus on public transport (such as the Northern Beaches B-Line and SmartRail), demand management and continued investment in pinch points to ensure fast and reliable access in these locations over the next 20 years.

Metropolitan freight

Strong growth in the Greater Sydney freight task is expected, from 235 Mt in 2016 to 334 Mt in 2036 and 462 Mt in 2056, and is being driven by increased population and related construction and consumption.[184] Freight movements in Sydney are dominated by manufacturing production, construction materials and wholesale retail, representing over 80 per cent of the freight task.

Investment that increases the proportion of freight moved by rail will help to mitigate the wider impacts of this task. Metropolitan roads will continue to be the dominant carrier in the Sydney network, largely due to the typically short distances involved in most freight trips, which mean they are generally not contestable by rail.

Bulk handling network

New commercial and residential development will require an ongoing supply of building materials. Inbound flows of raw materials (such as bitumen, aggregates and sand) and outbound flows associated with cement and concrete and waste products are generated from the building process. In 2016, Greater Sydney consumed approximately 41 Mt of construction material, which translates to more than 5,500 truck trips per day on the network.[185]

To ensure there is an efficient bulk-handling network to support the Eastern Harbour City, it will be important to maintain Glebe Island as a working port for at least the next 20 years, while recognising that it needs to be better integrated with existing and planned urban

184 Transport for NSW 2017c, p. 5
185 Ibid.

development. Glebe Island allows for the efficient transport of the construction materials needed to support the growth of the Eastern Harbour City, with fewer noise, air pollution and safety impacts than freight vehicles.

Recommendation 58

Infrastructure NSW recommends that Transport for NSW lead the development of a bulk materials transport and handling plan for Greater Sydney by the end of 2019 to support the construction and waste management sectors.

Integrate land use and freight planning

As Sydney grows, competition for valuable land will intensify. Pressure to accommodate population growth may have unintended consequences for the operation of freight infrastructure, including impacts on the efficiency of supply chains.

To address these issues, the NSW Government introduced the *Three Ports State Environmental Planning Policy (SEPP)* in 2014. This policy created consistent planning controls across Port Botany, Port Kembla and the Port of Newcastle, protecting these vital assets from incompatible land uses and establishing appropriate zoning of land and waterways to accommodate port uses.

The most common planning instrument used when providing public infrastructure is the 2007 *Infrastructure SEPP*, which outlines provisions for development around key infrastructure assets such as roads, railways, and utilities. In 2016, the Department of Planning and Environment commenced a review of this policy.

Even with this legislative protection, planned residential and commercial developments are at risk of encroaching on key corridors and precincts, increasing conflicts between heavy vehicle traffic and people's legitimate desire to live in a safe and quiet neighbourhood. The result is lost economic opportunities and, often, higher costs for freight operators which could get factored into the price of goods for end-users.

The 2018 SIS, *Greater Sydney Region Plan* and *Future Transport 2056* identify the strategically important freight, port and airport precincts, and key freight connections needed for the next 40 forty years. The NSW Government now needs to update the relevant planning instruments to minimise the negative impacts of freight movements and related activities, while ensuring there is limited encroachment of urban development on these movements, activities and connections. These instruments should:

- preserve strategically important clusters of industrial land in proximity to international gateways and freight-related infrastructure (such as intermodal terminals, major roads and freight rail lines)

- identify, protect and preserve the existing and future freight-related road, rail and pipeline infrastructure. This includes identifying compatible and incompatible land uses in proximity to freight-related infrastructure

- restrict the expansion of permitted uses on industrial lands around international gateways and freight-related infrastructure to avoid displacing traditional industrial developments (that is, reducing pressure on the affordability of industrial lands for 'lower value' industrial uses)

- prohibit incompatible development along key access roads so that they can be used for truck routes to transport freight, including dangerous goods.

Recommendation 59

Infrastructure NSW recommends that the Department of Planning and Environment update the relevant State Environmental Planning Policies by the end of 2019 to further protect strategically important ports, airports, industrial lands, freight precincts and key corridors from incompatible uses to ensure the efficient movement of freight in Sydney and NSW, now and into the future.

Freight precincts

Airfreight is only a small part of the overall freight task, comprising approximately 0.5 Mt in 2016, but its value is significant. In 2015-16, NSW received $38 billion in imports by air and exported $12 billion worth of goods. The value of goods moved by airfreight through Sydney Airport is the same as almost the entire agricultural production of Australia.[186]

Throughput at Port Botany has historically grown by more than six per cent a year, with periodic slowdowns due to droughts or unfavourable global economic conditions. Growth over the last five years has been slower, at only three to four per cent a year. The dynamics of the port are driven by imports (which comprise about two thirds of movements at the port), with exports dominated by the evacuation of empty containers to Asia. The limits of Port Botany's operating capacity are likely to be reached before 2046.

186 Transport for NSW 2017d

Once the Sydney Gateway, Port Botany Rail Duplication and road pinch point works to improve freight flows in the Port Botany and Sydney Airport precinct are completed, the city's major road and rail networks will efficiently connect Sydney's eastern international gateways to strategic centres via WestConnex and the Port Botany line. These major infrastructure upgrades need to be complemented by efficient vehicle access to Port Botany via Botany Road, Foreshore Road and General Holmes Drive. Despite their national significance, these works remain only partially funded. This needs to be rectified as a matter of urgency, with funding support from the Commonwealth Government.

Western Sydney has ready access to the National Land Transport Network and emerging global gateways, but strong growth in freight movements in western Sydney over the next 20 years will expose capacity constraints on existing networks. To address congestion issues on key arterial roads and enable the efficient distribution of containers to and from Port Botany, rail will need to play a much greater role via dedicated lines linked to a network of intermodal terminals across Sydney.

The Moorebank Intermodal Terminal, Port Botany Rail Duplication and policy reforms including the Port Botany Landside Improvement Strategy (which enhances the efficient coordination of road and rail freight in and out of Port Botany) are the highest priority investments necessary to achieve a target of carrying 40 per cent of containerised traffic on rail to and from Port Botany. Within the next 40 years, developments around Western Sydney Airport and the

creation of additional intermodal terminals will require a Western Sydney Freight Line, complementing other long-term investments in freight networks such as the Outer Sydney Orbital.

A reliable road network will be needed to give trucks efficient access to the Moorebank Intermodal Terminal. To achieve this, Transport for NSW has developed the Moorebank Intermodal Terminal Road Access Strategy. The first stage recommends that the M5 be upgraded to eliminate the existing bottleneck between Moorebank Avenue and the Hume Highway and to extend Cambridge Avenue to provide an alternative road access to the terminal.

Recommendation 60

Infrastructure NSW recommends that Transport for NSW finalise business cases by the end of 2018 to enable the NSW Government to partner with the Commonwealth Government to fund investment in Sydney Gateway, Port Botany Rail Duplication and Foreshore Road/Botany Road, as well as the Moorebank Intermodal Terminal Road Access Strategy, to remove bottlenecks on connections to and from Sydney Airport and Port Botany and to capitalise on development of the Moorebank Intermodal Terminal.

9.3.4   Sydney's Eastern Harbour City

The Eastern Harbour City will remain the main engine for the NSW economy. It is Sydney's link into globally connected finance, services, education and innovation networks and the primary international gateway for

people, goods and services into and out of Australia. The Eastern Harbour City will need to accommodate strong population and job growth, with an additional 600,000 people living within its established suburbs and renewal areas by 2036.

Infrastructure NSW recognises the need to protect and enhance the competitive advantage of the Eastern Harbour City's economy and its world-class amenity. Investment recommendations target productivity, liveability, access and connectivity enhancements that:

- maintain the Eastern Harbour City's position as an established globally competitive finance, services, education, innovation and FinTech hub by assuring efficient and reliable mass movement access to its employment centres

- leverage the Eastern Harbour City's rich endowments in natural and built capital to accommodate population growth and maintain high levels of amenity and liveability by integrating land use with transport

- create vibrant neighbourhoods and improve the public realm, recognising the city- and place-shaping functions of transport investment decisions

- improve connectivity between current and emerging innovation precincts, research institutions and financial and business services at the periphery of the CBD

- maintain the Eastern Harbour City's position as the primary international gateway for people, goods and services by providing efficient and reliable connections to Port Botany and Sydney Airport.

Maintain mass transit accessibility to the Eastern Harbour City

Now and in the future, the Eastern Harbour City will continue to provide the majority of jobs in Greater Sydney, with an additional 480,000 jobs created by 2036. In the face of this significant future jobs and population growth, travel demand on routes into the CBD is expected to grow strongly.

Without further investment, radial links in the Eastern Harbour City from Sydney Airport, Parramatta and the north, north-western and south-western Sydney access corridors, which already cater for the highest demand during the morning peak period, will suffer from severe crowding and congestion.

The SmartRail program and Sydney Metro City & South West will help alleviate these pressures to some extent. However, in the short to medium term, an augmentation of public transport capacity is needed, particularly in the critical corridor between the Eastern Harbour and Central River cities. Sydney Metro West will provide this capacity boost, doubling mass transit capacity on services in the corridor. Based on Transport for NSW's work to date, and assuming it is affordable, Sydney Metro West could be implemented by around 2027 – mid-way through the timeframe for this 2018 SIS.

Given this long lead time, while Sydney Metro West is being developed and delivered, on-road rapid bus transit that supports the Sydney to Parramatta corridor should be delivered as a priority on Parramatta Road and Victoria Road. High-frequency bus services could provide additional capacity for the 70 per cent of trips made in the corridor that are less than 10 kilometres

in length, and would complement Sydney Metro West when it is developed.

On-road rapid transit schemes could increase inbound bus capacity in the Sydney to Parramatta corridor by nearly eight per cent in the peak hour, moving upwards of 4,200 people per hour per lane – around 2,700 more than a regular traffic lane.

However, high quality on-road public transport will not be feasible if the Government continues to insist on preserving existing levels of road space for general car traffic. With record investment in projects like WestConnex putting large volumes of traffic into tunnels, higher priority should be given to public transport by converting existing traffic lanes to full-time public transport lanes, without the need for significant land acquisition.

Recommendation 61

Infrastructure NSW recommends that, by the end of 2018, Transport for NSW develop business cases for on-road rapid transit and priority infrastructure that caters for buses and high-efficiency vehicles on Parramatta Road and Victoria Road in support of the Sydney Metro West project.

Improve connectivity around the Sydney CBD

With current and future investment plans, radial movements into and out of Sydney's CBD will remain well served by public transport and high capacity road links. However, movement in and around the periphery of the CBD is constrained by limits on road capacity and impermeable physical barriers. Better public transport connections would enhance the

vibrant, innovative and highly-productive areas located at the periphery of Sydney's established CBD, such as the health, research and education precincts in Camperdown and Randwick and knowledge and digital-creative start-ups in Pyrmont and Australian Technology Park in Eveleigh, as well as major growth precincts in Green Square, Central to Eveleigh and the Bays Precinct.

Future Transport 2056 identifies rapid bus links from the Eastern Suburbs to the Inner West that provide this connectivity. These include links from Randwick to Sydney University to the Bays Precinct and from Maroubra Junction to Sydney Airport to Marrickville. Reallocating road space and prioritising movements for these services will enable them to be delivered affordably, earlier and more effectively than otherwise would be the case.

Recommendation 62

Infrastructure NSW recommends that Transport for NSW develop business cases by the end of 2019 for staged investment in on-road rapid transport links for buses and high efficiency vehicles on key corridors at the periphery of the Harbour CBD over the next five to 10 years.

9.3.5   Sydney's Central River City

The Central River City is the geographic centre of Sydney, featuring a diverse economy, recreational facilities and a world-class health and education precinct at Westmead. With Greater Parramatta to the Olympic Peninsula as the focus for development, it will provide a greater choice of housing, major entertainment and cultural facilities, and green spaces within enriched waterways and restored landscapes. To support this transformation, the Central River City needs further investment to deepen and increase its access to labour markets and enhance its function and attractiveness as a place of business and economic activity. Infrastructure NSW recommends investments that:

- support the aspiration for the Central River City to become a stronger and better connected liveable city and a major centre for knowledge-based employment by improving connectivity between CBD precincts and key economic assets

- cater for significant population growth in the Central River City, with priority investment in Greater Parramatta to the Olympic Peninsula that integrates land use and transport planning

- establish the Central River City as the centre of the Greater Sydney high-order transport network with improved mass transit connectivity to the Eastern Harbour City and Western Parklands City

- encourage economic development and jobs growth in Greater Parramatta and other centres by creating agglomeration opportunities through increasing accessibility and permeability to and from major centres and skilled labour markets

- reduce social exclusion and disadvantage through improved access to services and opportunities.

Enhance radial links to the Central River City

To support the creation the Central River City, it's economic and social catchment needs to grow, with additional transport network capacity and improved radial connectivity to Greater Parramatta. Ultimately, the Central River City should become the centre of Greater Sydney's high-order transport network by capitalising on its geographic location at the heart of the city.

Infrastructure NSW supports the staged investment approach outlined in *Future Transport 2056* – an approach that will better connect Parramatta to the Eastern Harbour City and Western Parklands City and enable economic development and jobs growth. Transport investment should target agglomeration opportunities by increasing connectivity to the major centres and labour markets of Blacktown, Norwest, Epping, Macquarie Park, Sydney Olympic Park and Bankstown that are located in a radial pattern around Parramatta, as shown in Figure 40.

Parts of the Central River City south and south-west of Parramatta, are among the most disadvantaged areas in Sydney. While the causes of this disadvantage are complex, overcoming the social exclusion that results should be a key driver of investment choices: a high level of accessibility by public transport can help to address this issue.

Programs like SmartRail and extensions to the rail network will improve mass transit connectivity to the Central River City, but rail-based investments have long lead times and are costly. In the interim, investment should focus on small-scale measures to improve existing infrastructure networks and services. Bus rapid transit lines in the Central River City currently provide good connectivity between Greater Parramatta and the strategic centres of Liverpool, Rouse Hill, Blacktown and Norwest. In the short term, the priority should be to improve the two existing T-Ways with enhanced signal priority, capacity and connectivity by integrating these separate systems.

Recommendation 63

Infrastructure NSW recommends that Transport for NSW develop a business case by the end of 2019 to augment the capacity and productivity of the Liverpool to Parramatta and North West T-Ways with additional services, enhanced signal priority and a Wentworthville T-Way-to-T-Way connection to link the two separate lines.

Figure 40 – Strategic transport connections for the Central River City

Major north-south road traffic flows in the Central River City radiate from the centre of Greater Parramatta, channelling traffic through the Greater Parramatta CBD, reducing its amenity and creating localised congestion. An outer ring road that creates a bypass around Parramatta via the A28/A40 corridor, together with traffic calming measures within this ring road, would protect Parramatta's CBD and residential areas from traffic intrusion, improve amenity and provide better north-south connectivity.

Recommendation 64

Infrastructure NSW recommends that Transport for NSW develop a business case by the end of 2019 to establish an outer Parramatta ring road bypass to protect the Parramatta CBD from traffic intrusion.

Similarly, the existing north-south arterial roads between the M2 and the M5 that access Greater Parramatta, such as the A3, A6, A28 and A40 corridors, will need to cater for the additional demand that will accompany population growth. Investing in technology to better monitor traffic conditions, manage congestion, prioritise high- efficiency vehicles and respond to incidents in real time will improve reliability on the key arterial roads on this corridor.

Source: Transport for NSW 2017

Recommendation 65

Infrastructure NSW recommends that Transport for NSW develop business cases by the end of 2019 for the progressive upgrade of key north-south arterials between the M2 and the M5 to Smart road facilities to improve connectivity, safety and reliability.

On-road rapid transit that connects strategic centres such as Bankstown, Hurstville, Kogarah, Epping and Macquarie Park to Greater Parramatta should be a short- to medium-term priority, ahead of any investment in rail-based mass transit. Reallocating road space and prioritising access for on-road rapid transit will be crucial to achieve this affordably and to present a credible, competitive alternative to private vehicle trips on key corridors. Investments in bus services should be considered in the context of long-term planning for mass transit to and from Parramatta to ensure they play a supporting role for mass transit when it becomes feasible.

Recommendation 66

Infrastructure NSW recommends that Transport for NSW develop business cases by the end of 2019 for investment in on-road rapid transit links for buses and high efficiency vehicles between Greater Parramatta and surrounding strategic centres such as Bankstown, Hurstville, Kogarah and Macquarie Park.

Transport for NSW has proposed Stage 2 of the Parramatta Light Rail project. This is intended to link Stage 1 of Parramatta Light Rail near Rydalmere to Sydney Olympic Park, crossing the Parramatta River via a new bridge at Wentworth Point. Improving connectivity to Sydney Olympic Park and the Wentworth Point peninsula will increase accessibility and help to cater for growth. The relative merit of Stage 2 as an investment priority should be considered once the business case is complete and the route, benefits and costs are clear.

The business case should examine the optimal route for the project, how it will integrate with planned on-road rapid transit on Victoria Road, the potential for extensions to Strathfield and/or Burwood and how it might integrate with the Sydney Metro West project.

Recommendation 67

Infrastructure NSW recommends that Transport for NSW develop the business case for Stage 2 of Parramatta Light Rail project by the end of 2018 to enable the NSW Government to make an informed investment decision on the project.

Improve connectivity within Greater Parramatta and the Olympic Peninsula

Greater Parramatta to the Olympic Peninsula is the focal point of the Central River City and will change dramatically as current, planned and future transport infrastructure converges in the area. It is critical to develop a strategic picture of how these investments will interact, be tied together and can be leveraged successfully to integrate health, urban development, education, innovation and cultural precincts across the area.

A Greater Parramatta Access Plan would fulfil this need, identifying ways of integrating the various precincts across the Greater Parramatta to the Olympic Peninsula area by improving their connectivity, calming traffic and enhancing urban amenity. As discussed in Chapter 2, the Greater Sydney Commission's growth infrastructure compact provide a mechanism to link these infrastructure investments to growth thresholds, providing certainty about what infrastructure is needed to support growth and when it will be delivered.

Recommendation 68

Infrastructure NSW recommends that by the end of 2018, Transport for NSW and the Greater Sydney Commission develop a Greater Parramatta Access Plan leading to a strategic business case for a program of works under the pilot growth infrastructure compact.

9.3.6   Sydney's Western Parkland City

The Western Parkland City is Sydney's greatest opportunity to create a new, future-focused, sustainable city that supports the long-term growth of the metropolitan region. Western Sydney Airport will be the catalyst for an emerging business and tourism gateway that will support a strong trade, logistics, advanced manufacturing, health, education and science economy. As this new city develops, better connections will be needed between Liverpool, Campbelltown and Greater Penrith, international education facilities and residential communities.

The timing of the delivery of infrastructure in the Western Parkland City will have a significant influence on achieving the vision for the new city. In particular, it will influence the success of the shift from a suburban to an urban environment, including better support for walkability and public transport viability and investment and business attraction to boost local job opportunities.

The Western Parkland City will need substantial transport investment to overcome a legacy of car dependency, urban sprawl and poor job containment. This legacy has led to long travel times and commute distances with a heavy reliance on private motor vehicles for transport, and an imbalance in high-value jobs between the east and west that means over 300,000 western Sydney residents leave the region each day. The area also has higher levels of social disadvantage, social exclusion and poorer health outcomes than other parts of Greater Sydney.

Recognising the role infrastructure can play in shaping the future city into a sustainable and productive urban form, Infrastructure NSW recommends investments that:

- create a vibrant, liveable and self-sufficient city from greenfield growth and existing, geographically dispersed centres
- foster the development of Greater Sydney by connecting the Western Parkland City to the Eastern Harbour and Central River cities
- support the development of a strong trade, logistics, advanced manufacturing, health, education and science economy with high quality access to Western Sydney Airport and improved connectivity between existing centres
- accommodate future population growth in Western Sydney within a sustainable, compact urban form
- bolster the resilience of the transport network
- establish the South Creek integrated growth corridor, underpinned by mass transit
- reduce social exclusion and disadvantage with improved access to services and opportunities.

Preserve corridors to connect Western Parkland City to Greater Sydney's transport network

By 2036, the Western Parkland City will have grown by an additional 500,000 people to over 1.4 million people. This growth will generate additional transport demand in existing and new areas, leading to congestion on some key arterial roads and crowding on rail corridors. Existing transport links will need to be upgraded and extended to accommodate this extra demand and improve the connectivity of new growth areas to established centres.

Implementing the recommendations in this chapter for Greater Sydney as whole would contribute to establishing a sustainable transport system for the Western Parkland City. In addition, the NSW and Commonwealth Governments are investing $3.6 billion in the Western Sydney Infrastructure Plan to establish the strategic road network for the area and provide the foundation for on-road public transport (as outlined in previous sections of this chapter). Further investment in road and public transport links will be needed, although the city's future transport, energy, communications, freight and logistics needs have yet to be fully identified.

Despite this uncertainty, the NSW Government should act now to preserve key infrastructure corridors and strategic land uses. Opportunities to rationalise and integrate uses into multi-use corridors should be pursued. Infrastructure requirements and hardship resources should be factored into long-term land use and budget plans.

Recognising the influence of mass transit on urban form and investment attraction, sequencing of development should be used as a tool to better align growth with infrastructure delivery – specifically, the delivery of mass transit infrastructure.

Recommendation 69

Infrastructure NSW recommends that the NSW Government plan and protect the corridors and precincts necessary for future transport, freight, logistics, energy and communications facilities and infrastructure in the Western Parkland City.

In the next 20 years, investment in public transport in the Western Parkland City should focus on increasing the frequency and coverage of existing bus services, facilitating demand responsive services, using proposed investments in the Western Sydney Infrastructure Plan and other arterial road links for on-road priority services, and planning for and protecting future corridors – in advance of providing staged investment in rail-based mass transit.

While mass transit is not a near-term priority, the first phase should incorporate a connection from the T1 Western Line to Western Sydney Airport and the adjacent new CBD for the Western Parkland City. As this is developed, opportunities to advance the second stage to extend south from Western Sydney Airport to Campbelltown-Macarthur through intergovernmental partnerships should be considered. In the longer term, further development of the mass transit network could explore potential connections from centres including Leppington and Campbelltown-Macarthur and beyond.

Coupling this mass transit spine with land use will be crucial to shaping an urban form that is more sustainable and supports jobs growth in the Western Parkland City.

The scale of investment in this mass transit link is significant, and cannot be justified ahead of new mass transit links in the Central City. It should only be considered as feasible in the next 20 years if

investment from the Commonwealth Government and private sector significantly offsets the contribution of the NSW Government.

Recommendation 70

Infrastructure NSW recommends the NSW Government partner with the Commonwealth Government to plan the staged investment in mass transit to support the Western Parkland City over the period from 2036 to 2056.

As Western Sydney Airport matures, more rapid connections to the geographic heart of Sydney and its large passenger catchment will be needed. Patronage forecasts suggest that, by around the mid-2030s, a step-change in aviation demand for Western Sydney Airport will occur as Sydney Airport reaches capacity. Without significant co-investment, from the Commonwealth Government or others, it is only at this point that rail connections to the airport should be built.

Recommendation 71

Infrastructure NSW recommends that investment in rapid, express rail services to Western Sydney Airport be considered only as a long-term proposition when an expected step-change in airport patronage occurs.

10. Energy

STRATEGIC OBJECTIVE   Encourage private sector investment to deliver secure, reliable, affordable, low emissions energy supply

SNAPSHOT

- Energy assets in NSW are mostly privately owned and operated within the National Electricity Market (NEM) and gas market policies, regulations and institutions.

- The NSW Government can influence energy infrastructure outcomes nationally through the Council of Australian Governments (COAG) Energy Council and at a State level regarding safety and technical matters, including network reliability and customer service.

- The transformation of the energy supply chain towards renewable, distributed, demand-side technologies presents challenges for supply security and reliability. At the same time, these developments are also improving energy productivity, leading to new business models, new products and services, and potential savings.

- About 80 per cent of NSW power generation is coal-fired and gas-fired and is generally sufficient to meet forecast maximum operational demand in the short term. The Australian Energy Market Operator has estimated that 1,000MW of new dispatchable supply to NSW and Victoria will be required before the expected retirement of 2,000MW in 2022 (AGL's Liddell coal plant).

- Without appropriate action, the retirement of existing coal generators and high energy prices could lead to structural industry changes and job losses, as well as hardship for businesses, households and communities.

- To complement national action – in line with the COAG Energy Council's agreed actions to address challenges to security, reliability and affordability in the market – a key priority for the NSW Government should be to encourage private sector investment in fuel, generation and transmission infrastructure using policy levers within its control.

- The recommendations from the final report of the NSW Energy Taskforce complement national action and Infrastructure NSW supports the implementation of these recommendations.

- Infrastructure NSW supports the primacy of the National Energy Market and considers that NSW Government action should not include government funding of new generation capacity or schemes that send distortionary price signals and discourage or prevent private sector investment.

- Infrastructure NSW considers that unified carbon and energy policy and regulatory settings represent the best way to provide investment and divestment certainty to the energy market.

RESPONSE	Summary of key recommendations
Plan for complementary measures	• Implement the COAG Energy Council-endorsed recommendations emerging from the Energy Security Board and the Finkel Review and ensure, through leadership and close monitoring, that energy market actions meet NSW consumers specific needs and circumstances. • Avoid funding new generation capacity or introducing schemes that send distortionary price signals that discourage or prevent private sector investment. • Review the benefits of moving the State transmission and distribution reliability standards to a national framework.
Continue to support secure fuel supply	• Accelerate the NSW Government's Strategic Release Framework for Coal and Petroleum Exploration, where necessary.
Encourage new energy infrastructure	• Review local planning rules and the electricity supply regulatory framework to promote new technologies and energy infrastructure. • Accelerate national and state regulations for consumer protection and safety. • Develop regional economic growth programs to support skills development and industries affected by the energy transition.
Improve energy efficiency	• Promote demand management and nationally harmonised, market-based schemes for energy efficiency. • Strengthen and expand the coverage of national energy efficiency standards for all building and infrastructure developments. • Strengthen and promote the use of the NSW Government Resource Efficiency Policy to drive down Government's energy costs.

10.1 Recent progress

In line with recommendations from the *State Infrastructure Strategy 2012*, the NSW Government embarked on structural reform of its poles and wires businesses, culminating in the long-term lease of 100 per cent of TransGrid and 50.4 per cent lease of both Ausgrid and Endeavour Energy. The NSW Government's remaining energy assets comprise Essential Energy and a 58 per cent interest in Snowy Hydro generation.

Investment in three interstate transmission links and the upgrade to the Sydney CBD transmission supply network are progressing through the planning and regulatory approval processes. The State's transmission reliability performance standards have been updated by the Independent Pricing and Regulatory Tribunal (IPART) to apply from the next regulatory period, beginning in July 2018.

The *NSW Gas Plan* was published in 2015 to guide private sector investment in gas infrastructure. Development of the Narrabri gas field and pipeline is at the Environmental Impact Assessment (EIA) stage.

NSW energy infrastructure is shown in Figure 41.

10.2 Challenges and opportunities

Reliable and affordable energy is fundamental to the State's prosperity and economy, to the productivity of its businesses and to household and community wellbeing. Energy is a key input for many businesses and rising costs threaten the State's growth. The Australian Competition and Consumer Commission's (ACCC) Retail Electricity Pricing Inquiry Preliminary Report found that electricity prices in Australia have gone from a source of competitive advantage to a drain on business productivity and have become a serious affordability concern for households.[187]

187 Australian Competition and Consumer Commission 2017, p. 5

Figure 41 – NSW energy infrastructure
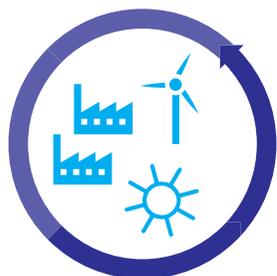
Generation
10 major
power stations
+ small generators
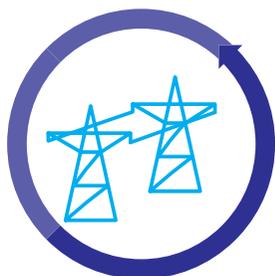
**Transmission
and Distribution**

TransGrid
Ausgrid
Endeavour Energy
Essential Energy

Retail
Over 20 retailers
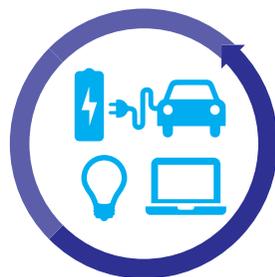
Beyond the meter
Solar generation
Batteries
Advanced metering
infrastructure
Electric vehicles
Communications/analytics

Source: Infrastructure NSW 2017

NSW faces investment risks, including:

- The transformation of the energy supply chain towards renewable, distributed and demand side technologies is creating reliability and security risks.

- The introduction of intermittent wind and solar generation without sufficient dispatchable resources (in the form of reliable generation, storage, demand response or a combination) has led to weaker energy system security.[188]

- The combination of very hot weather and generator and transmission network failure has resulted in a loss of supply.[189]

- The NEM is not delivering enough investment in new dispatchable resources to maintain the target level of supply reliability.[190]

- Existing baseload (coal-fired) power stations are ageing. AGL has announced closure dates for Liddell in 2022 and Bayswater by 2035.[191] Origin has committed to closing Eraring by 2032.[192]

- Prices faced by households in NSW have risen by nearly 80 per cent in real terms since 2004,[193] largely driven by higher network prices, higher wholesale prices due to tightening supply and higher export prices for gas.

- The international competitiveness of NSW manufacturers has been diminishing due to gas and electricity price increases.[194] Should further industries close due to higher gas and electricity prices, regional towns with strong food processing

and manufacturing businesses (including Bathurst, Goulburn, Griffith, Tamworth and Wagga Wagga) will particularly feel the loss of regional economic activity.

The NSW Government is committed to the primacy of the National Energy Objective, and to national market-based responses to these challenges. Infrastructure NSW supports this position.

In 2017, the *Independent Review into the Future Security of the National Electricity Market* (the Finkel Review), commissioned by the COAG Energy Council, recommended enhancements to the NEM to improve security and reliability, and to do so at the lowest cost for consumers.[195] The Finkel Review reported that a lack of investment has been driven by uncertainty around emissions reduction policies, and that this has pushed up electricity prices and undermined reliability.[196]

The Australian Energy Market Operator (AEMO) has quantified what each region needs in new generation investment to preserve reliability of supply. AEMO reports that NSW and Victoria, as one region, require investment of around 1,000 megawatts of additional dispatchable resources before the retirement of Liddell Power Station in 2022.[197] This is in addition to the 5,303 megawatts of proposed investment in NSW in wind (4,466 megawatts) and solar (837 megawatts).[198]

188 Australian Energy Market Operator (AEMO) 2017, p. 1
189 NSW Energy Security Taskforce 2017a, p. vi
190 Australian Energy Market Operator (AEMO) 2017, p. 1
191 AGL 2017
192 Origin Energy 2017
193 Australian Competition and Consumer Commission 2017, p. 12
194 Ibid, p. 10

195 Commonwealth of Australia 2017, p. 5
196 Ibid, p. 10
197 Australian Energy Market Operator (AEMO) 2017, p. 13
198 Ibid, p. 23

10.2.1 National energy reforms

Coherent and consistent national market policies and rules are needed to support three inter-related objectives: security and reliability, universal access to affordable energy services and reduced emissions (the 'energy trilemma').[199]

On 14 July 2017, the COAG Energy Council agreed to 49 of the 50 recommendations in the Finkel Review's final report. The following national measures are a priority for addressing key energy investment risks to NSW:

- implement gas market reform measures to ensure adequate domestic supply
- introduce new transmission and generation security obligations
- update connection standards for wind and solar generators.[200]

The new regulations will also include a three-year disclosure obligation for closure of generators to ensure there is orderly retirement. These obligations will apply to NSW's ageing fleet of coal-fired baseload power stations.

The Finkel Review's recommendation for a Clean Energy Target was not accepted by the Commonwealth Government. The COAG Energy Council is now considering the Commonwealth Government's proposed *National Energy Guarantee*, recommended by the Energy Security Board, as a mechanism to deliver energy security and emissions reductions. The proposal would introduce two new

obligations on electricity retailers, to meet a reliability and an emissions guarantee, and would apply from 2020, when the Renewable Energy Target ends.[201]

As part of the implementation of these national reforms, the NSW Government should identify its own actions. This includes identifying areas where NSW can provide leadership in national energy reform to support market investments and innovation. The final report of the NSW Energy Security Taskforce provides recommendations aimed at complementing the actions of the COAG Energy Council. Infrastructure NSW supports the implementation of these recommendations. In the longer term, the NSW Government's measures and plans for the energy sector will need to increase in scope and ambition if national policies do not deliver market investment in the sector. The NSW Government will need to closely monitor policy development and implementation and delivery of the investment pipeline (including delivery of transmission interconnectors, land reservation for transmission corridors or renewable generation zones) to ensure market outcomes and innovation are achieved.

10.2.2 Climate change policy framework

Under the *Paris Agreement*, Australia has committed to reduce emissions to between 26 and 28 per cent on 2005 levels by 2030.[202] National mechanisms for the energy sector's contribution to the delivery of this target are the Renewable Energy Target and the Clean Energy Fund. The NSW Government has set an aspirational target of zero net emissions by 2050 as part of the *NSW Climate Change Policy Framework*.

10.3 Response

10.3.1 NSW complementary measures

The nation is in a period of energy transition, reform and innovation.

In such a time, Infrastructure NSW considers that the NSW Government should use the policy levers within its control to encourage private sector investment and innovation in modern energy infrastructure to maximise the benefits to consumers. This includes taking steps to:

- support secure fuel supply development
- encourage new, least-cost and technology-neutral energy infrastructure
- improve demand management and energy efficiency.

The Finkel Review has provided recommendations and timelines to support stronger transmission planning, new generation and reliability standards. The NSW Government will implement the Finkel Review through its role in delivering the workplan prepared by the AEMC.[203]

The NSW Government will need to consider supply and demand modelling at a more granular level (than that currently done by AEMO) to monitor the reliability of the NSW system.

Consistent with the Finkel Review's recommendation for Regulatory Investment Tests, the NSW Government should review the need for NSW's transmission and distribution reliability standards to be transitioned

199 Commonwealth of Australia 2016, p. 10
200 Commonwealth of Australia 2017, p. 5

201 Energy Security Board 2017
202 Department of Environment and Energy 2015, p. 1

203 Australian Energy Market Commission 2017

to a nationally consistent, economically derived framework that is transparent for consumers.[204] In 2016, the Government adopted new transmission reliability standards, recommended by IPART, using an economic framework that optimises reliability and providing the most value to customers with the cost of infrastructure. IPART reported that the framework would be strengthened by a nationally consistent approach to the value of and measures for reliability. A review would need to be completed in time to inform the next regulatory determination processes for transmission and distribution businesses.

Recommendation 72

Infrastructure NSW recommends that the NSW Government implement the COAG Energy Council endorsed recommendations and ensure, through leadership and close monitoring, that actions taken by the energy market closely reflect the specific needs and circumstances of NSW energy consumers.

Recommendation 73

Infrastructure NSW recommends that the NSW Government avoid funding new generation capacity or introducing schemes that send distortionary price signals that prevent private sector investment.

Recommendation 74

Infrastructure NSW recommends that the NSW Government undertake a review of the benefits of transitioning the existing State-based transmission and distribution reliability standards to a national framework administered by the Australian Energy Regulator. The review should be undertaken by mid-2020 prior to a further review of Regulatory Investment Tests, to be commissioned by the COAG Energy Council.

10.3.2   Continue to support secure fuel supply

NSW faces risks in relation to the affordable supply of fuel for coal and gas fired generators.

Following the interruption to supply on 10 February 2017, resulting from very hot summer weather combined with generator and transmission network failures, the NSW Government commissioned the NSW Energy Security Taskforce to "investigate the need for best practice, long-term planning to ensure that the State is well placed to prevent, respond to and recover from events, when they occur".

