Staying Ahead:

State Infrastructure Strategy 2022–2042

Infrastructure NSW | May 2022

Acknowledgement of Country

Infrastructure NSW acknowledges the Traditional Custodians of the lands where we walk, work and live, and pays respect to their Elders past and present.

We acknowledge and respect their continuing connection to the land, seas and waterways of NSW, and the continuation of their cultural, spiritual and educational practices.

In preparing the State Infrastructure Strategy, we acknowledge the importance of Aboriginal and Torres Strait Islander people's unique history of land and water management, and of art, culture and society, that began over 65,000 years ago.[1]

Damulay Ngurang (Mother's Day) celebrations, Infrastructure NSW

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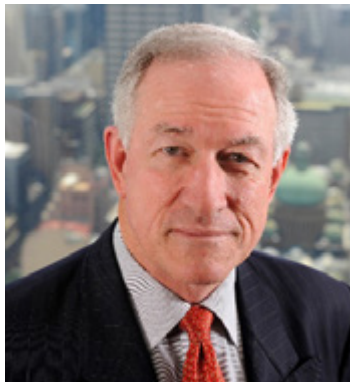


Chair's Foreword

Dear Minister,

It is with pleasure that I present the *State Infrastructure Strategy 2022-2042: Staying Ahead* (2022 SIS) to the NSW Government on behalf of Infrastructure NSW, in accordance with the *Infrastructure NSW Act 2011*.

The 2022 SIS sets out Infrastructure NSW's advice on the infrastructure needs and priorities of the State for the next 20 years, and beyond.

For the past decade, NSW has progressed an infrastructure investment program unmatched for generations within the State or elsewhere in Australia in its scale and transformational impact.

Many major metropolitan and regional projects have been delivered, with more due to be completed over coming years. These projects will contribute to greater economic efficiency, support future jobs growth and improve amenity, convenience and security for communities across the State over coming decades.

This 2022 SIS reports that while much has been delivered, the pace of investment is likely to continue over the next 20 years. Moreover, we believe that the State can afford to maintain the high level of investment seen in recent years, provided this continued investment is well targeted at high value, high return projects and provided the Government pursues effective policies to attract private sector infrastructure investment.

For the reasons set out in this Strategy, Infrastructure NSW recommends that the Government be prepared to sustain high levels of infrastructure funding. This will allow NSW to continue to stay ahead by supporting robust economic growth of the State's existing and emerging industries, and by providing quality services for a strongly growing NSW population. The precise year-on-year level and mix of investment will be determined by medium-term land use and sector-specific plans. Opportunities to reduce investment levels will be limited by the need to maintain a much larger asset base, to optimise the benefits of in-place infrastructure networks and to harden the resilience of critical community services.

Infrastructure NSW's view is that NSW is destined to enjoy robust population and economic growth over the next 20 years and beyond. Government should plan to stay ahead of this growth, looking through the flat-lining of the past two COVID-affected years towards renewed annual population growth, driven by both natural increase and the resumption of net inbound migration. Population growth at pre-pandemic levels should be the Government's base case planning assumption for the long term. The risks of under-investment are greater than the risks of providing infrastructure a few years before population catches up and can be minimised by establishing sound, long-term priorities based on rigorously tested business cases, with the timing of investments adjusted as future trends dictate.

However, renewed population growth does not mean demand for infrastructure and services as traditionally delivered. Government should retain and expand many of the more efficient, proven ways to deliver services pioneered during the pandemic such as telehealth, video court hearings and digital education.

NSW is now a seasoned deliverer of major infrastructure projects, but the shape of the infrastructure task over the next 20 years will be different from the past decade. While selected megaprojects will continue to be the backbone of transformational investments, such as improved rail services and motorways within and between metropolitan centres, a more diverse set of smaller projects will provide high paybacks over the period ahead. Smaller-scale improvement in local amenities should continue – such as fixing road pinch points, replacing old bridges, creating more open green space and active transport corridors. Programs such as these will be essential to enliven the State's vision of efficient 30-minute cities and liveable 15-minute neighbourhoods. The State's infrastructure must also meet higher community expectations by contributing to environmental sustainability through projects that protect and enhance the natural environment, make more efficient use of natural resources and reduce pollution and waste.

Importantly, many future investments will require longer, multi-stage program delivery and therefore require multi-year, whole-of-project funding commitments by Government. For example, a staged approach over extended timeframes will be needed to realise the full economic potential of the State's precincts, including Greater Sydney precincts such as Tech Central and the Bradfield City Centre, and the six regional Special Activation Precincts.

A further theme of this Strategy is the importance of maintaining the quality, resilience and contemporary standard of existing State infrastructure assets through a sharper focus on and increased commitment to essential maintenance programs. A systematic approach is recommended to address vulnerabilities arising from increasing natural hazards and emerging technology risks.

Many of the recommendations in this Strategy are for policy settings that will facilitate private infrastructure investment and develop community support for essential resilience in key economic services. Two examples are electricity and water. In electricity, the Government's commitment to the clean energy transition will require multi-decade policy settings in a sector that has not been budget-dependent in recent decades. Policy settings must facilitate private sector investment and avoid the risk of excessive government intervention that would diminish the appetite for private investment and increase calls upon scarce taxpayer funds. In water, the Government must secure community support for additional water security projects, including augmented water storage and increased use of safe, recycled potable water as is widely accepted in many less rainfall-challenged cities around the world. Community support will be essential to enhance water security cost-effectively and to reduce demand for major new capital infrastructure.

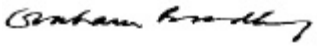
Finally, city and regional planning policies must now focus on optimising the amenity value created by the major transport investments of the past decade by facilitating higher and better use of land around new transport hubs. For example, planning policies should facilitate well-designed apartment and medium density homes around the new Sydney Metro stations. Without such planning, the 30-minute city vision will prove elusive and housing growth will demand much higher infrastructure capital and operating costs. As with the 2018 SIS, this Strategy emphasises again the importance of 'joined-up' planning between the Greater Sydney Region Plan and the State's transport strategies.

This Strategy recognises that maintaining infrastructure spending will be an ongoing challenge in the post-COVID recovery period. To meet this challenge, we recommend continuing successful policies, such as asset recycling, appropriate user contributions, securing more whole-of-project funding support from the Australian Government and adopting innovative ways to leverage private sector co-investments. Doing so successfully is essential if NSW is to stay ahead of future changes and challenges, realise the exciting infrastructure-led growth opportunities in new and existing industries and continue to improve the quality of life for all NSW citizens.

In closing, I thank my colleagues at Infrastructure NSW – ably led by CEO, Simon Draper – for their preparation of this Strategy and I thank the many expert advisors who have contributed to it.

I commend the 2022 SIS to the Government.

Yours faithfully,



Graham Bradley AM, Chair

Overview

Over the past decade the NSW Government has delivered a suite of transformational infrastructure projects across both metropolitan and regional areas. Major rail and road networks are already unrecognisable and many transport projects are currently in delivery. The State's hospitals, schools, correctional facilities, sporting complexes and cultural assets have all benefitted from strong levels of investment.

Many of these projects have been identified and recommended in previous State Infrastructure Strategies and all have been regularly scrutinised by Infrastructure NSW as part of its role in advising the NSW Government on effective delivery of its investment program.

While many hallmark infrastructure projects are now in operation or under construction, there remains plenty to do. Ongoing investment is required to keep pace with population growth, strengthen the competitiveness of NSW industries, capitalise on new economic opportunities and achieve the Government's social and environmental policy goals. The nature, orientation and year-on-year profile of the investment is subject to ongoing consideration, and that is to be expected. However, the gains of the past decade will only be secured if investment continues. Also, the scope to reduce investment levels will be limited by the need to maintain a larger asset portfolio, embed resilience into new and existing assets, manage major transitions in energy and water, and realise new economic opportunities.

NSW can best fund and implement a sizable ongoing program by selecting high-value programs that can be delivered in manageable stages – an important theme of the *State Infrastructure Strategy 2022-2042: Staying Ahead* (2022 SIS). Infrastructure NSW recommends that the State's priorities over the next 20 years involve a different mix of projects than the past decade, as the focus on megaprojects should give way to a combination of smaller and medium-sized projects, in many cases delivered in stages as multi-year programs.

In this vein, the 2022 SIS calls for more attention to technology upgrades, augmentation and hardening of existing assets and networks and structured maintenance.

The durability of the State's future investment program will be enhanced by working effectively with partners – private sector participants who co-invest and can make the most of new opportunities, construction industry partners who have worked so closely with us to date, local government and the Australian Government which is often a co-sponsor of significant programs and projects. That has been the State's approach to date, and so it should continue, with the addition of some improvements recommended in this Strategy.

An enduring program requires diversified investment and orderly delivery

As momentum and confidence have grown, the number of large, complex projects in NSW has increased markedly. While these megaprojects can offer long-term benefits, they are challenging to plan and deliver, and benefits flow only when all elements are complete. They are by nature expensive, disruptive across many communities, contractually complex, and demanding on industry and government agencies. Despite best endeavours, they are often a voyage of discovery on in-ground conditions.

Against this backdrop, NSW is now a veteran deliverer of major projects and should apply its experience and capability to deliver future large, complex projects in a sensibly prioritised and sequenced manner.

This 2022 SIS recommends that the NSW Government continue with a formidable program of investment, but one that achieves a balance between megaprojects and medium-sized and smaller investments that can be delivered in staged programs. This approach is commended by the high payoffs of well selected smaller projects, more manageable project cost risks as well as limited capacity of government and the construction industry to deliver more megaprojects in the near term.

At present, NSW and other jurisdictions have several megaprojects on foot creating high levels of demand. At the same time, construction industry capacity, supply chains and skills have all been stretched by COVID-19 and other world events. It would be especially challenging to deliver additional megaprojects in a cost-efficient manner in coming years.

Faced with these realities, Infrastructure NSW recommends reconsidering the timing and sequence of a number of large, complex projects that are not yet in procurement. These include – Beaches Link, Parramatta Light Rail Stage 2, the M6 Motorway Stage 2, the central tunnel for the Great Western Highway Katoomba to Lithgow upgrade, any further major Sydney Metro or rail projects (Sydney CBD to Zetland, Western Sydney International Airport to Leppington or Campbelltown), and major regional dam projects (New Dungowan and Wyangala).

These projects should be re-sequenced to ensure that they commence only when existing large, complex projects are in stable and advanced delivery. Resequencing will require reassessing business cases prior to investment decisions in order to re-test the relative benefits of each project. In a constrained construction market, it is even more important that investments and delivery resources are directed at the major projects that will deliver the greatest benefits.

The Australian Government also plays an important role in funding infrastructure projects, but those funding decisions should not cause the NSW Government to divert from a measured approach to large, complex projects. This 2022 SIS observes that funding announcements are often made on the basis of limited analysis and recommends a more considered approach to investment decisions, project budgets, cost-sharing and delivery timelines.

That does not mean that the State should down-tools on major projects that will be delivered in the future. Major project options should be explored to a level that allows corridors and critical sites to be identified, protected and considered for purchase, in order to preserve future options. In the foreseeable future, the rate at which large, complex projects can be delivered will be influenced by the effective delivery of existing projects as well as how successfully government

and industry implement procurement practices that de-risk projects, reduce the cost of bidding, draw on capacity of tier 2 and tier 3 contractors and increase the size and skills of the workforce.

In previous strategies, Infrastructure NSW has recommended that the Warragamba Dam Wall Raising should proceed in order to address a severe exposure to flood risk. That recommendation stands in this 2022 SIS, albeit that the Warragamba Dam Wall Raising is a large, complex project. This recommendation reflects the rigour of work done to date and the importance of the project in providing flood mitigation to a large and vulnerable area of Sydney.

Future investment requires multi-year programs

A more balanced and programmatic approach to investment is well suited to NSW's current environment. Some of the highest benefit investments in coming decades will be in the form of staged improvement programs. These changes are expected at several scales, from the Greater Cities Commission's Six Cities vision to precincts and regional hubs, and in local communities.