The Taskforce heard from several generators and large users about the challenge of obtaining reasonably priced forward contracts for coal. It also identified planning and environmental licensing risks associated with prospective new supply.[205]

The Taskforce reported that, on 10 February 2017, some generators were operating below capacity due

to Environment Protection License thermal limitations when temperatures in Lake Macquarie were high. (The relevant licences have since been amended to provide greater flexibility for power station operations)

Gas is needed to generate electricity at times of peak demand and to support the integration of variable renewable energy. NSW imports over 95 per cent of its gas. The ACCC has reported that mitigating the effects of high electricity costs will involve efforts to improve the availability and affordability of gas powered generation.[206] The NSW Government's *Strategic Release Framework for Gas and Petroleum Exploration* (2015) sets out the required measures for increasing fuel supply, consistent with the *NSW Gas Plan* (2014). In addition to Narrabri, there are two potential strategic gas exploration sites in NSW under examination: one located north of Broken Hill, the Bancannia Trough, and another north of Wilcannia, the Pondie Range Trough.[207]

The time from exploration to production is likely to exceed 10 years, due to the time it takes to prove probable reserves during exploration, followed by the timeframe for obtaining major project approval processes and for constructing production and pipeline facilities.

In 2017, the NSW Government consulted on reforms to improve major project assessment and approval processes. Infrastructure NSW recommends that the Department of Planning and Environment pursue further reforms (described in Chapter 3) to support the development of energy infrastructure investment proposals.

204 Council of Australian Governments (COAG) Energy Council 2017, pp. 4-7; Independent Pricing and Regulatory Tribunal (IPART) New South Wales 2016, p. 2

205 NSW Energy Security Taskforce 2017a, pp. 22-23

206 Australian Competition and Consumer Commission 2017, pp. 151-152
207 Minister for Resources 2017

Recommendation 75

Infrastructure NSW recommends that by mid-2018, the Department of Planning and Environment accelerate the competitive release of exploration areas, in accordance with the NSW Government's Strategic Release Framework for Coal and Petroleum Exploration.

10.3.3 Encourage new energy infrastructure

Advanced energy technologies include new forms of distributed generation and storage, smart grid software, automation, peer-to-peer trading technologies and electric vehicles. These technologies are changing the nature of the grid and disrupting traditional economic relationships. Important trends include:

- technologies that change energy productivity and demand profiles, such as the electrification of transport, batteries (and other storage such as pumped hydro), sensors, advanced metering and automated operations of the network

- microgrids and distributed generation that bypasses the distribution network or changes the networks from one-way to two-way flows, requiring digital metering and control. There are 1,400 megawatts of 'behind-the-meter' distributed generation in NSW mainly through rooftop solar PV [208]

- digitalisation and data analytics, which enable more control and automatic, real-time optimisation of consumption and production, and interaction with and trading between customers.

Pumped hydro

Pumped hydro has the capacity to act as an effective electrical energy storage technology and assist with providing firm despatchable solutions for the intermittent supply characteristics of wind and solar. A study by the Australian National University identified 8,578 potential sites in NSW. The University reported that the development of a few of the best sites by 2022 could balance the grid when Liddell and other coal power stations close.[209]

The NSW Government should encourage new energy infrastructure that may be proposed for NSW and develop policy and guidance to facilitate market investment in this infrastructure, along with their location and connection requirements.

In addition, new technologies and innovation that potentially increase the productivity of energy infrastructure could be further supported by:

- a review of State and local planning rules (including environmental planning policies or codes) to facilitate new distributed energy and microgrid precincts, storage locations and vehicle charging. A regulatory trial could be used to determine whether these are eligible to be complying developments, in permissible zoning

- the development of coordinated national and state regulations for consumer protection and safety requirements for the connection of microgrids and distributed energy resources, such as rooftop solar and new large scale renewable energy plants.

The NSW Energy Security Taskforce recommends these actions to encourage innovation[210] and the NSW Government has used the Climate Change Fund to accelerate technology and innovation in the past. Infrastructure NSW supports continuing to use this Fund with a focus on encouraging new, innovative energy infrastructure.

Recommendation 76

Infrastructure NSW recommends that during 2018, the Department of Planning and Environment review local planning rules and the electricity supply regulatory framework to enable new technologies and energy infrastructure and other solutions including vehicle charging. This includes using regulatory trials to determine whether these solutions are eligible to be complying developments.

Recommendation 77

Infrastructure NSW recommends that by the end of 2019, the Department of Planning and Environment accelerate national and state regulations for consumer protection and safety requirements for new energy technologies.

Recommendation 78

Infrastructure NSW recommends that the NSW Government continue to use the Climate Change Fund to deploy demand management and new energy technologies.

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208 NSW Energy Security Taskforce 2017a, p. 9

209 Blakers, A et al 2017

210 NSW Energy Security Taskforce 2017b

Figure 42 – New energy system needs to accommodate two-way electricity flows and new business models
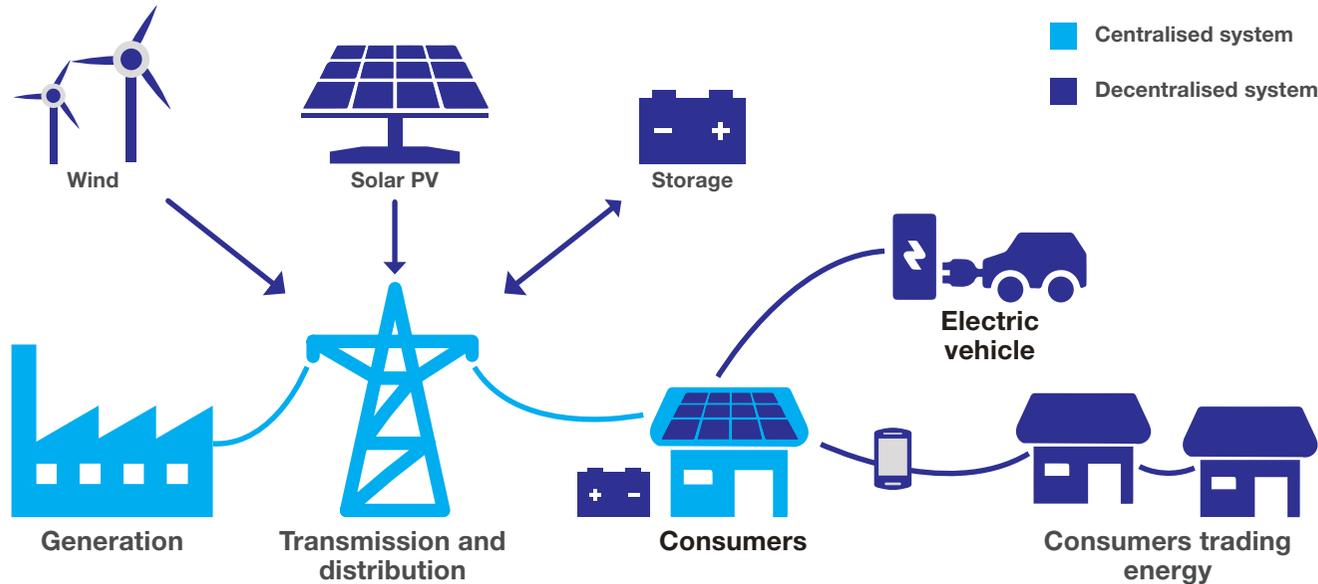
Source: Infrastructure NSW 2017

Electric vehicles

Although electric vehicles currently comprise only 0.1 per cent of light vehicle purchases, a range of analysts predict strong take up as they approach price parity with comparable vehicles with internal combustion engines. Uptake projections range from up to 20 per cent of new car sales in 2020 to more than 40 per cent in 2030.[211]

The technology is likely to improve energy productivity as electric vehicles offer off-peak load balancing opportunities. A network of public charging infrastructure, as well as in-home charging, is critical – without disrupting the ability of the electricity network to function reliably and affordably for other uses. AEMO expects the 20-year impact of electric vehicles on Australia's energy consumption will only be around 6.94 TWh per year by 2036, increasing total consumption by around four per cent without increasing maximum demand for NSW over the period 2015 to 2036.[212]

10.3.4 Support the energy transition

The adoption of new technologies and new business opportunities will change future workforce requirements of the energy sector. The Government will contribute, through the COAG Energy Council, to the development of a national assessment of the future workforce requirements for the electricity sector to ensure a properly skilled workforce is available. The Finkel review recommended further work with industry on the barriers and opportunities for innovation and job creation, as well as the skills requirements, customer requirements and regulations to encourage the take up of new energy technologies.

As the current coal generation fleet retires, workers and households that rely on jobs in the electricity industry directly – and indirectly in industries that become less competitive due to higher costs – should be supported to minimise the social and economic disruption they face. Sufficient notice will need to be given to prepare the community and a coordinated set of measures will be required, such as retraining in new industries and social support services, to help workers, households and communities with the transition.

The NSW Government already provides industry support programs, such as funding the Energy and Resources Knowledge Hub and the 'Energy NSW' initiative to drive growth, innovation and collaboration across the sector. These initiatives operate within the Energy Efficiency Action Plan and Renewable Energy

211 Transport for NSW 2017
212 Australian Energy Market Operator 2016

Action Plan, which include actions to grow renewable energy expertise, skills and jobs.[213]

Infrastructure NSW considers that the Government should prepare a holistic response for the electricity industry and energy intensive industries to support their transition. The holistic response would include skills development, infrastructure for jobs growth and targeted industry support, using the State's existing Regional Economic Growth program.

Recommendation 79

Infrastructure NSW recommends that the NSW Government focus existing mechanisms, such as the Regional Economic Growth program, on supporting skills development and industries affected by the energy transition.

10.3.5   Emergency responsiveness

As noted in section 10.3.2, following the interruption to supply on 10 February 2017, the NSW Government commissioned the NSW Energy Security Taskforce to examine the need for best practice, long-term planning to ensure that the State can prevent, respond to and recover from events that disrupt energy supply. The Taskforce undertook its investigations in two stages.

The Taskforce's initial report investigated emergency responses during extreme hot periods. The Taskforce has since noted that the Government has made substantial progress implementing the recommendations of the initial report.[214]   The final report made recommendations to strengthen the

longer-term resilience of the NSW electricity system.[215] Key recommendations of the final report align with those made in this chapter.

10.3.6   Improve energy efficiency

More tools are needed to help energy customers manage their bills and improve and reduce their energy use, especially at times of peak demand.

The Energy Security Taskforce reported that efficient demand management in NSW would:

- allow more efficient management of power system security and reliability risks
- reduce peaks, which should reduce overall system costs
- help to manage increasing intermittency in the system and contribute to emissions reduction.[216]

In September 2017, as part of the Energy Bill Relief Package, market-based schemes to support energy efficiency were announced.[217]

The Building and Sustainability Index (BASIX) has improved the energy efficiency for most building developments, including housing and commercial developments. Infrastructure NSW recommends that the Department of Planning and Environment expand the coverage of the BASIX framework to cover retail, commercial and multi-use developments and infrastructure.

Use of digital metering and advanced energy controls can reward customers for reducing peak demand. Customer information and changes enabled by smart

metering would further encourage and reward shifting demand. The ACCC intends to further investigate measures to ease price pressure, including incentives for demand management, and to consider the wider use of smart metering and cost-reflective pricing, which may lower network costs and boost competition and incentives to retailers.[218]

Infrastructure NSW recommends that the NSW Government improve the management of its own energy demand (including high demand events) by strengthening the NSW Government *Resource Efficiency Policy*. This policy provides the mechanism for leveraging the NSW Government's purchasing to drive down its energy costs.

Recommendation 80

Infrastructure NSW recommends that by mid-2019, the Department of Planning and Environment further strengthen the regulated energy efficiency standards for retail, commercial and multi-use developments and infrastructure developments.

Recommendation 81

Infrastructure NSW recommends that by the end of 2018, the Office of Environment and Heritage develop an updated NSW Government Resource Efficiency Policy with targets and minimum standards for demand management and energy efficient measures to ensure compliance across all agencies.

213 NSW Planning & Environment: Resources & Energy 2016, p. 13
214 NSW Energy Security Taskforce 2017b

215 Ibid, p. 1
216 Ibid, p. 38
217 NSW Department of Planning and Environment 2017

218 Australian Competition and Consumer Council 2017, pp. 152-153

11. Water

STRATEGIC OBJECTIVE   **Support the growth, productivity and liveability of metropolitan and regional communities by ensuring that water security, quality and wastewater services protect public health and the environment**

SNAPSHOT

- The water story in NSW is different west and east of the Great Dividing Range:
  - West of the Divide covers 82.5 per cent of the area of NSW and 11.6 per cent of the population. The main demands for water are for commercial uses such as agriculture and mining, and to support the prosperity of regional towns. The regulation of this water resource is under the NSW legislation and is consistent with the obligations in Murray-Darling Basin Plan.
  - East of the Divide covers 17.5 per cent of the area of NSW and 88.4 per cent of the population and includes Sydney, Newcastle and Wollongong. The regulation of the water supply is managed under NSW Government Water Sharing Plans, and strategic management plans are in place for the Greater Sydney Metropolitan Region and the Lower Hunter.
- Climate change and population growth will continue to influence water allocation and investment decisions, but metropolitan and regional centres, smaller regional towns and significant industries, each face quite different challenges.
- In the next 20 years and beyond, the most important environmental change – and one with significant implications for infrastructure – is likely to be a reduction in the availability of water. Contributing factors to this reduction include rising temperature, changing rainfall patterns and increases in the allocation of water for important environmental uses.
- The water sector in NSW is heavily regulated and asset-intensive. Improved operational performance, more efficient asset utilisation and better management and conservation practices will be critical to addressing current and future water challenges.
- A long-term view needs to be taken about the management of water resources and how best to ensure water security and quality. In regional NSW, major capital investment focus on high priority catchments, assets, towns and projects.
- Capital investment decisions also need to be considered within the framework of the Murray-Darling Basin Plan, which sets limits on the amount of water that can be taken from the Basin. All Basin states must prepare Water Resource Plans (WRPs) and be accredited by the Federal Minister for Water by 30 June 2019. NSW has 22 WRPs to complete out of a total of 36. This is both a significant task and an opportunity to develop a long-term adaptive management framework for water, for the benefit of NSW.
- Long-term planning of water infrastructure for Sydney should be predicated on the need to serve a city of over eight million people by 2056.
- NSW must also ensure it has the robust climate science capability required to manage water resources appropriately and make informed investment decisions.

RESPONSE	Summary of key recommendations
Reduce the potential effects of climate change on the management of water	• Assess the climate science capability required for water resource management and for infrastructure investment decision-making.
Develop a Water Statement	• Develop a NSW Water Statement to provide transparency about the management and control of the State's water resources.
Improve the water security in priority catchments	• Identify investment options in the priority catchments of Gwydir and Macquarie. • Develop regional water strategies for the priority catchments of Richmond and Bega.
Improve drinking water quality for regional towns	• Develop a risk-based approach to identify priority infrastructure projects that protect drinking water safety in regional NSW towns.
Achieve longer-term water security for the Hunter region	• Finalise the Hunter regional water strategy to achieve longer-term water security for the region, including the Central Coast, and review water sharing arrangements. • Prepare a strategic business case to connect Lostock and Glennies Creek dams. • Prepare a strategic business case for a potable water pipeline connecting Singleton to the Hunter Water network.
Support Sydney's growth	• Develop a 20-year Strategic Capital Plan for Sydney's water and wastewater systems for consideration by the NSW Government and inclusion in Sydney Water's Pricing Submission to the Independent Pricing and Regulatory Tribunal. • Complete the South Creek Corridor strategic business case. • Develop options for the augmentation of Sydney's water supply, including the findings of the South Creek strategic business case, and provide advice to the NSW Government.

11.1   Recent progress

As recommended in the *State Infrastructure Strategy Update 2014*:

- the NSW Government has reserved $1 billion in the Restart NSW fund for a program of targeted water infrastructure projects. As a result, a permanent water supply pipeline for Broken Hill will be commissioned in early 2019
- the Hunter regional water strategy, funded by Restart NSW, was completed in June 2017, identifying options to create an integrated water supply network for the upper and lower Hunter as well as the Central Coast. It is a model for other regional water strategies
- progress on the other priority catchments identified by Infrastructure NSW in 2014 (the Gwydir and Macquarie) has been slow and should be accelerated
- the Metropolitan Water Plan was published in March 2017
- the Hawkesbury-Nepean Valley Flood Risk Management Strategy was approved by the NSW Government and funding of $58 million announced in June 2016 for the implementation of phase one by 2020
- WaterNSW completed its 20-year capital strategy in August 2017.

The NSW Government reformed water management arrangements with the *Water NSW Act*, which commenced in 2015. This creates a separation of functions, with WaterNSW responsible for the delivery of water and water services to the majority of water-entitlement holders and the NSW Department of Industry – Water (DPI Water) responsible for long-term resource planning and regulation policy, and for managing the State's obligations under the Murray-Darling Basin Agreement.

The creation of the Greater Sydney Commission in November 2015 provides an opportunity to coordinate and align planning focused on Sydney becoming a water-sensitive city that recycles water extensively, incorporating a green grid of parks and bushland, cooling neighbourhoods and workplaces, and creating great public amenity.

The NSW Government released the *NSW Climate Change Policy Framework* in November 2016, which commits it to achieving net-zero emissions by 2050 and to helping NSW to become more resilient in the face of a changing climate.

The Country Towns Water Supply and Sewerage (CTWSS) program concluded in June 2017, with 519 projects completed, valued at $3.3 billion, including $1.2 billion investment from the NSW Government. A further 37 projects, valued at $234.6 million, have had a contribution of $104.3 million from Restart NSW in 2016-17. The Safe and Secure Water Supply program announced in June 2017, funded by a $1 billion reservation from Restart NSW, will continue to provide greater water security to regional towns.

In December 2017, the NSW Government introduced a water reform action plan including the establishment of the Natural Resources Access Regulator to oversee compliance and enforcement of water laws in NSW. This reform plan is in response to the Independent investigation into NSW water management and compliance (2017).[219]

219 Matthews, K 2017

11.2   Challenges and opportunities

11.2.1   Developing a robust climate science capability

As discussed in Chapters 1 and 5, the climate of NSW is changing. Average temperatures have been steadily rising since the 1960s: the decade from 2001 to 2010 was the hottest on record; 2014 was the hottest year in NSW's history; and further warming is projected for the near future. Much of the State's irrigated agriculture is located in the south-east, a region already sensitive to changes in water availability. Climate change may exacerbate problems of water security in these areas.[220]

Studies predict that the Murray–Darling Basin climate is likely to become drier and more variable in the future.[221] Average surface water availability across the entire Basin is projected to fall by 10 per cent by 2050. The impact is expected to be greater in the southern area of the Basin, including southern NSW, with fewer storms meaning less rainfall, reducing water availability.

Climate variability is likely to mean more extreme droughts and more extreme floods. Weather events such as East Coast Lows, which caused significant flooding along the east coast of Australia, particularly in Queensland in 2010-11, may become less frequent but more intense when they do occur. The risks that stem from such events are not confined to the loss of life and property; the GDP of Australia was reduced by an estimated $30 billion due to the Queensland floods.[222]

220 NSW Office of Environment and Heritage 2017
221 See for example SEAC (2010)
222 House of Representatives Standing Committee on Economics (June 2011)

Figure 43 – Predicted rainfall changes to 2030

Drier Summer and Winter

Wetter Autumn and Spring

Drier Winter and Spring

Wetter Summer and Autumn

Drier Spring

Wetter Summer and Autumn

Legend

Drier summer and winter (outside of historical variability in winter)

Drier spring (some areas outside of historical variability)

Drier winter and spring (within historical variability)

Wetter autumn and spring (within historical variability)

Wetter summer and autumn (some areas outside of historical variability in summer)

Wetter summer and autumn (some areas outside historical variability)

Source: Office of Environment and Heritage, *NSW and ACT Regional Climate Model 2014*

The priorities for long-term infrastructure investment are to ensure resilience, provide water security in times of drought and withstand floodwaters.

In 2014, Infrastructure NSW identified the Upper Hunter as a priority catchment for the development of a regional water strategy. To predict possible climate change effects on the Upper Hunter, extensive paleoclimate and hydrological analysis was undertaken, which indicated that the risk of drought for the Upper Hunter may be greater in the future than suggested by the historical record.[223] Analysis of changing rainfall patterns shows diminishing rainfall in the Upper Hunter. These climate change conditions could reduce the water security benefits of existing and/or proposed infrastructure to capture rainfall in the Upper Hunter.

The Upper Hunter example shows the importance of a robust climate science capability for understanding and reducing the potential effects of climate change on the management of water resources and infrastructure. The most effective approach is a national one, which builds on the substantial climate science capability developed to date. A recent review[224] recommended improved coordination of climate science across Australian governments, universities and research agencies and more investment in modelling capability. NSW should make sure it has enough climate change information to support whole-of-government decision-making over the next 20 years.

223 OD Hydrology 2017a
224 Australian Academy of Science 2017

Recommendation 82

Infrastructure NSW recommends that the NSW Government assesses the climate science capability it requires for water resource management and infrastructure investment decision-making and act to meet its requirements by mid-2019.

11.3   Response

11.3.1   NSW Water Statement

Water security is critical and reviews following the millennium drought highlighted community concerns about the lack of long-term planning. Infrastructure NSW considers that there is an opportunity to build on the legislative water reforms introduced in 2015 and 2017 and enhance the strategic framework for sustainable water resource management in NSW through the publication of a Water Statement. The proposed Statement should set out the current framework that regulates water resource allocation and management to inform the community, market participants and investment decisions. The Statement is consistent with the NSW Government's water reform action plan and its goal to "ensure transparency in how we share, allocate and manage water".[225]

Water reform in Australia has made solid progress. In many respects, water governance and the development of water resources in Australia are most advanced in the Murray-Darling Basin. This is particularly the case in relation to water markets, where

the 'unique underlying characteristics' of the Basin Plan, especially the southern connected system, make it conducive to water trading.[226]

In 2017, water reform was back in the spotlight, with the Productivity Commission undertaking its inaugural inquiry into the National Water Initiative (NWI) to assess progress in achieving reform objectives and identify any need for future reform. The *Water Act 2007* requires the Commission to review the NWI every three years, and to review the effectiveness of the Basin Plan every five years, with the review to be completed in 2018.

As these developments indicate, the focus of national reform has been predominantly on rural water within the Basin Plan. In NSW, the Basin Plan covers over 80 per cent of the State's land mass and critical industries such as irrigated agriculture. However, it does not cover the coastal catchments, where over 88 per cent of the population lives. A NSW Water Statement would provide a full picture about managing the State's total water resource, including in:

- metropolitan areas under strategic management plans
- coastal catchments under NSW Government Water Sharing Plans
- inland catchments subject to the Murray-Darling Basin Plan.

As illustrated by the Hunter regional water strategy, there are priority issues to be addressed outside of the Basin Plan. It is timely to consolidate a holistic NSW Water Statement to set out the current framework that regulates water resource allocation and management,

provide context for investment decisions and support the significant effort that NSW is making to develop the 22 Water Resource Plans (WRPs) required for the Basin Plan.

The NSW Water Statement would provide transparency about current arrangements for water access entitlements under Water Sharing Plans, and explain water licensing arrangements such as high security and general security. Transparency in these arrangements is critical for the community to have confidence in compliance systems. The Statement would provide an overview of water resources, their allocation and management. It would improve understanding of potential and emerging risks and extreme events, such as drought and flood, and enable measurement of the sustainable use of the State's water resource. It could also inform market decisions for investment.

This initiative would address the current public information asymmetry about how water resources are being managed in NSW and align decision-making with the objectives of the Basin Plan and NSW legislation. It would support an adaptive management approach to address the key challenges for risk management given the uncertainty of climate change effects on water resource allocation and infrastructure investment decisions.

The NSW Water Statement could:

- support the critical needs of NSW industries and communities by ensuring water security and quality of supply
- support regional development and enhance opportunities for promoting a diverse economy

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225   NSW Government 2017, p. 4

226   ACCC submission to Productivity Commission Inquiry into National Water Reform Issues Paper (April 2017), p. 3

- facilitate a water supply system that is responsive to changing demands
- facilitate financial efficiency in the delivery of water
- protect and maintain the certainty of water rights
- provide the market with opportunities to determine and manage its own risks
- protect the integrity and sustainability of environmental and cultural assets.

The development of regional water strategies to underpin the proposed NSW Water Statement should be accelerated.

The Hunter regional water strategy provides a model. Ideally, regional water strategies should be a collaboration between the Department of Industry assessing regional growth demands on the water resource and water service providers (in this case Water NSW and Hunter Water) developing strategies, including for infrastructure, in response.

The proposed NSW Water Statement will assist the government to finalise the WRPs required under the Murray-Darling Basin Agreement by June 2019 for accreditation by the Commonwealth. WRPs are to be in place for 10 years, unless amended. The first review of the Agreement will occur in 2026. Completing this resource management planning, and doing it well, is critical to maximising the value of the State's water resources for users and the environment. Figure 44 provides an overview of the river network in NSW.

Recommendation 83

Infrastructure NSW recommends that by early 2019, the NSW Government publish a NSW Water Statement to set out the current over-arching policy context, targets and strategic outcomes for the allocation, conservation, management and control of water resources to meet the challenges of climate change and population growth, and ensure a prosperous economy.

Recommendation 84

Infrastructure NSW recommends that the NSW Government commence the development of regional water strategies for all catchments by early 2019 to underpin the proposed NSW Water Statement.

11.3.2   Identifying 'hot spot' catchments

In 2014, Infrastructure NSW developed a Catchment Needs Assessment Framework (CNAF) to identify the regulated river valleys facing the most significant water management challenges, using four indices:

- Drought Security Index (DSI), a likelihood indicator of low water allocations
- Flow Utilisation Index (FUI), a likelihood indicator of annual flow supporting greater use
- Flood Management Index (FMI), a likelihood indicator of dams capturing large flow events
- Delivery Efficiency Index (DEI), a likelihood indicator of water delivery losses being reduced.

These indices were quantitative and were calculated for each of the regulated river valleys based on river modelling (using the last 100 years of climatic data) and an assessment of current asset performance. There is some inter-relationship between the indices. For example, a catchment with low *Delivery Efficiency* is also likely to have lower *Drought Security*, given the higher water losses, particularly during drier periods. Conversely, a valley could improve its Drought Security without necessarily increasing *Flow Utilisation*, because additional storage enhances the ability to capture water in wetter periods and utilise it in drier periods, without necessarily increasing long-term average use. An improvement in *Flood Management* could also enable an improvement in *Drought Security* through additional or augmented storage capacity.

In summary, Infrastructure NSW's needs analysis assigned the highest priority inland river catchments as the Gwydir, Macquarie and Lachlan. All three catchments have low *Drought Security* due to low/variable rainfall, high evaporation and limited storages. This combination of climate, topography and existing asset performance indicates the potential need for augmentation of, or investment in, additional storage capacity to improve water security. In both the Gwydir and the Macquarie, *Delivery Efficiency* is also a priority; for the Lachlan, *Flood Management* is a priority, given the lack of airspace in existing dams.

In 2014, Infrastructure NSW recommended that the CNAF be developed further. The NSW Department of Industry has collaborated with the University of Technology Sydney's Advanced Analytics Unit to review the 2014 CNAF and draw on a wider range of information to improve strategic planning to support water security

Figure 44 – The major river network east and west of the Great Dividing Range

West of the Divide
Long, slow moving rivers flow westward across flat, dry land to empty into the ocean at the mouth of the Murray River near Adelaide, South Australia.

East of the Divide
The terrain is steeper and climate wetter with faster flowing rivers that run east into the ocean.

Hillshade

0 – 499m

500 – 999m

999 – 1999m

1999 – 2228m
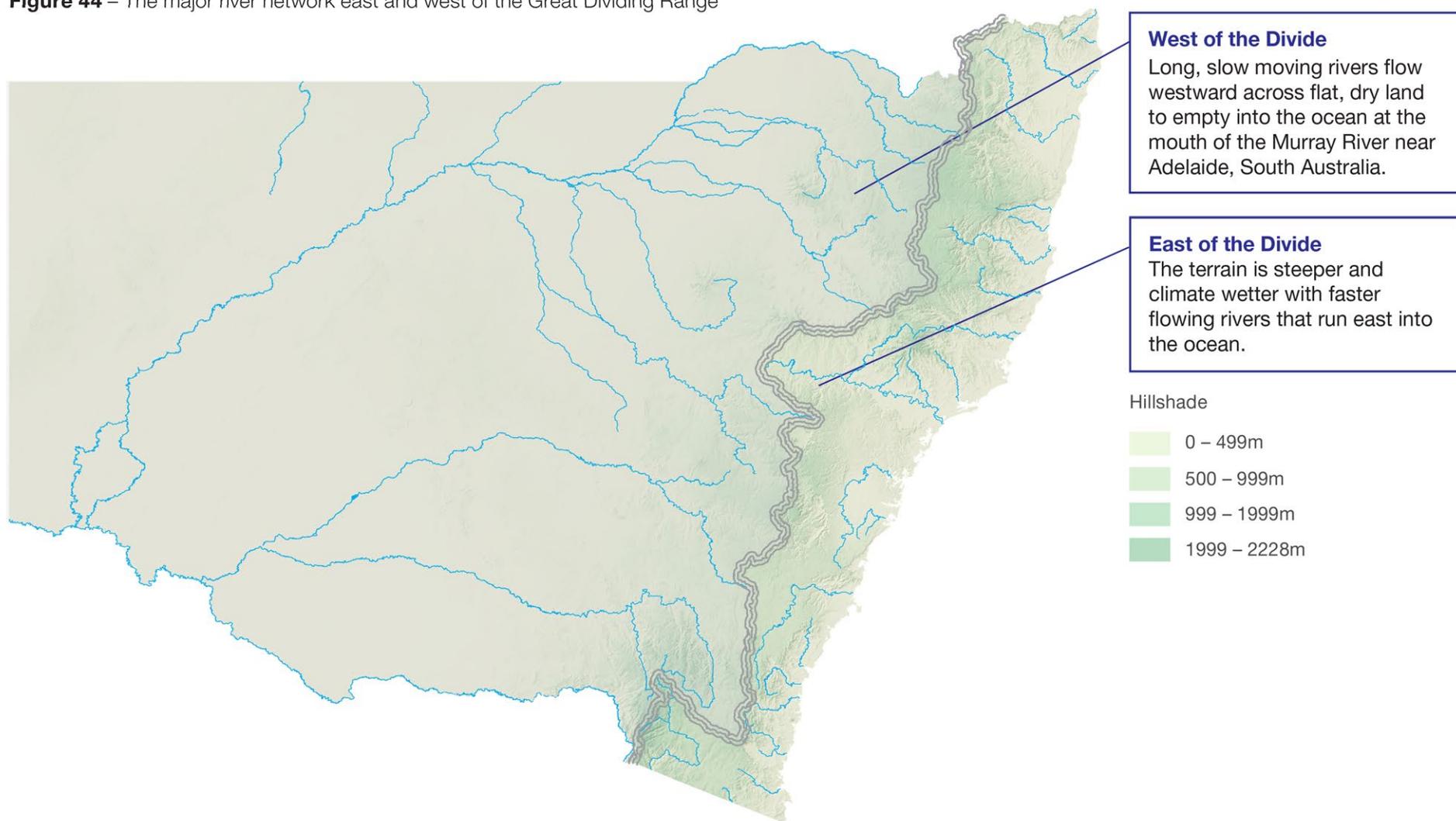
Source: Rivers, Bioregional Assessment Programme licensed under CC BY 3.0; Jarvis A., H.I. Reuter, A. Nelson, E. Guevara 2008, Hole-filled seamless SRTM data V4, International Centre for Tropical Agriculture (CIAT)

and productivity in NSW. The priority catchments identified in the 2014 CNAF were reviewed with updated population and climate change projections in 2017 and found to be reasonable and consistent.

Recommendation 85

Infrastructure NSW recommends that by the end of 2018, the Department of Industry and Water NSW complete the development of regional water strategies that identify investment priorities and other policy options in the priority catchments of Gwydir and Macquarie.

The CNAF developed in 2014 for regulated river valleys has been adapted in 2017 by the Department of Industry (with the University of Technology Sydney) and Infrastructure NSW to review coastal unregulated catchments. 'Risk' was assessed as the relative risk to irrigation due to insufficient unregulated water supply; 'opportunity' was assessed as the relative opportunity for improved irrigation from unregulated water sources.

The Richmond River catchment was identified as having a high risk as well as high opportunity for irrigation development. The risk is high due to a combination of underutilisation of high cost regulated surface water and a reliance on unregulated groundwater flows that are reduced in dry periods. The irrigation opportunity in the catchment is due to the relatively high levels of potentially irrigable land that could be sustained if water storage infrastructure were available, including from underutilised assets. The Bega River catchment has been assessed as having high risk with low opportunity for improved

irrigation, requiring further analysis of groundwater and networking options.

Recommendation 86

Infrastructure NSW recommends that by early 2019, the Department of Industry, in consultation with relevant water service providers, develop regional water strategies for the Richmond and Bega priority catchments.

11.3.3   Improving drinking water in regional towns

There are 92 local water utilities (LWUs) in regional NSW, providing water supply and sewerage services to regional towns and hamlets. LWUs have continued to achieve generally-high performance standards[227] despite enduring challenging operating conditions of drought and flood, population growth and loss, financial constraints and climate variability.

LWUs provide services within a complex regulatory landscape. The National Health and Medical Research Council published a consultation paper in 2014 proposing to introduce a microbial Health-Based Target (HBT) into the Australian Drinking Water Guidelines (ADWG). The ADWG set out a Framework for Management, which most NSW LWUs now have in place in the form of Drinking Water Management Systems, with support and assistance from the NSW Department of Health. These frameworks rely on a risk-based and multi-barrier approach to supply safe drinking water, including management of the end-to-end process – the catchments, storages, extraction,

treatment and maintenance of reticulation systems. The capability, training and certification of staff are critical: access to trained operators can be an issue for some regional towns. Voluntary collaboration between regional local water utilities could provide opportunities for more efficient service provision.

The final form and effective date for inclusion of the HBTs is yet to be determined nationally. In NSW, the Department of Industry has conducted a high-level exercise to estimate the potential financial impact of achieving the proposed HBTs for regional town water supplies. It estimates the impact to be over $1.5 billion. This unconstrained estimate assumes the upgrade or replacement of all existing LWU water treatment plants and the installation of new plants. It will also be necessary to recover ongoing operation and maintenance costs, which may impact water prices in regional towns. Investment decisions must consider the financial impact on regional towns.

Following completion of the Country Towns Scheme in June 2017, the NSW Government reserved over $500 million in the Restart NSW Fund for the *Safe and Secure Water* program for priority projects over the next 10 years, or until funding runs out. The NSW Department of Industry, in consultation with NSW Health, must ensure that this funding is targeted to the highest need and allocated efficiently.

227 NSW Department of Primary Industries Water 2016, pp. x-xiii

<div style="background:#d3d3d3">

Recommendation 87

Infrastructure NSW recommends that the Department of Industry, in consultation with NSW Health, develop a risk-based approach by early 2018 to identify priority infrastructure projects that protect drinking water safety in regional NSW towns.

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11.3.4 Finalising the Hunter regional water strategy

East of the Great Divide, the highest priority catchment identified in the 2014 SIS was the Upper Hunter due to its low 'flow utilisation', which indicates a capacity for growth, and low drought security. Infrastructure NSW recommended that further studies and modelling be undertaken, considering the allocations of all major licensed water users in the Hunter,[228] to identify the best mix of policy and delivery efficiency investments to take advantage of unutilised flows and underutilised infrastructure.

Drought security is the major consideration for water users across the Hunter region, which includes the Hunter, Manning and Central Coast catchments. These areas are identified as a broader region because they are connected by inter-basin pipelines.

In the last 20 years, the Hunter region has quadrupled its output of coal, experienced deregulation in the dairy and power industries, and seen continued population growth in its major urban centres. This growth and change in demand has resulted in periods of extremely

low levels of water reliability for agriculture, industry and mining during times of drought, such as in 2007.

Challenges over the next 20 years include the economic adjustments associated with the closure of AGL's Macquarie power stations in 2022 and 2035. The projected growth of agriculture and mining is vulnerable to low levels of water reliability and supply augmentation will be required by 2035 to support growth in urban centres.

Water security risks were considered in several studies commissioned by the NSW Department of Industry as it developed the Hunter regional water strategy. Key findings from these studies include:

- Drought security is the primary economic risk facing the Upper Hunter. This risk extends to all sectors including urban, agriculture, mining and power generation.
- The current dams are adequate in capacity to meet licensed allocations.
- General Security water users, such as, agriculture and some mining, face the greatest risk. Allocations for General Security users would drop to under 30 per cent for long periods during five major droughts of the kind experienced in the past 100 years.[229] A repeat of the 1940s drought (the worst on record) would see General Security allocations reduced to zero for approximately 12 consecutive years, assuming existing infrastructure and under current Water Sharing Plan rules.[230]
- Paleoclimate analysis of the last 10,000 years, and stochastic generation of rainfall and evaporation data, suggests that droughts of 15 to 20 years duration, as well as extended wet periods, are

possible.[231] The most extreme drought on record, which occurred in the 1940s, may represent a recurrence event of 1 in 40 years, rather than 1 in 100 years.[232] Analysis of changing rainfall patterns shows diminishing rainfall in the Upper Hunter. These climate change conditions could reduce the water security benefits of existing and/or proposed infrastructure to capture rainfall in the Upper Hunter.

- Reductions in the base flows of rivers have occurred, and will continue to occur, as mining intercepts groundwater aquifers, lowers the water table near rivers, and intercepts surface runoff.[233]
- The proposed closure of Liddell Power Station in 2022 will not significantly mitigate the risk of failure of supply to water users in the Upper Hunter Valley.[234] However, the closure of both Liddell and Bayswater power plants by 2035 provides an opportunity for improved water security, with potential redistribution of 36,000 megalitres of water a year.
- Infrastructure options that increase the 'networking' of water in the Hunter region will potentially deliver the most benefit, but only with policy adjustments to redistribute water allocations. The top three priorities for further assessment were identified as:
  - a bi-directional pipeline connection between Lostock and Glennies Creek dam (owned by WaterNSW)
  - the construction of a potable water pipeline from Hunter Water Corporation's network to Singleton
  - the continued operation of the Barnard Scheme after the power stations close in 2035. [235]

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228 There are three major operators of storages in the Hunter: WaterNSW, Hunter Water and AGL Macquarie. There is also a pipeline connection between Hunter Water and Central Coast Water.

229 Keim, A S 2016
230 Alluvium and Marsden Jacobs 2017, p. 4

231 Keim, A S 2016
232 OD Hydrology 2017
233 Department of Primary Industries Water 2013
234 Alluvium & Marsden Jacobs 2017
235 Department of Finance, Services and Innovation 2017

- To maximise the economic benefits of these infrastructure options, the statutory Water Sharing Plans and administrative arrangements within the Hunter region would need to change.
- Large-scale recycled water options are not economically viable if the power stations shut down by 2035.
- The wetlands of the Hunter River Estuary are of international importance and are listed under the Ramsar Convention.[236] Modelling of the Hunter River Estuary indicated that the options investigated could be managed to maintain the wetland's characteristics[237] and, in doing so, meet Australia's international obligations under the Convention.

In summary, the Hunter regional water strategy, illustrated in Figure 45, has identified policy and infrastructure options that warrant further investigation to achieve longer-term water security for the region, including the Central Coast.

Recommendation 88

Infrastructure NSW recommends that the Department of Industry finalise the Hunter regional water strategy by early 2018 to achieve longer-term water security for the region, including the Central Coast.

Recommendation 89

Infrastructure NSW recommends that the Department of Industry review water-sharing arrangements by early 2019 to enable an informed response to the closure of power generation plants in the Hunter region.

Recommendation 90

Infrastructure NSW recommends that by early 2019, Water NSW prepare a strategic business case for the option of connecting Lostock and Glennies Creek dams.

Figure 45 – Greater Hunter integrated water network

Source: Infrastructure NSW 2017

236 United Nations Convention on Wetlands of International Importance especially as Waterfowl Habitat Ramsar (2 February 1971)
237 Breeton R and Taylor-Wood E 2010

Recommendation 91

Infrastructure NSW recommends that by early 2019, Hunter Water prepare a strategic business case for the option of constructing a potable water pipeline to Singleton, connecting to the Hunter Water network.

11.3.5   Supporting Sydney's growth

For Greater Sydney, the challenge of accommodating an estimated 1.7 million additional people by 2036 will require a response that is not 'business as usual'. In fact, Sydney Water's strategic planning must anticipate an eventual doubling of the population to about 8.3 million people by 2056.

Sydney Water achieved a significant reduction in water demand during the 1990s and early 2000s, which – together with major system investments of the previous decade – has created significant 'headroom' in water and waste water systems. On the back of Sydney Water's very efficient capital utilisation over the last decade, there are now signs that its ability to accommodate further growth, at the low incremental costs of the recent past, is running out. Network capacity is limited, with key assets under pressure, and a wholesale strategic rethink is warranted for near and longer-term investment.

The magnitude and rate of the population growth that Sydney Water faces requires an integrated and comprehensive strategy to resolve interrelated issues, including:

- Increased stress on existing assets:
  - there is limited headroom in existing assets, with reduced low-cost capacity available for growth
  - 75 to 80 per cent of Sydney's wastewater is treated at three landlocked major coastal treatment plants where capacity expansions are difficult to implement
  - about 80 per cent of treated water supply capacity is concentrated at Prospect.
- Increased pressure on water resources (both drinking water supply and recreational):
  - significantly increased demands on the raw water supply. If a 10 per cent rebound in per capita demand is experienced, the raw water sustainable yield would be exceeded within about seven years. It would take about five to six years to implement additional raw water supplies, so planning for augmentation should begin now
  - wastewater discharges will mean increased pollution loads for high-value water resources, such as inland waterways, beaches and harbours.
- Regulatory impediments to water recycling for nutrient management, water supply augmentation and realisation of a vegetated 'green' urban form in new development areas of higher environmental sensitivity (such as inland waterways):
  - these sensitive areas will require very high levels of wastewater treatment to protect inland waterways, which will be significantly costlier to construct and operate than treatment plants located at the coast
  - broad scale, non-potable, recycled water options could entail less than half the net present cost of the existing St Mary's scheme, which involves very expensive reverse osmosis treatment of wastewater for discharge into highly sensitive inland waterways.

The following areas offer the greatest opportunity to adopt an integrated approach to water cycle and land use management, provided the opportunity is taken early in the development cycle:

- Augmentation of the major sewer networks in Sydney's north and south (the Northern Suburbs Ocean Outfall System and the South-Western Ocean Outfall System). These major sewer networks will transport 75 per cent of Sydney's wastewater in 2035 and could require significant capital costs in the billions of dollars. Wet weather overflow abatement on the major sewer networks will also require significant planning and investment.
- Growth, treatment upgrades and greenhouse gas initiatives that could more than double the tonnage of solids needing treatment and disposal:
  - biosolids management will require substantial investment in digestion and dewatering facilities and confirmation of sufficient capacity at land application sites
  - acceptance of food wastes for processing presents a potential business opportunity.

In summary, the rate of population growth in Sydney means significant capital expenditure is needed in the near, medium and long term. An integrated strategic plan is needed in time for the June 2019 submission to IPART to ensure Sydney Water does not underestimate its costs and fail to obtain sufficient funding to provide for growth impacts.

Recommendation 92

Infrastructure NSW recommends that Sydney Water develop a 20-year Strategic Capital Plan for Sydney's water and waste water systems by early 2019 for consideration by the NSW Government and inclusion in its Pricing Submission to the Independent Pricing and Regulatory Tribunal due in mid-2019.

Much of the development forecast for Sydney, including Western Sydney Airport, will occur in sensitive inland river catchments – South Creek and the Hawkesbury-Nepean (see Figure 46). It is therefore important to identify the major water infrastructure investments required for the Western Parkland City within the context of rapidly changing land use. As part of the development of the 2018 SIS, Infrastructure NSW is coordinating the South Creek Corridor Strategy (SCCS) as a sectoral review under its Act.

The SCCS aims to provide a coordinated framework for major infrastructure investment decisions that will:

- support significant population growth in the corridor (including accelerated housing supply)
- underpin the development of liveable and sustainable communities (parkland, blue/green corridor)
- provide regulatory certainty for integrated water and land use planning to test options for broad scale non-potable recycling of wastewater as the most efficient way to manage nutrients on land and augment water supply.

This approach will support the concept of the blue-green corridor and Western Parkland City urban form, delivering housing supply and employment opportunities while protecting and managing sensitive environmental assets.

The SCCS's scope includes major work streams to deliver:

- economic analysis of current barriers to recycled water schemes at regional scale and the financial implications for NSW Government agencies (including Sydney Water), a framework for

Figure 46 – South Creek corridor

Legend:
- South Creek Catchment
- South Creek / riparian corridor
- Western Sydney Airport
- Rivers

Source: Infrastructure NSW 2017

market participation and pricing principles to be considered by IPART

- population growth scenario modelling and land uses
- a catchment-specific water quality setting mechanism for nutrient control
- a 20-year Major Asset Strategy to guide infrastructure investment decisions
- a Regional Parklands Master Plan for managing open spaces and blue/green grid elements in the south-west and western Sydney Growth Areas
- appropriate urban form and land use planning statutory instruments
- portfolio options analysis for the augmentation of Sydney's water supply including water efficiency and integrated urban water design with increased use of stormwater and recycled water, for consideration with other bulk supply options
- the SCCS strategic business case.

Recommendation 93

Infrastructure NSW recommends the completion of the South Creek Corridor strategic business case by late 2018.

Recommendation 94

Infrastructure NSW recommends that Water NSW and Sydney Water consider a portfolio of options for the augmentation of Sydney's water supply, including the findings of the South Creek strategic business case, and provide advice to the NSW Government for its consideration by early 2019.

12. Health

STRATEGIC OBJECTIVE **Plan and deliver world-class health infrastructure that supports a 21st century health system and improved health outcomes for the people of NSW**

SNAPSHOT

- NSW Health is responsible for the delivery of healthcare services to 7.7 million NSW residents across an area of over 800,000 km^2.

- Recurrent expenditure on health is 26.6 per cent of the NSW Government's total recurrent spend. Without changes to how the health system operates, this will rise to 36 per cent over the next 40 years.

- In the next 20 years, the demand for healthcare will grow by over 50 per cent, compared to population growth of 28 per cent. The highest rates of growth are expected to occur in the next five years, mainly due to the increase in 70 to 84-year-olds who are the highest users of health services.

- There is a need for disruptive innovation in healthcare to manage increasing demand and deliver more affordable and sustainable long-term solutions. This includes more investment in technology-enabled out-of-hospital healthcare models.

- NSW Health's facilities are valued at approximately $22 billion, including over 230 public hospitals and 226 ambulance stations. Approximately 40 per cent of this infrastructure is over 50 years old and will struggle to accommodate newer models of care and technologies. Investment in the continued upgrading of hospital facilities must be accompanied by investment in infrastructure that supports new ways of coping with demand outside hospitals, including community, home-based and virtual care.

- Developing and refurbishing health assets to deliver new models of care will require sustained investment, as well as changes to land use planning policies. A new 20-year Health Infrastructure Strategy should be prepared to support the future delivery of health services across the State, including a focus on enabling more complex and higher volumes of services to be delivered in the community, where this is safe and appropriate.

- Technological innovation is set to change the way healthcare is delivered over the next 20 years. Cognitive technologies, telehealth, robotic surgery, mobile applications and other technology-enabled health solutions will require investment in new types of health infrastructure, including data storage and digital connectivity. Building on the foundations of the current eHealth Strategy 2016-2026, the NSW Government needs to continue to invest in technology-enabled healthcare.

- Innovative partnership and procurement models, and contestable approaches to funding and service delivery, will also be needed to realise the significant potential health and economic benefits from new healthcare models, integrated regional health services and cutting-edge health and education precincts.

- Environments that promote health are a key component in keeping people healthy and out of hospital. The planning, design and development of places and neighbourhoods should be geared to improving health outcomes through the provision of walking, cycling and active recreation opportunities.

RESPONSE	Summary of key recommendations
Conduct a detailed assessment of future infrastructure needs	• Develop a 20-year Health Infrastructure Strategy that incorporates flexibility, enables system integration, innovation and technology, to inform investment in future-focused infrastructure. • Assess ageing health assets to determine whether they are fit-for-purpose, explore the potential to develop greenfield sites and consider divesting assets that are not fit-for-purpose for future care models. • Consider investment in infrastructure for health benefits as part of an integrated health and town planning strategy, such as walking and cycling infrastructure and parks and recreation facilities.
Invest in eHealth and technology	• Deliver the current *eHealth Strategy 2016-2026*. • Periodically refresh the eHealth Strategy to support an ongoing investment in technology-enabled health care including: mobile health; cognitive technologies; and virtual healthcare delivery.
Improve health asset management	• Include an assessment of strategic assets and asset management as part of the Health Infrastructure Strategy.
Access markets to improve health system efficiency	• Consider public private partnerships to finance health infrastructure and clinical care delivery, where they deliver value and improved clinical outcomes for the community.

12.1   Recent progress

Since 2012, the NSW Government has invested heavily in health infrastructure, delivering more than 50 new and upgraded health facilities across rural, regional and metropolitan NSW. The 2017-18 Budget provided a significant short-term investment boost of $2.8 billion investment over four years into health infrastructure.[238]

This ongoing investment supports the implementation and delivery of the current Health Strategy, the *NSW Health State Plan: Towards 2021* and related plans including the *eHealth Strategy for NSW Health 2016 – 2026*.

Since 2012, the NSW Government has continued the development of the Northern Beaches Hospital, via a Public Private Partnership (PPP). The Government has committed nearly $1 billion to the Westmead Hospitals Redevelopment and has undertaken integrated cross-agency collaboration to support Westmead's development as a leading health and education precinct.

Over the last decade, the Government has committed more than $45 million of capital funds to develop HealthOne sites across NSW where general practice, community health services and other health services can be co-located. As at November 2017, there were 27 operational HealthOne sites in NSW extending across 11 Local Health Districts (LHDs). In 2014, the

NSW Government reserved $100 million to accelerate the delivery of Integrated Care, which is being carried out under the *HealthOne Strategy*.

The *HealthOne Strategy* comprises 20 sites identified in the *State Infrastructure Strategy Update 2014* for investment through development, redevelopment or refurbishment. Priority was given to areas with an ageing population and an increased demand for integrated community health services, including mental health and drug and alcohol services. Each HealthOne service will be configured to meet the needs of the local community and will vary from site to site.

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238 NSW Treasury 2017

The NSW Government is also investing in multipurpose services (MPSs) to better integrate health and aged care services. MPSs include a range of services to meet the unique needs of each community. Services such as inpatient care, respite, palliative care, residential aged care, emergency care, allied health, oral health, GPs and community health services may be included.

The Multipurpose Services Strategy (MPS Strategy) Stage 5 is a further $300 million investment to provide health and aged care services for small and remote rural communities. Sites at Walgett, Tocumwal and Holbrook are complete and operational. Construction has begun or will commence in 2017-18 at Barham, Bonalbo, Molong, Coolah, Culcairn, Rylstone and Tumbarumba. Planning continues for facilities at Cobar, Harden, Braidwood, Yass and Murrurundi (see Figure 47).

Delivery of the Regional Ambulance Infrastructure Reconfiguration Program is also ongoing. This $122 million program will reconfigure rural and regional ambulance infrastructure to respond to service demand. A total of 22 new, rebuilt and updated NSW Ambulance Stations have been announced by the NSW Government. Construction is complete at Wagga Wagga, Ardlethan, Coolamon and Harden. Construction has commenced for facilities at Griffith, Molong, Kiama, Bay and Basin, Berry, Toukley, Wyong, and Wauchope (see Figure 49). Planning is underway for the facility at Bathurst.

Figure 47 – Rural ambulance infrastructure reconfiguration and Regional Multipurpose Services and projects, as at December 2017

Regional multipurpose services projects
- Existing MPS Centre
- Complete stage 5 project
- Under construction
- In Planning

Rural ambulance reconfiguration
- Complete
- Under construction
- In Planning

Source: NSW Health 2017
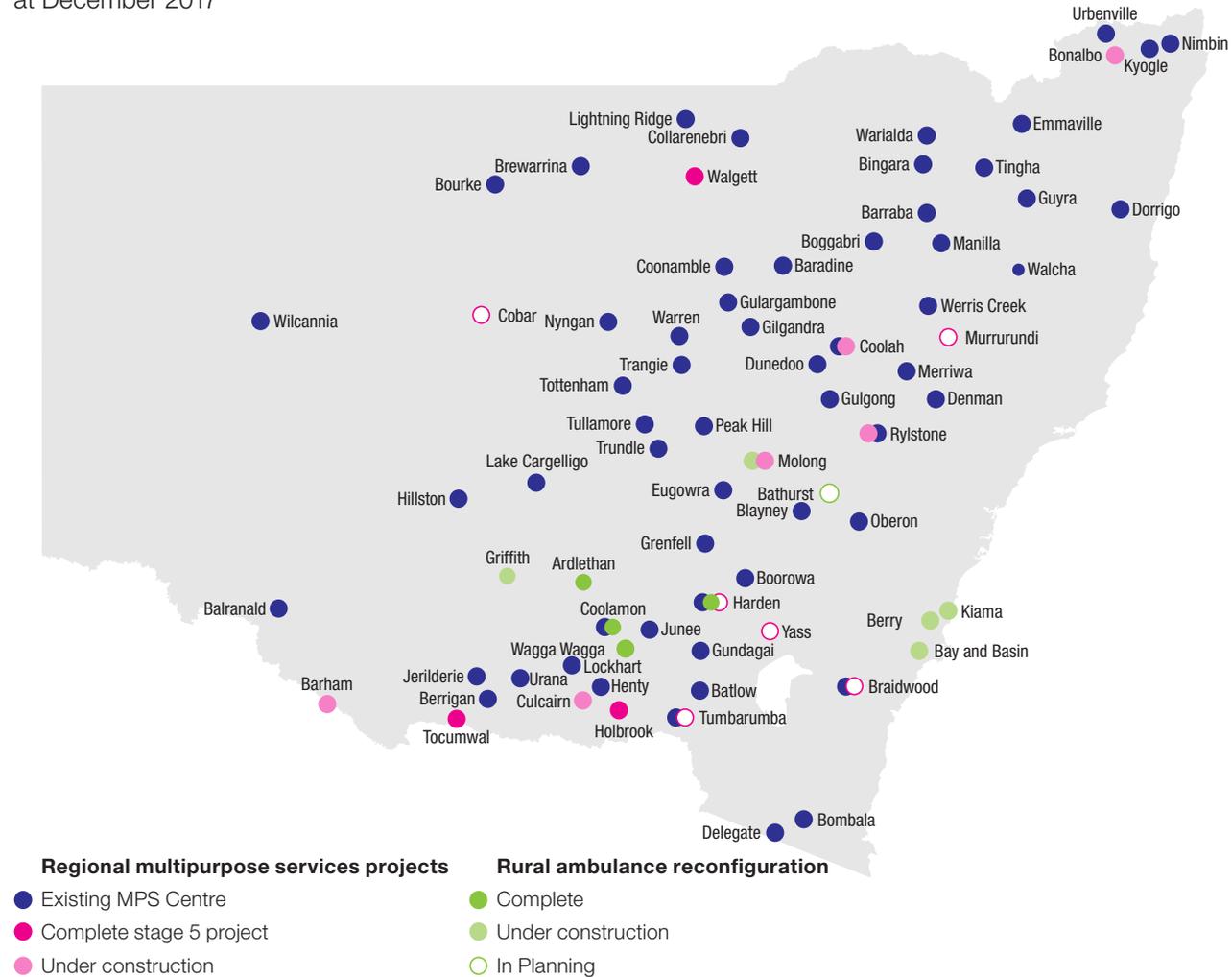
12.2 Challenges and opportunities

The healthcare system needs to evolve to meet future needs and trends, including population growth, an ageing population that uses services more frequently, the shift in disease burden to chronic and complex conditions, and new and more accessible services made available by advances in technology.

12.2.1 A growing and ageing population

The uneven nature of population growth in NSW will influence demand for health services and place considerable pressure on the health system in high growth areas. Western Sydney and South Western Sydney are the two largest Local Health Districts (LHD), representing 25 per cent of the State population in 2016, and are projected to be the fastest growing districts in the next 20 years (see Figure 48). The population of the Western Sydney LHD is projected to grow by half a million people, or 56 per cent, and the population for the South Western Sydney LHD is projected to grow by 436,000 people, or 45 per cent, by 2036.

The significant forecast growth in the aged population will increase the demand for health services and change the types of services required and how they are delivered. People over 70 years of age consume more care than any other section of the population and are less able to make a financial contribution to their care. Across all OECD countries, the ratio will shift from four working-age people for every person aged over 65 to roughly two working-age people for every person aged over 65 by 2040.[239]

In NSW, the population over 70 years old is expected to grow from 853,000 in 2016 to over 1.55 million by 2036, an increase of 85 per cent (see Figure 49). The Hunter New England LHD currently has the highest number of people aged 70 and over, accounting for 13 per cent of the State's total. This is estimated to increase from 120,350 in 2016 to 205,070 in 2036, an increase of 70 per cent. The Western Sydney, South Western Sydney and Nepean Blue Mountains LHDs are estimated to have the most significant growth in the local population aged over 70, with increases over the next 20 years of 128 per cent, 124 per cent and 116 per cent respectively.

Over the next 20 years, the demand for in-patient health services is forecast to grow by over 50 per cent, compared to population growth of just 28 per cent, due in large measure to the ageing population (see Figure 50).

12.2.2 The increasing cost of healthcare

The NSW Intergenerational Report (2016) identified health spending as a key pressure for the NSW Government. If 'business as usual' practices continue, health expenses will increase from around 29 per cent of NSW Government expenses in 2014-15 to 36 per cent by 2055-56. Health services represent the largest share of State expenditure and have the fastest projected growth rate. Estimates in the NSW Intergenerational Report indicated that health costs in NSW are expected to grow by about six per cent a

Figure 48 – Population projections for NSW Local Health Districts, 2016 – 2036
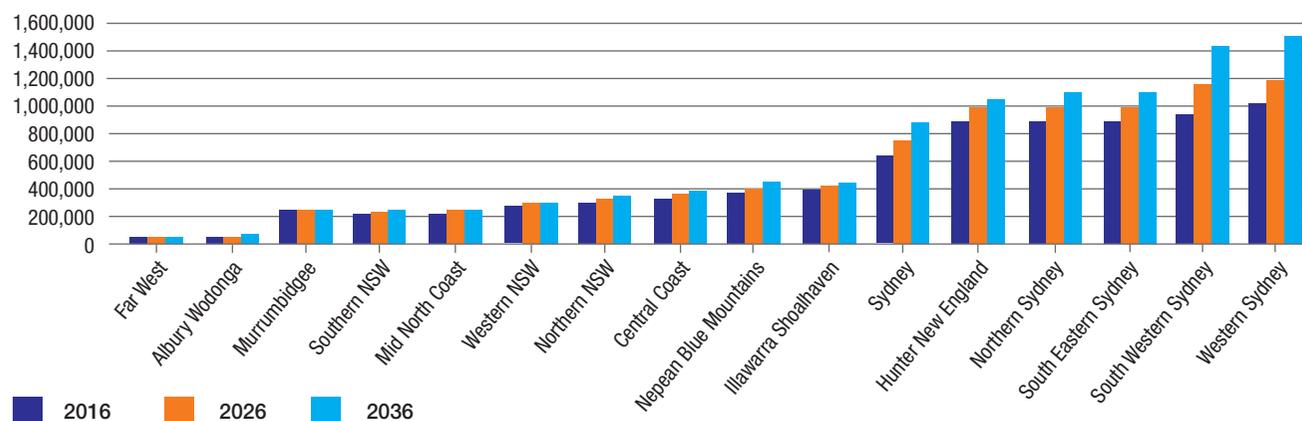
Source: NSW Department of Planning and Environment 2016

239 Business Council of Australia 2015, p. 10 (citing OECD statistics)

Figure 49 – NSW population projections, population aged 70 years and older, 2016 – 2036
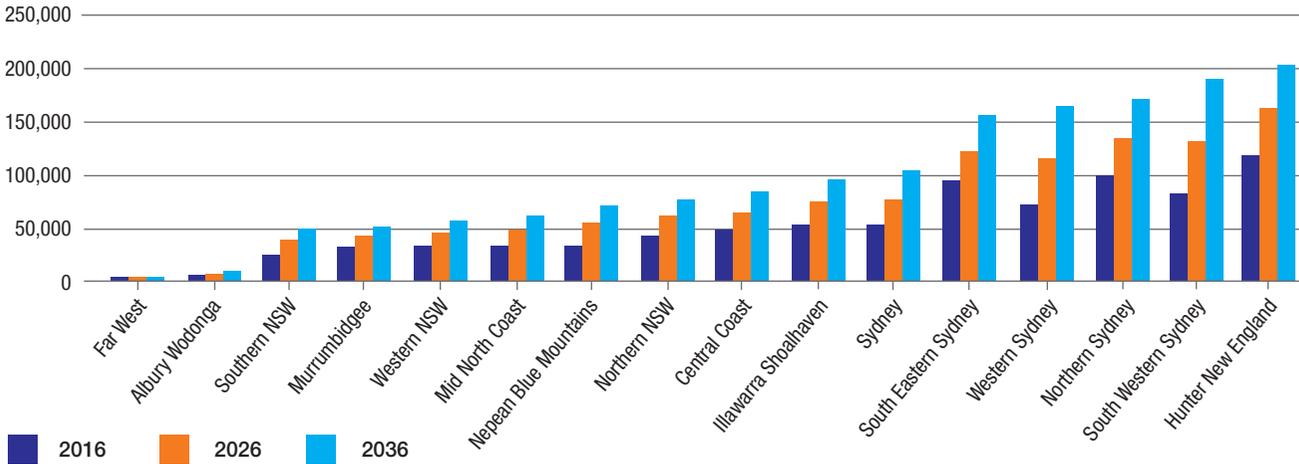
Source: NSW Department of Planning and Environment 2016

**Figure 50** – NSW Health public hospital activity growth against population growth, 2016 – 2036
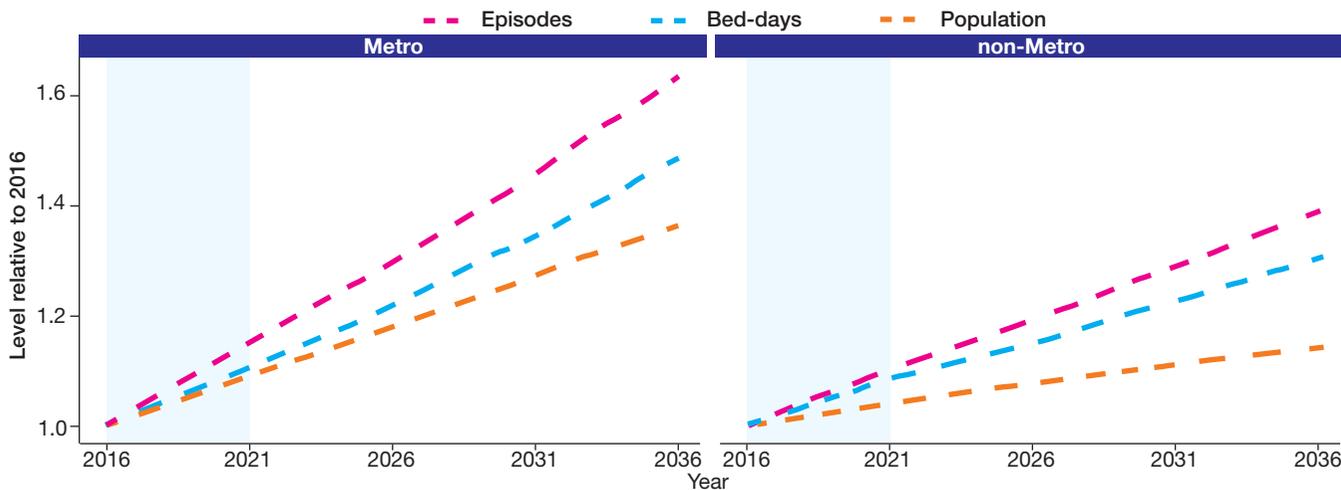
Sources: NSW Health 2017; NSW Department of Planning and Environment 2016

year over the next decade and beyond, with most of the costs growth occurring in the hospital system.[240]

This growth rate in spending assumes that NSW Health continues to plan for and deliver health services in the same way that it does today. Existing projections based on traditional models suggest that up to 10,000 new hospital beds may be required by 2030 to meet demographic demands. However, these projections do not account for the rapidly changing nature of healthcare delivery. The number of hospital beds per thousand people has been dropping steadily in Australia since the early 1970s and is likely to continue to drop as care is delivered increasingly in people's homes and their communities, or even virtually. In the future, hospital care will be required only for the most acute surgical interventions and severe medical conditions allowing more people to remain in their homes and to receive care than previously required hospitalisation.

NSW Health is adopting new ways of delivering services as part of a program to manage the rising costs of healthcare. These include preventative strategies to reduce demand and alternative models of care that can replace high-cost hospital-based treatments. Health partnerships (using the not-for-profit and private sectors), reducing duplication and clinical variations to deliver better value care, developing workforce capabilities and investing in infrastructure to drive future efficiencies are also being explored.

240 NSW Treasury 2017, p. 10

Figure 51 – Share of total NSW Government
expenditure 2014-15 to 2055-56

Per cent share of total expenses

2014–15
2055–56
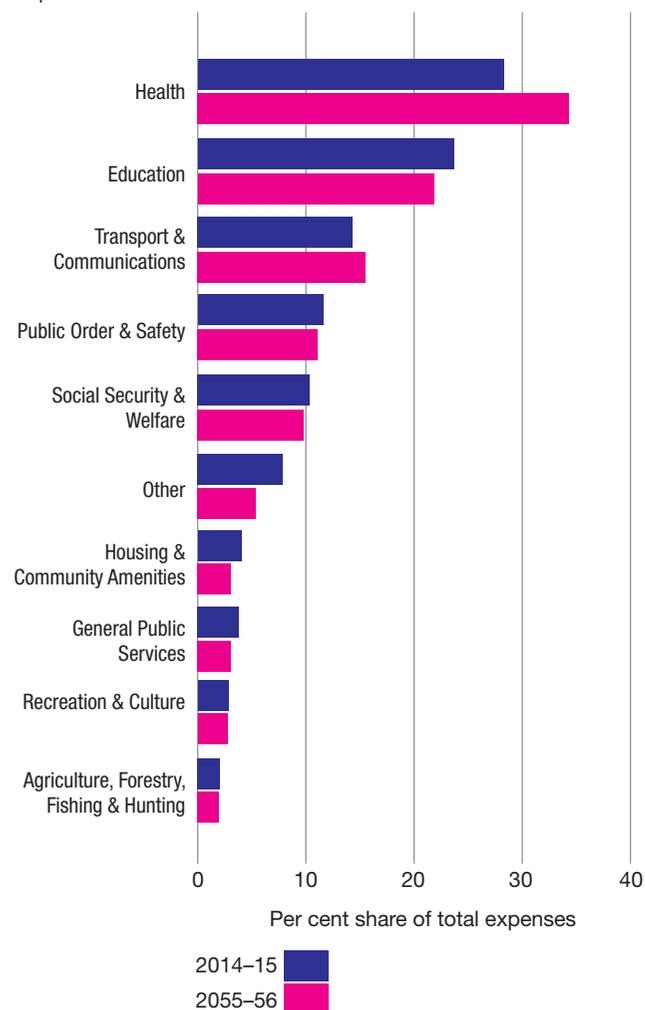
Source: NSW Treasury 2016, *Intergenerational Report 2016*

12.2.3   A complex operating environment

In NSW, healthcare is provided through a
comprehensive network of services ranging from
large principal referral hospitals providing highly
complex emergency and planned services, through
to community health centres and care in people's
homes. The health care system includes ambulance
services, population health and preventative services,
mental health, primary care (including general practice),
allied health services, pharmacy, dental and residential
aged care. A diverse range of services is delivered by
different levels of government as well as by the private
and not-for-profit sectors.

The Productivity Commission has described the
health system as large, fragmented and complex with
significant interdependencies between public and non-
government providers as well as Commonwealth and
state governments.[241] The nature of the system means
that cost pressures, policy decisions and infrastructure
investments need to be managed as part of a system-
wide approach.

The hospital system on its own cannot meet the
changing needs of a community where people
are living longer, often with chronic and complex
healthcare needs, including mental illnesses. New
models of care will be needed – including partnerships
across the health sector, flexible funding streams, new
workforce models and eHealth solutions – to create the
connected and integrated healthcare system required
to meet growing and changing healthcare needs
across NSW.

241   Productivity Commission 2015, pp. 9-10

Figure 52 – Australia's health system overview

Share of recurrent expenditure
- Hospitals
- Primary health care
- Other services

Responsibility for services
- Combined public and private sector
- State and territory governments
- Private providers

Source of funding
- Australian Government
- State and territory governments
- Private
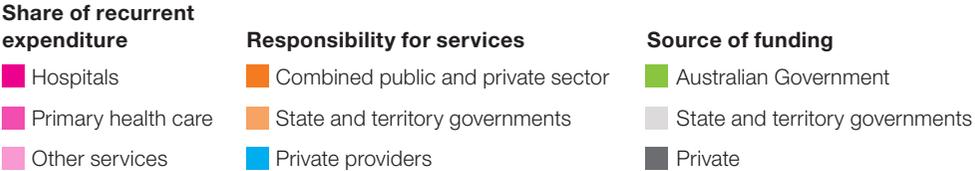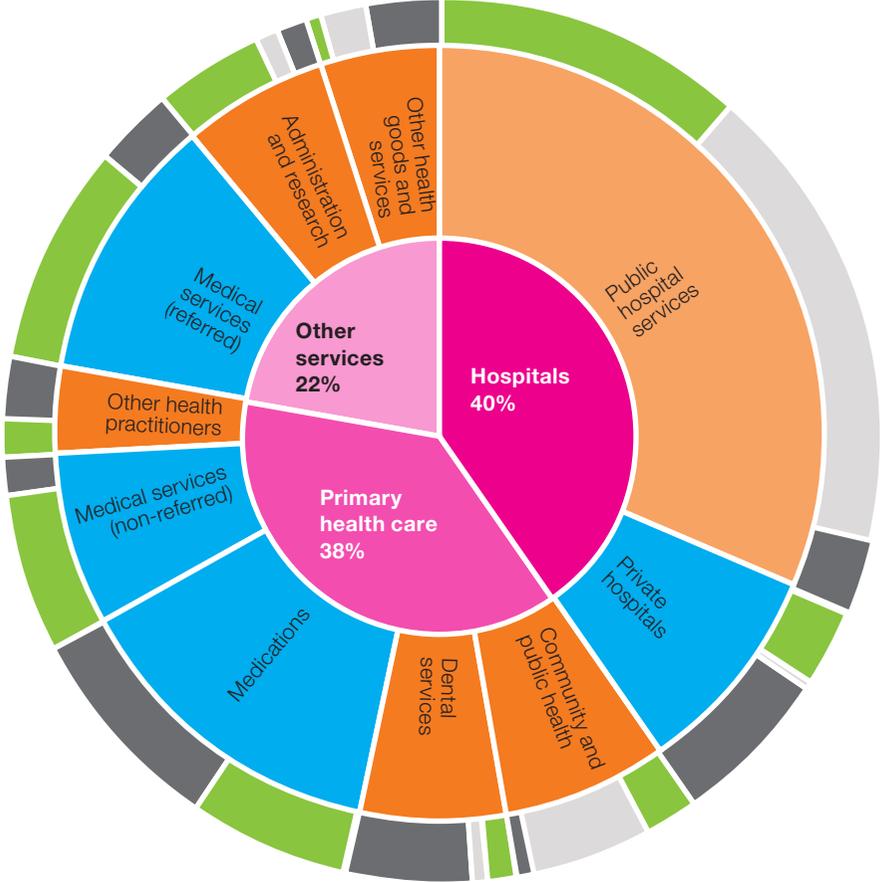
Source: Australian Institute of Health and Welfare 2016, Australia's Health

Figure 53 – Health sector roles and responsibilities

	Funding and financing	Service delivery	Policy and regulation
Hospitals	Australian Government NSW Government Non-Government	NSW Government Non-Government	Australian Government NSW Government
Primary health care	Australian Government NSW Government Non-Government	NSW Government Non-Government	Australian Government NSW Government
Other (e.g. referred services)	Australian Government NSW Government Non-Government	NSW Government Non-Government	Australian Government NSW Government

Source: Productivity Commission 2015

12.2.4   Ageing health infrastructure

Approximately 40 per cent of NSW Health's built infrastructure is over 50 years old. This necessitates ongoing investment in maintenance and upgrades to meet current needs. An integrated approach is imperative to ensure that the use and condition of these key assets are aligned to clinical needs and that they deliver value for money across government. This is a significant challenge due to the age and condition of some older property assets, the difference scope and sizes of each LHD's assets base and required improvements in the tracking and analysis of maintenance expenditure.[242] Many sites need to be retro-fitted with digital connectivity infrastructure and power supply.