Greater integration of the State's metropolitan centres will be realised over decades and requires relentless focus and extensive engagement with many communities. It will demand steady and well-considered infrastructure investment programs to increase the ease and speed of connections between cities, both physical and virtual. While the program of integration is long-term, many of the investments can begin over coming years to address the highest pay-off improvements.

Infrastructure NSW recommends annual recurring investment programs in improved rail services between cities, better public transport within each city and a focus on better digital connectivity in targeted precincts. Further priorities will emerge and be incorporated as the Greater Cities Commission works with community leaders in the Lower Hunter, Central Coast and Illawarra-Shoalhaven.

Similarly, the growth of new economic precincts is a long-term enterprise. In some cases, such as the Western Parkland City and Bradfield, and the Special Activation Precincts (SAPs) in regional NSW, precincts will be defined by major new infrastructure, such as Western Sydney International (Nancy-Bird Walton) Airport and Inland Rail. However, local public infrastructure in those places is of equal importance, and most of the facilities, buildings and operations required to realise the goals of the new precincts will come from private sector participants. These investments will be delivered incrementally over an extended timeframe.

Finally, programs of investments are required in local infrastructure. Some of the greatest benefits of new infrastructure investment are experienced in local communities. Over the past decade, local constraints have been a focus: road congestion pinch points, station upgrades, expansions to schools, local hospitals and community support services. Those programs must continue, but this Strategy recommends a wider focus. It is increasingly accepted that green open space and quality civic places should be part of the core plan for all precincts and neighbourhoods and that successful communities require local access to services, within 15 minutes, ideally by walking or cycling. A much greater focus is also needed on creating or supporting local museums, galleries, performance spaces and sporting facilities in more communities.

Long-term programs require recurring funding commitments across many years, and in some cases decades. The benefits of these programs will only be realised if Government is resolute in seeing them through. Similarly, delivery agencies require disciplines, routines and capability to determine priorities and phasing for a large number of smaller projects. This task deserves keen attention after a long period delivering very large, complex projects. In shifting focus to a broader portfolio of programs, the State will need prioritised plans for asset and network improvements, drawing on strong asset management disciplines and processes. Prioritised plans for smaller and medium-sized projects will be articulated in sectoral infrastructure and service plans and in asset management programs required of each agency.

Service reliability comes to the fore

The job of matching infrastructure capacity to growing demand will never be complete – it requires ongoing attention. However, strides have been made over the past decade to address a long-standing backlog of investments, targeted at capacity constraints. With a much larger asset base and citizens who have grown accustomed to high standards, maintaining service reliability will become ever more important. This task is underscored by direct threats to service reliability, including more frequent and severe weather events and changing climate conditions, public health crises, and cyber-security threats.

In this context, the State's infrastructure program must turn to more routine forms of investment. The threshold task is a comprehensive understanding of which assets and services are most vulnerable to failure or hazards, including a statewide hazard assessment. Ensuring service reliability then requires a resolute, structured and systematic approach to maintaining and modernising existing assets through technology upgrades, asset hardening to eliminate points of vulnerability, augmentation of networks to create duplication and redundancy and, in some cases, relocation of assets. It also involves building some assets that may incur infrequent use but reduce risks to communities and assets, such as levees and flood mitigation capacity in dams.

Investments in service reliability are rarely one-off. As with other parts of the future program, they are ongoing packages of small works, requiring reliable annual funding and delivery plans, targeted at improvements with the highest payoff, over extended periods.

In short, Infrastructure NSW recommends a thorough understanding of asset vulnerability, a sharp focus on asset maintenance programs, application of technology to the State's asset base as well as a systematic approach to assets that are vulnerable to hazards and risks.

Infrastructure is critical in addressing housing affordability

New housing supply can only be delivered where infrastructure keeps pace with land use planning. Community acceptance of new development relies on good local amenity – transport connections, schools and health services, public civic and green spaces, protection of local character and access to services close to home. Achieving those outcomes requires timely planning, funding and delivery of local infrastructure in tandem with rezonings and subdivisions, based on well-developed master plans. Processes for local infrastructure funding and delivery approval must be efficient and reliable for those investing in new housing supply, and for home buyers. Feedback from stakeholders suggests that this has not always been the case and improving the reliability and efficiency of infrastructure delivery should be as much a focus as land use planning and rezoning.

There are opportunities to improve the supply of housing in greenfield areas as well as in established areas where major transport investments have been made. In greenfield areas, infrastructure is most immediately needed in North West Sydney, South West Sydney, Greater Newcastle and the Hunter, and in regional centres where Special Activation Precincts and Regional Job Precincts will create demand for homes. Each will require enabling infrastructure to be funded and delivered in a timely manner.

Established metropolitan areas around new Sydney Metro stations and light rail stops offer opportunities for more homes in convenient locations, generally apartment style along with medium density housing. Those opportunities are well known and are often the rationale for new infrastructure, but the full potential is not always realised. Plans for additional homes require consensus in the community that can only come from early engagement and by funding local infrastructure to support well planned and high amenity neighbourhoods. It also requires early consensus across Government that the opportunities created by new transport infrastructure will be viable, jointly protected, pursued and, where necessary, funded. With more rail and Metro lines in delivery, it is critical to ensure that promises of great neighbourhoods and home affordability are realised.

Wherever new housing supply is established, this Strategy supports the notion that the quality of local amenity will be upheld by a '15-minute neighbourhood' approach, ensuring residents can access most services and facilities by walking or cycling 15 minutes. This approach will require programs focused on local high streets, open spaces, and safe and enjoyable walking and cycling infrastructure.

There are also parts of the housing market where government is a direct investor and housing itself is part of the infrastructure portfolio. State governments have long been the primary provider of social housing for households on persistently low incomes. The supply of social housing in NSW lags demand and there are often misalignments in terms of housing type and size, as well as location. Those persistent problems are compounded by a heavy load in maintaining existing social housing. When supply lags demand, it is tempting to devote available funds to create new supply rather than maintenance. This was highlighted in the 2018 SIS and remains unfinished business. Infrastructure NSW is again recommending that social housing supply and maintenance should form a part of the committed future investment program, and for this to be done in partnership with non-governmental organisations.

There are also opportunities to work with Aboriginal communities to improve housing supply and quality, including recommitting to the Roads to Home investment program delivered by the Aboriginal Housing Office, as well as ensuring that Aboriginal people get the full benefits of lands and resources secured under NSW Land Rights Act. These programs need to focus not only on housing, but also on meeting essential health and infrastructure needs, such as potable water, energy and digital connections.

Leverage the State's extensive asset base to support growth

Over the timeframes we consider in this Strategy, both the economy and the NSW community will grow, most likely at levels that reflect historical trends. To accommodate this growth, NSW should capitalise as far as possible on the infrastructure legacy. This means integrating land use plans with available capacity and exploiting the ability of existing assets and networks to be augmented for higher use.

As set out above, demand for new housing supply utilising existing infrastructure will require attention to community support for more homes. In established areas, increasing utilisation of infrastructure assets requires a keen eye on quality of design and on shared open space. Release of new residential areas should target utilisation of existing networks and assets, and timely delivery of additional local services, drawing on accrued funds for regional infrastructure.

Industry deserves similar attention. Much of the infrastructure and land that is critical to supporting the State's industries is capable of higher utilisation but requires social licence to increase activity. Technological improvements over time should allow vehicles and equipment to become more automated, electrified and quieter. Infrastructure NSW recommends working with the Department of Planning and Environment to identify cases where planning controls impose disproportionate restrictions on utilisation of existing infrastructure and could be reconsidered in a manner consistent with enjoyment by local communities.

Successfully transitioning the energy and water sectors

For some time, the energy and water sectors have not required significant government infrastructure spending. They have been mature, stable sectors and not budget dependent. This can no longer be guaranteed.

The current clean electricity transition is inevitable, but profound and demanding. In achieving the NSW Government policy of Net Zero emissions by 2050 and a 50% cut in emissions by 2030, the wellbeing of NSW communities requires that the transition be efficient, orderly and affordable. NSW now has a Roadmap for the electricity sector that should be implemented in a manner that stays true to its initial goals and approach, which uses existing electricity market financial instruments and is technologically neutral. As the program is over several decades,

this will take diligence and resolve on the part of the NSW Government to stay the course. Arrangements for generation investment are clear and tenders are commencing in 2022, but delivery of a very large uptick in transmission infrastructure will require more State guidance and scrutiny than would be the case without the transition. Transmission developments will need effective community engagement and social licence, and the NSW Government will have to show the way in that process.

Water security has a less certain path. The transition underway in electricity has an equivalent in water, but it is less advanced. NSW towns and cities rely heavily on rainfall-dependent supply, often from a single source, and discharge used water as waste. That approach cannot endure in a climate that experiences large cyclical variations, accompanied by long-term trends in rainfall that are likely to exacerbate extremes.

Diversification of rainfall-dependent water supply through pipelines has been successful in some places, but when rain has failed in one region, it often fails in many regions. Increasing storage capacity is an option in some catchments, but there are environmental and safety limits, and it can lead to a zero-sum outcome, with retention and use by one group coming at the expense of other valuable uses. This inevitably leads to further consideration of efficiency in water storage, delivery and use, demand management, desalination capacity and reconsidering Government's approach to wastewater and stormwater, including potential for potable recycled water.

Changes to how water is managed will require high levels of community and business confidence. Infrastructure NSW recommends commencing work to engage citizens, who are increasingly informed on public health matters, on the options that must be pursued. This must include drinking water quality in regional towns where local government has a major role.

Capitalising on co-investment

The infrastructure task in NSW is not the job of State Government alone. The Australian Government has a well-established role in funding investment of national significance, and the scope of that co-investment has broadened in recent years. However, the Australian Government's approach to project risks and budgets remains difficult. State Government and industry are clear that budgets for major projects are uncertain until the project is well scoped, designed, has received planning consent, the market has been formally engaged and, in some cases, delivery is underway. The Australian Government continues a practice of committing funding early, but often well short of a mature assessment of cost. NSW should endeavour to work with the Australian Government to ensure best budgeting practices are incorporated into funding arrangements.

Private investors also remain essential to the success of the State infrastructure program. In many cases, opportunities for private investment in infrastructure can be expanded by engaging earlier with the market, incorporating market input and expertise, and clarifying regulatory and policy positions. This will be particularly important in new precincts. Similarly, State investment often relies heavily on complementary investment by private businesses to capitalise on the infrastructure for housing, services or industry. Infrastructure NSW recommends steps to keep private sector investment on the table for new programs, and front of mind when planning and developing new precincts.

Service delivery has changed – so must infrastructure

Even prior to the COVID pandemic, new digital methods of service delivery were making some headway. The pandemic has forced even the most reticent to participate in video calls for important functions in education, health, justice and even Parliament. Few people want to dispense entirely with in-person contact, but there should be no turning back on digital delivery of more routine services.

Infrastructure should follow and there are two implications. First, the NSW Government can have confidence about building more targeted physical infrastructure, knowing that some capacity can be provided by appropriately designed and secure digital services. Second, the State's physical infrastructure must be modern and

capable of supporting reliable digital services. Many legacy buildings are not well suited to modern service delivery, let alone modern digital service delivery, and some should be turned over to better uses while services are provided from more contemporary facilities. Government and the community will also benefit from co-locating services and new facilities in one place, regardless of which agency is delivering the service.

Making it stick

The State's infrastructure investment program has come a long way. It is large, diverse and well managed. It has experienced enormous successes and the State is battle-hardened in delivery. There is nothing to prove, but an enormous amount to do. The NSW Government's focus should now be to sustain the work and create an enduring investment program that will underpin the prosperity and wellbeing of NSW.

Meeting future challenges and seizing opportunities

Following an extensive research program, and consultation with Government agencies and industry, Infrastructure NSW presents the *State Infrastructure Strategy 2022-2042: Staying Ahead.* The Strategy is framed around nine long-term objectives and Infrastructure NSW's call to Government, focused on meeting future challenges and seizing opportunities.

2022 State Infrastructure Strategy objectives, strategic directions and recommendations summary

	2022 SIS objectives and strategic directions	Recommendations summary (see Chapters 3-11 for full recommendations)
	**Boost economy-wide productivity and competitiveness** The State's population will likely resume its strong pre-COVID growth trends. Infrastructure investment will be required to continue at high levels to meet the needs of a growing population and economy, to attract the jobs of the future, and to enhance the liveability of cities and regions. The NSW Government should pursue policies to better utilise the State's existing and new assets. Alongside new investment, this will boost the performance of industries where NSW is already strong, and those where NSW can achieve competitive leadership. The State has an ambitious program of industry-themed precincts in metropolitan and regional NSW that require a focused and staged infrastructure program to support long-term delivery, investment and talent attraction. **Strategic directions:** ▸ Deliver efficient transport networks to support thriving cities, businesses and communities. ▸ Improve freight efficiency, security and capacity to support NSW's industries and supply chains. ▸ Support existing, and emerging knowledge and manufacturing industries in dedicated precincts with high-quality infrastructure. ▸ Address gaps in cultural and sporting infrastructure that can help attract visitors and skilled workers to the State.	1. Invest in public transport networks to support growth of Greater Sydney 2. Produce detailed prioritised lists of smaller improvement and optimisation works to the transport network 3. Progressively deliver the Western Parkland City Transport Program 4. Progressively fund and deliver the Fast Rail Strategy based on a prioritised and staged program of network enhancements 5. Deliver next stages of the 16 Regional Cities Services Improvement Program to enhance regional NSW connectivity 6. Plan and deliver projects to increase the efficiency and reliability of freight networks in regional NSW 7. Support the growing Greater Sydney freight task through investments and initiatives that leverage existing and emerging international gateways 8. Undertake strategic land use planning and corridor protection to enable efficient movement of both container and bulk freight 9. Review progress of cultural and sporting infrastructure strategies and investigate new investment opportunities to support the visitor economy

	2022 SIS objectives and strategic directions	Recommendations summary (see Chapters 3-11 for full recommendations)
	**Service growing communities** NSW must deliver quality infrastructure to match population growth and the evolving needs of citizens. This includes better access to essential services for vulnerable and disadvantaged communities, and delivering secure, affordable and diverse housing across NSW. Plans for additional homes in convenient locations require early engagement with local communities to ensure well-planned and high amenity neighbourhoods. This in turn will help attract and retain skilled people, and encourage private investment from around the world. **Strategic directions:** ▸ Deliver housing in great neighbourhoods for all parts of the community. ▸ Improve access to efficient, quality services through better use of assets and a better mix of physical infrastructure and technology-enabled solutions. ▸ Continue NSW's investment program in sectors that require renewal, with a focus on TAFE and Justice.	**10.** Fund and deliver enabling infrastructure to support approved or pending housing supply **11.** Fund and deliver a prioritised active transport infrastructure program to support liveability and 15-minute neighbourhoods **12.** Establish a financially sustainable social housing and related infrastructure program **13.** Deliver Aboriginal housing and enabling infrastructure programs in partnership with local communities **14.** Improve efficiency and service quality in the social infrastructure sectors through co-location and divestment of legacy assets **15.** Establish a prioritised program of investments for Justice and TAFE infrastructure services, and identify options to complement initiatives outlined in the 20-year health and education sector infrastructure strategies

	2022 SIS objectives and strategic directions	Recommendations summary (see Chapters 3-11 for full recommendations)
	**Embed reliability and resilience** Infrastructure assets often have long lives and need to be resilient to withstand shocks that compromise performance. Recent experiences have illustrated the broad range of pressures that can be placed on infrastructure systems, including natural hazards, public health crises and cyber security threats. Policy changes are needed to proactively assess and reduce the risk and impact of shocks on communities and the economy, and build back to a more resilient standard. **Strategic directions:** ▸ Apply a structured and systematic approach to resilience across multiple asset types, multiple risks and the infrastructure asset lifecycle. ▸ Establish a rigorous and funded program to identify and remedy assets most likely to cause service failure. ▸ Deliver assets that reduce the risk and impact of major natural hazards and shocks.	**16.** Adopt a whole-of-system approach to enhance risk identification and assessment **17.** Develop place-based resilience and infrastructure adaptation strategies that assess local risk and incorporate infrastructure and non-infrastructure solutions for vulnerable locations across NSW **18.** Fund and deliver an investment program designed to improve the resilience of the State's most vulnerable and critical assets **19.** Establish a program of prioritised resilience infrastructure and accelerate project delivery **20.** Improve transport network response and recovery performance **21.** Propose new funding models for ongoing and reliable investment in resilience infrastructure and asset hardening

	2022 SIS objectives and strategic directions	Recommendations summary (see Chapters 3-11 for full recommendations)
	**Achieve an orderly and efficient transition to Net Zero** The NSW Government has adopted a goal of Net Zero emissions by 2050 and a 50% cut in emissions by 2030. The 2020 Electricity Infrastructure Roadmap has set a pathway for the electricity sector transition. Implementation requires policies over the coming decades that will secure a new wave of investment in electricity reliability and affordability, predominantly by the private sector and through market mechanisms. The transport sector is the second highest emitting sector after electricity and will also need an affordable and comprehensive transition plan. The NSW Government's Electric Vehicle Strategy is an early step towards such a plan. **Strategic directions:** ▸ Ensure that the clean energy transition is orderly and cost effective. ▸ Preserve a market-based approach to investment in electricity generation, transmission and retail to minimise the need for government subsidies. ▸ Support a new wave in transmission infrastructure in a manner consistent with community expectations. ▸ Pursue cost-effective initiatives to reduce emissions from State assets and infrastructure.	**22.** Steadfast implementation of the NSW Electricity Infrastructure Roadmap in support of reliability and affordability **23.** De-risk the planned delivery of a large program of new transmission infrastructure **24.** Uplift capability and capacity across government and industry partners to secure delivery of the infrastructure needed in the NSW Electricity Infrastructure Roadmap **25.** Share the benefits of the Electricity Infrastructure Roadmap with the regions hosting infrastructure and with communities in transition **26.** Finalise a roadmap to meet emissions reduction targets in transport, beyond forecast fleet transition **27.** Develop a roadmap for the NSW public infrastructure to achieve Net Zero

	2022 SIS objectives and strategic directions	Recommendations summary (see Chapters 3-11 for full recommendations)
	**Enhance long-term water security** Water security is a major long-term challenge for NSW. The State's water supply is largely rainfall dependent and vulnerable to cyclical and climatic trends. At the same time, any material augmentation and diversification of water supply will require high levels of investment in new assets and will also require community support for increased storage and water recycling. Community engagement on regional water policies should be undertaken before the State again finds itself in drought. In regional areas, there are also imperatives to support local investment that ensures water quality for all communities. This requires a programmatic approach, steady funding and highly effective working relationships with and among local authorities. **Strategic directions:** ▸ Increase water security through demand management, water and wastewater recycling, and rainfall-independent supply. ▸ Improve management of water in regional communities in partnership with local authorities. ▸ Embed integrated water cycle management approaches, including storm water harvesting and recycled water projects, as standard practice in land use planning, precinct development and major projects.	**28.** Increase the resilience of Greater Sydney's water supply through a full range of options, including better conservation and more diverse sources **29.** Develop a roadmap for the adoption of purified recycled drinking water, including measures to build community support and demonstrate the efficacy of the technology **30.** Improve water security and quality in regional NSW **31.** Investigate and propose alternatives to the delivery of major dam projects in the Peel, Lachlan and Border Rivers catchments **32.** Bolster long-term funding and capability to support financial sustainability of local water utilities and ensure minimum service levels are achieved

	2022 SIS objectives and strategic directions	Recommendations summary (see Chapters 3-11 for full recommendations)
	**Protect our natural endowments** Protecting the State's natural environment requires attention to all assets across the infrastructure lifecycle, from construction through to operations. Government needs affordable policies to mitigate the impact of infrastructure delivery and operations on biodiversity and natural heritage. The State can use infrastructure to improve the natural environment and ensure the sustainable use of natural resources and materials through reuse and recycling. **Strategic directions:** ▸ Foster sustainable use of natural resources and construction materials through reuse and recycling. ▸ Implement a strategic and practical approach to managing biodiversity. ▸ Capitalise on blue-green infrastructure opportunities.	**33.** Improve sustainability throughout the infrastructure lifecycle **34.** Expedite development of an NSW Biodiversity Strategy and Biodiversity Holding Fund **35.** Promote the development of a blue-green infrastructure network across NSW **36.** Identify and plan for future waste infrastructure needs as part of the Greater Sydney Region Plan and Regional Plans
	**Harness the power of data and digital technology** The benefits of combining digital technology with physical infrastructure are increasingly compelling. The right application can increase the productivity, efficiency, and safety of physical infrastructure assets and networks. It is also an essential enabler of good infrastructure planning, delivery, maintenance and operation. Taking full advantage of rapidly emerging digital technologies will require internationally competitive and secure high-speed digital connectivity across NSW, and the right policies and standards to embed the use and application of digital and smart technology in infrastructure. **Strategic directions:** ▸ Ensure secure high-speed digital connectivity in key precincts. ▸ Prioritise the application and use of data and digital technology across all aspects of service delivery and throughout the infrastructure asset lifecycle. ▸ Modernise legacy infrastructure and government systems, while retaining agility to avoid asset redundancy.	**37.** Accelerate investment in digital connectivity in State sponsored precincts **38.** Adopt the use of digital technology in infrastructure planning, delivery and operation **39.** Prioritise and invest in technology upgrades to improve efficiency of passenger and freight transport networks **40.** Prioritise digital service delivery over building new physical infrastructure, where the goals of the initiative can be feasibly achieved in that manner **41.** Deliver an investment program to digitise government services and infrastructure **42.** Uplift cyber security capabilities and practices in infrastructure planning, delivery and operation

	2022 SIS objectives and strategic directions	Recommendations summary (see Chapters 3-11 for full recommendations)
	**Integrate infrastructure, land use and service planning** Joined-up planning is imperative for efficient investment across all government assets, but especially important to support the State's investment in new economic precincts. Designated economic precincts should meet expected market demand, and investment should be co-ordinated and staged accordingly. The private sector needs to be involved earlier in these plans to allow Government to understand their needs and to leverage their expertise and innovative proposals, noting that investors and developers will ultimately bear most of the commercial and technical risks. In all land use planning, NSW should leverage the spare capacity created in existing and planned infrastructure, such as in major transport corridors. **Strategic directions:** ▸ Coordinate infrastructure, land use and service planning to meet housing, employment, industry and community needs. ▸ Increase private sector participation in the delivery of government-led precincts. ▸ Regularly update planning regulation and land use controls to reflect current circumstances.	**43.** Optimise the use of industrial and urban services lands through integrated strategic land use planning with infrastructure investment **44.** Deliver more housing, jobs, amenities and services in locations where there is spare capacity in existing and planned infrastructure **45.** Preserve and strategically manage protected corridors for future use **46.** Increase private sector participation, co-design and co-investment in State-sponsored precinct delivery **47.** Actively reflect history, culture and heritage in places and infrastructure