12.2.5   Technology and disruption

Healthcare is an industry that is expected to experience significant disruption over the next decade. Most of this disruption is likely to be driven by the advent of cognitive technologies, artificial intelligence (AI), personalised medicine and virtual healthcare that enables service delivery outside of hospitals. Technology disruption in other industries has shown that organisations are exposed to risk when they:

- deny the existence of disruption rather than confront the uncertainty
- fail to act because innovation could potentially render existing assets and investments obsolete
- become constrained by the idea that the future will mirror the past.

Delivering new and upgraded health infrastructure

The 2017-18 Budget provided a significant short-term investment boost for health infrastructure, committing an additional $2.8 billion over four years to 2020-21, bringing the total investment over that period to a record $7.7 billion. This ongoing investment will support the implementation and delivery of the current Health Strategy, the *NSW Health State Plan: Towards 2021* and related plans including the eHealth Strategy. It will enable NSW Health to deliver new facilities, upgrades and redevelopments across NSW.

Major works commencing in 2017-18 include:

- the reconfiguration and expansion of Randwick Hospital Campus (estimated total cost $720 million)
- Campbelltown Hospital Stage 2, comprising mental health and South West paediatric services (estimated total cost $632 million)
- the Nepean Hospital and integrated ambulatory services redevelopment and hospital car park (estimated total cost $576 million)
- a new Tweed Hospital on a greenfield site (estimated total cost $534.1 million)
- the Concord Hospital upgrade (estimated total cost $341.2 million).

There will be ongoing investment in major strategies such as the *Multipurpose Services Strategy*, Rural Ambulance Infrastructure Reconfiguration and *HealthOne Strategy* (estimated total cost $522 million). Other health infrastructure projects that received capital investment in the 2017-18 Budget include:

- redevelopment of hospitals at Albury, Coffs Harbour, Cooma, Goulburn, Inverell, Lismore, Shellharbour, Wagga Wagga and Wyong (nearly $48 million)
- new hospitals at Macksville, Maitland, and Mudgee ($36 million)
- stage 2 of the Hornsby Hospital redevelopment ($24 million including $4 million for the car park)
- car parks at Campbelltown, Shoalhaven and St George hospitals ($13.7 million)
- phase 2 of the Medical Research Infrastructure Initiatives ($10 million)
- planning for a statewide mental health capital works program and future capital works at Rouse Hill, Griffith, Tumut, Liverpool and St George Hospitals ($15 million).

242   NSW Health 2016

The health sector has significant structural barriers to adopting new behaviours and solutions. The Committee for Economic Development of Australia (CEDA) has argued that business systems in the health sector have failed to keep pace with technological improvements and that the sector is not oriented around the needs of patients, but is instead overwhelmingly an arrangement of producer interests.[243] Likewise, the Business Council of Australia has observed that existing supply models have been unable to match the efficiency gains made in the rest of the economy.[244]

Over the past decade, NSW has invested more significantly in eHealth than any other state in the country and has built the foundations of an electronic health system that can cater for future technology advances. The eHealth strategy for NSW encompasses programs that support new models of care. These include telehealth, electronic medications management, statewide access to digital imaging and the use of voice recognition software as part of the second phase of the electronic medical records program. eHealth is being used to improve patient care by making patient information being readily available to clinicians across the State, engaging clinicians and other health workers to implement statewide systems in their local facilities and setting performance standards to ensure information systems meet the needs of clinicians and patients.

eHealth Strategy for NSW Health 2016 – 2026

At June 2016, more than 73 per cent of health employees were using electronic medical records across the NSW Health facilities to provide care. During 2015-16, electronic charts were opened more than 12 million times – a 30 per cent increase over the previous year.

The 2017-18 State Budget provided an additional $536 million for enhanced eHealth information technology projects to deliver improved digital infrastructure for patients and staff across NSW.

12.3 Response

NSW Health is currently delivering the *NSW State Health Plan: Towards 2021*, which is based on three directions:

• keeping people healthy

• providing world-class clinical care

• delivering truly integrated care.

These directions are supported by four strategies:

• supporting and developing the workforce

• supporting and harnessing research and innovation

• enabling eHealth

• designing and building future focused infrastructure.[245]

The Health Plan's directions and strategies underpin the current investment in health services and provide

a strong direction for the short term. NSW Health develops an annual asset strategy, with a 10-year outlook, that outlines its strategic directions, the drivers for infrastructure investment and approaches to managing and maintaining its asset portfolio.

12.3.1 Planning for the longer term

Health has benefited from significant capital investment in new and modernised hospitals over the past six years. Beyond the $7.7 billion currently committed for new infrastructure to 2020-21, the opportunity exists to develop a long-term strategy that will support and enable new models of care within the health system and allow it to cope with the challenges of long-term population growth, settlement patterns as well as increasing and changing demand.

A longer term strategy will enable NSW Health to consider the impact of mobile and virtual health care delivered in people's homes and communities rather than in traditional hospital beds, and to ensure that the future health infrastructure system is designed to support an ongoing focus on demand management for acute care.

The journey the health system will take over the next 20 years is comparable to changes in the banking system. Banking has moved from a reliance on services delivered in branches, to ready access to services via automated teller machines, mobile and virtual banking – where most services are available at any time of day, anywhere in the world, via mobile phones. Similarly, the healthcare of the future will be delivered to patients via virtual and mobile technologies – at home, in the community or, if they have complex and severe needs, in the hospital. This shift to mobile healthcare requires careful planning of the electronic, digital, analytic and

243 CEDA 2017, p. 30
244 Business Council of Australia 2015, p. 1

245 NSW Health 2014, p. 164

mobile infrastructure needs of a future healthcare system. That planning needs to commence now.

Value based care – moving from volume to value

Capital investment represents just seven per cent of total NSW health expenditure in 2017-18. NSW Health is examining and implementing non-asset strategies to manage rising healthcare costs. These strategies include:

- alternatives to hospital based models of care
- improved system integration
- reduced variation in care
- preventative health measures.

Like many health systems around the world, NSW is progressing along a long-term transformational journey from volume to value. This puts the patient at the centre of care and focuses on the experience and outcomes of patients and clinicians.

"*Value based healthcare means that we continually measure the experience and health outcomes of patients…with the aim of constantly improving the patient reported and medical quality…thereby receive the largest amount of value for our patients per spend…*"[246]

NSW Health is investing in the *Leading Better Value Care Program* to improve the efficiency, effectiveness and integration of care across the health system to reduce rates of growth in health costs.

246 Definition of Value-based Healthcare at Sahlgrenska University Hospital (SU), Koff, E 2016

Figure 54 – Change in capital expenditure profile to support future of healthcare (Indicative Only)

Legend:
- Current Spend Profile
- Illustrative Future Spend Profile

X-axis: Health & Medical Research | Health IT | Ambulance & Emergency Services | Sub-acute & Mental Health Services | Acute Health Services | Community Health Services
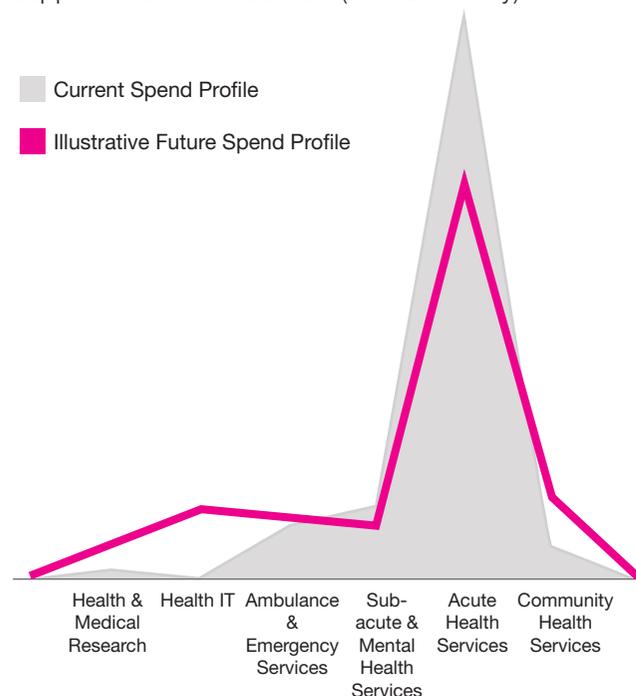
Source: Deloitte Analysis 2017

In delivering the vision for the future of health, there will inevitably be changes to the allocation of investment across healthcare programs. New models of care and technological innovation will require a rebalancing of capital expenditure, away from conventional hospitals and towards community-based care and technology-enabled facilities.

This re-profiling will need to be supported with care strategies that reduce rates of hospital admissions in NSW for clinical conditions that can be treated effectively outside of a hospital.

Future investment decisions should commit to investment in infrastructure that will improve integration between hospital and primary care, and help prevent unnecessary hospital readmissions and attendances at Emergency Departments. Further investment in new non-hospital based infrastructure or re-purposing of existing assets will be required to support the future care strategies.

12.3.2 Development of a 20-year Health Infrastructure Strategy

Infrastructure NSW recommends the development of a robust 20-year Health Infrastructure Strategy to achieve a coordinated and integrated response across government, non-government and private sector providers of health services. The Strategy should focus on delivering new models of care, investing in fit-for-purpose health infrastructure and accessing the benefits of technology for future services. A longer-term commitment to the principles contained in the *NSW State Health Plan: Towards 2021* will also create opportunities for dialogue about the future of healthcare in NSW with the non-government and private sector, and with the Commonwealth Government.

This Strategy should consider all the elements of the health system, including integrated care, ambulance services and cross-government policies (such as planning instruments), that are required to support future infrastructure needs. More facilities, community health assets and other health services are likely to be needed in new and high growth areas. The role and function of some existing assets should be reviewed to ensure they are fit-for-purpose in the longer term. NSW Health should plan for investment in future-focused infrastructure that incorporates flexibility, innovation, eHealth and mobile technologies and that will support improved efficiency and effectiveness in health service delivery.

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Guiding principles for the 20-year Health Infrastructure Strategy

- Provide infrastructure that supports the delivery of world-class health care services
- Develop fit-for-purpose infrastructure that is planned to align with forecast population growth and demographics
- Identify and protect strategic areas for future health infrastructure needs at early stages of land use planning
- Support improved health outcomes for people and the community
- Support access to quality health services and facilities across the whole of NSW, either through physical access or access to eHealth and telemedicine
- Deliver services more efficiently to contribute to managing the forecast increases in costs of providing health services through service improvements and ongoing contestability of service provision (where appropriate) for health infrastructure
- Support increasing the flexible use of system capacity and capability to meet the needs of people using and employed by the system at every stage
- Continue to seek opportunities to further develop eHealth systems and to encourage patients to access eHealth services where appropriate
- Develop and maintain a sound (digital) information system on asset management condition and capacity
- Achieve strengthened long-term planning to support the provision of service delivery priorities

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12.3.3 Developing facilities that support new models of care

In assessing capital needs for new health facilities, Infrastructure NSW supports shifting the focus from being primarily on large hospitals and acute inpatient beds to a more holistic response requiring new forms of health infrastructure that can support cost-effective and patient-centric healthcare delivery in the community. This is consistent with the direction being followed in health systems around the world.

In the future, a higher volume and complexity of healthcare services will be delivered in homes, GP surgeries and community care centres. In addition to existing care settings, new types of facilities may be required, such as rapid response units or day care facilities for elderly people (this will require partnerships with the Commonwealth Government). Innovative models will help to manage the demand generated by the growing and ageing population, changing settlement patterns, and the management of chronic disease.

The role of health infrastructure will need to be reimagined to include next generation communications networks, physical robots, data storage, cybersecurity, connected home devices, virtual care centres and more.

As well as investigating future requirements for facilities, the NSW Government needs to continue to deliver new health care facilities. Over the next 20 years, the Government should continue to invest in hospital upgrades, redevelopments and new

construction to ensure health services are being delivered to align with population and settlement patterns. This investment should be coupled with an increasing focus on demand management for acute care services, where appropriate, and this demand management focus should inform investment decisions.

Planning and development of the projects that have been identified by NSW Health through their forward planning processes should continue, with programming and funding decisions to be made to align with the Health Infrastructure Strategy, and supported by business cases.

12.3.4   Integrated land use through precincts and campuses

Over the past 20 years, the footprint of hospitals and health facilities has become increasingly integrated with other related and supporting land uses. Hospitals have become health campuses or precincts that incorporate integrated education and medical research facilities and firms, related health services and worker housing. The NSW Government needs to plan for future health precincts beyond the metropolitan boundary to meet the needs of rural and regional communities.

Integrated planning for rural and regional areas

The delivery of health services in proximity to remote and regional communities is a challenge because of the size of NSW. The advent of better remote monitoring capabilities, virtual healthcare and mobile healthcare apps will support improved delivery of healthcare for rural and remote patients via the application of a 'hub and spoke' approach to health service delivery in regional areas.

Economic modelling highlights the significant contribution that investment in health infrastructure has on local economies through the creation of jobs, flow-on effects from the purchasing of goods and services, and further business investment. In many places, the LHD and other health services are major employers in the communities they serve. Figure 54 shows the proportion of new capital works announced since 2011 compared to the proportion of population growth and acute activity between metropolitan, rural/regional and statewide projects. Given its levels of population and activity growth, the rural sector has received a large share of capital investment to upgrade ageing infrastructure and in recognition of the economic and social benefits that health infrastructure brings to communities.

New integrated healthcare delivery models will support and complement the economic contribution made by existing hospital and health care services and will need ongoing investment to support their rollout across the State.

Figure 55 – Rural and regional health facts

New Capital Works announced since 2011

Statewide 4%
Metro 52%
Rural / Regional 44%

Population Growth 2015-2026

Rural / Regional 261,422
Metro 944,688
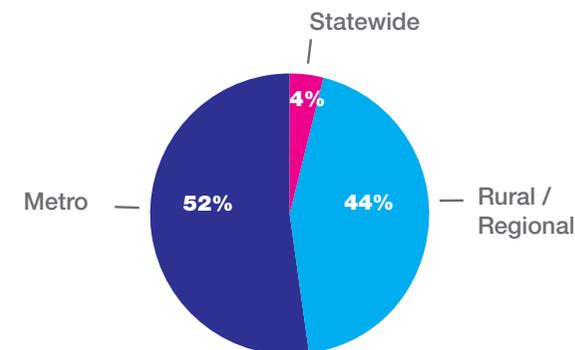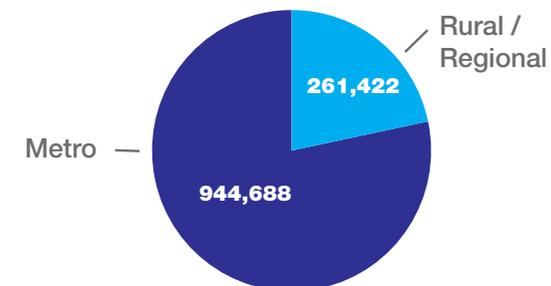
Proportion of Acute Activity: Metro v Regional

Rural / Regional 41%
Metro 59%
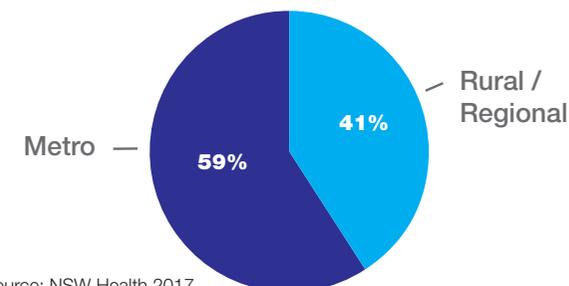
Source: NSW Health 2017

Health and education precincts

Quality health services have partnerships with academia and the provision of training at their core. Partnerships with medical research institutes and with medical and other health-related faculties at universities lead to high quality research outcomes, medical breakthroughs and improved patient care and treatment. These collaborations often involve multiple hospitals and universities, as well as private firms. The commercialisation of research generated by these precincts can make a significant contribution to NSW's international competitiveness.

Twelve established and emerging health and education precincts have been identified in the draft Greater Sydney Commission District Plans (shown in Figure 56), which also outline steps to maximise the economic and employment potential of these precincts.

A NSW Government benchmarking study[247] has found that the evolution of health education precincts follows a 'maturity pathway': as health precincts evolve, the economic productivity of the precinct increases substantially. This evolution sees precincts develop into progressively more complex models, including clusters, precincts and innovation districts. The eleven health and education precincts in Sydney are at different points along the 'maturity pathway'. While not all precincts will be able to develop into internationally competitive innovation districts, ongoing investment in their development is recommended.

Design living spaces to accommodate care in the home

The draft *Greater Sydney Region Plan* notes that accessible, well-designed places and homes can allow people to stay in their neighbourhoods as they age. Strategies that promote more healthy ageing will help to offset the significant forecast growth in demand in health services. Some cities around the world are investing in housing and infrastructure strategies that encourage a more active lifestyle to combat the onset of obesity and chronic disease. NSW Health should work with other agencies to optimise health promotion and disease prevention measures within NSW's built environment.

The need for acute care in the home, as an alternative to care in a hospital, is being driven by advances in medicine, increased pressure on the healthcare system and evidence of improved health outcomes for patients who spend less time in hospital.

NSW Health is currently using technology to support the healthcare system as it changes and evolves, embedding eHealth into everyday models of care that help link patients, service providers and communities with a smarter healthcare system. eHealth and other technologies will enable a stronger approach to delivery of care in the home, leading to different approaches to accessing and delivering health care. Approaches to out-of-hospital care need further development and work will need to be undertaken with the Commonwealth Government to ensure funding mechanisms for health services keep pace with advances in healthcare service delivery.

12.3.5   A strategic review of existing assets

Locating the right assets in the right places to provide readily accessible services to a growing and ageing population will be an ongoing challenge as Sydney grows and regional NSW population increasingly move into towns and cities. The proposed 20-year Health Infrastructure Strategy should consider where assets should be located and whether rebuilding and renewing existing assets would provide better service outcomes than building new, fit-for-purpose infrastructure precincts and divesting legacy assets.

NSW Health's assets are valued at over $22 billion across land, buildings, plant and equipment.[248] The Strategy should consider how NSW Health can achieve consistency in asset management, the supply of power and digital connectivity needed at all sites, and the need for further improvements in the performance and utilisation of assets.

NSW Health should continue to run programs like the Asset Refurbishment and Replacement Program (ARRP), which funds backlog remedial maintenance works at public hospitals. This 10-year, $500 million program funds projects to restore existing systems and assets to a capability where they will reliably support health services, as well as extending the life of building assets.[249]

247 Greater Sydney Commission 2017, p. 99

248 NSW Heath 2016, pp. 6-7
249 Health Infrastructure 2015, http://www.hinfra.health.nsw.gov.au/ our-projects/project-search/projects/asset_refurbishment_and_ replacement_program

Figure 56 – Health and Education Precincts – Sydney

Westmead Health and Education Precinct

This Precinct is a key component of the Greater Parramatta and the Olympic Peninsula vision. This redevelopment is transforming the precinct into an innovative, contemporary and integrated centre which will continue to deliver high quality healthcare. The redevelopment is expected to increase the Precinct's workforce from 18,000 to 32,000 by 2036 and with the potential to reach 50,000 by 2036.

Penrith Health and Education Precinct

The Precinct opened in 2014. Over $1.5 billion worth of investment across more than 20 projects which should provide an additional 12,000 jobs by 2036. In November 2016, a $550M redevelopment of Nepean Hospital was announced to support delivery of world-class facilities for the Western Sydney community.

Liverpool Health and Education Precinct

The Precinct was established in partnership with the South West Sydney Local Health District (SWSLHD), Western Sydney Business Chamber (WSBC), and Liverpool City Council to increase the opportunity for health, research and education investment around the hospital.

Camperdown-Ultimo Health and Education Precinct

The Camperdown-Ultimo Precinct comprises Royal Prince Alfred Hospital, Sydney University, the University of Technology and Notre Dame University. It is close to Central to Eveleigh, the Australian Technology Park and forms part of Sydney City. In 2016, an estimated 31% of all jobs in the precinct were in the health and education sector.

Randwick Health and Education Precinct

The NSW Government is investing $720M Prince of Wales Hospital redevelopment. A partnership with South East Sydney Local Health District (SESLHD), the Sydney Children's Hospital Network (SCHN), Randwick City Council (RCC) and the University of New South Wales (UNSW) has been established to deliver the Randwick Health Collaboration Vision which will deliver improvements across the Specialised Health and Academic Sciences Precinct and a major new health research campus.

Map labels:
Penrith-Nepean Health and Education Precinct
Blacktown Health and Education Precinct
Westmead Health and Education Precinct
Concord Health and Education Precinct
Liverpool Health and Education Precinct
Bankstown-Lidcombe Health and Education Precinct
Cambelltown-Macarthur Health and Education Precinct
Kogarah Health and Education Precinct
Northern Beaches Health and Education Precinct
St Leonards-North Shore Health and Education Precinct
Camperdown-Ultimo Health and Education Precinct
Randwick Health and Education Precinct

Source: NSW Health 2017

Figure 57 – Total current public and private healthcare spending per person adjusted for cost of living, by potential years of life lost, NSW and comparator countries, 2014 (or nearest year)
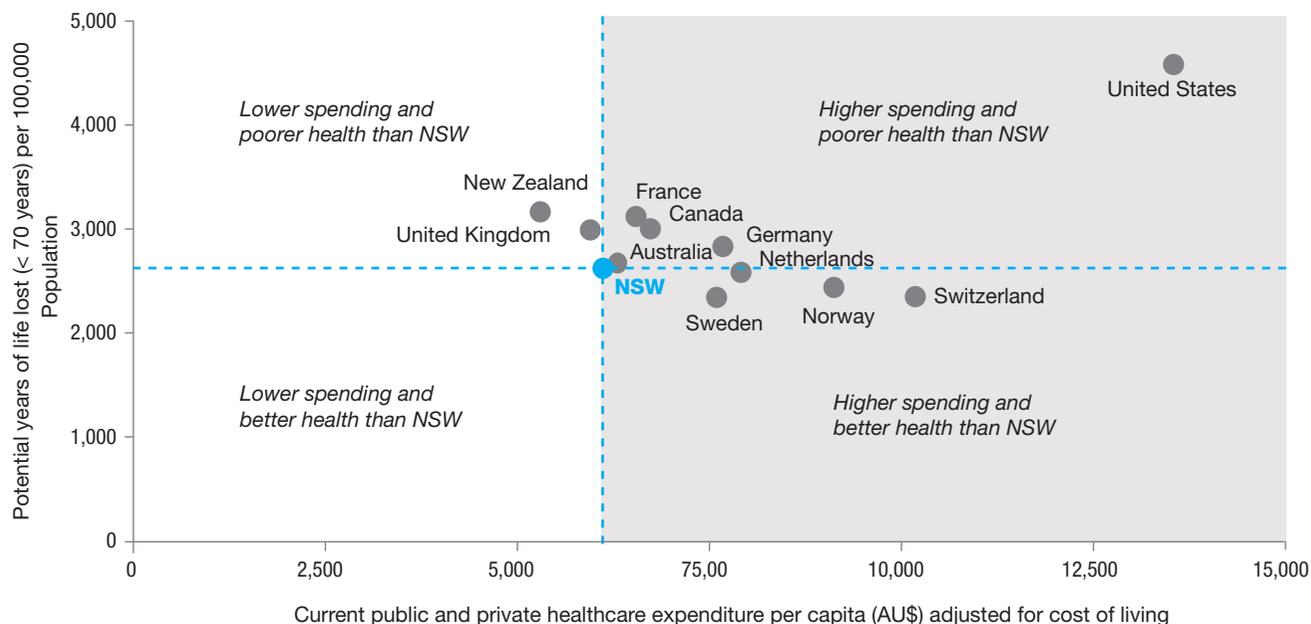
Source: Bureau of Health Information 2017, *Healthcare in Focus 2016*

12.3.6 Partnering with non-government providers in NSW

The NSW Government should continue to access opportunities to increase non-government participation in health. Using partnerships with the private and not-for-profit sectors should form part of this approach.

The extent of these opportunities will depend on the Government's willingness to enable markets and create incentives for innovation and improvement in service delivery. Incentivised partnerships with non-government and private health providers will enhance co-design, co-location, community engagement and management.[250]

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Recommendation 95

Infrastructure NSW recommends that the NSW Government continue the high level of investment in fit-for-purpose health infrastructure over the 10-year period from 2018 to 2028.

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250 NSW Government 2016, p. 10

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Recommendation 96

Infrastructure NSW recommends that NSW Health develop a 20-year Health Infrastructure Strategy by early 2019 that supports the future delivery of health services and includes:

- a future-focused analysis of emerging healthcare and non-healthcare technological disruptors and the likely impact on infrastructure required over the next 20 years

- an assessment of the suitability of existing facilities to support future care requirements and enable a higher volume and complexity of services to be delivered in the community

- investigating sites for future health facilities where new development is expected such as North Bringelly and Leppington

- a 20-year strategy for asset management and renewal

- an examination of the role of NSW Health in the delivery of future models of care; for example, identifying and securing land for additional integrated community care facilities, health and medical research hubs and research centres, remote monitoring facilities and rapid response units

- further investment in ambulatory rehabilitation and mental health clinics and investment in assets to house vehicle fleets and mobile medical equipment

- consideration of options for innovative procurement models and increased private and non-government sector delivery of health infrastructure and services.

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12.3.7 Ongoing investment in technology transformation

The benefits of eHealth solutions extend well beyond the electronic capture and recording of patient information. The future of healthcare innovation is moving rapidly towards the everyday use of software 'bots', mobile technologies, bioinformatics, artificial intelligence diagnostic systems and other technology-enabled tools that allow clinicians to deliver healthcare in faster, more mobile and more integrated ways.

Over the next 20 years, the impact of technology-enabled health care is likely to be significant, dramatic and disruptive. The NSW eHealth strategy needs to be refreshed to look beyond electronic information systems and consider ways to support the delivery of healthcare enabled by the latest technological advances. Building on the foundations laid by the current eHealth Strategy, the NSW Government should continue its high levels of investment in the next generation of eHealth and technology-enabled healthcare.

Beyond the implementation of the current eHealth strategy, the NSW Government should continue to embrace technology in the delivery of health services, including.

- seeking to make more data available to support research and innovation that improves service delivery and system efficiency
- continuing to develop connectivity and digital tools that support improved health outcomes
- investing in new technology that improves service delivery and health outcomes.

The advent of personalised precision medicine that allows more tailored treatments for individuals based on genetic, metabolic and microbiological analysis will support more effective out-of-hospital care. These developments will need to be supported by investment in data storage and analytic capacity, remote monitoring centres, biobanks and research data platforms.

Data storage, information and availability of data

Information is central to an efficient and effective health system and an essential component of performance reporting, patient information and sharing of records.[251] Data gathered and held in the health sector is a valuable resource for improving service delivery and supporting research, development and innovation in the health sector. The NSW Government should make more data available in the health sector to support ongoing improvements in service delivery and patient-centred models of care. Data release may also provide economic benefits: in the United States, an open source health data initiative led to large increases in patient- and provider-focused applications and in venture capital investment.[252]

Emerging digital technologies are creating new ways to monitor patients in hospitals. These technologies generate masses of data that can be integrated and aggregated to create a holistic view of a patient or an operational unit's activity and real-time status. Programs such as the UK National Health Service's *Getting It Right First Time* highlight the importance of streamlined and accessible data to improve the health system.[253] Not only do the interactions between outcomes of care

251 Productivity Commission 2015, p. 73
252 Business Council of Australia 2015, p. 18
253 NHS, http://gettingitrightfirsttime.co.uk/what-we-do/

Clinical Command Centre, Cleveland, Ohio

The Clinical Command Centre at Cleveland Clinic's eHospital facilitates problem identification and swift intervention by physicians and nurses. The eHospital's 'bunker' – a clinical command centre on the hospital's main campus – was initiated in 2014. Physicians, critical care nurses and technical staff monitor patient data on a digital wall in the bunker in real time across six intensive care units (ICUs) located in Cleveland Clinic's four hospitals: the main campus and Fairview, Medina and South Pointe hospitals.

Each patient has a tile on the screen on the wall with their name, age, hospital location and vital signs trend line. The risk status, instead of complicated numbers, is a simple dot – green for low risk and red for high risk – that beeps intermittently. The team monitors red dots closely and alerts ICU ground staff about possible interventions.[254]

With multidimensional data, the team uses analytical algorithms to stratify patients based on risk and demographic profiles. The team also uses data from electronic health records to provide advanced alerts for patients who portray higher risk levels. In the first half of 2015, the bunker team reviewed data on more than 37,800 ICU patients.

254 Ibid.

and input costs become more transparent, such initiatives also provide, in one easily accessible place, a comprehensive clinical, performance and financial picture for each unit. None of this is possible without a solid foundation of capturing, storing, securing and analysing data within a system-wide digital infrastructure.

Connectivity and digital tools that support improved outcomes

Providing access to health services online, as well as resources that help people self-select care options and manage their own health, should form part of the future health system. Education campaigns that help build users' digital literacy and knowledge of the healthcare options available to them will help reduce the demand for in-hospital care and treatment and support health in the home.

The future of in-home care includes mass monitoring of patients at home by doctors or nurses, in a virtual care centre setting. Smart devices and algorithms are enabling quality care and disease management to take place within the home, and adverse events detected by these devices can trigger alerts to families, care teams or emergency services.

A wide range of digital and web-based health technologies are currently available to patients within the NSW Health system, including remote telemonitoring of patients at home and the secure use of applications on personal devices such as mobile phones and tablets. The next generation of telehealth will see:

- patients recording their own blood pressure, glucose levels and medication
- in-home sensors and accelerometers detecting falls

- patients wearing scannable wristbands to improve continuity of care in the hospital setting
- smart health assistants providing medical advice and reminders
- Electronic Medical Records (eMR) connected to in-home monitoring devices
- electronic referrals and virtual appointment scheduling.

The increasing adoption of telehealth services globally reflects a shift in demand in the health system from the acute to the primary sector, providing effective delivery of care at a lower cost and changing the infrastructure mix required for the future health system. Telehealth services improve the ability and willingness of patients to better manage their own conditions, leading to a gradual constraint in the growth of demand.[255]

Telehealth offers benefits for patients, carers and healthcare workers through improved access, availability and efficiency. Patient-centred, clinician-led telehealth provides an efficient and effective model of care that complements face-to-face consultation. Telehealth has been particularly important in rural and remote areas, where it has had a positive impact on patients and clinicians through reduced travel times and improved access to specialists and advice. For clinicians, it also improves access to continuing education and professional development.

Integrated ICT is an essential building block for all health strategies.[256] Technologies such as the Internet of Things, wearables, in-home sensors, cognitive computing and next generation communication networks are some of the technologies required to facilitate in-home care.

255 Altman, L et al 2014, p. 3
256 Nicholson, C et al 2014

Patient Reported Outcome Measures, NSW

Systematic collection and real-time availability of patient reported measures, including outcomes and experience, across multiple care settings present significant challenges as the enabling eHealth technology is not widely available or connected and integrated into other existing corporate and clinical information systems. Patient-Reported Outcome Measures (PROMs) ask patients to assess elements of their own health, quality of life and functioning. The resulting data can be used to show how healthcare interventions and treatments affect these aspects of a person's day-to-day life.[257]

At present, PROMs are being used to evaluate healthcare effectiveness at different levels of the health system, from the individual to the service and system levels. Their use during clinical consultations and in multidisciplinary team discussions is thought to contribute to shared clinical decision-making and patient-centred care. PROM data that is collected during the patient-clinician encounter can be aggregated to support comparative effectiveness research, performance measurement, population surveillance and an understanding of the cost-effectiveness of healthcare.

The routine integration of PROM information into evaluation and decision-making activities beyond the clinical consultation is attracting international interest. This has potential advantages for increasing the relevance of the data collected, building large-scale or national datasets and ultimately improving patient care.

257 Williams, K et al 2016, p. 3

Vision for telehealth in NSW

Telehealth enables access to integrated, high quality, patient-centred and safe clinical care through remote delivery between a health professional and patient, or between health professionals. The vision for telehealth in NSW includes:

- funding arrangements to better support telehealth usage
- effective change management to ensure a health workforce that is accepting and capable of using telehealth
- effective collaboration across the public, private and non-government sectors to support integrated telehealth use
- basic technology and physical infrastructure to support the effective operation of telehealth
- widespread use of a variety of telehealth technologies across all healthcare facilities and health specialties

- effective scheduling and booking system to operate across NSW, supported by a global contact list
- innovation in telehealth-enabled models of care
- evaluation and continuous improvement of telehealth services.[258]

Artificial intelligence and robotics

Internationally, artificial intelligence (AI) has received much interest for its potential applications in healthcare. AI can help to review patient records, doctors' notes, discharge summaries, prescriptions, pathology and radiology results, and external data sources (such as weather and other seasonal trends) to augment patient care and clinical operations. It can assist with repetitive jobs, such as analysing digital images, lab results and electronic health records to detect problems quickly and reliably. It can mine the data in medical records to provide better and faster health services and assist in the design of treatment plans and medication management.[259] Recent advances mean that AI is also demonstrating potential in assisting in the diagnosis of some diseases and it may also have application in online medical consultations.[260]

The automation of clinical processes is not about replacing the health system as it exists today, but rather about improving the efficiency, accuracy and experience of care, while minimising the variations and risks caused by human error or misjudgement. Automation and AI do not fundamentally change models of care, but they can make them better.

Similarly, the automation of hospital ancillary and back-office services with physical robots can generate considerable cost and time efficiencies, and improve reliability. By simply touching a screen, nurses and other medical staff can summon robots for specific tasks. Hospitals that incorporate robotics into their operations will require overhead space or will need to be reconfigured to allow the robotic and human workforce to work seamlessly together.

The new Royal Adelaide Hospital has deployed several types of robots to assist with hospital operations, including:

- automated guided vehicles for moving linen, waste, meals and pharmacy supplies through the hospital
- automated pharmacy cabinets for tracking the use and dispensing of pharmaceuticals
- microbiology automation for complete automation of specimen processing.

There are opportunities to achieve substantial efficiencies using robotics – both physical robots and intelligent algorithms. Deloitte analysis shows that 54 per cent of jobs in the UK Health and Social Services have a medium or high likelihood of being automated in the next two decades.[261] Even if just a portion of the predicted savings are realised, it would allow a significant amount of operational expenditure to be redirected to further health innovation and to improving patient outcomes.

Robotic surgery

Robotic surgery is the latest evolution of minimally invasive surgical procedures. During surgery, three or four robotic arms are inserted into the patient though small incisions in the abdomen. One arm is a camera, two arms act as the surgeon's hands and a fourth arm may be used to move obstructions out of the way. The patient is surrounded by a complete surgical team, while the surgeon is seated at a nearby console. The surgeon uses a viewfinder, which provides a three-dimensional image of the surgical field, and the surgeon's hands are placed in special devices that direct the instruments. The robotic arms mitigate

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258 Nous Group 2015

259 Medical Futurist 2017
260 Ibid.

261 Deloitte 2017

tremors in the physician's hands and increase the physician's range of motion. This enhanced precision is helpful during especially delicate procedures.

Robotic surgery provides significant benefits over traditional procedures, including shorter hospital stays, less blood loss and pain, fewer complications (including less risk of infection) and a faster return to normal activities.