	2022 SIS objectives and strategic directions	Recommendations summary (see Chapters 3-11 for full recommendations)
	**Design the investment program to endure** Infrastructure demands on the NSW Government budget will continue to be significant. While the type and mix of infrastructure projects will change, investments in the maintenance of infrastructure are set to increase. Infrastructure NSW recommends that the balance of spending should tip towards technology upgrades, augmentation of existing assets and networks, and structured maintenance as the asset base in NSW matures in line with international peers. The Government should continue with successful policies such as asset recycling, user charges and value capture to sustain its infrastructure investment pipeline. It should also seek more private sector co-investment and more long-term programmatic funding support from the Commonwealth. The working relationship between Government and the construction industry is beyond transactional, and there is a public interest in embedding good procurement practice and in supporting a sustainable, innovative and competitive construction industry. **Strategic directions:** ▸ Reconsider megaprojects and invest in existing infrastructure through augmentation, digitisation and maintenance. ▸ Diversify funding sources to deliver future investments. ▸ Ensure the construction market has the capacity, capability and productivity to meet increasing demands. ▸ Consolidate a robust process for investment prioritisation, project sequencing and investment appraisal.	**48.** Reconsider the timing and sequence of future megaprojects to diversify the State's investment program and mitigate delivery risks **49.** Make asset maintenance and augmentation a high priority for the future infrastructure program **50.** Adopt data-enabled asset management and investment decision making across the NSW Government **51.** Publish a pipeline of major asset maintenance, upgrade and renewal opportunities **52.** Partner with the Australian Government to achieve sustainable co-funding arrangements **53.** Develop a 'roadmap' for a long-term reform of user contributions across the road and public transport networks **54.** Utilise all viable commercial models and approaches to enable additional opportunities for private sector investment in infrastructure **55.** Update investment planning and decision-making frameworks to improve options identification and development practices, scenario analysis and test deliverability of projects **56.** Support innovation in construction through productivity initiatives jointly sponsored with industry **57.** Develop new skills and capabilities required for infrastructure projects, and widen opportunities for communities to participate through targeted actions in training and employment initiatives

State Infrastructure Strategy
2022–2042

Introduction

01

Barangaroo Reserve and Sydney CBD, Infrastructure NSW

IN THIS SECTION

1.1 Role of Infrastructure NSW

Established under the *Infrastructure NSW Act 2011* (the Act), Infrastructure NSW is a NSW Government agency that provides independent, evidence-based advice to the NSW Minister for Infrastructure and NSW Government agencies in relation to infrastructure priorities, projects and strategic policy issues (see Box 1.1).

As stipulated in the Act, Infrastructure NSW is required to review the 20-year State Infrastructure Strategy (SIS) every five years (or at any other time requested by the NSW Minister for Infrastructure) and submit a revised strategy to the NSW Minister for Infrastructure. Part 4, Section 17 of the Act stipulates that Infrastructure NSW's 20-year SIS must assess the current state, needs and strategic priorities for infrastructure in New South Wales for the next 20 years. In doing so, Infrastructure NSW is to have regard to any State strategic priority advised by the NSW Minister for Infrastructure.

Box 1.1

The role of Infrastructure NSW

Infrastructure NSW advises the NSW Minister for Infrastructure on the needs and strategic priorities for infrastructure in New South Wales. Infrastructure NSW's purpose is set out in the *Infrastructure NSW Act 2011*, which tasks the agency with 14 functions, including:

- preparation and submission to the NSW Minister for Infrastructure of a 20-year State Infrastructure Strategy (SIS)
- preparation and submission to the NSW Minister for Infrastructure of annual rolling 5-year infrastructure plans (or at any other time requested by the NSW Minister for Infrastructure) and other plans as requested by the NSW Minister for Infrastructure
- preparation of sectoral SIS statements
- review and evaluation of proposed major infrastructure projects by NSW Government agencies or the private sector
- advising on economic or regulatory impediments to the efficient delivery of infrastructure projects and appropriate funding models for infrastructure
- coordination of infrastructure submissions by NSW to the Australian Government.

1.2 Leveraging a decade of investment and previous Strategies

The 2022 SIS is the fourth edition since Infrastructure NSW's inaugural SIS was released in 2012. While much has changed during the past 10 years, the need for long-term strategic infrastructure planning remains unchanged.

Reflecting previous editions, the 2022 SIS identifies infrastructure needs and strategic priorities for the State over the next 20 years. The Strategy builds on the extensive program of infrastructure investment delivered over the past decade and seeks to leverage the ambitious pipeline of investments already committed by the NSW Government. It builds on the 2018 SIS recommendations, many of which are either complete or in the implementation stage (see Figure 1.1).

NSW Government strategies, policies and reform initiatives, either in delivery or for near term release, have informed the development of the 2022 SIS. The State's challenges and opportunities are complex and an integrated and collaborative approach to public service delivery is needed more than ever.

The 2022 SIS recommendations take the strategic directions from the 2018 SIS (see Box 1.2) and critical initiatives of the NSW Government to the next level and identify new challenges and opportunities for the NSW Government.

Figure 1.1 – Status of the 2018 SIS recommendations adopted by the NSW Government

Source: Infrastructure NSW (2022) as at March 2022

Box 1.2

***Building Momentum:* 2018 State Infrastructure Strategy – strategic directions**

The 2018 State Infrastructure Strategy (SIS) was released in March 2018, with the Premier adopting 113 out of 121 recommendations made by Infrastructure NSW.

In contrast to the two previous 20-year strategies, *Building Momentum* switched the focus from developing an infrastructure project pipeline to achieving sustainable growth for New South Wales by aligning investment in infrastructure with land use decisions and achieving innovation in service delivery.

The 2018 SIS strategic directions included:

- achieve better integration of land use and infrastructure planning
- improve infrastructure delivery to maximise value for money
- optimise asset management and performance of existing infrastructure
- make infrastructure more resilient
- improve digital connectivity
- adopt innovative service delivery models.

The 2018 SIS also made recommendations for agencies to develop sector-specific plans in health, vocational education, justice and water. These sectoral plans were intended to complement those developed for transport and school investment under the previous SIS. Sectoral strategies prepared since the 2018 SIS have been critical to ensuring that all areas of the State's investment in infrastructure are guided by coordinated, robust, complementary and longer-term strategies and supporting plans.

1.3 Major planning uncertainties

Infrastructure serves the needs of both the present and future generations. The long lifespan of infrastructure and uncertainty about future circumstances require critical analysis of future scenarios by decision-makers to find adaptable solutions, while avoiding irreversible premature commitments.

NSW uses a set of Common Planning Assumptions which include long-term forecasts of population and demographic change, economic and fiscal conditions, and transport travel demand. To avoid being anchored to a central case, the Common Planning Assumptions are complemented by scenario analysis to assess divergence from current forecasts that could affect strategic infrastructure priorities.[2]

Conditions that emerge in NSW over the coming 20 years will be influenced by external forces, many largely beyond the direct control of the NSW Government. These structural forces often move beyond the predictability of cyclical changes and need to be carefully considered in the decision-making process.

Major planning uncertainties and potential long-term challenges and opportunities faced by the State are shown in Table 1.1.

Projections of population growth and demographic trends remain fundamental to informed service and infrastructure planning. The 2022 SIS seeks to avoid over-weighting COVID-19 disruptions to population and economic growth stemming from pandemic-related closed borders and restrictions to the movement of people and goods (see Box 1.3).

Infrastructure NSW adopts the view that the State will return to its pre-COVID population and economic growth trends over the medium and longer term. However, implementation of specific projects recommended in this 2022 SIS may need to be flexible should there be significant change to base case assumptions.

This Strategy also makes an important distinction between the impacts of more frequent and severe shocks that will cause long-term structural shifts and those that are short-term and isolated in nature.

Table 1.1 – Major disruptors and potential long-term challenges and opportunities faced by NSW

Major disruptors	Potential long-term challenges and opportunities
Geopolitical instability affecting global trading patterns, export opportunities, supply chain reliability and infrastructure investment and ownership	• Realigned security and trade partnerships • The growing economic inter-dependency and political influence of Asia • Increased risk of cyber-attacks on information and communications technology (ICT) networks and government concern for the ownership and operation of critical infrastructure • Greater focus on supply chain vulnerabilities • Potentially higher levels of net migration, as people seek better economic opportunities
Technology transformation affecting productivity, labour markets, demand for human services, life expectancy and social relationships	• Faster telecommunications connectivity (5G and beyond), facilitating a broader array of devices and sensor networks (Internet of Things – IoT) that offer more efficient service delivery and resource use • Cheaper and more sophisticated data processing and storage (data centres, cloud and edge computing) supporting artificial intelligence applications that enable automation and robotics across many industry sectors • Increasing convergence between biotechnology (genomics, synthetic biology) and digital technology (machine learning), accelerating bio-medical innovation[3]
Electricity market transition from coal to clean energy affecting energy costs and reliability, infrastructure resilience, business continuity, and economic competitiveness	• Electricity market transition and emissions reduction targets are challenging installed infrastructure but driving new investment and growth opportunities • Climate change concerns and increased energy costs are challenging the competitiveness of emission-intensive sectors

Major disruptors	Potential long-term challenges and opportunities
New population settlement patterns, affecting land use planning, transport, utility demand and infrastructure investment	▸ Remote/hybrid work preferences that may alter the spatial distribution of economic activity, population settlement and infrastructure use patterns ▸ Industry drive for competitive advantage through automation and digital connectivity, changing the nature and location of jobs ▸ Citizen preferences for access to digital services and use of digital platforms to enable greater equality of access to economic opportunities
Changing models of government service delivery affecting public and private sector infrastructure investment, infrastructure ownership, and government service delivery	▸ Deeper civil society and private sector participation with government in service delivery ▸ Reducing asset ownership and increasing provision of 'everything-as-a-service'[4]
Geographic distribution of socio-economic outcomes which influences local infrastructure and service needs	▸ Cost of living and housing affordability pressures diminish access to employment and education opportunities ▸ Differences in digital connectivity coverage and speeds across metropolitan, regional and rural NSW affect access to government services ▸ Industry restructures (such as electricity market transition) require time-limited government transition support to communities that are impacted significantly

Box 1.3

Dealing with uncertainty – possible COVID-19 impacts

At the time of writing, COVID-19 continues to cause disruption to the NSW economy and society. Even if these disruptions are short-lived, they may accelerate or even reverse some trends, leading to uncertainty around future patterns of demand for infrastructure and services. Several factors may have implications for the State's infrastructure:

Population growth is expected to slow temporarily, but net inward migration for NSW is expected to resume, leading to growth in the State's population and demand for infrastructure in the medium term. The uncertainty relates to the rate and timing of the resumption of growth.

Changing demographic and consumption patterns may result from increased remote and hybrid working, an ageing population and increased use of digital service delivery.

Regionalisation and suburbanisation trends may change spatial demand patterns for infrastructure services. However, large-scale remote working could be short-lived. While there has been widespread reporting of urban populations moving to the regions, current data suggest around 48,000 people have moved intrastate from Greater Sydney between March 2020 to March 2021, a relatively small proportion of a population of 5.3 million.[5]

Growth in online retail has accelerated during the pandemic, placing pressure on last- mile freight services and kerbside deliveries. This trend is expected to continue post-pandemic, given it offers convenience and increased service choices.

Public transport use dropped significantly during lockdown, while road and active travel, such as cycling or walking, increased. However, this trend was largely reversed once restrictions were lifted: during the first half of 2021 public transport patronage recovered to 80% of pre-COVID levels, before a further lockdown was introduced. There has been ongoing volatility, and trends for the long-term horizon associated with infrastructure planning remain uncertain, but it may be unwise to rely on an assumption of sustained drop in demand.

Digital services and customer applications such as telehealth, remote education and real-time transport information have increased in use and acceptance. There are greater customer expectations of digital service options. This presents future opportunities for more cost-efficient government service delivery and may affect patterns on demand and use of infrastructure services.

Access to services was disrupted by the COVID-19 pandemic, which revealed existing socio-economic challenges and vulnerabilities in some communities. Infrastructure planning and delivery may need to take account of digital connectivity for regional and remote communities.

Supply chains have been disrupted as international borders closed during the pandemic. Geopolitical developments are also causing some reconsideration of the need to diversify sources of important goods and equipment.

When making infrastructure decisions, it is important to distinguish between events that may be high-impact but short-lived and emerging trends that may continue in the long term. Future infrastructure planning in a volatile world should mitigate risks and leverage opportunities for the NSW Government to deliver optimal value through public infrastructure investments.