Robotic surgery in NSW

Robotic surgery is performed in some NSW public hospitals, including Nepean, Liverpool and Royal Prince Alfred (RPA) hospitals. An increasing number of private hospitals in the State are also undertaking robotic surgery. In April 2017, the Surgical and Robotics Training Institute was opened at RPA. The Institute is the first in the Southern Hemisphere and has the capacity to train 400 surgeons a year and offer more public patients access to less invasive procedures. Most Australian surgeons have previously had to travel to California to develop their robotic skills.

Recommendation 97

Infrastructure NSW recommends that NSW Health continue to deliver the *NSW eHealth Strategy 2016-2026*, including full delivery of eHealth Integrated Digital Patient Records and the eHealth whole of system digital platform.

Recommendation 98

Infrastructure NSW recommends that NSW Health periodically refresh the eHealth strategy to:

- assess IT infrastructure requirements in acute care facilities to enable digital innovation such as clinical command centres and artificial intelligence, including data storage, communications networks and technology, as well as digital platforms

- investigate the implications of integrating a robotic workforce into existing acute care facilities, including space allocation for robot command centres and robot pathways through hospital corridors, redevelopment of pathology labs and pharmacy, and ward, theatre and room configurations

- assess the availability of ICT infrastructure to facilitate in-home monitoring and response, including data storage, access to next generation communications networks and digital platforms

- assess the ability for existing research infrastructure to support ongoing health technology research.

12.3.8 Investment in infrastructure to improve health outcomes

Preventative action in health, including infrastructure that supports physical activity and safe environments, should form part of the 20-year Health Infrastructure Strategy. Infrastructure NSW recommends that the NSW Government support investment in walking and cycling infrastructure, parks and open space to support these health benefits, guided by existing land use strategies and transport plans. This investment needs to be supported by information campaigns that target communities with at-risk populations and proximity to this infrastructure.

The Productivity Commission has argued that Australia needs to invest more in preventative health to reduce the disease burden, improve health outcomes and get better value from expenditure. Preventative health – taking steps to avoid illness and reduce its impacts – relies on individuals to look after themselves through either exercise or medical check-ups, such as cancer screening. Australia's expenditure on preventative health is low compared to other OECD countries, at around 1.5 per cent of total health expenditure.[262]

Investment in preventative services will need to increase as the population ages and as the consequential value from avoiding disease and illness increases over time. In Australia, some estimates are that one-third of the total disease burden is attributable to modifiable risk factors.[263]

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262 Productivity Commission 2015, p. 40
263 Ibid, p. 42 (citing NPHT 2009)

Healthy Living Master Plan, Singapore

The Singapore Government is investing in infrastructure to encourage healthy lifestyles to reduce the burden of chronic disease and obesity on the health system. The Healthy Living Master Plan Taskforce – a whole-of-government and whole-of-society assembly – was formed in September 2012 to investigate ways of making healthy living accessible, natural, and effortless for all Singaporeans. Key infrastructure initiatives include:

- improving access to parks and fitness corners and ensuring that these facilities complement each other, and encouraging activities that improve their utility

- continuing urban development such that 90 per cent of residents live within 400 metres of a park and have access to green spaces

- developing off-road cycling networks and sheltered walkways connecting public transport and popular destinations

- implementing Active Design principles and guidelines for residential infrastructure. Examples include features that support stair climbing, such as well-designed and well-ventilated stairwells, and outdoor spaces for walking and cycling

- providing eateries and vending machines to provide healthier options in parks, schools, workplaces, and other settings

- the program encourages citizens to make simple lifestyle changes to combat chronic disease and aims to reduce the obesity rate to 10 per cent or less by 2020.[264]

Recommendation 99

Infrastructure NSW recommends that the NSW Government increase investment in walking and cycling infrastructure and parks and open spaces as part of the ongoing integration of health into land use planning and transport strategies.

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264 Medical Futurist 2017

13. Education

STRATEGIC OBJECTIVE **Deliver infrastructure to keep pace with student numbers and provide modern, digitally-enabled learning environments for all students**

SNAPSHOT

- Enrolments in government and non-government schools are expected to increase by about 25 per cent over the next 20 years, with more than 80 per cent of the growth occurring in Sydney.
- The Department of Education's *School Assets Strategic Plan* (SASP) provides a robust framework for delivering the additional school infrastructure needed to support growing enrolments, but current funding will only deliver about one quarter of the learning spaces needed.
- The SASP represents a major reform for the education sector and its success will rely on the Department of Education working collaboratively with the community, other government agencies, local councils, the non-government school sector and the private sector.
- Many existing schools suffer from poor digital connectivity and rigid, inefficient layouts that require renewal and refurbishment to support contemporary teaching and learning spaces.
- Demountable buildings are space-inefficient and do not accommodate flexible learning spaces consistent with Future Learning.
- Digital technology provides an avenue for increased equity and opportunities in learning. Education experiences that are currently compromised by time, space or financial constraints could be improved through digital teaching and learning.
- Joint and shared used of facilities makes school assets available to the community outside school hours, as well as giving schools access to community facilities. These arrangements help to meet a growing demand for facilities by making better use of assets and sharing the costs of new or improved facilities.
- TAFE NSW needs to ensure that its assets support changing skills requirements, increasing competition from other education and training providers, and a greater focus on higher level skills.

RESPONSE	Summary of key recommendations
Meet growth demands through delivery of the SASP	• Fully fund and implement the *School Assets Strategic Plan*. • Progressively upgrade all existing permanent learning spaces to Future Learning environments over the long term.
Regularly review and update the SASP	• Assess the impact of operational policies and procedures on infrastructure requirements. • Identify how the functional limitations of demountable classrooms can be addressed, potentially through modified designs, or a retrofitting or replacement program. • Routinely assess the vulnerability of the Department of Education's assets to the impacts of climate change, natural disasters and human related threats, and identify cost-effective adaptation and mitigation measures.
Make schools the heart of the community	• Embed consideration of joint and shared used, partnership, and place-making opportunities in Schools Community Planning. • Ensure skilled resources are dedicated to promoting and facilitating joint and shared use opportunities.
Energy and digital transformation	• Prepare a *School Energy Strategy 2018 – 2030*. • Prepare a *School Digital Transformation Strategy 2018 – 2025*. • Prepare a business case for a *Connecting Metropolitan Schools* program.
Work collaboratively with partners	• Support the non-government school sector to meet its growth challenges and to identify, and where possible, remove barriers to that sector growing its student share.
Transform TAFE NSW's asset portfolio	• Prepare and implement a 20-year TAFE NSW Infrastructure Strategy.

13.1 Recent progress

Consistent with the *State Infrastructure Strategy Update 2014*, the Department of Education has completed a *School Assets Strategic Plan 2031* (SASP) to guide the delivery of school infrastructure in NSW over a 15-year period.

The NSW Government has established School Infrastructure NSW (SINSW), a dedicated unit within the Department of Education, to implement the SASP and manage the department's assets.

The NSW Government's 2017/18 Budget includes $4.2 billion over four years to build more than 120 new and upgraded schools.

13.2 Challenges and opportunities

13.2.1 A significant increase in the school-aged population

The government school population in NSW has been stable for three decades, catering to between 750,000 and 800,000 students. Increasing immigration, higher birth rates and increasing numbers of women of reproductive age have resulted in a record number of

births, leading to a sustained growth in the number of students entering NSW schools.

Enrolments in NSW Government schools will increase from almost 800,000 to almost one million over the next 20 years. Enrolments in non-government schools are expected to increase from almost 400,000 to almost 500,000 over the same period. More than 80 per cent of the growth in student enrolments will occur in Sydney.

13.2.2 Investing for student growth and modern learning environments

Based on the standards set out in the SASP, current funding provides 1,500 of the 6,650 additional learning spaces needed to support the growth in enrolments to 2036. Over and above delivering new and refurbished assets, many existing schools suffer from poor digital connectivity and rigid, inefficient layouts that do not support current or anticipated teaching and learning practices. These assets will require renewal and refurbishment to improve their functionality and to provide contemporary teaching and learning spaces.

Figure 58 – Total NSW government students, 1980 – 2036

Actual Primary
Projected Primary
Actual Secondary
Projected Secondary
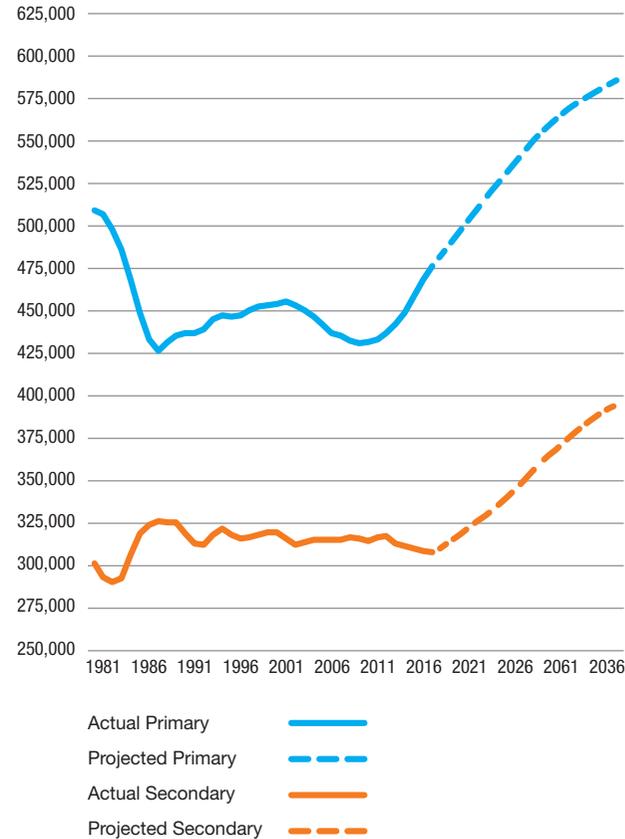
Source: NSW Department of Education 2017

13.3 Response

13.3.1 Implementing the School Assets Strategic Plan

The SASP sets the framework for the delivery of school infrastructure to 2031. It supports 'Future Learning' outcomes through the provision of adaptable, technology-enabled teaching and learning spaces (see breakout box at right). It identifies new ways of planning for schools and seeks to leverage existing assets and partnerships to reduce the financial burden on government of a 'business as usual 'approach. A review by the NSW Auditor General concluded that the SASP was a robust plan and that the actions it contained were research- and evidence-based.[265] As noted above, the SASP is only partially funded. Infrastructure NSW recommends that the NSW Government fully fund and implement the SASP.

Recommendation 100

Infrastructure NSW recommends that the NSW Government fully fund and implement the *School Assets Strategic Plan*.

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265 Audit Office of NSW 2017a, p. 2

Future Learning

NSW schools are adopting 'Future Learning', which incorporates adaptable teaching and learning spaces that seek to increase student engagement and encourage collaboration. Future Learning spaces (see image below) are reconfigurable, open spaces with supporting technology. These spaces allow a mix of face-to-face, collaborative and individual learning, including online and blended learning. Features include:

- reconfigurable teaching and learning spaces that can be easily repurposed to suit the lesson subject and structure
- mobile touch sensitive screens, allowing students to engage with learning materials
- wi-fi and software, allowing devices in a room, including tablets and laptops, to interact
- writable walls and surfaces encouraging student to investigate and collaborate.

Source: NSW Department of Education 2017

Implementation risks

The SASP represents a major reform to the planning and delivery of education infrastructure in NSW. The NSW Auditor-General highlighted a number of risks to its successful implementation, including opposition from school communities, a reduction in the proportion of students educated in non-government schools and a failure to sufficiently streamline the planning approvals system.

To maximise the benefits of investing in flexible, adaptable teaching and learning spaces, universities will need to ensure that modern teaching methods are embedded into the syllabus for new teachers. School principals will need to support new and existing teachers to take advantage of the new teaching environment.

The Department of Education, through the newly established SINSW, is responsible for implementing the SASP. Given the size and complexity of its infrastructure program, the Department of Education will need to implement a 'best practice' program management and reporting framework. The framework will need to incorporate monitoring and reporting against performance metrics and budgets for each of the following program areas:

- **growing infrastructure** – keeping pace with student demand
- **upgrading functionality** – ensuring facilities are fit-for-purpose
- **renewing infrastructure** – renewing assets as they near the end of their life cycle
- **maintaining infrastructure** – meeting evidence-based maintenance targets

- **servicing schools** – keeping schools clean
- **compliance** – ensuring schools comply with statutory obligations
- **generated revenue** – reinvesting revenues from partnership arrangements into school infrastructure.

The Department of Education will need to work collaboratively with government agencies in the delivery of new and expanded schools. Conversely, other government agencies will need to consider the impact of urban renewal and major infrastructure proposals on the capacity of current and forecast school infrastructure. It will be important for the Department of Education to work closely with local communities in planning new and upgraded school infrastructure. To ensure it is transparent and consistent in how it consults with the community and government stakeholders, the Department of Education should develop a consultation framework for the delivery of new and upgraded schools.

While the necessary focus of the SASP is on meeting forecast growth, funding constraints mean that this focus may limit opportunities to invest in upgrades to existing schools in rural and regional areas and low growth areas in metropolitan Sydney. The scale and concentration of capital investment in many parts of Sydney risks the development of a 'two-speed' education system, where noticeably different learning environments are provided to students depending on their location. Infrastructure NSW recommends that the Department of Education progressively convert all existing permanent learning spaces to Future Learning environments. Given the significant costs involved, the conversion program should be regarded as a long-term proposition, potentially beyond the term of the

2018 SIS. A business case should be completed if the program is to be accelerated.

Recommendation 101

Infrastructure NSW recommends that the Department of Education develop and implement a comprehensive *School Assets Strategic Plan* program management and reporting framework by the end of 2018.

Recommendation 102

Infrastructure NSW recommends that the Department of Education establish a consultation framework by the end of 2018 that ensures consideration of community views and whole-of-government and place-based outcomes in the delivery of new and upgraded schools.

Recommendation 103

Infrastructure NSW recommends that the Department of Education develop a program to progressively convert all existing permanent learning spaces to Future Learning environments over the long term.

13.3.2   Reviewing and updating the SASP

The Department of Education proposes to regularly review and update the SASP. In doing so, it will need to act on the Auditor-General's conclusion that there may be opportunities to reduce infrastructure requirements through policy and procedural changes. These may include improving asset utilisation by converting

single-sex schools into co-educational schools and converting selective schools into comprehensive schools with selective streams. There may also be opportunities to consider more K-12 schools, which combine kindergarten, primary and secondary schooling.

Demountable classrooms

To meet the needs of the growing student population, the SASP is premised on:

- demountable classrooms being considered to accommodate student growth of up to seven years
- contemporary modular classrooms being considered to accommodate growth that continues beyond seven years
- site redevelopments, vertical schools and new permanent buildings being considered where schools experience sustained increases in student numbers, poor quality existing buildings or confined space.

The SASP indicates that demountable and modular classrooms can absorb approximately half of the projected student growth to 2036. Such units are proposed for use where they can be accommodated in line with School Site Planning Standards.

Contemporary modular classrooms are environmentally sustainable, well ventilated, accessible and space-efficient. Importantly, they support Future Learning by providing flexible learning spaces. Demountable buildings are space-inefficient and do not accommodate flexible learning spaces consistent with Future Learning. Although demountable classrooms can be constructed quickly and at

relatively low cost, the Department of Education should ensure they are used only as genuinely temporary solutions to surges in enrolments. They should not be a permanent, or even semi-permanent, solution.

To ensure that all students have access to a high standard of educational facilities, the Department of Education should identify how the functional limitations of demountable classrooms can be addressed, potentially through modified designs or a retrofitting or replacement program.

Resilience

The SASP does not address the resilience of school infrastructure. Schools, like other buildings, are subject to a broad range of risks, including hail damage, flooding, sea level rise and bushfires. However, the resilience of school infrastructure is particularly important as schools often fulfil the role of community evacuation zones. Where possible, and without compromising accessibility, schools should be located outside risk zones. Schools within risk zones should have carefully prepared evacuation plans and, where feasible, be constructed to provide a level of protection from risk.

As noted in Chapter 5, business case and investment decision processes need to consider infrastructure risk and resilience. Consistent with the approach detailed in Chapter 4, the Department of Education should undertake rolling, periodic assessments of the vulnerability of its assets to the impacts of climate change (such as sea level rise), natural disasters (such as floods, bushfires, heatwaves and storms) and human-related threats (such as cyberthreats). This risk and resilience assessment could form part of regular updates to the SASP.

Recommendation 104

Infrastructure NSW recommends that in its next review of the *School Assets Strategic Plan*, the Department of Education:

- assess the impact of operational policies and procedures on infrastructure requirements
- identify how the functional limitations of demountable classrooms can be addressed
- assess the vulnerability of its assets to the impacts of climate change, natural disasters and human-related threats, and identify cost-effective adaptation and mitigation measures.

13.3.3 Coordinating asset planning

The SASP introduced a new approach to the planning and use of school assets. Schools Community Planning assesses school needs, recognising that developing the best and most cost-effective solution to meet enrolment demand in one school involves considering the nearby schools in the same community.

To understand the school needs of a given community, the Department of Education assesses a range of factors, including demographic trends, educational requirements, school condition, catchment boundaries, consolidation and co-location opportunities, transport links and community feedback.

This process should, as a matter of course, consider opportunities to better locate, use and share school assets. School infrastructure resilience issues should also be assessed through the School Community Planning process.

To support effective strategic planning, Schools Community Planning needs to be guided by a common set of consistent, reliable and up-to-date population, housing and employment projections, released according to a fixed schedule. While NSW Common Planning Assumptions have been established, the data sources are not supported by a schedule or program of data releases. Recommendations in relation to this point are provided in Chapter 2.

Recommendation 105

Infrastructure NSW recommends that the Schools Community Planning process routinely consider:

- opportunities for joint and shared use arrangements
- opportunities to partner with the private sector
- supporting place-making by working with local councils and government agencies in strategic land use planning
- opportunities for locating schools on surplus government land and government development sites, or through land transfers between government agencies
- infrastructure resilience issues.

13.3.4 Streamlining planning approvals

If government and non-government schools are to meet projected student demand, the planning system will need to deliver quicker outcomes. Until recently, some zoning and planning controls were incompatible with the higher density and joint-use school models required to cater for growth. In September 2017, a new Education State Environmental Planning Policy

(ESEPP) was implemented to streamline approvals processes for the delivery of new schools, childcare facilities, universities and TAFEs. The ESEPP:

- simplifies and standardises approvals processes, including broadening the range of exempt and complying development
- sets out clear planning rules for proposed developments
- establishes statewide assessment requirements and design considerations.

The ESEPP allows non-government schools to expand and upgrade facilities using the same planning provisions as government schools. To deliver the SASP, the Department of Education will need to work with the Department of Planning and Environment to ensure the effective implementation and use of the ESEPP. The Department of Education should monitor the success of the new SEPP over the next 18 months to assess whether any further streamlining of approvals is warranted.

The Department of Education and Department of Planning and Environment should also work together to consider:

- how developer contributions could be broadened to contribute to both land acquisition costs (currently covered) and capital works costs
- how the planning system could encourage the delivery of school infrastructure; for instance, through bonus schemes under which additional development is allowed in return for providing school infrastructure.

13.3.5 Improving asset utilisation and management

Building larger schools on smaller sites

As more than 80 per cent of student growth is expected to occur in metropolitan Sydney, the Department of Education will need to increase capacity at many existing Sydney schools. The SASP assumes increased enrolment capacities for new and redeveloped schools, where feasible, to 1,000 student primary schools (up from 640) and 2,000 student secondary schools (up from 1,190).

Primary school size targets in highly urbanised areas have been reduced to 1.5 hectares (down from three hectares) and secondary school targets have been reduced to 2.5 hectares (down from six hectares). Size targets for new schools on greenfield sites and in regional areas have been reduced to two hectares for primary schools (down from three hectares) and four hectares for secondary schools (down from six hectares).

The Department of Education intends to develop bigger schools on smaller sites by adopting more efficient designs, such as multi-storey and high-rise designs. This will require land use planning controls that facilitate larger

Figure 59 – Planned Arthur Phillip High School, Parramatta

Source: NSW Department of Education 2017

building heights and floor space ratios and a continuation of the current practice of minimising onsite car-parking on school sites. It may also require negotiating the shared use of local parks and other facilities with local councils.

Addressing maintenance needs

Well-maintained and functional classrooms make an important contribution to student outcomes. A significant number of school buildings in NSW need maintenance. The average age of these buildings is 46 years, with seven per cent of all school buildings currently rated as in a poor or end-of-life condition (safe but not fit-for-purpose).

To address this issue, the NSW Government has targeted achieving an average maintenance liability of no more than three per cent of the replacement value of the school asset base. The NSW Government is investing $747 million over the next four years to bring school infrastructure in line with this 'best practice' standard.

Improving school energy use and efficiency

Technology-driven teaching and learning, and increased use of air conditioning, is driving higher energy consumption in schools. To improve energy security and efficiency across the school asset base, the Department of Education should review current energy consumption in NSW schools and identify ways of managing future energy use.

This review should result in the development of a School Energy Strategy 2018-2030. The Strategy should forecast the potential energy costs in a 'business as usual' environment and consider the future energy market, the current state of energy consumption in schools and future levels of energy consumption. It should make

recommendations to reduce or stabilise costs while delivering future-focused teaching and learning spaces.

Recommendation 106

Infrastructure NSW recommends that the Department of Education prepare a School Energy Strategy (2018 – 2030) by mid-2018.

13.3.6 Improving school digital connectivity

Digital technology provides an avenue for increased equity and opportunities in learning. Education experiences that are currently compromised by time, space or financial constraints could be improved as digital technologies act to reduce operational and equipment costs.[266]

In NSW, digital connectivity is critical to ensuring all students, particularly those in regional and remote schools, have access to equal educational opportunities. A 2017 NSW Auditor-General report concluded that many school wireless networks do not have the capacity to deal with current and future needs, and that this was putting at risk the Department of Education's vision of 'any learning opportunity, anywhere, anytime'.[267]

While all new facilities will include the infrastructure to enable a digital transformation, the Department of Education has yet to quantify the timeframes for and costs of providing equivalent capabilities in existing schools. To ensure an equitable transformation to digital teaching and learning opportunities, and the avoidance of a two-speed educational system, existing assets will need to be upgraded.

The $46 million *Connecting Country Schools* program is boosting wireless access and internet capacity in up to 13,000 learning spaces in around 900 regional schools. It is recommended that, subject to completion of a business case, the NSW Government invest in a digital connectivity program for metropolitan schools.

To maximise the opportunities presented by digital technology, and associated investments in digitally-enabled Future Learning environments, the Department of Education should develop a *Schools Digital Transformation Strategy (2018-2025).* While the final technology mix should be determined as part of the Strategy, Infrastructure NSW recommends that the Department of Education target fibre or equivalent quality connections to all schools by 2025. Investment proposals identified in the Strategy will need to follow normal government approval processes.

The Strategy should seek to use the whole-of-government digital purchasing program coordinated through the Department of Finance, Services and Innovation. The Department of Education should consider inviting the non-government school sector to participate and benefit from the State's purchasing power.

Recommendation 107

Infrastructure NSW recommends that the Department of Education prepare a Schools Digital Transformation Strategy (2018-2025) in partnership with the Department of Finance, Services and Innovation by the end of 2018.

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266 Data 61, p. 3
267 Audit Office of NSW 2017b, pp. 2-3

Recommendation 108

Infrastructure NSW recommends that the Department of Education prepare a business case by mid-2018 for a Connecting Metropolitan Schools program to improve digital connectivity in metropolitan schools.

13.3.7   Leveraging partnerships

Increasing non-government school sector service delivery

Approximately 65 per cent of students in NSW currently attend government schools, with the remaining 35 per cent attending non-government sector schools. The SASP assumes that this split will remain essentially the same to 2036 and notes the risk (in terms of additional infrastructure costs to government) if the non-government sector share were to drop. A five per cent reduction in the proportion of students attending a non-government school would lead to an increase of $3.4 billion in additional government school infrastructure through to 2036.

Given the forecast surge in enrolments, collaboration with the non-government school sector will be critical to maintaining the current share of students between the sectors, as a minimum. The sector has established the NSW School Assets Planning Alliance as a forum for the government and non-government school sectors to plan and implement integrated asset solutions. It allows for the sharing of demographic data and information on planned school developments. The non-government school sector is also engaged in the Schools Community Planning process.

The SASP does not consider opportunities or barriers to the non-government school sector increasing its share of students, which may include:

- relaxing the requirement for the non-government school sector to pay Section 94 developer contributions. The government school sector does not pay developer contributions and is, in fact, the recipient of developer contributions

- addressing regulatory barriers, such as enrolment caps imposed by local councils as part of the development assessment process. Transparency is required to ensure that any enrolment caps (which limit the number of students on a school site) are genuinely linked to development constraints, such as traffic impacts

- improving non-government school sector access to funding and/or finance. The NSW Government administers the Building Grant Assistance Scheme which provides capital assistance to eligible non-government schools. The Western Australian Government makes available low interest loans to assist non-government schools with capital development projects, including land acquisition, new building construction and upgrading of established facilities.

Recommendation 109

Infrastructure NSW recommends that the Department of Education support the non-government school sector to meet its growth challenges and to identify and, where possible, remove barriers to that sector growing its student share.

Figure 60 – Total student growth by government and non-government share
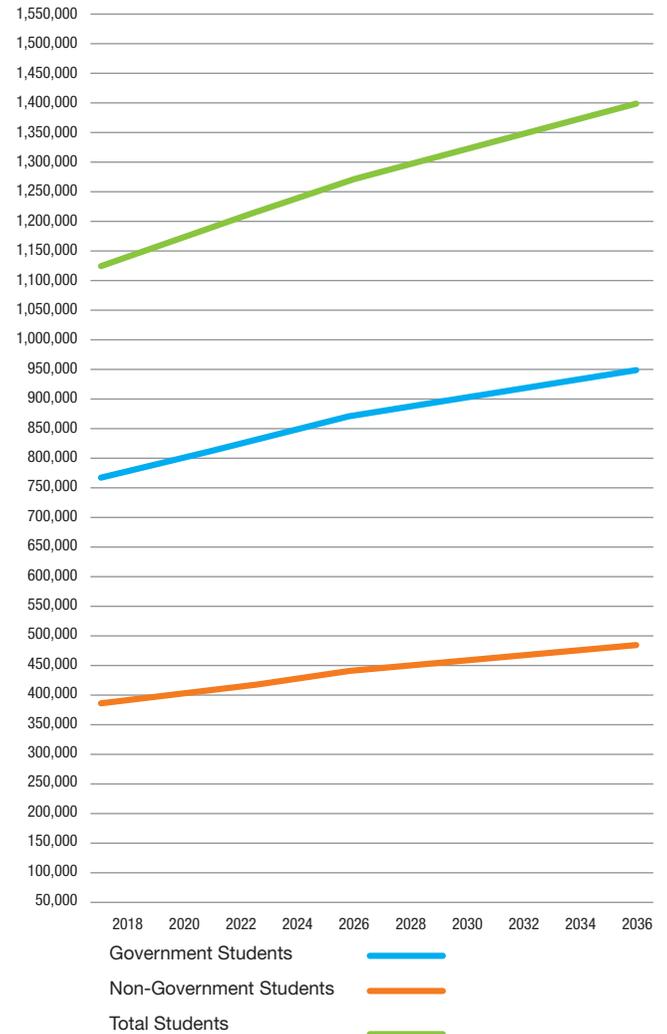
Source: NSW Department of Education 2017

Greater joint and shared use of facilities

Joint and shared use of facilities make school assets, such as sports fields and halls, available to the community outside school hours, as well as giving schools access to community facilities (see breakout box). Such arrangements can help to meet a growing demand for facilities by better utilising existing assets and sharing the costs of new or improved facilities. They may delay or remove the need for additional school or community infrastructure, allow maintenance costs to be shared and offer schools the opportunity to generate revenues from their assets.

The concept of the joint or shared use of facilities is not new and there is broad consensus on its benefits.[268] However, there remain real or perceived barriers to its implementation, including that:

- joint use arrangements are complex and require long-term commitments
- government budget processes sometimes restrict flexible funding and financing arrangements
- issues that require consideration (such as funding contributions, construction and maintenance arrangements and agreement terms) are often outside the expertise of individual school principals
- shared use agreements have to be negotiated on an individual basis with school principals, resulting in inconsistent approaches.

While the Department of Education has developed guidance documents to facilitate joint use agreements, and provides support where shared use arrangements extend beyond 12 months, a more proactive, centralised role is required.

The establishment of SINSW provides an opportunity for a renewed focus on the adoption of joint and shared use agreements. SINSW should be resourced to proactively support schools and local communities in establishing joint and shared use initiatives. This will require SINSW staff to have appropriate commercial, legal and consultation skills.

As a means of encouraging joint and shared use arrangements (and thereby decreasing costs to the NSW Government), revenues generated by schools through joint and shared use arrangements should be retained by those schools for reinvestment. This approach would be consistent with the NSW Government's commitment to reinvesting revenue raised from education asset recycling and land sales back into education facilities.

Joint use

Combined facilities are planned, funded and built between the Department of Education and a public or private sector organisation. The facilities may be built on school land or on the land of a partner organisation. For example, a local council invests in a new oval and changerooms on school grounds. The oval is jointly used with the council, who maintains it and hires it out to sports groups outside school hours.

Shared use

An agreement allows an existing school asset to be used for non-school purposes. Assets stay under the school's control. For example, a school hires out an existing hall to a local yoga group in after-school hours or licenses its use for out-of-hours school care.

Ballina High School

A new school will start operating in the Ballina township in 2019. Being developed in a joint use partnership with Ballina Shire Council, it will incorporate a regional standard indoor sporting centre and performing arts facilities. The joint use arrangement allows the development of a facility that would have been beyond the scope of either organisation on its own.

Source: NSW Department of Education 2017

268 Audit Office of NSW 2017c; NSW Department of Education 2016, p. 70; Infrastructure NSW 2012, p. 178; Infrastructure NSW 2014, p. 103; Infrastructure Victoria 2016, p. 120

Source: NSW Department of Education 2017

Recommendation 110

Infrastructure NSW recommends that the Department of Education facilitate joint and shared use arrangements by:

- finalising the Joint Use Policy and Guidelines for implementation as part of Schools Community Planning by mid-2018

- developing and promoting standard use agreements

- ensuring appropriately skilled resources are dedicated to promoting and facilitating joint and shared use

- working with the Greater Sydney Commission and Department of Planning and Environment to promote the integration of school and community facilities in masterplanning processes

- working with NSW Treasury to explore flexible funding and financing options within the Capital Planning Process.

Private sector delivery opportunities

Partnering with the private sector provides opportunities to deliver school infrastructure more quickly and to capture the economic benefits of providing new schools (where new schools increase surrounding land values). As part of Schools Community Planning, the Department should develop a pipeline of opportunities to deliver school infrastructure in partnership with the private sector.

The Department of Education could package private sector delivery of new and upgraded schools with ongoing asset maintenance and refurbishment contracts. Similarly, there may be innovative approaches in the provision of modern, portable classrooms

(through sale and lease back arrangements), or even in the provision of air-conditioning services to schools (where the private sector invests in the necessary assets and the Department of Education pays a service fee).

Consideration should be given to opportunities to engage with developers to deliver schools as part of wider housing and mixed use developments, including innovative models where schools are delivered as part of an integrated development (alongside commercial and residential development).

A coordinated and collaborative approach with the university sector

The NSW higher education sector is the largest in the country, with more than 430,000 students across 10 public universities and 58 registered non-university providers.[269] As automation and artificial intelligence accelerate the pace of change in the job market, employability will be linked increasingly to higher skill levels. Labour force projections are that less than 10 per cent of new jobs will be available for people who do not progress past year 12 by 2022.[270] Current trends show demand for university qualifications will increase by 34 per cent by 2025 as the students of today's NSW schooling system become the students of tomorrow's tertiary sector.[271]

Population growth in western Sydney (the Western City and the Central City) will require a highly skilled workforce and the creation of more knowledge-based jobs to secure the region's prosperity. Western Sydney University is currently the major provider in the region. The university has established a presence across all major city centres and educates the largest domestic undergraduate cohort

in Australia: over 34,000 students.[272] Other universities, including the University of Sydney and University of Wollongong, are also establishing presences in the region. The NSW Government should work closely with the university sector to ensure a coordinated, long-term approach to the delivery of universities in western Sydney. This work should consider greater collaboration between secondary schools and the university sector.

The sector is also critical to driving growth in the regions. Regional universities serve the industries around them by specialising in region-specific research. Co-location of research activity with industry through regional campuses is a strong driver of regional business innovation. Regional universities are also crucial to skilling regional workforces. For example, 70 per cent of graduates from Charles Sturt University find their first jobs outside of a metropolitan area.[273]

There is an opportunity for more regions throughout NSW to benefit more from the social and economic impact of international students. In 2016, NSW universities received $2.3 billion[274] in revenue from international students, which is used to help subsidise investments in high quality teaching and research activities and infrastructure. However, most international students are concentrated at metropolitan universities, with around 76 per cent of all overseas students enrolled at five universities.[275]

The NSW Government should work with the university sector to identify ways of sharing the opportunities

269 Department of Education and Training 2015
270 Department of Employment 2017
271 Deloitte Access Economics 2015, p. ix

272 Department of Education and Training 2015
273 Department of Industry, Innovation and Science 2016, p. 41
274 Audit Office of NSW 2017d, p. 31
275 Department of Education and Training 2015

presented by the international student market with regional areas.

13.3.8   Modernising TAFE NSW facilities

TAFE NSW is the largest vocational education and training provider in the State. It has nearly 2,000 buildings across 175 sites. Its services are delivered through a mix of sites that it owns, leases or shares with schools, universities or local councils. It is increasingly delivering training in employers' workplaces.

Much of TAFE NSW's current asset portfolio is no longer fit-for-purpose. Many facilities have inefficient, inflexible layouts that are unable to use the latest teaching and learning technology. The high costs and constraints associated with the current assets limit TAFE NSW's ability to improve service delivery and respond to changes in student demand.

The vocational education and training environment is characterised by changing skills requirements, increasing competition from other education and training providers, advances in digital learning technologies and a stronger focus on higher-level skills. TAFE NSW's services must be aligned to the requirements of the modern economy. It needs to provide contemporary training methods using the latest digital technology, and will need to maintain and upgrade facilities to support new service delivery models, including online and blended learning.

13.3.9   TAFE NSW Infrastructure Strategy

Consistent with the recommendation in the *State Infrastructure Strategy Update 2014*, TAFE NSW developed a *Strategic Asset Management Plan*

(SAMP) in 2015. The five-year SAMP set out an asset reform strategy and asset ownership options, including the establishment of a separate specialist TAFE asset management unit.

Since then, the NSW Government has released *A Vision for TAFE NSW* and TAFE NSW has released its *Strategic Plan 2016-22*. These strategic documents outline new governance models for TAFE NSW, including the new 'One TAFE' operating model. Given these significant changes, and to align the five-year SAMP with the 20-year infrastructure strategies prepared by other government agencies, Infrastructure NSW recommends that TAFE NSW update the SAMP by preparing a 20-year TAFE NSW Infrastructure Strategy by the first quarter of 2019.

The Strategy should guide TAFE NSW in reviewing its asset portfolio and transforming it into one that is fit-for-purpose. It should seek to promote increased shared use arrangements with third parties (such as schools, universities and industry) to support flexible learning. It should identify opportunities to reinvest proceeds from the sales of underutilised buildings into modern teaching facilities and resources.

TAFE NSW facilities should be considered strategic place-making assets, harnessing opportunities to co-locate with industry and/or government in existing or proposed industry precincts. To that end, TAFE NSW should work collaboratively with key government agencies to identify and secure these opportunities early in strategic land use planning processes.

TAFE NSW is committed to its presence in regional NSW. Such a presence provides, among other things,

opportunities for disadvantaged and disengaged groups to access vocational education and training pathways. In instances where service delivery is not financially sustainable but supports critical community functions, the NSW Government will need to consider providing appropriate funding support.

Technology is changing the nature of the NSW economy and the knowledge and skill requirements for jobs. In turn, this is changing the services TAFE NSW needs to provide and the way in which those services are delivered. Students now demand training online, in the workplace, anywhere, anytime and on any device. TAFE NSW is implementing an Interconnected Training Network to redefine the way teaching, learning and community interaction occurs. It is integrating physical and virtual learning environments, giving students the option to learn where and how they choose.

Recommendation 111

Infrastructure NSW recommends that TAFE NSW prepare a 20-year TAFE NSW Infrastructure Strategy by the first quarter of 2019, which considers:

- right-sizing of the asset portfolio through continued delivery of the Interconnected Training Network and the divestment of assets that are not fit-for-purpose or underutilised
- the delivery of training services across NSW, including regional NSW and to people facing disadvantage, through the strategic location and standardised design of the Interconnected Training Network
- pursuing partnerships with third parties to support the rollout of the Interconnected Training Network.

14. Justice

STRATEGIC OBJECTIVE **Adopt a more integrated approach to strategic asset planning, asset management and service delivery across the Justice Cluster**

SNAPSHOT	
	• The justice system is highly interdependent. Policy and investment decisions in individual justice agencies have impacts on other agencies upstream or downstream. Recent investment in policing has not been accompanied by corresponding investments in courts and corrective services, which has resulted in case backlogs and prison capacity pressures.
	• Emergency management agencies are experiencing funding pressures driven by the need to manage and maintain their substantial fleet and property portfolios while continuing to grow to meet community needs.
	• Asset conditions and management processes vary across the Justice Cluster. In many instances, assets across the cluster are ageing and poorly located.
	• There is scope to improve and better integrate long-term asset planning and management across the Justice Cluster. Technology has the potential to drive efficiencies by reducing reliance on a physical 'on the ground' presence, streamlining information flows and enabling better long-term planning.

RESPONSE	Summary of key recommendations
Adopt a more integrated approach to strategic asset planning, performance and management	• Complete a review of asset management across the Justice Cluster by mid-2018. • Drawing on the asset management review, develop a 20-year Justice Infrastructure Strategy by the first quarter of 2019.
Invest in court and prison capacity to meet demand	• Prepare business cases by the end of 2018 to address court capacity in the Sydney CBD, South West Sydney and key locations in Regional NSW. • Prepare a business case and undertake site investigations and related community consultation by the end of 2018 to address the requirement for additional long-term prison bed capacity in Greater Sydney.

14.1   Recent progress

The Justice Cluster was not addressed in detail in either the *State Infrastructure Strategy 2012* or the *State Infrastructure Strategy Update 2014*. This was due to the expectation that existing infrastructure would be sufficient to meet demand. However, since 2014, the Cluster has been facing growing infrastructure challenges. This has led to its inclusion in the 2018 SIS.

Several key investments and initiatives have been progressed across the Cluster since 2014, including:

- technology improvements for police – including providing the NSW Police Force with advanced technology to fight crime and enhance officer mobility through the $100 million Policing for Tomorrow Technology Fund, and modernising and upgrading the Computerised Operational Policing System (COPS)

- technology improvements for courts – including expanding Justice Audio Visual Link (AVL) capabilities across the justice sector and commencing the development of a business case for modernising courts through business process redesign, enabled by technology

- new and upgraded court facilities – including redevelopment of the Children's Court in Surry Hills, building a new Forensic Pathology and Coroners Court at Lidcombe, and major upgrades of the Wollongong and Wagga Wagga courthouses

- criminal justice reform – a $570 million program of reform measures to reduce demand on the justice system and rates of reoffending

- increasing prison bed capacity – a $3.1 billion program of prison bed capacity projects across NSW, including $700 million for the New Grafton Correctional Centre, to address short- and medium-term prison population growth

- the establishment of Justice Infrastructure NSW – a specialist planning and delivery group within the Department of Justice. Justice Infrastructure NSW will lead an integrated approach to planning, investment prioritisation, delivery and asset management across the Cluster

- development of the *Corrective Services Infrastructure Strategy 2017-37* – a 20-year, outcomes-focused infrastructure strategy to guide investment in corrective services assets.

14.2   Challenges and opportunities

Managing interdependencies across the justice system and government

The justice system is highly interdependent. Policy and investment decisions in individual justice agencies have impacts on other agencies upstream or downstream. Investing in technology that enables better policing is likely to increase the number of cases flowing through courts and the number of prisoners in custody. To function efficiently, a high level of coordination across each part of the system is needed. The relationships between different parts of the criminal justice system are illustrated in Figure 61.

A range of broader government social services also affects demands placed on the justice system, including housing, mental health support, education and family and community services. A person should

Figure 61 – Criminal justice system flow diagram
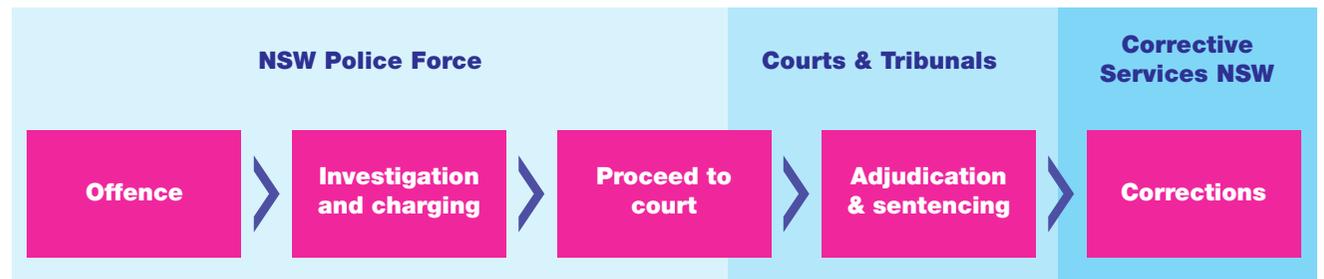
Source: NSW Department of Justice, adapted by Infrastructure NSW, 2017

be supported by these services before and after leaving the justice system to reduce the risk of re-offending and reduce pressures on courts and prisons.

Co-locating Justice Cluster services

There are opportunities for better coordination across the justice system, which may include the co-location of:

- criminal justice facilities to reduce transport requirements, improve interagency processes and improve asset utilisation
- emergency services, police and ambulance services to enable more efficient emergency management
- emergency services facilities, especially for back office functions, to improve efficiency and coordination.

Managing the imbalance across the justice system

Demand in the criminal justice system has grown significantly since 2012. This growth has occurred while crime rates have generally been stable or falling, and is mainly driven by more productive police operations. Legal proceedings initiated per officer has grown by around five per cent per year.

In 2015-16, the Justice Cluster identified that significantly more people were being brought into the justice system than courts and corrective services could manage. This caused a large and growing case backlog in the District Court and a rapid increase in the prison population. Growth in case backlog has been limited since mid-2015 but remains at double its historic level. The prison population growth has also slowed in the last year, but remains high and growing.

The Department of Justice established the Criminal Justice Transformation Board in 2015 to take a 'whole-of-system' view on operational decision-making. An information and analysis function, including a criminal justice impact assessment process, has also been developed to forecast the impact of policy decisions on the system.

Infrastructure demand is also influenced by:

- **government policy** – for example, increasing prisoner rehabilitation programs requires supporting infrastructure
- **operational practices** – for example, operating from transport hubs and multi-agency justice precincts creates prisoner transport efficiencies.

Demand management measures are critical to the sustainability of the justice system. In addition to investing in new and expanded infrastructure to relieve pressure on the system, a range of policy and legislative initiatives are being progressed, including:

- encouraging early guilty pleas
- new sentencing laws aimed at holding offenders to account and reducing reoffending
- new laws to enable smarter management of parolees
- developing a range of initiatives that target persistent and repeat offenders
- allowing certain driving disqualifications to be lifted early, subject to a minimum offence-free period
- allowing some strictly indictable offences to be heard by the Local Court rather than the District Court.

Integrating asset planning, investment and management

Infrastructure requirements in the justice system mainly relate to the criminal system. Most civil matters are resolved outside court and those that proceed to adjudication mostly appear in the Supreme Court, NSW Civil and Administrative Tribunal and certain District Courts.

The approach to strategic asset planning, investment and management varies across the Justice Cluster. While Corrective Services NSW has recently adopted a 20-year infrastructure strategy, the NSW Police Force uses a shorter planning horizon and courts and tribunals have no long-term strategy in place.

To plan with confidence, the Justice Cluster will need to better integrate asset planning, investment and management across the sector. This will require a complete understanding of current asset capacity and conditions across the Cluster, critical system pressure points and the potential solutions offered by digital technology.

Optimising investment in technology

The justice sector would benefit from a greater take-up of technologies that improve its efficiency and reduce its reliance on the physical presence of personnel for activities that could be performed over digital channels. For example, the rollout of Justice AVL capabilities enables court proceedings to occur via video and has resulted in significant efficiencies across the criminal justice system. Implementation of online filing, registry and forms has also improved the civil system.

There are opportunities to deliver more civil justice services over digital platforms that enable partial or full self-service, and reduce the current high reliance on physical documentation across the court system.

Further investment in cross-agency ICT systems is needed to streamline information flows and deliver system-wide benefits. There is also significant potential to make better use of data, including police crime statistics, within the sector to improve investment planning.

14.2.1   NSW Police Force

As the frontline for the justice system, police must respond flexibly to service demand pressures and work jointly with other frontline government service delivery agencies. Police are increasingly involved in the management of social issues before they transition to other social service agencies. They must also manage the flow-on impacts of new or amended legislation on NSW Police Force resources, such as amendments to the *NSW Bail Act 2013*.

NSW Police Force

More than **20,600** employees, including approximately **16,700** police officers and over **4,000** civilian staff

76 local area commands operate from **432** police stations delivering policing services to communities, while specialist commands also cover land, sea and air operations

Source: NSW Department of Justice 2017

Ageing assets

Most of the NSW Police Force's significant portfolio of police stations is old and requires ongoing maintenance and capital investment to ensure it remains fit-for-purpose. Many regional police stations are co-located with heritage-listed courthouses, which can add to maintenance costs.

The NSW Police Force is restructuring to ensure it can meet changing community needs and crime trends. It is considering how police assets, including properties and their location, can support changes to police operations.

A *Property Portfolio Delivery Plan* has also been developed to inform property investment and maintenance requirements over a five-to-ten-year period.

Asset planning and management processes within the NSW Police Force are reasonably advanced. But investments have been made largely in isolation from the broader justice system and have not been accompanied by corresponding investments in courts and corrective services.

Improving policing with technology

Technological advancements are already leading to more efficient policing; for instance, through Body-Worn Video that collects evidence and uses 3D mapping and printing to create technically accurate models and reconstructions of crime scenes and evidence.

There are significant opportunities to further leverage these advancements and improve the use of police ICT systems. The NSW Police Force ICT landscape is complex and diverse, with approximately 300 different

applications ranging from corporate systems to specialised technologies used in the field. Police have recently commenced a major upgrade of the COPS.

Looking ahead, there will be further opportunities to change how police stations function; for example, by enabling certain administrative and procedural functions to be completed online. The adoption of technology that reduces a physical police presence will need to be carefully managed to ensure communities continue to feel safe.

14.2.2   Courts and Tribunals

As the central entities providing criminal, civil and tribunal functions across NSW, court and tribunal systems need to operate efficiently to support fast, fair and accessible justice.

Demand for court services is driven by a complex interaction of factors including policing priorities and rates of re-offending. Courts are also impacted by the changing nature of civil matters, which are influenced by economic conditions and the increasing use of alternative dispute resolution processes. The *Civil Justice Strategy* is being developed to improve access to justice and make it easier for people and businesses to resolve disputes in NSW.[276]

There are growing trial backlogs and substantial delays in finalising District Court criminal cases in NSW. These have been driven largely by:

- increases in the number of people being charged with indictable offences

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276 Currently under development as at February 2018

- increases in the number and proportion of matters proceeding to trial
- growing caseloads for serious crimes, which often involve lengthy and complex trials
- avoidable late guilty pleas.

These pressures are exacerbated by complex court administration, a lack of courts in key locations and a shortage of capacity in existing metropolitan courts. In the 2015-16 financial year, the number of District Court cases older than 12 months increased by 20 per cent.[277]

Aligning court locations with demand

NSW courts and tribunals operate from 176 locations across NSW. Generally, NSW courts and tribunals infrastructure was built before 1930 in locations that reflect historical settlement patterns. As with corrective services, the location of the infrastructure network is not aligned to current service needs. In 2013-14, just 40 per cent of courthouses dealt with 90 per cent of the court caseload in NSW.

Some regional courts remain underutilised and court sittings in some regional areas could be consolidated, enabling these assets to be repurposed or recycled. Moreover, some ageing assets are unable to appropriately and effectively serve their purpose.

Planned physical infrastructure investment over the next five years will provide additional capacity in key strategic locations, including the Sydney CBD, Parramatta, south-west Sydney and regional growth areas like the Far North Coast. The development of a long-term asset investment strategy would help to guide future investment decisions.

Improving courts with technology

The OECD has found that justice systems devoting a larger share of their budget to information technology achieve shorter average trial lengths, as well as higher productivity from judges (measured as number of cases per judge).[278] Despite these potential benefits, there has been limited investment in technology for NSW courts in recent years, aside from the rollout of Justice AVL to enable court proceedings to occur via video.

A review of courts and tribunals services is underway, which includes examining the use of digital technology across the courts to improve access and efficiency. This may lead to moving more court processes to digital channels. Subject to funding, the new service delivery model will begin in 2018-19.

14.2.3 Corrective Services

The key objectives of Corrective Services NSW are to prevent and reduce reoffending, and to improve community safety and public confidence in the justice system. Demand for prison beds is directly impacted by the efficiency of police and courts, while a lack of prison bed capacity can have impacts on police and courts; for instance, by requiring stays in police or court cells.

In NSW, the key infrastructure challenge for corrective services is managing high growth and record total volumes in the prison population, which have created capacity constraints in the short to medium term (0-5 years). This growth in the prisoner population is the result of:

- increased volumes flowing through the justice system
- fewer people being granted bail
- longer remand periods due to court delays
- increased targeting by police of bail and parole breaches.

Growth in the prison population has led to a shortage of appropriate beds in the right locations, leaving the system inadequately equipped to respond to surges in the population. This results in higher transportation costs and unsettles inmates who must be transported between different facilities.

Investing to provide long-term capacity

Many of the State's correctional facilities are ageing and need to be upgraded to support the growing prisoner population and meet contemporary service standards. Of the State's 35 correctional centres, eight are more than 100 years old and four are more than 50 years old, making refurbishment or repurposing to meet contemporary service standards difficult.

Significant investment has recently been made in the New Grafton Correctional Centre and the Prison Bed Capacity Program to deal with short- and medium-term growth. This combined investment of $3.1 billion is delivering approximately 6,000 additional beds at various sites across NSW.

However, further substantial investment will be needed to accommodate long-term growth in the prison population, particularly in metropolitan locations, and provide fit-for-purpose beds that are suitable for the prisoner cohort and appropriately located. As more

277 Department of Justice 2017

278 OECD 2013, p. 5

fit-for-purpose beds are added to the system, obsolete beds and facilities can be decommissioned.

Using technology to improve efficiency

Many of the State's older correctional facilities have design or heritage constraints that limit their capacity to adopt new technology. Recent projects, like the new rapid build prisons at Wellington and Cessnock, are incorporating more technology, such as 360-degree cameras and new security systems that enhance the visibility of prisoner movements.

In addition to investing in electronic security equipment to maintain minimum-security industry standards across the prison network, there are opportunities to use technology to improve the efficiency of back office systems and data analysis.

Improving asset management

The *Corrective Services Infrastructure Strategy 2017-37* (CSIS) provides an outcomes-focused strategic framework for prison infrastructure planning and investment in NSW over the next 20 years. This strategy will guide Corrective Services NSW as it develops more sustainable and better value correctional facilities that are configured to better support operational requirements. This includes adopting a 'hub and spoke' model to achieve more efficient and sustainable asset utilisation, basing services around larger custodial operations in the northern, southern and metropolitan regions.

Management models for prison operations, including asset management, vary across the prison system, with a mix of internal and external providers. Substantial work went into defining clear operational outcomes

for the New Grafton Correctional Centre, and these operational outcomes have since been adopted by the John Morony Correctional Centre (south of Windsor) and Parklea Correctional Centre. Building on this work, there is an opportunity to rollout more contemporary, outcomes-focused approaches to prison operations, including through private sector operators where they can provide better value for money.

Corrective Services NSW is currently undertaking a benchmarking program across all publicly operated correctional centres. The program aims to improve the efficiency and effectiveness of NSW's publicly-operated correctional centres while maintaining safety and security. It will provide a baseline for comparing the performance of public and private operations. Future decisions on partnering with the private sector can then be considered on a case-by-case basis, taking into account value for money, risk, service delivery and community safety.

14.2.4   Juvenile Justice

Juvenile Justice NSW provides services to young people who are in contact with the criminal justice system – from diversion and early intervention through to incarceration, supervision and rehabilitation. Juvenile Justice NSW's custodial operations are impacted by:

- youth crime rates
- the rates of apprehension of suspected offenders by police
- the timeliness of access to and decisions of the judiciary

- the efficacy and availability of diversionary programs such as Youth on Track and Bail Assistance.

While the number of young people in custody has declined in recent years, Juvenile Justice NSW has had to manage an increasingly complex cohort of young people. These young people have often experienced abuse and neglect, substance addiction, disability and mental health issues. Contemporary infrastructure design, custodial standards and asset management strategies are required to effectively manage this complex cohort.

Targeted investment in ICT services across Juvenile Justice NSW would deliver substantial improvements and efficiencies in record management, the collection of data and the delivery of services.

14.2.5   Fire and Rescue NSW

Fire and Rescue NSW is responsible for fire, rescue and hazardous material services in cities and towns across NSW. Fire and Rescue NSW responds to around 125,000 emergencies per year: an average of 340 per day or roughly one call every four minutes. In addition to responding to emergencies, Fire and Rescue NSW focuses on preventing fires and building resilience among the households most at risk from home fires.

The average age of the Fire and Rescue NSW property asset portfolio is 50 years, with several properties over 100 years old. Over a quarter of all fire stations are heritage-listed. Many stations are not located

appropriately to service population growth and do not include facilities for female firefighters.

Fire and Rescue NSW has a fleet of approximately 700 fire engines and 250 smaller vehicles plus trailers. The average age of the fleet is around 10 years and 22 per cent of the fleet is older than the industry standard of 15 years. Capital budgets in recent years have been redirected to investment in new and upgraded properties.

14.2.6   NSW Rural Fire Service

The NSW Rural Fire Service is the largest volunteer fire service in the world. The agency's principal responsibility is to provide fire protection to communities, coordinate bush firefighting operations and respond to a wide range of emergency incidents across rural NSW. The NSW Rural Fire Service also has a critical role to play in bushfire mitigation and hazard reduction activities.

Infrastructure funding for the sector is delivered through the Rural Fire Fighting Fund (RFFF), which comprises contributions from the insurance industry (73.7 per cent), local government (11.7 per cent) and the NSW Government (14.6 per cent), with allocations determined by the Minister for Emergency Services through a collaborative 'bids and estimates' process. Assets meeting certain criteria are vested in local councils to operate and maintain.

Some existing stations are not suitable to accommodate high-value and essential fire-fighting assets and do not include facilities for female firefighters. Several brigades do not have a station at all.

With around 4,000 fire engines and a support fleet of around 3,000 other vehicles, the NSW Rural Fire Service's annual expenditure on replacements, upgrades, maintenance and repairs is significant. The NSW Rural Fire Service aims for a maximum 25-year life for each firefighting appliance, with strategies in place to achieve this in the coming years. The current average age of the service's fire engines is around 14 years.

14.2.7   NSW State Emergency Service

The NSW State Emergency Service (NSW SES) is the lead agency responsible for responding to floods, storms and tsunamis in NSW. The NSW SES has core roles in relation to community preparedness, prevention, response and recovery in relation to these hazards.

The ownership of NSW's emergency fleet of over 630 vehicles, 370 boats and 900 trailers has now transitioned from local government to the NSW SES. Over 16 per cent of the fleet exceeds maximum age KPIs and is in urgent need of replacement.

NSW SES is dependent upon local councils to provide and maintain the facilities it needs to undertake its statutory roles. Many of these facilities are aged and require significant maintenance.

NSW emergency services

Fire and Rescue NSW

7,131
full time and retained staff and

6,318
volunteers located across

337
fire stations in NSW

NSW Rural Fire Service

73,162
volunteer rural fire fighters attached to

2,029
brigades throughout the State

NSW State Emergency Services

8,658
volunteers and

245
units

Source: NSW Department of Justice 2017

14.3 Response

14.3.1   A long-term infrastructure strategy for the sector

The Department of Justice recently commenced a condition assessment of the asset portfolios of Corrective Services NSW, Juvenile Justice NSW and NSW Courts and Tribunals to provide an understanding of the maintenance backlog and recommendations for lifecycle cost planning. Work has also commenced across the Justice Cluster to gain a better understanding of the system's pressure points and opportunities for whole-of-system optimisation and service co-location benefits.

Infrastructure NSW considers that these initiatives should form part of a wider review of integrated asset planning, investment and management across the entire justice and emergency management sector. The review should incorporate and build on work already underway by the Department of Justice and other whole-of-government asset initiatives, including Property NSW. It should provide a baseline for, and inform the development of, a 20-year Justice Infrastructure Strategy to guide future infrastructure planning and investment.

Key considerations for the review of integrated asset management and the subsequent development of the Justice Infrastructure Strategy should include:

- providing a long-term, evidence-based investment strategy
- identifying opportunities for technology-enabled, service delivery efficiencies, particularly in courts and corrective services

- investigating opportunities for integrated back office systems
- identifying opportunities for smarter investment, management and divestment of property assets
- using 'big data' analysis to inform strategic planning and demand management
- benchmarking service delivery and identifying alternative service delivery models, where appropriate
- ensuring governance and investment processes result in more integrated asset investment
- ensuring ongoing asset condition assessments and investment decisions consider risk and resilience assessments.

Recommendation 112

Infrastructure NSW recommends that the Department of Justice undertake a review of asset management across the Justice Cluster. The review should be completed by mid-2018 and include:

- a baseline asset condition and capacity assessment
- a detailed review of the role of digital technology in asset management and service delivery
- an end-to-end assessment of system pressure points
- identification of opportunities for co-located services.

Recommendation 113

Infrastructure NSW recommends that the Department of Justice prepare a long-term 20-year Justice Infrastructure Strategy. The Strategy, to be informed by the asset management review, should be completed by the first quarter of 2019.

14.3.2   Continue planning to meet capacity constraints

Infrastructure NSW and the Department of Justice have agreed on investment principles to guide urgent infrastructure investment decisions to meet capacity constraints across the Justice Cluster until the long-term infrastructure strategy is completed. Regardless of the outcome of the review, longer-term court and prison capacity in the right locations will be necessary to meet projected demand. Planning for major investments to meet this demand should continue.

Recommendation 114

Infrastructure NSW recommends that by the end of 2018, the Department of Justice prepares business cases to address court capacity in the Sydney CBD, South West Sydney and key locations in regional NSW.

Recommendation 115

Infrastructure NSW recommends that the Department of Justice prepare a business case and undertake site investigations and related community consultation by the end of 2018 to address the requirement for additional long-term prison bed capacity in Greater Sydney.

15. Culture, sport and tourism

STRATEGIC OBJECTIVE Deliver world class institutions to maintain strong cultural and sporting sectors and support the visitor economy.

SNAPSHOT	• NSW is home to close to 40 per cent of Australia's creative industry and music and performing arts jobs. Sydney is headquarters for most arts and cultural businesses. The number of international tourists to NSW is expected to grow 150 per cent over the next 20 years to 10 million annual visitors.
	• The *State Infrastructure Strategy Update 2014* identified that NSW had fallen behind other states and global cities in its investment in cultural, sporting and tourism infrastructure and that a backlog of renewal and maintenance exists.
	• In 2014, the Government accepted Infrastructure NSW's recommendations to prepare a 20-year Cultural Infrastructure Strategy, set aside $1.6 billion for a major sports Stadia Strategy, $600 million for cultural infrastructure and $300 million for local sports facilities in regional NSW, and a further $300 million in a Regional Growth – Environment and Tourism Fund.
	• In October 2016, Infrastructure NSW submitted the Cultural Infrastructure Strategy to the Premier. The NSW Government has since undertaken consultation on the priorities for cultural infrastructure investment to develop a long-term cultural infrastructure plan.
	• The Government has acted on some of Infrastructure NSW recommendations. Investments underway include the Sydney Modern Project, Stage 1 of the Sydney Opera House renewal program and the Walsh Bay Arts and Cultural Precinct, grants under the Regional Cultural Fund and the finalisation of a business case for the relocation of the Museum of Applied Arts and Sciences to Parramatta.
	• The Government has proceeded with investment in the Western Sydney Stadium, a rectangular stadium in Parramatta seating 30,000 people to support a range of sports including rugby league, football and rugby union, as well as a range of events and community uses.
	• Tourism infrastructure investments are also underway, including regional tourism programs funded by Restart NSW. A NSW Cruise Development Plan has also been prepared

RESPONSE	**Summary of key recommendations**
Cultural infrastructure	• Publish and implement a NSW Government response to the recommendations of the 2016 Cultural Infrastructure Strategy.
Sport infrastructure	• Develop a Sport Infrastructure Strategy and a whole-of-sector investment framework.
	• Deliver community sport infrastructure programs
	• Complete final business cases to inform investment in major stadia.
Tourism infrastructure	• Develop a Tourism Infrastructure Strategy to guide investment that will support the new Regional Economic Development Strategies and visitor economy targets.
	• Prepare a strategic business case to assess options for providing additional cruise berthing capacity in Sydney.
	• Encourage the Commonwealth Government to review regulatory settings to improve aviation operations in Sydney.

15.1   Recent progress

In 2012, the NSW Government accepted the recommendation in the *2012 State Infrastructure Strategy* for investment in the International Convention Centre – ICC Sydney. Delivered in partnership with the private sector, the ICC Sydney opened in December 2016.

In 2014, the NSW Government accepted recommendations in the *State Infrastructure Strategy Update 2014* to develop a Cultural Infrastructure Strategy (CIS) and to develop and deliver a major sports stadia program and a regional environmental and tourism program.

The CIS was completed in 2016 and covers museums, archives, libraries, heritage assets, artistic and cultural centres. At the time of writing, the NSW Government had released the CIS and was preparing its full response to it following engagement with the cultural sector and the community. However, it has already announced its commitment to:

- $244 million in funding for the Art Gallery of NSW Sydney Modern Project, leveraging a further $100 million in private funding
- $228 million in funding for the Sydney Opera House Stage One Renewal
- $207 million in funding for the Walsh Bay Arts and Cultural Precinct
- $100 million in funding for the Regional Cultural Fund
- a new museum at Parramatta, subject to the completion of a business case.

Consistent with the recommendations in the CIS, the NSW Government has established the Cultural

Infrastructure Program Management Office – an office dedicated to the planning and delivery of cultural infrastructure – to enable a sector-wide, coordinated approach to cultural infrastructure in NSW. The new office means that the NSW Government is now well-placed to fully consider and respond to Infrastructure NSW's advice.

The NSW Government is investing in its stadia network, with the aim of attracting high-value international and national events to NSW, including:

- delivery of the new Western Sydney Stadium at Parramatta
- creating international sporting hubs at Moore Park and Sydney Olympic Park, as well as national centres in Wollongong and Newcastle
- use of other Tier 2 stadia to meet community needs, including establishing Centres of Excellence for elite training and forging strong community links.

The NSW Government has also committed $510 million in Restart NSW Funds to local government in regional NSW for cultural, sport and tourism infrastructure, comprised of:

- a $300 million Regional Growth, Environment and Tourism Fund Program aimed at developing cultural, recreation and environmental attractions for visitors and residents throughout regional NSW
- a $110 million investment in regional airports and new cruise terminals in Eden and Newcastle
- a $100 million investment in regional and local sports infrastructure in partnership with local councils and local sporting organisations.

279 Transport for NSW 2017, p. 5

15.2 Challenges and opportunities

A strong creative and cultural sector is a key contributor to NSW's global competitiveness and Sydney's position as a world city. It is a critical component of the NSW visitor economy and provides significant social benefits. Participation in the arts and sport nurtures communities and supports innovation and economic development, as well as playing a part in urban regeneration and renewal.

Tourism delivers $38 billion in economic benefits annually to the State and employs 261,000 people.[279] Tourism Research Australia forecasts that the volume of tourism exports, which includes accommodation,

NSW Tourism

International visitors
3.6M

Source: Transport for NSW 2017

Cruise passengers
1.3M

Source: Cruise Lines International Association 2016

Economic contribution
$38B

Source: Destination NSW 2016
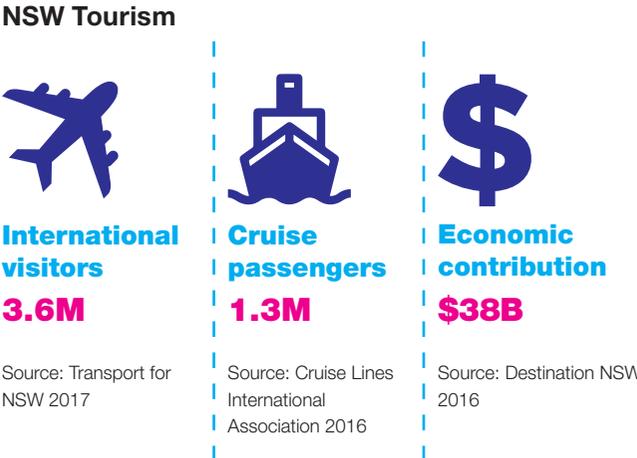
air travel and services, will grow by 6.7 per cent per annum over the coming decade, and that the number of international tourists to NSW will grow 150 per cent over the next 20 years to 10 million annual visitors[280]. This growth is expected to stimulate growth in tourism-related employment, particularly in regional NSW.

In addition to the visitor economy, the State's cultural assets supports NSW's creative and artistic industries, while museums, botanic and zoological assets and collections play key roles in Australia's scientific, natural, environmental and research industries. NSW is home to close to 40 per cent of Australia's creative industry and music and performing arts jobs. Sydney is headquarters for the majority of Australia's creative industry businesses.[281]

The *State Infrastructure Strategy Update 2014* highlighted that NSW had fallen behind other states and global cities in its investment in cultural, sporting and tourism infrastructure and collections. Other jurisdictions, notably Victoria, the ACT, Tasmania and New Zealand, have boosted their visitor economies through targeted investments that combine environmental and heritage protection with infrastructure.

The challenge of investing in culture, sport and tourism infrastructure is not the State Government's alone. In 2012 and 2014, Infrastructure NSW highlighted the need to attract co-funding from other levels of government and the private and philanthropic sectors.

280 Tourism Research Australia 2017, p. 13
281 NSW Trade and Investment 2013, p. 5

15.3 Response

Cultural Infrastructure Strategy

The *State Infrastructure Strategy Update 2014* recommended the development of a Cultural Infrastructure Strategy (CIS) to:

- review the State's cultural infrastructure assets and future needs
- advise the NSW Government on priorities for investment in the State's significant cultural places and institutions
- improve economic and social outcomes from the State's cultural assets
- ensure that future investment in cultural infrastructure delivers greater public value, consistent with the NSW Government's wider strategic priorities.

The CIS sought to establish an evidence-based 'whole-of-sector' investment framework for cultural infrastructure, setting clear priorities for near-term investment, recommending strategic directions for future investment and bringing rigour to strategic planning for cultural infrastructure across the State. The CIS identified the need to:

- adopt a more coordinated and more strategic approach to prioritising, planning and delivering cultural infrastructure to deliver substantive new investment in arts and cultural infrastructure, facilities and precincts in Greater Sydney (Eastern City, Central River City and Western Parkland City) and regional NSW
- develop and support new facilities and venues to keep up with the growing and changing demand

for arts and cultural experiences across Greater Sydney and in regional NSW, including flexible spaces that can accommodate diverse activities, delivered in partnership with councils and the private sector

- pursue a precinct-based approach to investment priorities as being central to successful cultural infrastructure investment and development
- integrate arts and cultural outcomes into urban development through planning proposals that nurture cultural production in everyday local spaces and enhance access to the arts in all communities
- explore new sources of investment in cultural infrastructure and ensure that investment delivers value for money.

The CIS identified critical gaps where demand and needs were not being met, where emerging opportunities were not being taken up and where Sydney and NSW were in danger of falling behind. Addressing these gaps will require significant new investment by the NSW Government.

The CIS identified the need to:

- **Keep pace: asset renewal and technological improvements** – A backlog of asset renewal and maintenance means that the flagship State Cultural Institutions (the Sydney Opera House, Art Gallery of NSW, Australian Museum, Museum of Applied Arts and Sciences and the State Library of NSW) as well as organisations such as Sydney Living Museums and regional galleries, studios, performing arts and rehearsal spaces, libraries and museums are struggling to maintain the functionality of their buildings, sustain high quality visitor experiences

and manage their collections at the appropriate standards.

- **Achieve excellence: modernise and upgrade State Cultural Institutions** – As a high priority, significant infrastructure renewal of the State Cultural Institutions is required (in addition to the backlog maintenance needs) to meet contemporary performance standards and public expectations. This investment will have flow-on effects for the rest of NSW, enabling these Institutions to expand their reach and partnerships and, through digitisation, enable greater access to collections and performances for everyone.

- **Leverage opportunities**: build NSW's competitive strengths – New investment is needed across Greater Sydney and regional NSW to address specific operational gaps and position NSW to build on its competitive strengths in hosting sought-after cultural events, performances and experiences. Examining opportunities to invest in spaces for small- to medium-sized cultural production is also a priority to support a healthy and competitive sector. Rising property prices have led many artists and creative innovators to move out of the CBD and other arts precincts, where rents are high, in search of more affordable studio or rehearsal spaces.

- **Cultural Infrastructure Investment Framework** – Cultural infrastructure investment in NSW has suffered historically from the lack of an agreed strategic, economic and planning framework and from limited demand analysis. This has impeded whole-of-sector planning and the setting of priorities for capital investment, in both government and the private sector. The CIS advocated a major shift in approach, proposing the future deployment

of capital funds in accordance with a strategic whole-of-sector Cultural Infrastructure Investment Framework. The framework seeks to ensure that potential projects are assessed against agreed objectives and criteria, and provide a rigorous demonstration of the benefits these projects aim to deliver.

- **Timing, investment priorities and funding pipeline** – The investment recommendations contained in the CIS represent a baseline investment to deliver the social and economic benefits of cultural infrastructure. Since Infrastructure NSW submitted the CIS, further work has reinforced the value of cultural infrastructure to the state.[282]. Final decisions on the CIS's recommendations rest with the NSW Government; the timing of proposed investments will depend on the availability of funding.

Recommendation 116

Infrastructure NSW recommends that, following appropriate consultation, the NSW Government publish its response to the recommendations of the 2016 *Cultural Infrastructure Strategy*.

15.3.1   Sport infrastructure

Participation in sport and active recreation contributes to the development of healthy, cohesive, resilient, liveable and strong communities. Investment in sport infrastructure helps to ensure that NSW has a network of spaces and places that enable participation in active recreation and performance at all levels.

The Office of Sport is developing a state Sport Infrastructure Strategy, which will map out the Government's plans for the redevelopment of the major stadia network, the provision of community sport infrastructure and facilities, and the creation of sport Centres of Excellence.

An integrated strategy for sport infrastructure, including an investment framework (as developed for the Cultural Infrastructure Strategy), will allow the Government to better assess and prioritise potential investments and develop a suitable asset management plan.

Recommendation 117

Infrastructure NSW recommends that by mid-2018, the Office of Sport complete a State Sport Infrastructure Strategy, a whole-of-sector, evidence-based investment framework and management plan.

The Office of Sport is collaborating with local government, sports and other sector partners to foster development of Sports Hubs and Centres of Excellence across the state.

The Office of Sport is currently focused on three areas: the provision of community sport infrastructure in regional NSW and in Sydney, the creation of sports hubs and Centres of Excellence, and the redevelopment of the major stadia network.

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282 Deloitte Access Economics 2017, p. 3

Community sport infrastructure

The NSW Government has committed $100 million to a Regional Sports Infrastructure program to develop regional sport infrastructure facilities in NSW. This program will be delivered over the next three years.