1.4 Guiding principles

Physical infrastructure is a means to achieving an end: it is an enabler for delivering better outcomes for NSW citizens.

NSW faces a range of complex challenges and opportunities. To be effective, the NSW Government will need to use a range of policy levers and initiatives to complement and get the best outcomes from investment in hard infrastructure. In developing the 2022 SIS, Infrastructure NSW applied the following guiding principles:

- **Optimise existing assets and networks** – opportunities to fully utilise existing assets should be prioritised, including through augmentation of existing networks, maintenance and upgrades.
- **Enhance outcomes with non-build initiatives** – supporting policies, standards, platforms and systems should be used to complement physical infrastructure.
- **Strengthen service reliability and resilience** – investments in existing assets should focus on lifting the reliability of those assets and resilience of communities most at risk of disruptive events.
- **Leverage private investment** – wherever possible, public funding should be supported by private funding and investment in complementary assets and services.
- **Ensure accountability arrangements are in place** – roles and responsibilities throughout the infrastructure lifecycle should be clarified to achieve desirable outcomes.
- **Partner with local governments and communities** – engagement and involvement of local governments, communities and other stakeholder groups should be embedded throughout planning, design, delivery and operation.
- **Drive collaboration across government** – integrated land use, infrastructure and service planning should be the default approach to solving complex infrastructure challenges.
- **Pursue long-term fiscal and market sustainability** – infrastructure funding sources should be diversified, and infrastructure investments rigorously prioritised and sequenced to ensure the market can deliver projects sustainably.

These guiding principles are consistent with the functions and roles of Infrastructure NSW, as outlined in the Infrastructure NSW Act, and align with best practices in other jurisdictions. NSW Government agencies involved in planning, procuring and delivering infrastructure are encouraged to apply similar guiding principles to inform their priorities.

1.5 2022 SIS sits alongside complementary strategies

The 2012 SIS and 2014 SIS were focused on developing an infrastructure project pipeline. The 2018 SIS focused on achieving sustainable growth in the NSW population and economy.

The 2018 SIS included recommendations for the development of sector-specific infrastructure plans in health, vocational education, justice and water to complement those previously developed for transport and school investment. These sectoral strategies are key to guiding State investment in infrastructure in a coordinated and complementary way.

In addition, the NSW Government has developed a range of economic and spatial strategies in recent years. These strategies outline investment and policy priorities of the NSW Government aimed at delivering better outcomes for the State.

Government strategies and policies

Table 1.2 outlines key NSW Government policies and strategies of relevance to the 2022 SIS.

Table 1.2 – Key NSW Government strategies and policies

Strategy/Policy	Overview
NSW Economic Blueprint 2040[6]	The Blueprint identifies challenges and risks, and highlights major opportunities for the NSW Government to grow industries, innovate and improve the economy to 2040.
20-Year Economic Vision for Regional NSW (including the Draft Refresh)[7, 8]	The Economic Vision sets out the NSW Government's priorities and plans to achieve long-term social and economic success for regional communities across the State over the next 20 years. The 2018 Economic Vision was refreshed in 2021 response to the drought, bushfires, flood and COVID-19 pandemic that changed the economic landscape in regional NSW.
Regional Economic Development Strategies[9]	These strategies identify regional specialisations and key industries, and provide the primary evidence base to identify and prioritise NSW Government investment and policy decisions to support regional economic development.
Greater Sydney Region Plan – A Metropolis of Three Cities[10]	The plan is built on a vision of three cities where residents live within 30 minutes of their jobs, education and health facilities, services, and great places.
2021-22 NSW Intergenerational Report[11]	With projections to 2061, the 2021-22 NSW Intergenerational Report (IGR) presents a snapshot of the future State to inform policies to make NSW the best place to live, work, run a business and raise a family.
The Smart Places Strategy[12]	The strategy takes a place-based approach to smart cities, connected infrastructure and services to realise the real value of smart places and interconnected systems. It aligns with related initiatives from the Australian Government, local councils and delivery partners in the private sector.
NSW Climate Change Policy Framework[13] **and Net Zero Plan Stage 1: 2020-2030**[14]	These strategies set the foundation for NSW's action on climate change and goal to reach Net Zero emissions by 2050. They outline the NSW Government's plan to grow the economy, create jobs and reduce emissions over the next decade.

Strategy/Policy	Overview
Visitor Economy Strategy 2030[15] **NSW Visitor Economy Infrastructure Strategy 2040 (in progress)**	Visitor Economy Strategy 2030 provides a roadmap to support all industries involved in the visitor economy to recover and grow following the impact of drought, bushfires and COVID-19. The NSW Visitor Economy Infrastructure Strategy 2040 provides a strategic framework to plan for and invest in visitor infrastructure over the next 20 years. Together, the strategies set a bold vision for NSW to be the premier visitor economy of the Asia-Pacific region by 2030.
Tech Central Camperdown-Ultimo Collaboration Area Place Strategy[16] Central Precinct Draft Strategic Vision[17]	Tech Central comprises land in and around the Central Station transport interchange. It is a key precinct identified as a catalyst for the broader economic growth of the State. Tech Central seeks to future-proof and diversify the NSW economy and cement its position as leader in the technology sector.
Western Parkland City / Western Sydney Aerotropolis Western Parkland City Draft Blueprint[18] Western Parkland City Draft Economic Development Roadmap – Phase 1[19] Western Sydney Aerotropolis Plan[20]	The Western Parkland City includes the development of Western Sydney International (Nancy-Bird Walton) Airport and the Bradfield City Centre. All three levels of government will invest in its future as Australia's leader in advanced industry, agriculture, research, exports, skilled employment, education and science, technology, engineering and mathematics (STEM).

Sector infrastructure strategies

Table 1.3 outlines key sector infrastructure strategies of relevance to the 2022 SIS.

Table 1.3 – Latest sector infrastructure strategies in NSW

Strategy	Overview
Future Transport 2056 (refresh)[21]	Future Transport 2056 comprises a suite of strategies and plans that set the 40-year vision, directions and principles for passenger and freight mobility in NSW, guiding transport investment over the longer term.
NSW Freight and Ports Plan 2018-2023	The Plan is a call to action for government and industry to collaborate on initiatives to improve the efficiency and safety of the freight task.
NSW Waste and Sustainable Materials Strategy 2041[22]	The NSW Waste and Sustainable Materials Strategy 2041 outlines actions the NSW Government will take over the next six years to reduce waste, design and use sustainable materials and start making the transition to a circular economy.
NSW Circular Economy Policy Statement[23]	The Circular Economy Policy Statement is a guide to making decisions that support the shift to a circular economy. It aims to embed circular economy principles in NSW Government decision making, policies, strategies and programs.
NSW Water Strategies (including metro and regional strategies)[24]	These 20-year statewide strategies aim to improve the resilience of the State's water resources over the coming decades. The strategies will address key challenges and opportunities for water management and service delivery across the State and set the strategic direction for the NSW water sector over the long term.
NSW Electricity Strategy[25]	The strategy and roadmap set out the NSW Government's plan for a reliable, affordable and sustainable electricity future that supports a growing economy. They address the transition to renewable energy capacity, firming capacity and transmission investment.
Electricity Infrastructure Roadmap[26]	
20-Year Health Infrastructure Strategy[27]	This strategy informs future planning for infrastructure investment for NSW health districts, networks and services.
NSW TAFE Infrastructure Strategy (in progress)	This long-term strategy examines assets, access and partnerships in the NSW TAFE sector.
Schools Digital Strategy[28]	This strategy charts the pathway to improving digital literacy and efficacy across the board in schools.

1.6 Implementation timeframes

State infrastructure strategies adopt a 20-year horizon. The value of this approach is that it encourages and supports long-term thinking, but the long-term implementation of these strategies is never a precise exercise. 2022 SIS recommendations have been categorised using three different implementation timeframes, shown in Table 1.4.

Table 1.4 – 2022 SIS recommendations – implementation timeframes

Implementation timeframe	Description
Immediate Priority (0-5 years)	Recommendations are to be initiated immediately and implemented as a matter of priority, with the view to deliver outcomes in the next 1 to 5 years. Recommendations are predominantly non-build initiatives for which the work should commence / progress immediately.
Medium Term Need (5-10 years)	Recommendations that require (further) planning and investigation, with the view to deliver an initiative or investment in the 5 to 10 years from the time of this Strategy. Examples include investigating options to resolve key freight network pinch points and bottlenecks in Greater Sydney; and enhancing the NSW blue-green infrastructure network.
Extended Program (multiple years / 10+ years)	Rolling programs that require ongoing planning and progressive investments in the medium to long term. Examples include continuation of the Safe and Secure Water Program and the Fast Rail Strategy network program. Other recommendations cater to the State's long-term needs, with some potentially requiring significant capital investment. Examples include undertaking planning for a second container port in NSW.

1.7 Next steps

Findings and recommendations of the 2022 SIS represent Infrastructure NSW's independent advice to the NSW Government to enable informed decision making on infrastructure investment and policy priorities during the next 20 years.

Section 18 of the Infrastructure NSW Act stipulates that the Minister for Infrastructure must adopt the strategy with or without amendments or refer it back to Infrastructure NSW for further consideration, and make the adopted strategy publicly available.

Following adoption and public release of the 2022 SIS, NSW Government agencies will be responsible for implementing initiatives outlined in the Strategy. For each recommendation, a lead agency has been nominated (in some instances, several) to take carriage and coordinate implementation.

Infrastructure NSW will continue to support and provide advice to agencies during implementation of the 2022 SIS, alongside its other core functions such as project business case assurance.

Progress in implementing the 2022 SIS will be tracked as part of the annual requirement for Infrastructure NSW to prepare and submit the 5-year infrastructure plan to the Minister for Infrastructure. In accordance with the Act, the 5-year infrastructure plan will have regard to the 20-year SIS adopted by the Minister for Infrastructure.

State Infrastructure Strategy
2022–2042

Review of 10-year program

02

NorthConnex tunnelling, Transport for NSW

IN THIS SECTION

2.1 A record infrastructure investment program

The NSW Government has pursued an ambitious infrastructure investment program over the past 10 years. Since 2012, three separate State Infrastructure Strategies have supported a record investment program enabled by proceeds from the sale of state-owned assets (see Figure 2.1).

Figure 2.1 – Key themes from previous strategies, and significant projects delivered and under delivery

Previous SIS editions	Key themes	Key projects and initiatives delivered / in delivery
 **2012 SIS** provided the first prioritised and costed long-term strategy, highlighting projects required to address key infrastructure deficiencies.	• Improving urban road capacity • More effective bus and train services to Sydney CBD • Regional and interstate transport infrastructure investment • New and upgraded dams across regional NSW • Long-term improvements in health system • Social infrastructure for growing population • Sustainable budgetary framework for infrastructure funding	• WestConnex* • F3-M2 link (NorthConnex)* • Central to UNSW light rail • Northern Beaches* bus corridors • Sydney Metro Northwest • Port Botany and Sydney Airport pinch points • Moorebank supporting infrastructure • Bridges for the Bush* • Hawkesbury Nepean flood mitigation measures
 **2014 SIS update** was developed to guide how the asset recycling proceeds should be best spent.	• Increasing Sydney's global competitiveness • Supporting population and economic growth in Greater Sydney, including Western Sydney • Enabling productive regional industries and connected regional communities	• $8 billion in rail network upgrades • Northern Extension of WestConnex • $1 billion for congestion mitigation and optimisation of existing road infrastructure • Acceleration of projects for Western Sydney including public transport links, schools, hospitals, and the Western Sydney Stadium • Implementation of regional initiatives including improving freight corridors and regional roads, and enhancing water security and quality
 **2018 SIS** looked beyond the project pipeline and identified policies and strategies needed to guide efficient infrastructure spending that meets the State's growing needs.	• Integrated land use and infrastructure planning • A greater focus on local communities • Stronger integrated sector planning • Resilience • Asset management and utilisation • Digital connectivity and technology • Targeted investment in regional hubs	• Comprehensive suite of sectoral strategies across NSW Government • Asset Management Policy and Assurance Framework for the NSW Public Sector • Moving towards a place-based approach, including Smart Places Strategy development • Cyber Security Strategy and Internet of Things Policy • Sydney Gateway • Moorebank Intermodal Terminal • Sydney Metro West* • Clarence Correctional Centre

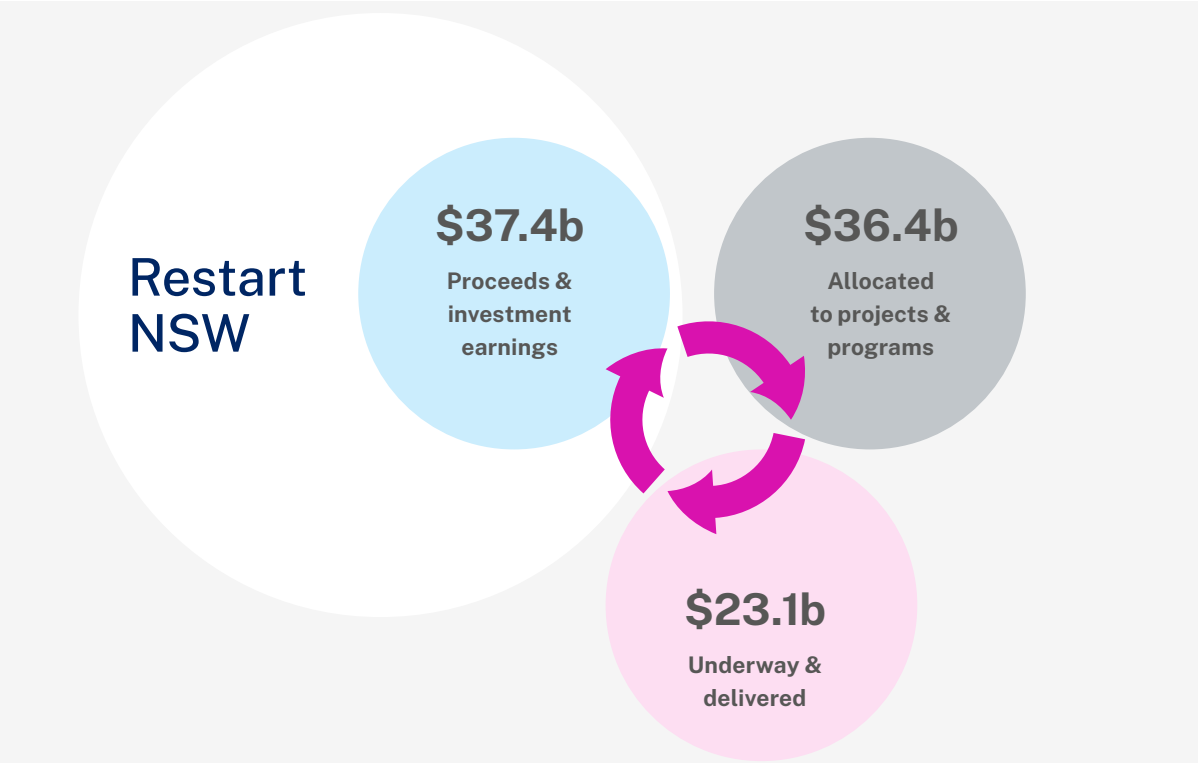
Note: *Projects that received funding from Restart NSW. Source: Infrastructure NSW (2022).

Over the past 10 years, record investment by both government and the private sector has created momentum and delivered hallmark projects and services. The State's spending on infrastructure has been on average around 3% of NSW Gross State Product (GSP) since 2011, compared to just over 2% across Organisation for Economic Co-operation and Development (OECD) countries.[29] This elevated level of infrastructure investment reflects catch up from the previous period of lower levels of investment. Long-term investment in infrastructure is projected to return to a lower growth trajectory,[30] bringing it more in line with other OECD countries.

Importantly, the private sector has invested in projects alongside government, as well as in newly-privatised infrastructure assets.[31]

The NSW Government's asset recycling strategy has supported this record infrastructure program. For example, the Restart NSW Fund was established in 2011 to hold the proceeds from asset sales that were reinvested to improve NSW's economic growth and productivity. Although only one component of the overall investment program, the Restart NSW Fund enabled targeted investment to deliver high-priority infrastructure projects across the State (see Figure 2.2).

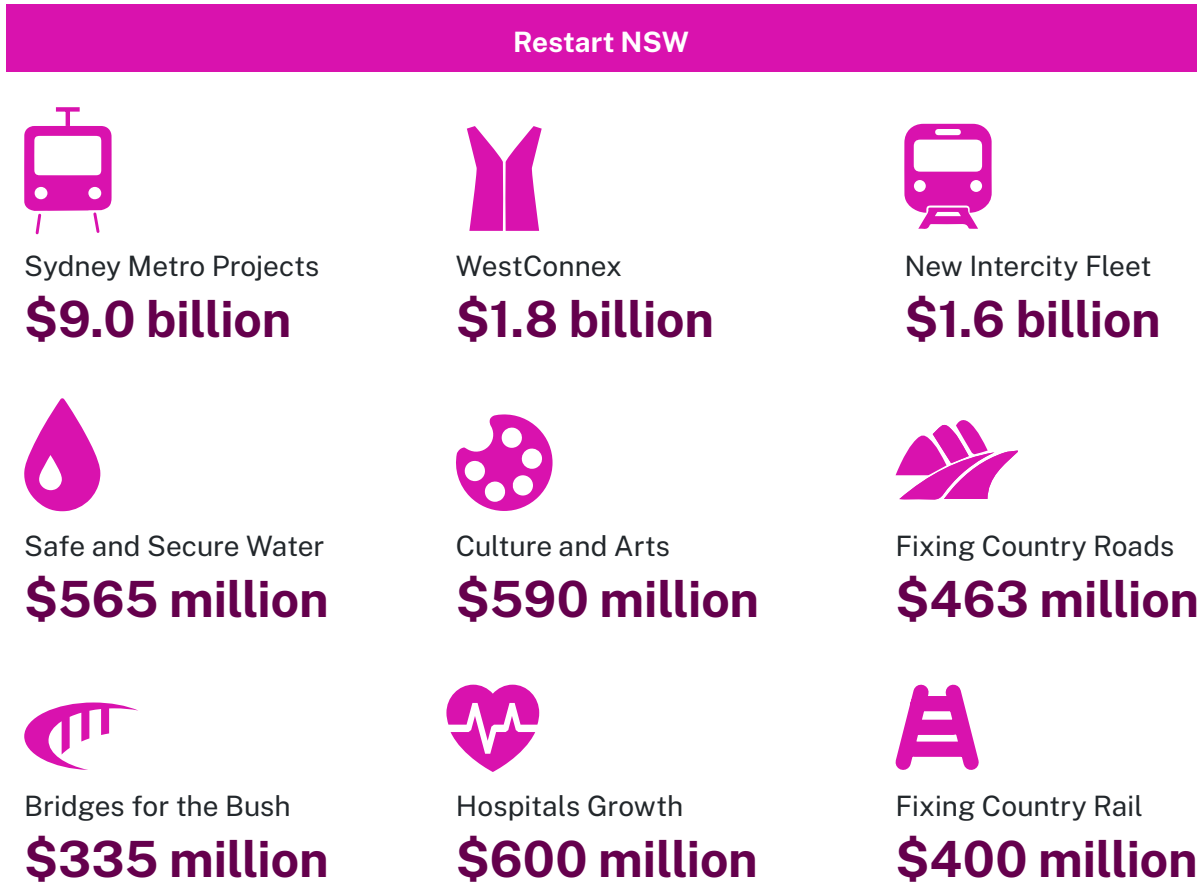
Figure 2.2 – Key Restart NSW and asset recycling achievements



Source: Infrastructure NSW, based on NSW Treasury (2021)

As at 30 June 2021, inflows to Restart NSW were expected to total $37.4 billion. Restart NSW has contributed funding for many significant projects and programs (see Figure 2.3).

Figure 2.3 – Funding committed by Restart NSW for significant projects and programs



Note: Values in the figure represent funding amounts committed to the projects by Restart NSW, not the total project costs

Source: Infrastructure NSW (2021)

Restart NSW has also funded over 740 local and community infrastructure projects, of which over 360 have already been delivered by local councils and community organisations. Restart NSW is expected to continue enabling upcoming transformational projects, including Sydney Metro West and the Regional Community Recovery Fund.[32]

The NSW Government targets 30% of Restart NSW funding allocation to regional areas, outside the metropolitan areas of Sydney, Newcastle and Wollongong, over the life of the fund.

The $4.2 billion Snowy Hydro Legacy Fund was established in June 2018 following the sale of the State's share in the Snowy Hydro Scheme to the Australian Government, with all proceeds to be spent on initiatives supporting economic development in regional NSW. Projects that are underway include:

- $185.4 million to deliver the Parkes Special Activation Precinct (SAP)
- $157.5 million for the Wagga Wagga SAP
- $100.0 million for Gig State, as part of the Regional Digital Connectivity program.[33]

2.2 Investment has delivered significant economic and social benefits

Between 2011-12 and 2020-21, the NSW Government invested $178.3 billion in new and upgraded infrastructure.[34,35] This investment made NSW more productive, competitive and responsive to the needs of NSW communities. Figure 2.4 highlights key NSW infrastructure achievements by sector over the past decade.

Figure 2.4 – Key NSW infrastructure achievements by sector

	Transport	Health	Education	Justice	Community housing	Culture, sport and tourism
Benefits / outcomes delivered	**50 +** **projects completed and 240 in delivery since 2018**	**170+** **health capital projects delivered since 2011**	**160+** **new and upgraded schools since 2011**	**7,700+** **additional prison beds since 2016**	**3,300+** **new community houses completed since 2012**	**Improved access to the cultural treasures and natural assets**
Key project examples	▸ Sydney Metro Northwest ▸ NorthConnex ▸ WestConnex ▸ Pacific Highway Upgrade ▸ M4 Smart Motorway	▸ Westmead Hospital Redevelopment Stage 1 ▸ Wagga Wagga Base Hospital Redevelopment	▸ Inner City High School ▸ Parramatta Public School redevelopment ▸ Cooler Classrooms Program ▸ TAFE Connected Learning Centres	▸ Clarence Correctional Centre ▸ New Queanbeyan Police Station and upgraded Gosford Police Station ▸ Digital Courts Reform project	▸ St George Community Housing ▸ Aboriginal Housing Office – social and community housing renewals	▸ Western Sydney Stadium ▸ Upgrade of the Museum of Contemporary Art ▸ Sydney International Convention, Exhibition and Entertainment precinct ▸ Walsh Bay Arts Precinct

Source: Data from TfNSW (2021), NSW Treasury (2021), DCJ (2021) and DPE (2021)

Success of the infrastructure investment program is measured not in dollars spent, but in benefits realised by the community. The discipline of structured and staged investment decision making as well as robust assurance processes and analysis after a project is completed have ensured the program delivers clear and measurable benefits. Examples of public investment leading to better outcomes for NSW citizens are provided in Boxes 2.1, 2.2 and 2.3.

Box 2.1

Case Study: NorthConnex[36]

NorthConnex, which opened in October 2020, is a vital link in the National Highway network. Constructed at a cost of $3 billion, it is expected to deliver $4 billion in value to the NSW and national economies and create up to 8700 jobs over its lifetime. Motorists between Newcastle and Melbourne save 15 minutes by passing around 21 traffic lights, while commuters and trucks heading to the Sydney CBD avoid 40 sets of traffic lights on the alternative Pacific Highway route. Aside from gains in efficiency from travel time savings, residents living close to Pennant Hills Road are benefiting from improved amenity and safety, with the reduction in noise and congestion from the diversion of up to 5000 trucks away from local roads.