In Sydney, the Office of Sport is working with the Greater Sydney Commission, local councils, Sports NSW, Parks and Leisure Australia, sporting organisations and government agencies (including the Department of Education and Department of Planning and Environment) to develop District Sport Facility Plans for sport and active recreation. The five District Sport Facility Plans are expected to be finalised by the end of 2018.

Sports hubs and centres of excellence

Sports hubs integrate a range of sport facilities and supporting services on one site, or in close proximity to each other, to optimise their efficiency and create business synergies.

Centres of Excellence provide world-class facilities for elite performance and youth development to ensure that NSW sports can compete for talent and events.

Major stadia network

In November 2017, the NSW Government announced an updated *Rebuilding the Major Stadia Network* in NSW program. The highest priority projects in the program are the delivery of the Western Sydney Stadium and the redevelopment of the Sydney Football Stadium at Moore Park and Stadium Australia at Sydney Olympic Park.

The next priorities in the Stadia Development Plan include a proposed new indoor sporting arena, completion of Spotless Stadium and a network of regional stadia capable of supporting first-class sporting competition and other premium events.

Business cases for these projects will be completed in 2018 for consideration by Government.

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Recommendation 118

Infrastructure NSW recommends that the Office of Sport:

- completes, during 2018, business cases for three facilities: Sydney Football Stadium, Stadium Australia and the proposed new Sydney indoor sport arena

- deliver, with local government, sports and other private partners, regional and metropolitan district sports infrastructure programs.

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15.3.2   Tourism infrastructure

Tourism infrastructure plays a key role in supporting the growth of NSW's visitor economy. In 2012, the Government established the Visitor Economy Industry Action Plan (VEIAP) and set a target of doubling the overnight visitor spend in NSW from $18.3 billion to $36.6 billion by 2020. In 2016, NSW attracted 33.2 million overnight visitors, who stayed a total of 183.3 million nights and spent $26.2 billion. Between March 2011 to March 2017, there was a 37.3 per cent increase in overnight visitor expenditure.[283]

The NSW Government has recently commissioned a review of the 2012 Visitor Economy Industry Action Plan to assess progress to date. The review, which is scheduled to be completed in early 2018, will identify actions to continue growing the visitor economy and will set new targets.[284] It will explore regionally unique visitor experiences, products and issues, and consider whether specific targets should be set for regional destinations.

Tourism infrastructure review and proposed framework

Infrastructure NSW proposes that, once the VEIAP has been completed, a Tourism Infrastructure Strategy be developed. The development of a Strategy should apply a whole-of-sector, evidence-based investment framework – equivalent to that developed for the Cultural Infrastructure Strategy.

The investment priorities for State-owned assets are difficult to determine without an overarching strategy, not least because of the fragmented holding of tourism assets across multiple agencies. An integrated review of the tourism assets (other than those covered by the Cultural Infrastructure Strategy) would allow the Government to identify and prioritise the investments likely to yield the highest economic and social benefits for NSW. It would also promote better collaboration across agencies and levels of government and with universities and the research sectors.

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283 Transport for NSW 2017, p. 16

284 Minister for Tourism and Major Events 2017

Recommendation 119

Infrastructure NSW recommends that by the end of 2018, the NSW Government develop a Tourism Infrastructure Strategy and whole-of-sector, evidence-based investment framework to guide investment in state-owned tourism and nature-based scientific, education, recreation and entertainment facilities.

Currently, the tourism sectors that are demonstrating the highest demand growth and potential infrastructure capacity constraints are the marine and coastal, natural and recreation sectors.[285] These are considered in detail below.

Marine infrastructure

Sydney cruise priorities

Over the past decade, the Australian cruise industry has grown on average by 20 per cent a year to reach almost 1.3 million cruise passengers annually.[286] In 2016-17, Sydney Harbour hosted more than 340 cruise ship visits – an 11 per cent increase over the 2015-16 season.[287] Over the 2016-17 season, more than half a million passengers visited Sydney on cruise ships, generating an estimated added value add of $2.7 billion for NSW.[288] Cruise ship operators are increasingly adding regional destinations to their itinerary, driving tourism expenditure and investment in regional NSW.

Sydney's current cruise ship berths at White Bay and the Overseas Passengers Terminal (OPT) are nearing capacity during the peak season (October to March). Many of the newer cruise ships are unable to access berthing facilities at White Bay as they are too large to pass under the Sydney Harbour Bridge. This creates capacity pressures at the OPT. As the size of ships continues to increase, many of the 'mega cruise ships' currently being built will be too large to berth at the OPT as they will interfere with other critical harbour operations.

In 2016, the NSW Government analysed options for expanding cruise industry capacity in Sydney and subsequently established an Independent Cruise Industry Reference Group to help inform the development of a NSW Cruise Development Plan. Analysis undertaken as part of this process identified the need for a combination of short-, medium- and long-term measures to address the capacity constraints facing the industry in Sydney. These measures should be developed further in a strategic business case to assess options for providing additional cruise berthing capacity in Sydney.

Circular Quay

Circular Quay is a nationally significant destination for all people – the 'waterfront to Australia'. It is a tourist and visitor destination, business precinct, transport interchange but most importantly, a nationally significant public space. As well as transport services, Circular Quay provides the gateway to some of Australia's most famous cultural, natural and built assets: Sydney Harbour; the Sydney Opera House; Royal Botanic Gardens, The Rocks and a visual link to the Sydney Harbour Bridge. Transport for NSW is

planning investment to renew the public domain as well as the transport services using an early market engagement approach that aims to encourage ideas from the private sector to inform Government's development of the concept and reference designs. Beyond working with the market to determine innovative delivery and funding opportunities, this approach allows for an integrated, multifaceted solution improving the amenity and attractiveness of Circular Quay as a whole, for all times of day, for all of its many functions.

Recommendation 120

Infrastructure NSW recommends that the NSW Government prepare strategic business cases by the end of 2018 for:

- providing additional cruise berthing capacity in Sydney
- renewing Circular Quay.

Coastal and boating priorities

Coastal, boating and marine assets play a key role in supporting the visitor economy.

Better coastal harbours and the revitalisation of the foreshore through infrastructure upgrades could enable further growth in tourism in the Central Coast, North Coast and South Coast regions.

Future regional coastal and boating programs will have a strong focus on projects that help drive economic development outcomes.

285 Tourism Research Australia 2017
286 Cruise Lines International Association 2016
287 Port Authority of NSW 2017
288 Cruise Lines International Association 2017

The oversight of coastal and boating infrastructure involves multiple State agencies and local government. Transport for NSW and the Department of Industry (Crown Lands and Water) have established a Coastal Infrastructure Unit to improve management of these projects.

Natural and recreational tourism assets

Outdoor and nature-based experiences constitute one of the fastest growing tourism sectors, with nature-based tourists in Australia staying longer and spending more than other tourists.[289]

National Parks

National Parks are a significant asset for the State's tourism economy, attracting 51 million visits (including local residents) and contributing $17 billion in expenditure in 2016.[290]

NSW's regional National Parks, including its four world heritage-listed parks (the Greater Blue Mountains, the Gondwana Rainforests in Northern NSW, Willandra Lakes in Mungo National Park and Lord Howe Island), have seen a 30 per cent increase in visitation over the past two years. Sixty nine per cent of all park-related visits are in regional areas.

The Office of Environment and Heritage has reported that a combination of ageing and inadequate facilities and rising demand is leading to overcrowding of park facilities such as car parks, picnic areas, tracks and accommodation. The Office has submitted economic studies and business cases to support Restart NSW funding of upgrades in national parks under the

Regional Growth, Environment and Tourism program. These business cases show net economic benefits to the State.

Botanical, zoological science and education facilities

Centennial Parklands is one of the world's leading public parklands, with 31 million visits each year, more than 750,000 registered participants in sport and recreational activities each year and another million who engage in active sport recreation.

Parramatta Park and Western Sydney Parklands receive six million visitors each year and include world heritage-listed convict sites.

Sydney's Royal Botanic Gardens and Domain receive over five million visits a year. In addition, 1.1 million city workers and residents attend major festivals and cultural events in the Gardens and use the Domain for recreational and sporting pursuits.

Taronga Zoo's Sydney and Dubbo parks attract 1.7 million visitors each year and are the largest paid attractions in NSW. Thirty eight per cent of visitors are international tourists and 15 per cent are from interstate.

The Office of Environment and Heritage, with the park Trusts, is developing proposals to extend and upgrade these facilities, including a new plant science centre, international educational centres and recreation and entertainment functions for tourists and residents. These proposals should be supported by business cases and considered in the context of the proposed Tourism Infrastructure Strategy.

Regional tourism

Increased tourism in regional NSW is a priority for achieving regional economic growth. A range of actions is necessary to support such growth:

- high quality public transport services. As part of *Future Transport 2056*, Transport for NSW has undertaken to investigate increasing NSW TrainLink's service frequencies to regional tourist destinations[291] and the re-purposing of underutilised assets for tourism-related uses, such as rail trails or tourist train services in regional NSW.[292]

- investigation of opportunities for investment in under-utilised Crown land, which is largely under the control of local government and volunteer organisations and often has inadequate services and visitor facilities

- support for indigenous cultural businesses to develop sustainable commercial opportunities

- investment to develop and renew deteriorating local government assets, art galleries and performance spaces.

Regional Growth, Environment and Tourism program

The business cases submitted for the first round of the Restart NSW Fund's Regional Growth, Environment and Tourism program provided evidence that investment in tourism opportunities such as these could deliver high economic benefits throughout regional NSW.

289 Transport and Tourism Forum Australia 2017
290 Office of Environment and Heritage 2017

291 Transport for NSW 2017, p. 50
292 Ibid, p. 48

Recommendation 121

Infrastructure NSW recommends that the NSW Government continue the Regional Growth, Environment and Tourism Fund for a further 10 years once the current Rebuilding NSW reservation is exhausted in around 2023.

Aviation connections

Transport for NSW has identified parts of regional NSW where improved visitor access could enable further growth of nature-based tourism, including through investment in regional airports. Restart NSW funding has been provided for upgrades at 23 regional airports.

As noted in Chapter 8, regional transport services are transitioning to a 'hub and spoke' model to better connect towns and centres to their closest regional city. This will enhance the efficiency, commercial viability and accessibility of key regional airports.[293]

It is important that sufficient aviation capacity is available for the projected 10 million annual international tourists who will come to New South Wales by 2036.

Aviation capacity in Sydney will be increased with the expected opening of Western Sydney Airport in the mid-2020s and it is likely that, over time, Western Sydney Airport will emerge as an important tourism gateway. However, in the meantime, Sydney Airport will remain the point of arrival for most international visitors and it is important that it operates to its highest potential.

The NSW Government should continue to press the Commonwealth Government to ensure that the regulatory settings that govern the Airport's operation are updated to reflect efficient, contemporary airline and airport operations.

Recommendation 122

Infrastructure NSW recommends that concurrent with the update to the Sydney Airport Master Plan in 2019, the NSW Government encourage the Commonwealth Government and Sydney Airport to conduct a review of regulatory settings to improve operation in the period preceding the opening of Western Sydney Airport.

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293 Ibid, p. 56

Glossary

A

AAA rating

A credit rating is a measure of how risky a borrower is in terms of the borrower's expected willingness and capacity to repay any debt on time. NSW is rated AAA by the two major credit rating agencies: S&P and Moody's. Maintaining the State's AAA credit rating is the central objective of the *Fiscal Responsibility Act 2012*. To support that objective, the NSW Government's fiscal strategy pursues the legislated targets of holding expense growth below long-term revenue growth and eliminating unfunded superannuation liabilities by 2030. The maintenance of the State's AAA credit rating is also a State Priority.

Active transport

Transport activities such as walking, running, cycling, scooters, skate boards, or vehicles with low levels of motor assistance such as electric bicycles.

Adaptation

Measures taken to deal with the impacts of climate change. Adaptation is an element of resilience, which includes the ability to adapt to climate as well as non-climate related shocks and stresses.

ADII: Australian Digital Inclusion Index

Measures three vital dimensions of digital inclusion – access, affordability and digital ability – and shows how they change over time, across social and economic circumstances and geographic locations.

AEMO: Australian Energy Market Operator

Responsible for operating gas and electricity markets and power systems, including the National Electricity Market (NEM), the interconnected power system in Australia's eastern and south-eastern seaboard. AEMO is incorporated as a company limited by guarantee under the *Corporations Act*.

Age profile of assets

A classification of any stock of infrastructure organised by age.

AI: Artificial intelligence

The theory and development of computer systems that can perform tasks that otherwise require human intelligence, such as visual perception, speech recognition and decision-making.

B

BASIX: Building Sustainability Index

A planning system assessment tool for measuring elements of a proposed design against sustainability targets. The tools aim to deliver equitable, effective water management and greenhouse gas reductions across NSW. BASIX is implemented under the *Environmental Planning and Assessment Act 1979*. BASIX applies to all residential dwelling types and is part of the development application process in NSW.

Big Data

Large structured and unstructured data sets that can be analysed using computers to identify trends, patterns, associations and interactions.

BIM: Building Information Modelling

An intelligent 3D model-based process that gives architecture, engineering and construction professionals the insight and tools to more efficiently plan, design, construct and manage buildings and infrastructure.

C

CAV: Connected and Automated Vehicles

A motor vehicle such as a car, truck or bus that uses technology to share data wirelessly with other vehicles, infrastructure, transport management and systems and mobile devices (connected) and has one or more of the primary driving controls (steering, acceleration, braking) that are automated for a sustained period of time. Levels of automation range from automated applications that assist the human driver with the driving task, through to fully and highly automated vehicles that can drive themselves.

See also 'Cooperative Intelligent Transport Systems (C-ITS)'.

Central River City

The Central City districts excluding those parts of Blacktown Local Government Area west of the M7 Motorway and those parts of Fairfield Local Government Area west of the Western Sydney Parklands.

CIP: Capital Investment Planning

A medium-range plan, with approximately a 10-year outlook, that provides a strategic framework for managing assets and guiding actions and investments to meet service goals.

C-ITS: Co-operative Intelligent Transport Systems

Technology to allow vehicles to communicate with other vehicles, traffic signals and roadside

infrastructure. The systems are also known as vehicle-to-vehicle communications, or vehicle-to-infrastructure communications.

C-ITS increase the quality and reliability of information available to drivers or other computer systems about their immediate environment, other vehicles and road users. Connected vehicles use dedicated short-range wireless systems to share information such as vehicle position, direction and speed. Based on this information, C-ITS technology has the potential to improve road safety and the efficiency of the road network.

Climate change

A change in global or regional climate patterns over time; in particular, a change apparent from the mid to late 20th century onwards and attributed largely to the increased levels of greenhouse gas emissions such as carbon dioxide.

CNAF: Catchment Needs Assessment Framework

Identifies priority or hotspot river catchments where water infrastructure investments should be prioritised to ensure future water security. The framework considers current and future urban water supply and irrigation needs across NSW, including consideration of climate change and population growth.

Commissioning and Contestability Policy

Comprises the NSW Treasury Policy, TPP16-05, guidelines and governance by a NSW Treasury implementation unit. Commissioning is defined as "an approach to considering the outcomes that need to be achieved, and designing, implementing and managing a system to deliver these outcomes in the

most effective way". It leverages the strengths of the public sector and, where appropriate, involves private and non-government organisations and individuals to deliver outcomes for customers. The NSW Government will use commissioning to understand customer needs, determine its role in meeting these needs and decide how to create, fund, manage, regulate and evaluate ongoing service delivery systems. Contestability is defined as "the process of evaluating and benchmarking services against credible alternatives and/or market testing in order to drive productivity, learning and improvement".

Consumer-centric outcome and services.

An outcome that is focused on the consumer and is perceived as positive by the consumer. Consumer-centric services provide a service that is focused on consumers that is received positively.

Critical infrastructure

The assets, systems and networks required to maintain the security, health and safety, and social and economic prosperity of a community, such as energy, water, communications, transport and health infrastructure.

Cyberattack

A hostile attempt by hackers to access, damage and/or destroy a computer network or system – usually with criminal intent.

Cybersecurity

Protection – or the state of being protected – against hostile, criminal and unauthorised access to and use of electronic data, networks and systems.

D

DE: Digital Engineering

A new way of performing engineering services (design, construction and maintenance of buildings and infrastructure) in which all plans are digital and can be loaded into augmented reality systems to provide real-time information to construction and maintenance teams. Also known as Building Information Modelling.

DEI: Delivery Efficiency Index

A likelihood indicator of water delivery losses being reduced.

Demand Responsive Transport (DRT) or on-demand transport

Transport services that are based on the demands of customers, rather than a fixed timetable. A demand responsive service may not operate on a fixed route (for example, taxis). Customers indicate that they would like to catch a service (via a smart phone or fixed communication systems) and a service is dispatched to collect all customers who have indicated they want to use it.

DRT is characterised by flexible routing and scheduling of small and medium vehicles operating in shared-ride mode between pick-up and drop-off locations according to passenger needs. DRT systems typically provide a public transport service for areas of low passenger demand, such as rural areas, where a regular bus service would not be viable. DRT services may also be provided specifically for people with disabilities, as with community transport programs.

Digital connectivity

The capacity for interconnections between digital platforms, systems and applications.

District Plans

The basis for strategic planning in a district and considering economic, social and environmental matters, as defined in the *Environmental Planning and Assessment Act 1979*. District Plans provide greater detail to implement the *Greater Sydney Region Plan* at a district level.

District Plans inform local government and the assessment of planning proposals, assist councils to plan and deliver for growth and change, and align their strategic plans to place-based outcomes.

In November 2017, the Greater Sydney Commission publicly exhibited the first ever 20-year District Plans, one for each of Greater Sydney's five districts (Central City, Eastern City, North, South and Western City). The District Plans set out opportunities, priorities and actions and identified how the *Greater Sydney Region Plan* can be put into action at a local level.

See also *Greater Sydney Region Plan*.

DSI: Drought Security Index

A likelihood indicator of low water allocations.

E

Eastern Harbour City

Spans the North, Eastern City and South Districts.

eHealth

eHealth is the use of a broad range of information and communication technologies like broadband connectivity, digital networking or smart software to help drive improvements in health and medical care for individuals and communities.

EIA: Environmental Impact Assessment.

ESEPP: Education State Environmental Planning Policy.

F

Financing

Financing refers to the supply of capital, such as debt and equity, used to pay for the upfront cost of an infrastructure project.

FinTech

Financial technology – computer programs and other technology used to support or enable banking and financial services. Also used to describe businesses in the finance and insurance industry that provide the services enabled by these technologies.

First-mile and last-mile

A term applied to both freight and public transport that refers to the first and final stages of the journey in which people or goods spread out to a broad range of origins or destinations. The first and last miles are the least efficient parts of a transport network (before or after people and goods can come together into more efficient and dense trunk routes).

Fiscal gap (also fiscal targets)

A government's approach to taxation and spending, both of which can affect the economy. A fiscal gap emerges when spending exceeds revenue in the government's projections. The NSW Government's fiscal strategy pursues the legislated fiscal targets of holding expense growth below long-term revenue growth.

See also 'AAA credit rating'.

FMI: Flood Management Index

A likelihood indicator of dams capturing large flow events.

Freight task

An industry term for the overall volume of goods that needs to be transported from A to B.

FUI: Flow Utilisation Index

A likelihood indicator of annual flow supporting greater use.

Funding

Funding is the cash flow used to pay back the money raised through the initial financing.

Future Learning space

Agile, adaptable teaching and learning spaces that seek to increase student engagement and encourage collaboration. Future learning spaces are reconfigurable open spaces with supporting technology.

Future proof

Ensuring that planning, services and infrastructure are delivered in such a way that allows for changes or developments to cater for future needs and populations. Examples include constructing a rail line that allows for future extension and expansion, or reserving key road and rail corridors for future transport projects.

Future Transport 2056

Transport for NSW has prepared *Future Transport 2056*, a long-term strategy and suite of accompanying documents that outline the vision for the NSW transport system for the next 40 years.

G

Gateway review

A series of short, intensive reviews conducted at critical points across a project's development and delivery. This process provides assurance and advice to improve project delivery, as well as early identification of any emerging issues.

See also 'IIAF'.

GIC: Growth Infrastructure Compact

Designed to assess the type, level and timing of infrastructure required for an area, considering scenarios for forecast housing and employment growth. GICs will be used to help identify new growth areas by first understanding infrastructure capacity.

Gig economy

A labour market characterised by the prevalence of short-term contracts or freelance work as opposed to permanent jobs.

GPOP: Greater Parramatta to the Olympic Peninsula

GPOP spans 13 kilometres east-west from Strathfield to Westmead and seven kilometres north-south from Carlingford to Lidcombe and Granville. GPOP includes the strategic centres of Greater Parramatta (Parramatta city and the precincts of Westmead, Parramatta North, Rydalmere and Camellia) and Sydney Olympic Park.

GPS: Global Positioning System

A satellite-based navigation system that uses 24 satellites orbiting around the globe. This system allows users to determine their exact location on the globe.

Greater Sydney (Greater Sydney region)

The region containing the 33 local government areas of Bayside, Blacktown, Blue Mountains, Burwood, Camden, Campbelltown, Canada Bay, Canterbury-Bankstown, Cumberland, Fairfield, Georges River, Hawkesbury, Hornsby, Hunters Hill, Inner West, Ku-ring-gai, Lane Cove, Liverpool, Mosman, Northern Beaches, North Sydney, Parramatta, Penrith, Randwick, Ryde, Strathfield, Sutherland, The City of

Sydney, The Hills, Waverley, Willoughby, Wollondilly and Woollahra.

Greater Sydney Regional Plan

The plan outlining how Greater Sydney will manage growth and change and guide infrastructure delivery. It sets the vision and strategy for Greater Sydney, to be implemented at a local level through District Plans.

See also 'District Plans'.

GSC: Greater Sydney Commission

An independent agency responsible for leading the metropolitan planning for the Greater Sydney Region and promoting orderly development in the region by aligning infrastructure decision-making with land use planning.

GSP: Gross State Product

The combined value of the state's goods and services produced within its borders for a particular time.

H

Health and Education Precinct

An employment area where the close proximity of major health and education facilities creates significant opportunities to drive innovation and productivity. Generally includes an A1 classified hospital and a university.

HFC: Hybrid Fibre Coaxial

Hybrid Fibre Coaxial refers to a broadband telecommunications network that combines optical fibre and coaxial cable. HFC is used for delivering

video, telephoning, voice telephoning, data and other interactive services over coaxial and fibre cables. It is globally employed by cable operators.

'Hub and spoke' model

A service delivery model that provides connections (spokes) to and from key centres (hubs). The spokes link to different hubs across an area, rather than focusing on one key hub.

I

ICT: Information Communications Technology

All devices, applications and systems that combined, allow people and organisations to interact in the digital world.

IIAF: Infrastructure Investor Assurance Framework

Infrastructure NSW has implemented the Infrastructure Investor Assurance Framework (IIAF) to better apply external independent assurance of major projects on behalf of the NSW Government, based on risk.

Infrastructure resilience

The ability of infrastructure to withstand disruption, operate in crisis and deal with and adapt to shocks and stresses.

Intelligent transport infrastructure

Refers to embedding sensors and communication devices into transport infrastructure (such as roads, bridges, rail lines, trains and buses) to allow them to take measurements and provide information about use, congestion, asset wear and tear, and possible maintenance issues.

Intercity transport connections

Modes of transport that travel between cities.

Intracity transport connections

Modes of transport that travel within a city.

IoT: Internet of Things

A development of the internet in which everyday objects have network connectivity, allowing them to send and receive data.

IPART: Independent Pricing and Regulatory Tribunal

Provides independent regulatory decisions and advice to protect the ongoing interests of the consumers, taxpayers and citizens of NSW.

ISO 55000 series

An international standard for the management of physical assets, made up of three standards covering principles, management systems and implementation.

J

Joint-use

Combined facilities that are planned, funded and built between the Department of Education and a public or private sector organisation. The facilities may be built on school land or on the land of a partner organisation. For example, a local council invests in a new synthetic oval and changerooms on school grounds. The oval is jointly used with the council, which maintains and hires it out to sports groups outside school hours.

Justice Cluster

The Justice Cluster refers to the NSW Department of Justice and related statutory agencies (Fire and Rescue NSW, Information and Privacy Commission NSW, Legal Aid NSW, NSW Crime Commission, NSW Crown Solicitor's Office, NSW Police Force, NSW Rural Fire Service, NSW State Emergency Service and Office of the Director of Public Prosecutions NSW).

K

KPI: Key Performance Indicators

A measurable value that demonstrates how effectively an objective is being achieved.

L

Last mile

See 'first-mile and last-mile'.

M

M2M: Machine to Machine

Technology that enables networked devices to exchange information and perform actions without the assistance of humans.

MaaS: Mobility as a Service

A business model for customers to access transport services. Under this model, customers can use a single account and booking interface to access a broad range of transport modes, none of which the customer owns. Examples would be allowing a customer to access public transport, car sharing and bike sharing all using the same system.

MaaS provides a digital marketplace that aggregates demand, allows services to compete, and makes multi-modal journeys seamless. The customer interface will be the MaaS provider not the transport operator, with seamless multimodality the service offering. Bundling, retailing, and technology platforms that improve the customer experience will offer transformational responsiveness, safety and reduced congestion.

Mass transit

High capacity forms of transport that move large numbers of people over a concentrated space or time. Examples include metro rail and heavy rail.

Mbps: Megabits per second

A unit of measurement for bandwidth and throughput on a network.

Megatrends

Megatrends are observed, persistent global factors that have significant consequences for society, the environment and the economy in the long term.

Metropolis of three cities

The three cities envisaged by the Greater Sydney Commission are the established Eastern Harbour City, the developing Central River City and emerging Western Parkland City. It is the vision for Greater Sydney – the urban area which is defined and planned as three cities.

Mitigation

Mitigation refers to actions to minimise greenhouse gas emissions to reduce the impacts of climate change. It can also refer to mitigation infrastructure, such as sea walls, built to reduce risk at the source.

MPSs: Multipurpose Services

A flexible service model for regional and rural communities that provides access to a range of integrated health services such as acute care, subacute care, allied health, oral health, aged care, primary and community services.

Mt: Million tonnes.

Megatonne: one million metric tonnes.

Mtpa: Megatonnes per annum – unit of measurement for annual freight volume.

Murray-Darling Basin Plan

A basin-wide coordinated approach to water management across the Murray-Darling Basin's four states (South Australia, Victoria, New South Wales and Queensland) and the Australian Capital Territory.

N

NARcliM: NSW / ACT Regional Climate Modelling project.

National Energy Objective

The National Electricity Objective is to "promote efficient investment in, and efficient operation and use of, electricity services for the long-term interests of consumers of electricity with respect to price, quality, safety, reliability and security of supply of electricity; and the reliability, safety and security of the national electricity system.

NEM: National Electricity Market

The wholesale market of generators who supply electricity selling to the retailers in real time under the control of the system operator (Australian Energy Market Operator), but the term is often used more broadly to include the financial market and the physical grid that sits alongside it. These three elements work together in the following way:

1. Wholesale market – where generators sell electricity and retailers buy it to on-sell to the consumer. As there are lots of generators and retailers participating, this is a highly competitive and an efficient way of ensuring electricity prices remain competitive.

2. Financial market – sits alongside the wholesale market and involves retailers and generators entering into hedging contracts to buy and sell electricity. These contracts set an agreed price for the electricity and help to manage the risk of price volatility.

3. The physical grid – the transmission and distribution networks that deliver electricity from power stations to homes and businesses anywhere in the system.

NWI: National Water Initiative

The national blueprint for water reform, agreed in 2004 by the Council of Australian Governments (COAG). Water resource plans are a key requirement of the Commonwealth Basin Plan 2012. Between 2016-19, 22 water resource plans will be developed for surface and groundwater regions in the NSW Murray-Darling Basin.

O

On-demand transport

See 'Demand Responsive Transport'.

P

Physical assets

A physical asset is a tangible item of economic, commercial or exchange value.

Place-based

Thinking and decisions that respond to and consider the different characteristics of places.

Point-to-point

Transport services that go directly from a passenger's origin to their destination. Outside of the private car, taxis and ridesharing services (such as Uber and Lyft) are the most common point-to-point transport modes.

Predictive maintenance

Used to determine the condition of equipment to determine when maintenance may need to be performed.

Growth Areas and Planned Precincts

Growth Areas and Planned Precincts are coordinated by state and local governments to deliver jobs, transport and more homes for key growth areas. Growth Areas are greenfield locations for new communities. Planned Precincts are generally located around existing transport corridors or strategic centres.

PPP: Public Private Partnership

An option the NSW Government uses to procure infrastructure. PPPs must comply with the National Public Private Partnerships Policy and Guidelines and NSW-specific requirements in the 2017 NSW Public Private Partnerships Guidelines (TPP17-07). While every PPP has its unique characteristics, the principle features of a PPP include:

- provision of service-enabling infrastructure that includes private sector skills to deliver a combination of design, construction, financing, maintenance, operations and delivery of services
- risk sharing between public and private sectors
- contribution by government through land, capital works, risk sharing or other supporting mechanisms
- payments from government or users to the private sector on the basis of service delivery.

R

Regional NSW

The planning regions of North Coast, New England, North West, Central West and Orana, Far West, Riverina Murray, South East and Tablelands, Illawarra-Shoalhaven, Central Coast and Hunter.

Regulated rivers

Under the *Water Management Act 2000,* a regulated river is one where downstream flows are regulated by a major storage or dam to supply irrigation water.

Resilience

Resilience is the capacity of infrastructure and communities to withstand disruption, operate effectively in crisis, deal with and adapt to shocks and stresses. Shocks include natural disasters such as floods, bushfires and storms, or anthropogenic disaster events such as cyberattacks. Stresses act to increase the impact of these shocks and could include climate change and the increasing digital connectivity and interdependence of infrastructure.

S

SASP: *School Assets Strategic Plan*.

School Community Planning

A new approach to assessing school needs across small areas called 'School Communities' to identify the best way to deliver schools for a community.

Sensor and Sensory systems

A sensor is a device that is used to 'sense' a physical condition or event. A sensor works by converting a

non-electrical input into an electrical signal that can be sent to an electronic circuit. A sensor does not function by itself – it is part of a larger system that comprises microprocessors, modem chips, power sources and other related devices.

Shared use

An agreement that allows an existing school asset to be used for non-school purposes. Assets stay under the schools control. For example, a school hires out an existing hall to a local yoga group in after-school hours or licenses its use for out-of-hours school care.

SINSW: School Infrastructure NSW.

Smart cities

Smart cities use technology and data collected about the city to manage assets and resources efficiently.

Smart infrastructure

Infrastructure with imbedded sensors to allow for the collection of information, to inform decision-making and improve performance.

Smart motorways

Motorways that use embedded sensors, analytics and customer feedback tools to actively manage congestion and safety and respond to traffic incidents.

Sustainability

Sustainability is about using environmental and economic resources in a way that meets the needs of the present without compromising the needs of future generations. Sustainability encompasses resilience

and adaptation, as well as climate change mitigation through the reduction of greenhouse gas emissions.

System asset management

A system that manages and maintains tangible and non-tangible items of value to an organisation.

System of systems

A collection of multiple, dispersed independent infrastructure systems that when added together create a new, more complex system which offers more functionality and performance than simply the sum of the constituent systems.

T

TAM: Total Asset Management

Also known as Capital Investment Planning, see 'Capital Investment Planning'.

Telehealth

Telehealth enables access to integrated, high quality, patient-centred and safe clinical care through remote delivery between health professional and patient, or between health professionals.

TEU: Twenty-foot equivalent unit

A measure of freight carrying capacity. The dimensions of one TEU are equal to that of a standard 20 foot shipping container.

Thirty-minute cities

A policy goal in which people are no further than 30 minutes away (using public transport) from their closest

metropolitan city and from services in their nearest strategic centre seven days a week.

Triple bottom line

An assessment technique that considers the economic, environmental and social impacts of a policy or project proposal. The NSW Treasury Cost Benefit Analysis Policy TPP 17-03 clarifies that the scope of impact analysis relevant to infrastructure investments should include environmental and social impacts as well as economic impacts on social welfare.

TWh: Terawatt hours.

U

Utility 'lead in' assets

The electricity, water, gas, telecommunications infrastructure between the utilities distribution network; for example, the electricity cable in a road reserve and the building entry point.

V

Value based care

Value based care puts the patient at the centre of care and focuses on the experience and outcomes of patients and clinicians.

W

Western Parkland City / Western Sydney Airport and Bringelly Aerotropolis

Covers the Western City districts (formerly the South-west and West Districts) less the Fairfield Local Government Area east of the Western Sydney parklands and those parts of Blacktown Local Government Area east of the M7 Motorway (which are included in the Central River City).

WRP: Water Resource Plans

Water Resource Plans are an important way of aligning Basin-wide and state-based water resource management to provide sustainable limits for the water resources of the Murray-Darling Basin.

Water Sharing Plans

Water Sharing Plans have been developed for rivers and groundwater systems across NSW following the introduction of the *Water Management Act 2000.* In the inland region of NSW, most water sources will also be subject to the requirements of the Commonwealth's Basin Plan.