Box 2.2

Case Study: Westmead Redevelopment

The Westmead Hospital Redevelopment Stage 1 and the Sydney Children's Hospital Network delivered two new emergency departments, one for adults and one for children in 2021. This included over 300 patient rooms and 1.5 floors for the University of Sydney to enable greater integration of education, research and health service delivery.[37]

The Central Acute Services Building was the centrepiece of the NSW Government's investment in the Westmead Redevelopment. The 14-storey building connects Westmead Hospital and The Children's Hospital at Westmead and provides over 95,500 square metres of space, hosting a range of adult and paediatric services including emergency, pharmacy, imaging and state-of-the art operating suites.

It is the tallest hospital building in Australia and embraces the new approach of vertical hospital design. The design was finalised during an extensive user group consultation process with clinicians, patients, families and community members.[38]

Box 2.3

Case Study: North West Metro[39]

The North West Metro opened on 26 May 2019 and was delivered on time and $1 billion under budget. Within two weeks, 1 million customer journeys were made and over 3000 services operated.

The new metro line links Rouse Hill with Chatswood and includes 13 metro stations and 4000 new commuter parking spaces.

The journey time from Rouse Hill to Chatswood is now about 35 minutes. In the first week of Metro services, patronage on buses travelling from Sydney's north west via the M2 to areas such as Macquarie Park, Chatswood, North Sydney and the CBD fell by about 18% in the morning peak, and 22% in the afternoon peak. Overall, the Metro has delivered improved customer amenity and travel time savings.

2.3 Improving NSW's international standing

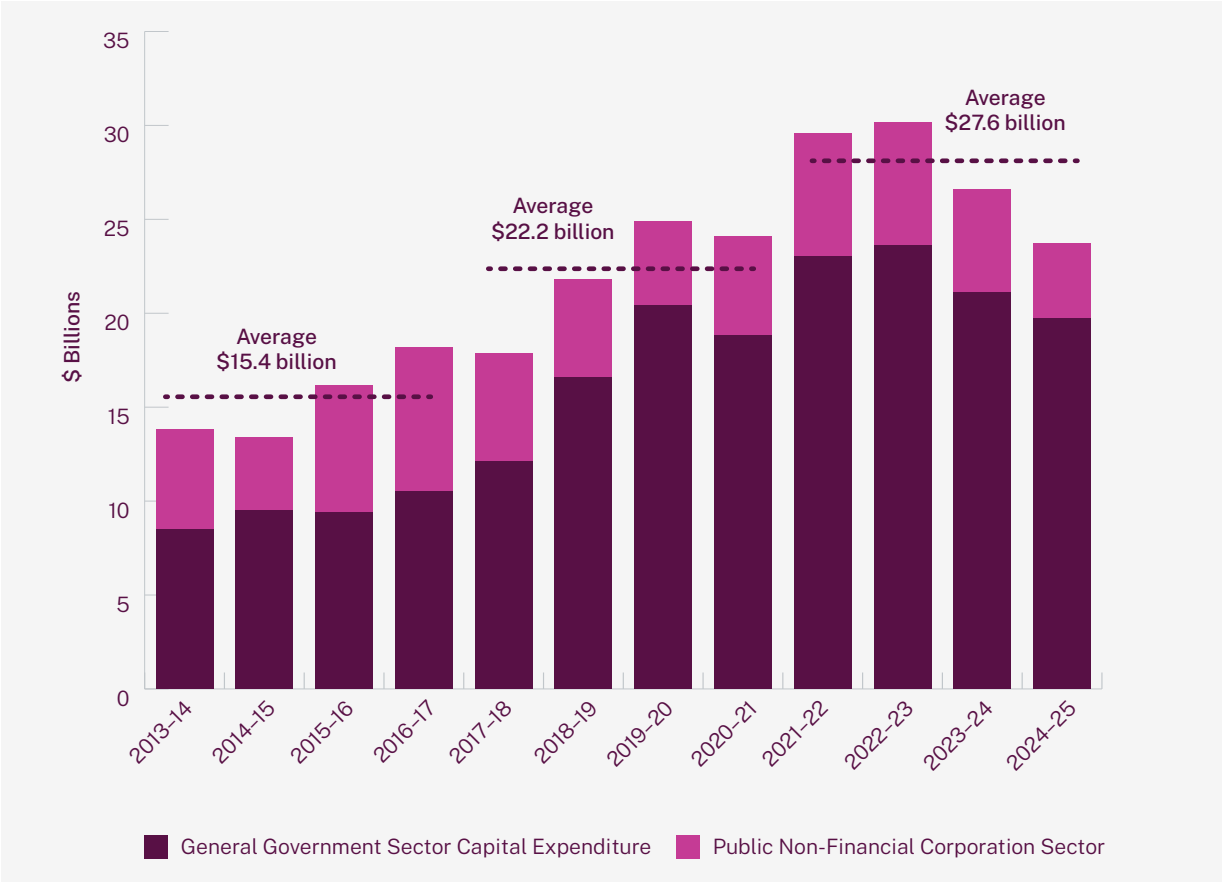
Infrastructure investments completed over the past decade and projects currently underway are essential to NSW's and Australia's international standing. Australia's infrastructure quality has continued to lag its international peers. The 2019 World Economic Forum's (WEF) Global Competitiveness Index ranked Australia 29th out of 141 countries in terms of infrastructure quality.

While this is an improvement from 2018, when Australia ranked 31st, it is still behind where NSW and the nation aspire to be.[40] NSW, as the most populous state with the largest economy, makes the largest contribution to national infrastructure spending and influences Australia's overall ranking.

Australia's global ranking is expected to further improve once recent infrastructure investments in NSW and Australia are incorporated in the data. Several investments in transport, health and education have been completed and many are under construction.

The future infrastructure investment pipeline in NSW remains healthy and consistent with the commitments of the past 10 years. The 2021-22 NSW Budget commits to an average annual infrastructure spend of $27.6 billion over 2021-22 to 2024-25 (see Figure 2.5). This means that, in the years ahead, NSW will keep making a critical contribution to national infrastructure spending and the quality of Australia's public infrastructure, while continuing to deliver significant economic, social and environmental benefits to the people of NSW.

Figure 2.5 – Growth in the NSW infrastructure program from 2013-14 to 2024-25



Source: NSW Treasury (2021)

Note: General Government Sector includes all government-controlled entities (for example, Department of Education, Ministry of Health) that perform regulatory functions, redistribute income and wealth and deliver non-market goods and services (for example, policy advice, regulatory and service delivery functions); Public Non-Financial Corporation Sector covers all government-controlled entities (for example, Sydney Water, NSW Land and Housing Corporation) that provide market goods or services and have a relatively higher share of own-source revenue.[41]

Boost economy–wide productivity and competitiveness

03

Sydney Football Stadium, Infrastructure NSW

IN THIS SECTION

Strategic directions

- Deliver efficient transport networks to support thriving cities, businesses and communities
- Improve freight efficiency, security and capacity to support NSW's industries and supply chains
- Support existing and emerging knowledge and manufacturing industries in dedicated precincts with high-quality infrastructure
- Address gaps in cultural and sporting infrastructure that can help attract visitors and skilled workers to the State

Continued investment in high-quality infrastructure is essential to support and strengthen the productivity and international competitiveness of NSW industries. The availability, cost and quality of public infrastructure are important levers government can use to boost productivity and overall prosperity.[42]

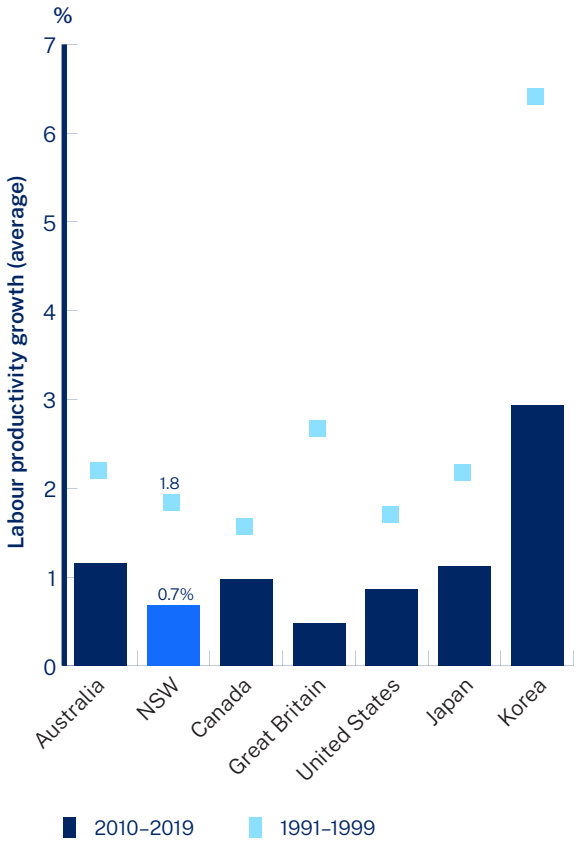
Over the past two decades, NSW's productivity growth has slowed, as it has in other developed economies (see Figure 3.1).[43,44] The high rates of productivity growth recorded in the 1990s reflected economic liberalisation over the preceding 20 years in Australia and overseas. Economic reform in Australia included the floating of the Australian dollar in 1983, financial market deregulation during the 1980s, significant tariff reduction between 1970 and 1990, and the National Competition Policy reforms of the 1990s,[45] as well as tax reform in the form of a national Goods and Services Tax (GST).

Despite significant technological advances over the past two decades, there has been no sustained improvement in productivity. There is no widely accepted explanation for this phenomenon.[46]

Economic and productivity growth in NSW are heavily dependent on infrastructure investments that unlock opportunities and drive competitiveness. Infrastructure is an essential input to production and constitutes more than 10% of inputs for most sectors (see Figure 3.2). The transport, electricity, telecommunications and water sectors are the most intensive users of infrastructure assets for production, while a much broader segment of the economy relies on transport infrastructure (road, rail, airfreight and logistics) as an input to production. Access to a skilled and healthy workforce through the provision of education and health services is also essential for industry to attract and retain the right talent.