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Appendices

Appendix 1 Recommendations

2   Integrating land use and infrastructure

1. Infrastructure NSW recommends that the Greater Sydney Commission lead the preparation of a place-based strategic business case for the pilot growth infrastructure compact in the Greater Parramatta to the Olympic Peninsula area by the end of 2018. (Planning: 0-5 years)

2. Infrastructure NSW recommends that, subject to the outcomes of the pilot growth infrastructure compact, the Department of Planning and Environment prepare place-based strategic business cases to inform future updates to Regional Plans and District Plans. (Planning: 0-5 years)

3. Infrastructure NSW recommends that NSW Government agencies integrate the infrastructure priorities necessary to support Growth Areas, Planned Precincts and growth infrastructure compacts (subject to the outcomes of the pilot growth infrastructure compact) into asset management plans and capital infrastructure plans. (Policy: 0-5 years)

4. Infrastructure NSW recommends that the NSW Government Architect develop a 'Movement and Place' practitioner's toolkit by the end of 2018 to support both *Better Placed – An Integrated Design Policy for NSW*' and the *Movement and Place Framework*. (Policy: 0-5 years)

5. Infrastructure NSW recommends that the Greater Sydney Commission establish a trial program to use predictive analytic tools to support the Greater Parramatta to Olympic Park pilot growth infrastructure compact by the end of 2018. (Policy: 0-5 years)

6. Infrastructure NSW recommends that the Department of Planning and Environment develop a plan by the end of 2018 for a 'Collaborate Before You Build' model for co-use of utility assets. (Policy: 0-5 years)

7. Infrastructure NSW recommends that the Department of Planning and Environment introduce planning rules to integrate telecommunications infrastructure (such as nodes, towers and pit and pipe infrastructure) into new developments by the end of 2018. (Policy: 0-5 years)

8. Infrastructure NSW recommends that the NSW Government provide funding for a second round of the Corridor Identification and Reservation Fund. (Investment: 0-5 years)

9. Infrastructure NSW recommends that the NSW Government continues the implementation of the reforms to Crown land and that, as part of the Land Negotiation Program, a review is undertaken by mid-2018 of the potential for Crown land to assist in meeting open space or employment objectives outlined in Regional Plans. (Policy: 0-5 years)

10. Infrastructure NSW recommends that the Department of Planning and Environment establish by 2020 a housing and employment supply pipeline that:
     * includes a five-year housing and employment supply forecast with a 20-year qualitative outlook
     * is published in the third quarter of each year to support Government asset management plans and Budget bids
     * includes analysis of zoning and development pipeline information
     * is digitally based and implemented over three years. (Policy: 0-5 years)

11. Infrastructure NSW recommends that NSW Government agencies work together on a common timeframe to publish population and employment projections, the housing and employment supply pipeline, and agency infrastructure planning actions to coordinate the availability of key information to support Capital Infrastructure Plans and annual Budget decisions. This new common timeframe should commence in preparation for the 2019-20 Budget cycle. (Policy: 0-5 years)

3   Infrastructure planning, prioritisation and delivery

12. Infrastructure NSW recommends that the Department of Planning and Environment pursue

further reforms to improve major project planning approval processes. Initial reforms should include:

- providing key environmental information – including species information, government and private sector monitoring, environmental studies and approvals, and scientific research
- preparing standardised risk-based performance requirements for each industry sector. (Policy: 0-5 years)

13. Infrastructure NSW recommends that the NSW Government, where possible, explore the potential for further asset recycling initiatives. (Policy: 0-5 years)

14. Infrastructure NSW recommends that the NSW Government establish a whole-of-government process, led by Infrastructure NSW and in partnership with industry, to identify and deliver major project procurement reforms by mid-2019. The reforms should focus on driving innovation, reducing bid costs and promoting competition. (Policy: 0-5 years)

4   Asset management – assurance and utilisation

15. Infrastructure NSW recommends that the NSW Government introduce a revised asset management policy that includes a new assurance model managed by Infrastructure NSW, including updated supporting policy and guidance materials, by the end of 2018. (Policy: 0-5 years)

16. Infrastructure NSW recommends that NSW Treasury update by the end of 2018 the data requirements for asset management plans prepared by agencies as inputs into NSW Treasury's Capital Investment Planning policy. (Policy: 0-5 years)

5   Resilience

17. Infrastructure NSW recommends that the NSW Government invest in initiatives to improve the collection of natural hazard information and complete the NSW Flood Data Access Program by 2020. (Policy: 0-5 years)

18. Infrastructure NSW recommends that the NSW Government nominate an agency to assume central accountability for coordinating the collection of statewide natural hazard information. (Policy: 0-5 years)

19. Infrastructure NSW recommends that the Department of Planning and Environment develop a Natural Hazard Policy, supported by a broader strategic process to embed resilience considerations into land use planning, by the end of 2019. (Policy: 0-5 years)

20. Infrastructure NSW recommends that the Office of Environment and Heritage and Office of Emergency Management jointly lead the development of infrastructure-specific risk assessment tools and guidance by mid-2019 to support government agencies, the private and not-for profit sectors, and local government, to better assess the vulnerabilities of new and existing infrastructure and to identify cost-effective adaption and mitigation measures. (Policy: 0-5 years)

21. Infrastructure NSW recommends that NSW Treasury and Infrastructure NSW require consideration of risk to natural hazards and human-related threats and resilience outcomes for new and upgraded infrastructure in project business cases, capital asset planning and assurance processes as a matter of course. (Policy: 0-5 years)

22. Infrastructure NSW recommends that Roads and Maritime Services prepare business cases for evacuation road upgrade packages in the Hawkesbury-Nepean Valley by the end of 2019. (Planning: 0-5 years)

6   Digital connectivity and technology

23. Infrastructure NSW recommends that the *Connecting Country Communities* program be used to improve connectivity in regional NSW and support access to uncontended 25Mbps download and 5Mbps upload capacity by 2020 and 50Mbps download and 10Mbps upload by 2025. (Policy: 5-10 years)

24. Infrastructure NSW recommends that the Department of Finance, Services and Innovation lead a stock-take of all fibre networks owned or managed by the NSW Government during 2018 and establish a fibre optic cable network database. (Policy: 0-5 years)

25. Infrastructure NSW recommends that the Department of Finance, Services and Innovation identify opportunities to leverage NSW Government-owned telecommunications assets to improve statewide connectivity in partnership with the telecommunications industry. These

assets include towers, fibre optic cable networks, and buildings, as well as expenditure on telecommunications services. (Policy: 0-5 years)

26. Infrastructure NSW recommends that the rollout of the Critical Communications Enhancement Program be completed and funding be provided to the NSW Telco Authority to deliver the required infrastructure. (Investment: 0-5 years)

27. Infrastructure NSW recommends that by the end of 2020 the Department of Finance, Services and Innovation develop and implement an Infrastructure Data Management Framework that incorporates access to open data, is searchable in real time and is spatially enabled to support market innovation and smart asset management with sector infrastructure experts. (Policy: 0-5 years)

28. Infrastructure NSW recommends that the Department of Finance, Services and Innovation lead the development of a data infrastructure ecosystem, starting with the Foundation Spatial Data Framework, to access the future benefits of digital mapping and modelling of infrastructure. (Investment: 0-5 years)

29. Infrastructure NSW recommends that the Department of Finance, Services and Innovation prepare a business case for upgrading the Foundation Spatial Data Framework from a map to a model (a real-time 3D model of the physical environment). (Planning: 0-5 years)

30. Infrastructure NSW recommends that the NSW Government develop a Smart Cities Strategy and program business case during 2018 to identify opportunities to deliver better services through collaboration and embracing the benefits of

technology for infrastructure and public services. (Planning: 0-5 years)

31. Infrastructure NSW recommends that the Department of Finance, Services and Innovation lead the development of a whole-of-government policy framework to guide investment in the Internet of Things (IoT) and connected infrastructure to maximise the benefits and manage the potential risks of connected infrastructure. (Policy: 0-5 years)

32. Infrastructure NSW recommends that the Department of Finance, Services and Innovation leads the development of a whole-of-government policy that sets the requirements for smart technology to be embedded in all new and significantly upgraded infrastructure from 2020 onwards. (Policy: 0-5 years)

33. Infrastructure NSW recommends that the existing risk-based approach to information and cyber security and support is strengthened under the direction of the Government Chief Information Security Officer in 2018, with appropriate investment including whole-of-government governance and coordination. (Policy: 0-5 years)

34. Infrastructure NSW recommends that from 2018, cybersecurity risk assessments be included as part of the assurance process for all ICT and connected infrastructure investments, in accordance with the risk framework developed by the Department of Finance, Services and Innovation. (Policy: 0-5 years)

35. Infrastructure NSW recommends that a secure-by-design approach for new initiatives and development be adopted in accordance

with standards set by the Government Chief Information Security Officer, including the IoT and connected infrastructure, and that this be included in the connected infrastructure policy framework by 2020. (Policy: 0-5 years)

7   Innovative service delivery models

36. Infrastructure NSW recommends that NSW Government agencies (with NSW Treasury) assess their ability and capability to respond to the *Commissioning and Contestability Policy* and implement steps to separate purchaser and provider roles. (Policy: 0-5 years)

37. Infrastructure NSW recommends that the NSW Government continue to proactively identify and support infrastructure or related services where regulation can enable new markets and products to develop. (Policy: 0-5 years)

38. Infrastructure NSW recommends that NSW Government agencies apply the *Commissioning and Contestability Policy* to the development of long-term infrastructure strategies to enhance customer outcomes and enable closer collaboration, particularly in health, education, TAFE and justice. (Policy: 0-5 years)

39. Infrastructure NSW recommends that the Department of Family and Community Services, continue to work with NSW Government agencies to explore opportunities to embed social and affordable housing into future infrastructure projects, noting the benefits delivered by increasing the supply of social and affordable housing close to services, transport and community facilities. A 'lessons learned' review of

existing models should be undertaken in the first quarter of 2018 and an options paper prepared for government by the end of 2018. (Policy: 0-5 years)

8   Geographic infrastructure directions

No recommendations.

9   Transport

Transport – Regional NSW

40.   Infrastructure NSW recommends that the Corridor Strategies and guidelines for submissions to the *Regional Road Freight Corridor Fund, Fixing Country Roads* and *Bridges for the Bush* programs adopt an increased focus on achieving goals related to road safety and network resilience. (Policy: 0-5 years)

41.   Infrastructure NSW recommends that the NSW Government continue the *Regional Road Freight Corridor Fund* for a further 10 years once the current Rebuilding NSW reservation is exhausted around 2025 to overcome physical challenges and network restrictions. Investment should target freight productivity upgrades on key east-west routes linking the National Land Transport Network via a 'top down' strategic approach, supported by completed *Corridor Strategies* and business cases. (Investment: 10-20 years)

42.   Infrastructure NSW recommends that the NSW Government continue the *Fixing Country Roads* and *Bridges for the Bush* programs for a further 10 years once the current Rebuilding NSW reservation is exhausted around 2025 to overcome physical challenges and network

restrictions. Investment should occur via a 'top down' strategic approach to target safety and productivity upgrades to the road network to unlock High Productivity Freight Vehicle network capacity. (Investment: 10-20 years)

43.   Infrastructure NSW recommends that the NSW Government continue the *Fixing Country Rail* program for a further 10 years once the Rebuilding NSW reservation is exhausted around 2025 to overcome local rail system constraints. Investment should occur via a 'top down' strategic approach underpinned by a high-level network strategy. (Investment: 10-20 years)

Transport – Central Coast & Illawarra

44.   Infrastructure NSW recommends that the NSW Government improve strategic connectivity between the Illawarra-Shoalhaven and the Western Parkland City by investing, subject to business cases, in the following projects over the next five to 10 years:

- upgrades to road access into the Illawarra via the M1 Princes Motorway, including the Mount Ousley interchange and M1 Princes Motorway between Bulli Tops and Mount Ousley

- freight and safety upgrades to Picton Road in recognition of its role as the primary connector between the M31 Hume Motorway and the M1 Princes Motorway. (Planning: 0-5 years; Investment: 5-10 years)

45.   Infrastructure NSW recommends that Transport for NSW develop business cases by the end of 2020 for the deployment of Smart motorway technology along the M1 Princes Motorway between Sydney and Wollongong and the

M1 Pacific Motorway between Sydney and Newcastle to help manage congestion, improve network resilience and capitalise on future vehicle technologies. (Planning: 0-5 years; Investment: 5-10 years)

Transport – Greater Sydney

46.   Infrastructure NSW recommends that it partner with NSW Government agencies to develop a 'road map' by the end of 2020 that examines the merits of, and outlines a pathway to, an integrated, system-wide user pricing regime across the Sydney metropolitan road and transport network that contemplates the impacts of electric and autonomous vehicle technology. (Policy: 0-5 years)

47.   Infrastructure NSW recommends that Transport for NSW develop a program to reallocate and prioritise road space for on-road rapid transport links for buses and high efficiency vehicles on major routes into the Sydney CBD as major projects like WestConnex, Sydney Metro and SmartRail are completed progressively over the next five to 10 years. (Investment: 0-10 years)

48.   Infrastructure NSW recommends that Transport for NSW develop business cases by the end of 2019 for the progressive delivery of a bus rapid transit network connecting the centres of Liverpool, Campbelltown, Greater Penrith, Blacktown and Western Sydney Airport over the next 10 years. (Planning: 0-5 years; Investment: 0-10 years)

49.   Infrastructure NSW recommends that the NSW Government continue the *Easing Sydney's*

Congestion program over the next 10 years with further progressive investment in targeted, small scale, high impact network management programs (such as pinch points, clearways and bus priority programs) and Co-operative Intelligent Transport Systems (such as upgrades to the Sydney Coordinated Adaptive Traffic System and Transport Management Centre). (Investment: 0-10 years)

50. Infrastructure NSW recommends that by the end of 2018, Transport for NSW develop business cases on a city-by-city basis for an annual program of investment in a network of protected cycleways linking major strategic centres across the three cities. This should be delivered in partnership with local government and be integrated with the Greater Sydney Commission Green Grid. (Planning: 0-5 years; Investment: 0-10 years)

51. Infrastructure NSW recommends that Transport for NSW, in partnership with local government, develop a 10-year rolling program that prioritises active transport at high volume and high profile locations in the Sydney CBD and other strategic centres. (Investment: 0-10 years)

52. Infrastructure NSW recommends that Transport for NSW complete business cases for Stage 1 and Stage 2 of the SmartRail program by the end of 2018 and 2019 respectively to enable progressive delivery of this program as a priority to provide capacity needed beyond 2021. (Planning: 0-5 years; Investment: 0-10 years

53. Infrastructure NSW recommends that Transport for NSW complete the Sydney Metro West

business case before the end of 2018 and continue to progress corridor planning and protection activities for future links in the Central River City and Western Parkland City. (Planning: 0-5 years; Investment: 5-10 years)

54. Infrastructure NSW recommends that by the end of 2018, Transport for NSW complete business cases and planning for the upgrade of major public transport interchanges at Central, Redfern and Circular Quay, and develop a program for the progressive upgrade of other major interchanges across Greater Sydney. (Planning: 0-5 years; Investment: 0-10 years)

55. Infrastructure NSW recommends that Transport for NSW develop business cases to complete the deployment of Smart motorway technology and digital infrastructure across the network in time for the expected opening of the Western Harbour Tunnel. (Planning: 0-5 years; Investment: 5-10 years)

56. Infrastructure NSW recommends that subject to completion of the business case in 2018, the NSW Government invest in the Western Harbour Tunnel to complete a Western CBD Bypass and inner urban motorway network. (Planning: 0-5 years; Investment: 5-10 years)

57. Infrastructure NSW recommends that Transport for NSW complete the business case for the Western Sydney Airport motorway for delivery in time for opening of the Western Sydney Airport. Corridor planning and protection for future strategic road links in the Western Parkland City and to the Illawarra-Shoalhaven should

continue to be progressed. (Planning: 0-5 years; Investment: 5-10 years)

58. Infrastructure NSW recommends that Transport for NSW lead the development of a bulk materials transport and handling plan for Greater Sydney by the end of 2019 to support the construction and waste management sectors. (Policy: 0-5 years)

59. Infrastructure NSW recommends that the Department of Planning and Environment update the relevant State Environmental Planning Policies by the end of 2019 to further protect strategically important ports, airports, industrial lands, freight precincts and key corridors from incompatible uses to ensure the efficient movement of freight in Sydney and NSW, now and into the future. (Policy: 0-5 years)

60. Infrastructure NSW recommends that Transport for NSW finalise business cases by the end of 2018 to enable the NSW Government to partner with the Commonwealth Government to fund investment in Sydney Gateway, Port Botany Rail Duplication and Foreshore Road/Botany Road, as well as the Moorebank Intermodal Terminal Road Access Strategy, to remove bottlenecks on connections to and from Sydney Airport and Port Botany and to capitalise on development of the Moorebank Intermodal Terminal. (Planning: 0-5 years; Investment: 0-5 years)

Transport – Eastern Harbour City

61. Infrastructure NSW recommends that, by the end of 2018, Transport for NSW develop business cases for on-road rapid transit and

priority infrastructure that caters for buses and high efficiency vehicles on Parramatta Road and Victoria Road in support of the Sydney Metro West project. (Planning: 0-5 years; Investment: 0-10 years)

62. Infrastructure NSW recommends that Transport for NSW develop business cases by the end of 2019 for staged investment in on-road rapid transport links for buses and high efficiency vehicles on key corridors at the periphery of the Harbour CBD over the next five to 10 years. (Planning: 0-5 years; Investment: 5-10 years)

Transport – Central River City

63. Infrastructure NSW recommends that Transport for NSW develop a business case by the end of 2019 to augment the capacity and productivity of the Liverpool to Parramatta and North West T-Ways with additional services, enhanced signal priority and a Wentworthville T-Way-to-T-Way connection to link the two separate networks. (Planning: 0-5 years; Investment: 0-5 years)

64. Infrastructure NSW recommends that Transport for NSW develop a business case by the end of 2019 to establish an outer Parramatta ring road bypass to protect the Parramatta CBD from traffic intrusion. (Planning: 0-5 years; Investment: 5-10 years)

65. Infrastructure NSW recommends that Transport for NSW develop business cases by the end of 2019 for the progressive upgrade of key north-south arterials between the M2 and the M5 to Smart road facilities to improve connectivity,

safety and reliability. (Planning: 0-5 years; Investment: 5-10 years)

66. Infrastructure NSW recommends that Transport for NSW develop business cases by the end of 2019 for investment in on-road rapid transit links for buses and high efficiency vehicles between Greater Parramatta and surrounding strategic centres such as Bankstown, Hurstville, Kogarah and Macquarie Park. (Planning: 0-5 years; Investment: 5-10 years)

67. Infrastructure NSW recommends that Transport for NSW develop the business case for Stage 2 of Parramatta Light Rail project by the end of 2018 to enable the NSW Government to make an informed investment decision on the project. (Planning: 0-5 years; Investment: 0-10 years

68. Infrastructure NSW recommends that by the end of 2018, Transport for NSW and the Greater Sydney Commission develop a Greater Parramatta Access Plan leading to a strategic business case for a program of works under the pilot growth infrastructure compact. (Planning: 0-5 years; Investment: 0-20 years)

Transport – Western Parklands City

69. Infrastructure NSW recommends that the NSW Government plan and protect the corridors and precincts necessary for future transport, freight, logistics, energy and communications facilities and infrastructure in the Western Parkland City. (Policy: 0-5 years)

70. Infrastructure NSW recommends the NSW Government partner with the Commonwealth Government to plan the staged investment in

mass transit to support the Western Parkland City over the period from 2036 to 2056. (Planning: 0-5 years; Investment: 20-40 years)

71. Infrastructure NSW recommends that investment in rapid, express rail services to Western Sydney Airport be considered only as a long-term proposition when an expected step-change in airport patronage occurs. (Planning: 0-5 years; Investment: 20-40 years)

10   Energy

72. Infrastructure NSW recommends that the NSW Government implement the COAG Energy Council endorsed recommendations and, through leadership and close monitoring, ensure that actions taken by the energy market closely reflect the specific needs and circumstances of NSW energy consumers. (Policy: 0-5 years)

73. Infrastructure NSW recommends that the NSW Government avoid funding new generation capacity or introducing schemes that send distortionary price signals that prevent private sector investment. (Policy: 0-5 years)

74. Infrastructure NSW recommends that the NSW Government undertake a review of the benefits of transitioning the existing State-based transmission and distribution reliability standards to a national framework administered by the Australian Energy Regulator. The review should be undertaken by mid-2020 prior to a further review of Regulatory Investment Tests, to be commissioned by the COAG Energy Council. (Policy: 0-5 years)

75. Infrastructure NSW recommends that by mid-2018, the Department of Planning and Environment accelerate the competitive release of exploration areas, in accordance with the NSW Government's *Strategic Release Framework for Coal and Petroleum Exploration*. (Policy: 0-5 years)

76. Infrastructure NSW recommends that during 2018, the Department of Planning and Environment review local planning rules and the electricity supply regulatory framework to enable new technologies and energy infrastructure and other solutions including vehicle charging. This includes using regulatory trials to determine whether these solutions are eligible to be complying developments. (Policy: 0-5 years)

77. Infrastructure NSW recommends that by the end of 2019 the Department of Planning and Environment accelerate national and state regulations for consumer protection and safety requirements for new energy technologies. (Policy: 0-5 years)

78. Infrastructure NSW recommends that the NSW Government continue to use the Climate Change Fund to deploy demand management and new energy technologies. (Policy: 0-5 years)

79. Infrastructure NSW recommends that the NSW Government focus existing mechanisms, such as the Regional Economic Growth program, on supporting skills development and jobs for industries affected by the energy transition. (Policy: 0-5 years)

80. Infrastructure NSW recommends that by mid-2019 the Department of Planning and Environment further strengthen the regulated energy efficiency standards for retail, commercial and multi-use developments and infrastructure developments. (Policy: 0-5 years)

81. Infrastructure NSW recommends that by the end of 2018, the Office of Environment and Heritage develop an updated NSW Government Resource Efficiency Policy with targets and minimum standards for demand management and energy efficient measures to ensure compliance across all agencies. (Policy: 0-5 years)

11   Water

82. Infrastructure NSW recommends that the NSW Government assesses the climate science capability it requires for water resource management and infrastructure investment decision-making and act to meet its requirements by mid-2019. (Policy: 0-5 years)

83. Infrastructure NSW recommends that by early 2019, the NSW Government publish a NSW Water Statement to set out the current over-arching policy context, targets and strategic outcomes for the allocation, conservation, management and control of water resources to meet the challenges of climate change and population growth, and ensure a prosperous economy. (Policy: 0-5 years)

84. Infrastructure NSW recommends that the NSW Government commence the development of regional water strategies for all catchments by early 2019 to underpin the proposed NSW Water Statement. (Policy: 0-5 years)

85. Infrastructure NSW recommends that by the end of 2018, the Department of Industry and Water NSW complete the development of regional water strategies that identify investment priorities and other policy options in the priority catchments of Gwydir and Macquarie. (Policy: 0-5 years)

86. Infrastructure NSW recommends that by early 2019, the Department of Industry, in consultation with relevant water service providers, develop regional water strategies for the Richmond and Bega priority catchments. (Policy: 0-5 years)

87. Infrastructure NSW recommends that the Department of Industry, in consultation with NSW Health, develop a risk-based approach by early 2018 to identify priority infrastructure projects that protect drinking water safety in regional NSW towns. (Policy: 0-5 years)

88. Infrastructure NSW recommends that the Department of Industry finalise the Hunter regional water strategy by early 2018 to achieve longer-term water security for the region, including the Central Coast. (Policy: 0-5 years)

89. Infrastructure NSW recommends that the Department of Industry review water-sharing arrangements by early 2019 to enable an informed response to the closure of power generation plants in the Hunter region. (Policy: 0-5 years)

90. Infrastructure NSW recommends that by early 2019, Water NSW prepare a strategic business case for the option of connecting Lostock and Glennies Creek dams. (Planning: 0-5 years)

91. Infrastructure NSW recommends that by early 2019, Hunter Water prepare a strategic business case for the option of constructing a potable water pipeline to Singleton, connecting to the Hunter Water network. (Planning: 0-5 years)

92. Infrastructure NSW recommends that Sydney Water develop a 20-year Strategic Capital Plan for Sydney's water and waste water systems by early 2019 for consideration by the NSW Government and inclusion in its Pricing Submission to the Independent Pricing and Regulatory Tribunal due in mid-2019. (Policy: 0-5 years)

93. Infrastructure NSW recommends the completion of the South Creek Corridor Strategic Business Case by late 2018. (Planning: 0-5 years)

94. Infrastructure NSW recommends that Water NSW and Sydney Water consider a portfolio of options for the augmentation of Sydney's water supply, including the findings of the South Creek Strategic Business Case, and provide advice to the NSW Government for its consideration by early 2019. (Planning: 0-5 years)

12 Health

95. Infrastructure NSW recommends that the NSW Government continue the high-level of investment in fit-for-purpose health infrastructure over the 10-year period from 2018 to 2028. (Investment: 0-10 years)

96. Infrastructure NSW recommends that NSW Health develop a 20-year Health Infrastructure Strategy by early 2019 that supports the future delivery of health services and includes:

- a future-focused analysis of emerging healthcare and non-healthcare technological disruptors and the likely impact on infrastructure required over the next 20 years

- an assessment of the suitability of existing facilities to support future care requirements and enable a higher volume and complexity of services to be delivered in the community

- investigating sites for future health facilities where new development is expected such as North Bringelly and Leppington

- a 20-year strategy for asset management and renewal

- an examination of the role of NSW Health in the delivery of future models of care, for example identifying and securing land for additional integrated community care facilities, health and medical research hubs and research centres, remote monitoring facilities and rapid response units

- further investment in ambulatory rehabilitation and mental health clinics and investment in assets to house vehicle fleets and mobile medical equipment

- consideration of options for innovative procurement models and increased private and non-government sector delivery of health infrastructure and services. (Policy: 0-5 years)

97. Infrastructure NSW recommends that NSW Health continue to deliver the *NSW eHealth Strategy 2016-2026*, including full delivery of eHealth Integrated Digital Patient Records and the eHealth whole-of-system digital platform. (Policy: 0-5 years)

98. Infrastructure NSW recommends that NSW Health periodically refresh the eHealth strategy to:

- assess IT infrastructure requirements in acute care facilities to enable digital innovation such as clinical command centres and artificial intelligence, including data storage, communications networks and technology, as well as digital platforms

- investigate the implications of integrating a robotic workforce into existing acute care facilities, including space allocation for robot command centres and robot pathways through hospital corridors, redevelopment of pathology labs and pharmacy, and ward, theatre and room configurations

- assess the availability of ICT infrastructure to facilitate in-home monitoring and response, including data storage, access to next generation communications networks and digital platforms

- assess the ability for existing research infrastructure to support ongoing health technology research. (Policy: 0-5 years)

99. Infrastructure NSW recommends that the NSW Government increase investment in walking and cycling infrastructure and parks and open spaces as part of the ongoing integration of health into land use planning and transport strategies. (Investment: 0-5 years)

13   Education

100. Infrastructure NSW recommends that the NSW Government fully fund and implement the *School Assets Strategic Plan*. (Investment: 0-20 years)

101. Infrastructure NSW recommends that the Department of Education develop and implement a comprehensive *School Assets Strategic Plan* program management and reporting framework by the end of 2018. (Policy: 0-5 years)

102. Infrastructure NSW recommends that the Department of Education establish a consultation framework by the end of 2018 that ensures consideration of community views and whole-of-government and place-based outcomes in the delivery of new and upgraded schools. (Policy: 0-5 years)

103. Infrastructure NSW recommends that the Department of Education develop a program to progressively convert all existing permanent learning spaces to Future Learning environments over the long term. (Investment: 0-40 years)

104. Infrastructure NSW recommends that in its next review of the *School Assets Strategic Plan*, the Department of Education:

- assess the impact of operational policies and procedures on infrastructure requirements
- identify how the functional limitations of demountable classrooms can be addressed
- assess the vulnerability of its assets to the impacts of climate change, natural disasters and human-related threats, and identify cost-effective adaptation and mitigation measures. (Policy: 0-5 years)

105. Infrastructure NSW recommends that the Schools Community Planning process routinely consider:

- opportunities for joint and shared use arrangements
- opportunities to partner with the private sector
- supporting place-making by working with local councils and government agencies in strategic land use planning
- opportunities for locating schools on surplus government land and government development sites, or through land transfers between government agencies
- infrastructure resilience issues. (Policy: 0-5 years)

106. Infrastructure NSW recommends that the Department of Education prepare a School Energy Strategy (2018 – 2030) by mid-2018. (Policy: 0-5 years)

107. Infrastructure NSW recommends that the Department of Education prepare a Schools *Digital Transformation Strategy (2018-2025)* in partnership with the Department of Finance, Services and Innovation by the end of 2018. (Policy: 0-5 years)

108. Infrastructure NSW recommends that the Department of Education prepare a business case by mid-2018 for a *Connecting Metropolitan Schools* program to improve digital connectivity in metropolitan schools. (Planning: 0-5 years)

109. Infrastructure NSW recommends that the Department of Education support the non-government school sector to meet its growth challenges and to identify and, where possible, remove barriers to that sector growing its student share. (Policy: 0-5 years)

110. Infrastructure NSW recommends that the Department of Education facilitate joint and shared use arrangements by:

- finalising the Joint Use Policy and Guidelines for implementation as part of Schools Community Planning by mid-2018
- developing and promoting standard use agreements
- ensuring appropriately skilled resources are dedicated to promoting and facilitating joint and shared use
- working with the Greater Sydney Commission and Department of Planning and Environment to promote the integration of school and community facilities in masterplanning processes
- working with NSW Treasury to explore flexible funding and financing options within the Capital Planning Process. (Policy: 0-5 years)

111. Infrastructure NSW recommends that TAFE NSW prepare a 20-year TAFE NSW Infrastructure Strategy by the first quarter of 2019, which considers:

- right-sizing of the asset portfolio through continued delivery of the Interconnected Training Network and the divestment of assets that are not fit-for-purpose or underutilised
- the delivery of training services across NSW, including regional NSW and to people facing disadvantage, through the strategic

location and standardised design of the Interconnected Training Network

- pursuing partnerships with third parties to support the rollout of the Interconnected Training Network. (Policy: 0-5 years)

14   Justice

112. Infrastructure NSW recommends that the Department of Justice undertake a review of asset management across the Justice Cluster. The review should be completed by mid-2018 and include:

- a baseline asset condition and capacity assessment
- a detailed review of the role of digital technology in asset management and service delivery
- an end-to-end assessment of system pressure points
- identification of opportunities for co-located services. (Policy: 0-5 years)

113. Infrastructure NSW recommends that the Department of Justice prepare a long-term 20-year Justice Infrastructure Strategy. The Strategy, to be informed by the asset management review, should be completed by the first quarter of 2019. (Policy: 0-5 years)

114. Infrastructure NSW recommends that by the end of 2018, the Department of Justice prepares business cases to address court capacity in the Sydney CBD, South West Sydney and key locations in regional NSW. (Planning: 0-5 years; Investment: 5-10 years)

115. Infrastructure NSW recommends that the Department of Justice prepare a business case and undertake site investigations and related community consultation by the end of 2018 to address the requirement for additional long-term prison bed capacity in Greater Sydney. (Planning: 0-5 years; Investment: 0-10 years)

15   Culture, sport and tourism

116. Infrastructure NSW recommends that, following appropriate consultation, the NSW Government publish its response to the recommendations of the *2016 Cultural Infrastructure Strategy*. (Policy: 0-5 years)

117. Infrastructure NSW recommends that by mid-2018, the Office of Sport complete a Sport Infrastructure Strategy, a whole-of-sector, evidence-based investment framework and management plan. (Policy: 0-5 years).

118. Infrastructure NSW recommends that the Office of Sport:

- completes, during 2018, business cases for three facilities: Sydney Football Stadium, Stadium Australia and the proposed new Sydney indoor sport arena.
- deliver, with local government, sports and other private partners, regional and metropolitan district sports infrastructure programs. (Planning: 0-5 years; Investment: 0-10 years)

119. Infrastructure NSW recommends that by the end of 2018, the NSW Government develop a Tourism Infrastructure Strategy and whole-of-sector, evidence-based investment framework to guide investment in state-owned tourism and nature-based scientific, education, recreation and entertainment facilities. (Policy: 0-5 years)

120. Infrastructure NSW recommends that the NSW Government prepare strategic business cases by the end of 2018 for:

- providing additional cruise berthing capacity in Sydney
- renewing Circular Quay. (Planning: 0-5 years; Investment 5-10 years)

121. Infrastructure NSW recommends that the NSW Government continue the Regional Growth, Environment and Tourism Fund for a further 10 years once the current Rebuilding NSW reservation is exhausted around 2023. (Investment 5-10 years)

122. Infrastructure NSW recommends that concurrent with the update to the Sydney Airport Master Plan in 2019, the NSW Government encourage the Commonwealth Government and Sydney Airport to conduct a review of regulatory settings to improve operation in the period preceding the opening of Western Sydney Airport. (Policy: 0-5 years)

Appendix 2 Expert reports

BIS Oxford Economics (April 2017),
"NSW Construction Delivery Assessment: Capability and Capacity".

The Centre for International Economics (October 2017),
"Drivers and Trends of the NSW Economy".

The Centre for International Economics (January 2018),
"Impact of the State Infrastructure Strategy 2018".

DATA61 CSIRO (February 2017),
"Digital Futures: Exploring the future impacts of digital technology on the NSW infrastructure system".

Deloitte Access Economics (December 2016),
"Development of State Infrastructure Strategy Scenarios".

The Grex Group (July 2017),
"NSW Infrastructure Digital Connectivity".

KPMG (May 2017),
"NSW Industry Development and Growth".

SGS Economics and Planning (July 2017),
"NSW Spatial Labour Patterns".

Appendix 3 Expert advisors

The role of experts

To support the development of evidence and the directions for the 2018 SIS, Infrastructure NSW appointed a panel of experts from different fields to provide guidance and independent advice. The experts included some of Australia's leading scientific, business and infrastructure experts, with experience in the fields of economics, jobs and skills, energy, climate change and natural resources, technology and innovation, and asset utilisation and efficiency.

The support and guidance provided by these experts in supporting the identification of future needs, issues and potential directions was invaluable to the development of a robust Strategy. These experts provided advice in an independent capacity and their advice should not be considered as representative of any institute with which they are affiliated.

Our experts

Professor Gary Banks AO

Gary Banks served as inaugural Chairman of the Productivity Commission, where he headed public inquiries relating to regulation and financing in major areas of economic and social infrastructure. He spent the last four years as Chief Executive and Dean of the Australia and New Zealand School of Government (ANZSOG). Gary also chaired the Council of Australian Governments' (COAG) Review of Government Services and oversaw the Office of Regulation Review. He is currently the Chair of the Australian Statistics Advisory Council and the OECD Regulatory Policy Committee.

In 2006, Gary chaired Prime Minister Howard's Regulation Taskforce (the' Banks Report') and in 2008 he chaired the Infrastructure Stream at the 2020 Summit. He has worked for international organisations and is an independent director of the Macquarie Group. In 2013, he was appointed to the Prime Minister's Business Advisory Council. He is a Professorial Fellow at the Melbourne Institute, a Fellow of the Academy of Social Sciences Australia and a National Fellow of the Institute of Public Administration Australia (IPAA), for whom he delivered the 2013 Garran Oration. His policy contributions have been recognised in the Economic Society's inaugural Distinguished Public Policy Fellow Award (2014) and the Order of Australia (2007).

Professor Mary O'Kane AC

Until 31 January 2018, Mary O'Kane was the NSW Chief Scientist & Engineer. She is a company director and Executive Chairman of O'Kane Associates, a Sydney-based consulting practice specialising in government reviews and research and innovation matters. She is Chair of the Cooperative Research Centre (CRC) for Spatial Information, the Space Environment Management CRC and the Institute of Marine and Antarctic Studies at the University of Tasmania, and is a Director of the New Zealand Antarctic Research Institute, Capital Markets CRC, Innovative Manufacturing CRC and Business Events Sydney.

Professor O'Kane was Vice-Chancellor of the University of Adelaide from 1996-2001. She is also a former Chair of the board of the Australian Centre for Renewable Energy and the board of the Development Gateway, and a former member of the Commonwealth's Review of the National Innovation System, Australian Research Council and the CRC Committee, the board of FH Faulding & Co Ltd and the board of CSIRO. She is a Fellow of the Academy of Technological Sciences and Engineering and an Honorary Fellow of Engineers Australia.

David Thodey AO

David Thodey is Chairman of the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia's national scientific research agency. He is also Chairman of Jobs for NSW, which is focused on job creation in NSW, on the Board of Ramsay Health Care, and he is on the Advisory Boards of Square Peg Capital and UHG.

David is a global business leader focused on technology and telecommunications with more than 30 years of experience creating brand and shareholder value. He had a successful career as CEO of IBM and then Telstra, Australia's leading telecommunications and information services company. David has also had a significant leadership role in the Australian business community, particularly in 2014 during his involvement with the B20, a forum through which the private sector produces policy recommendations for the annual meeting of the Group of 20 (G20) leaders. He has formerly held positions including Deputy Chair of the Australian Information Industry Association and Vice-Chairman of the International Business Leaders Advisory Council.

In 2017, David was appointed an Officer of the Order of Australia for distinguished service to business, notably to the telecommunications and information technology sectors, to the promotion of ethical leadership and workplace diversity, and to basketball.

Adjunct Professor Jennifer Westacott

Jennifer Westacott brings extensive policy experience from both the public and private sectors. She has provided advice and assistance to some of Australia's major corporations on climate change and sustainability matters, and to governments around Australia on major reform and infrastructure priorities. Jennifer has been Chief Executive of the Business Council of Australia since 2011, facilitating the contribution of the BCA across a variety of policy agendas.

For over 20 years Jennifer occupied critical leadership positions in the New South Wales and Victorian governments. She has held the positions of Director of Housing and Secretary of Education in Victoria, and Director-General of the New South Wales Department of Infrastructure, Planning and Natural Resources. From 2005 to 2011 Jennifer was a senior partner at KPMG, heading up the firm's Sustainability, Climate Change and Water practice and its NSW State Government practice. Jennifer was also a board director for the firm. Jennifer is a National Fellow of the Institute of Public Administration Australia and a Fellow of the Australian Institute of Company Directors. Since 2013, she has been a Non-Executive Director of Wesfarmers Limited and Chair of the Mental Health Council of Australia.

Tony Wood

Tony Wood has led the Grattan Institute's Energy Program since 2011. The Grattan Institute is dedicated to independent research and developing high quality public policy for Australia's future, and Tony has led the delivery of thirteen major reports on energy and climate change. He has developed a strong relationship with governments and industry, and is a regular contributor on key energy issues. From 2009 until 2014, he also had a role as Program Director of Clean Energy Projects at the Clinton Foundation, advising governments in the Asia-Pacific region on effective deployment of large-scale, low-emission energy technologies such as solar and Carbon Capture and Storage (CCS).

Earlier in his career, Tony spent 14 years working at Origin Energy in senior executive roles covering retail and LPG line management and corporate affairs. In 2008, he was seconded to provide an industry perspective to the first Garnaut Climate Change review.