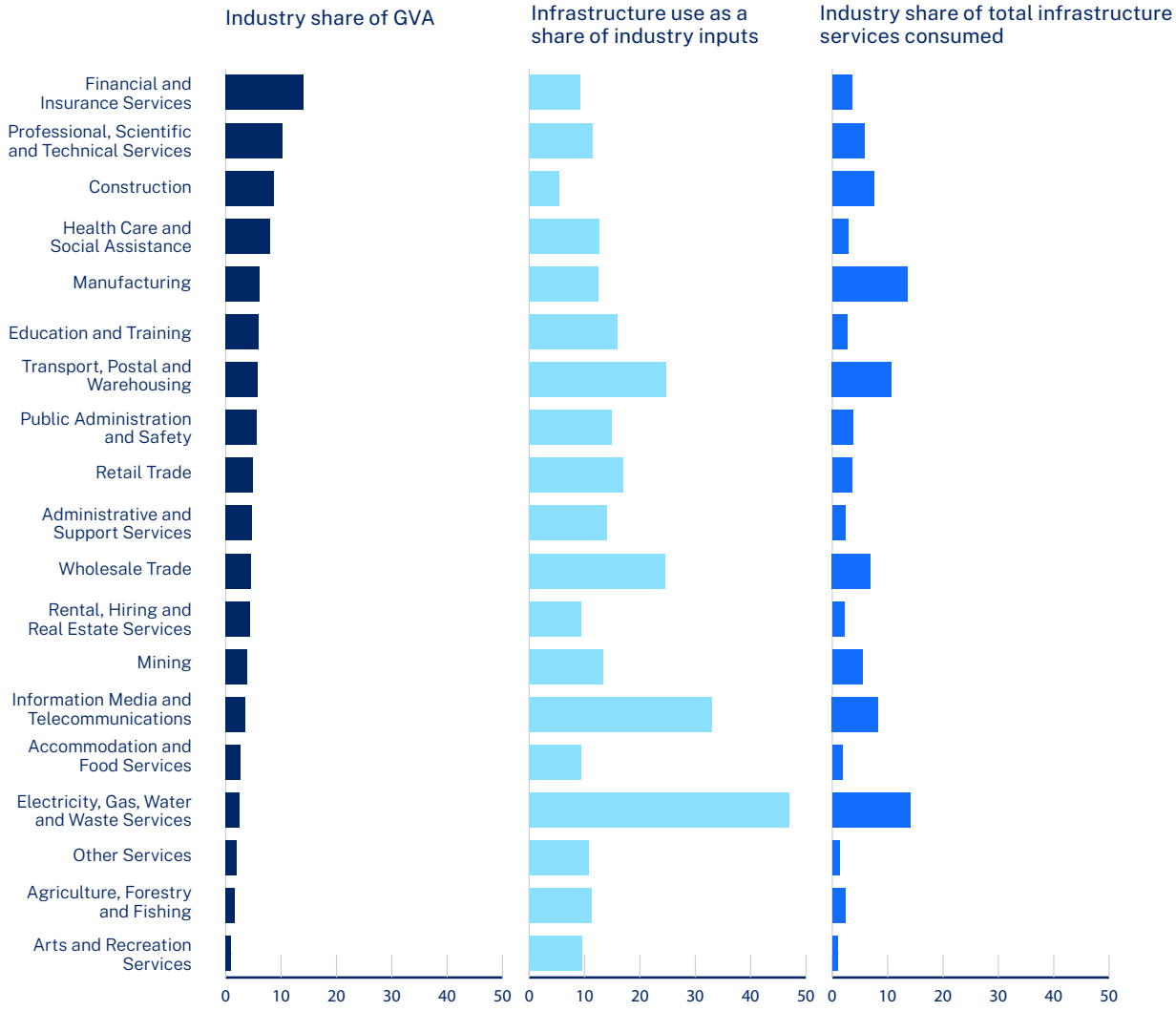
In this regard, the NSW Government plays a critical role in supporting a competitive State economy through the selection and timely provision of infrastructure. While the focus of this chapter is largely on transport sector infrastructure priorities, other productivity-enhancing opportunities are outlined in Chapters 4-11 of the 2022 SIS that should be considered for their economic contribution, as well as their direct roles in delivering community services.

Figure 3.1 – Average labour productivity growth across comparable jurisdictions



Source: ABS Cat. 5220.0 Australian National Accounts: State Accounts, Cat. 6202.0 Labour Force, Australia for NSW data; OECD (2021), GDP per hour worked (indicator) for national data

Figure 3.2 – The role and input of infrastructure by industry



Source: ABS (2017 and 2020) and Infrastructure NSW analysis

3.1 Lift the economic performance of Greater Sydney

Sydney is Australia's global city,[47] accounting for 24% of Australia's Gross Domestic Product (GDP).[48] Sydney hosts several priority precincts and key international gateways with a focus on knowledge-intensive service industries. These industries, such as financial and insurance services, account for well over a third of NSW's economic output – and are primarily based in the Sydney CBD.[49]

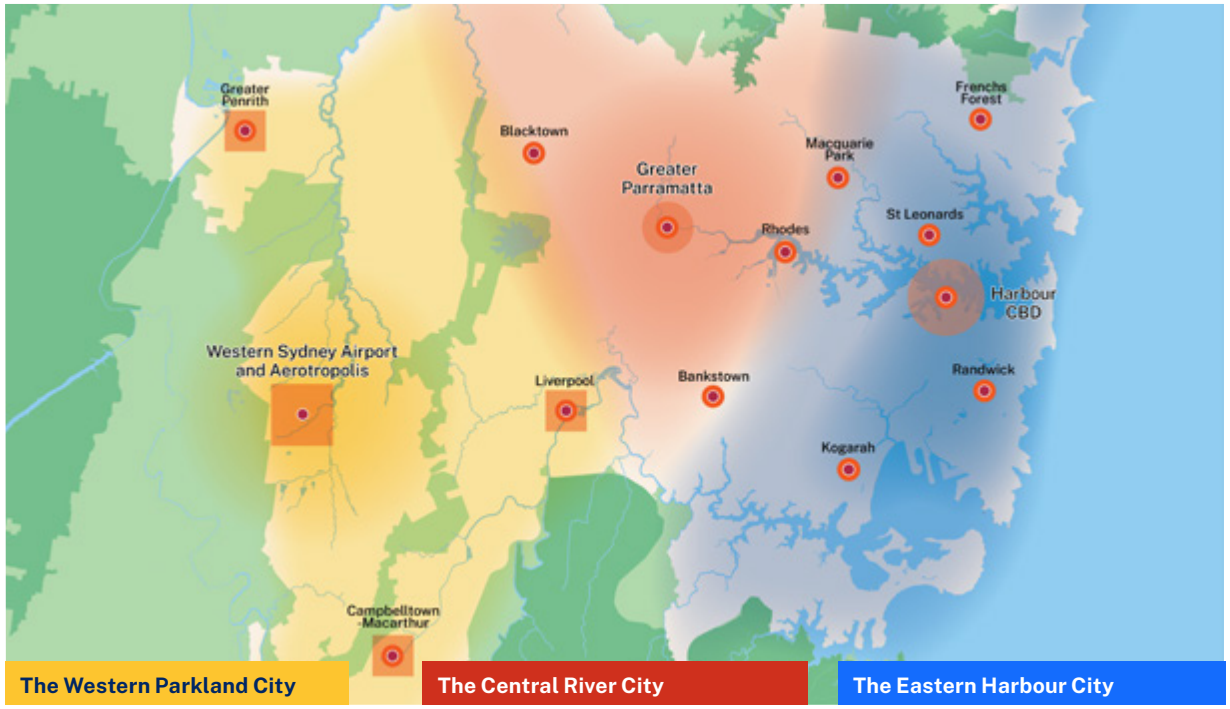
Sydney is the cultural capital of NSW, home to several global education and tourism institutions and consistently ranked among the world's most liveable cities.[50] Exports from the finance, professional services, education and tourism service industries account for 40% of total NSW exports: the highest share of any state.

For these reasons, the State's ability to attract global investment and talent relies on Sydney's international competitiveness and liveability.

Greater Sydney's future development path as 'a metropolis of three cities' remains the cornerstone of many NSW policies and strategies that are relevant to the 2022 SIS. The role infrastructure investment will play in the future development of Greater Sydney can be characterised as follows:

- **managing the future growth of the Eastern Harbour City** in a way that maintains its global attractiveness and competitiveness and addresses the challenges that affect similarly successful cities. These include traffic congestion, constrained urban freight movements, the freight needs of international gateways, housing affordability, cultural vibrancy and broader liveability concerns
- **improving accessibility and liveability of the Central River City** by enhancing radial transport links, growing its economic catchment and supporting its attractiveness as a centre for economic, jobs, and housing growth
- **supporting emerging industries in the Western Parkland City and the innovation precincts in the Eastern Harbour and Central River Cities** through new urban transport and freight links, secure, reliable and affordable water and energy supply, globally competitive digital connectivity and a skilled labour force that meets the needs of the future.

Figure 3.3 – Map of the three cities model



The Western Parkland City

Home to the Western Sydney Airport and development of Bradfield and the Aerotropolis.

Role of Infrastructure

- Supporting emerging industries and innovation districts through physical and digital connectivity
- Secure, reliable and affordable water and energy supply

The Central River City

Geographic heart of Sydney that will become the administrative capital of Greater Sydney

Role of Infrastructure

- Improving accessibility and liveability
- Growing its economic catchment and attractiveness

The Eastern Harbour City

NSW's global financial, economic and cultural hub

Role of Infrastructure

- Managing future growth
- Maintaining global attractiveness and competitiveness

Source: Infrastructure NSW, based on Greater Sydney Commission (2021)

Capitalising on investments in mass transit and major corridors

Significant investment over the past decade has supported the growth of the CBD and Eastern Economic Corridor between Macquarie Park and Sydney Airport. This has resulted in a transformation of the Sydney CBD, with the emergence of new high-value precincts such as Barangaroo.

The committed pipeline of city-shaping infrastructure will continue to change the shape of the Greater Sydney Region across its three cities. These investments will deliver substantial benefits for Sydney by enabling more efficient and reliable road and rail networks. Record investment in public transport will increase mode share for rail, metro and bus patronage.

The 2018 SIS acknowledged Transport for NSW's proposed staged investment approach to major public transport, and highlighted Sydney Metro West as the immediate priority for expanding mass transit capacity between the Eastern Harbour City and the Central River City. With construction of Sydney Metro West now underway, it is essential to realise the benefits of this major investment through land use decisions and policy initiatives that will drive patronage along this corridor by establishing more homes and services around the new stations.

Further extensions of the rail network will focus on Parramatta as a central hub and move away from a radial approach focused on the Sydney CBD. As highlighted in the 2018 SIS, after Sydney Metro West, new links from Parramatta to Epping and Parramatta to Kogarah are the next major priorities for the Greater Sydney rail network.[51] These extensions would broaden the catchment that can access the Central River City, including Parramatta CBD where substantial investments have been made to attract businesses, jobs and households.

To ensure these significant public investments deliver genuine and lasting benefits, this trunk infrastructure needs to be augmented with investment in the intermediate and local transport network, as well as network-wide intelligent transport system (ITS) improvements such as 'smart motorways' and traffic signalling upgrades (see Chapter 9 for more). Other priorities include augmentation of roads, such as Parramatta Road and Victoria Road, where investments can alleviate traffic – presenting the opportunity to improve liveability and public transport access through rapid bus services. Such investments will further improve accessibility to key centres and precincts, improve the resilience of the network and support and encourage housing growth along these major corridors.

Prioritising network optimisation – the foundation for productivity growth

This Strategy proposes that the NSW Government increase its focus on programs of works designed to lift the service reliability of networks, after a prolonged period where large, complex projects demanded the attention of government and industry. The performance of Sydney relies on regular and incremental improvements to existing assets and networks. Each network is only as good as its weakest point. The optimal performance of networks requires constant attention to improvements in operations and asset capacity.

Major transport agencies typically have a long list of possible small-to-medium size network improvements and augmentations at various stages of maturity – many have been investigated and evaluated, and some have preliminary design options. Success comes from knowing which of these smaller improvements will have the greatest payoffs, the interdependencies between them and an ability to routinely pursue these improvements, year in and year out. Without these improvements, the benefits of major State investments cannot be fully realised.

There is a need to elevate attention to coordination and prioritisation of network improvements to deliver them more effectively and at scale. This Strategy recommends undertaking a thorough 'stocktake' of small and medium-sized network improvement opportunities and refreshing routines to prioritise their funding and delivery.

A strong basis for this work already exists in transport planning. The Government should build on these efforts and ensure that long lists of small and medium-sized works become short lists that are regularly assessed, prioritised and delivered. The opportunity will arise in the next round of Transport for NSW's Services and Infrastructure Plans, which will need to be detailed and set out clear, deliverable actions for programs of incremental network improvements.

Laying foundations to achieve the Western Parkland City

The challenge in building a strong foundation for the Western Parkland City stems from the scale of the investment required in the long term, the duration over which that investment will play out and how to stage the delivery of infrastructure to match incremental growth.

The Western Sydney International (Nancy-Bird Walton) Airport is due to commence operation in 2026 and will require significant but staged investments to enable passenger access to and from the airport. Effective road and freight access to surrounding precincts is essential to facilitate commercial and industrial activity and residential development. This includes priorities to upgrade Elizabeth Drive, Eastern Ring Road and Fifteenth Avenue as outlined in the Western Parkland City Draft Blueprint.[52]

Current population and employment growth projections suggest the need for major infrastructure services – such as mass transit – is a medium- to long-term priority. Construction market capacity issues also mean that not all major projects can be delivered at the same time. Extensions to the mass transit network within the Western Parkland City, and links to the Central River City and the broader Sydney transport network, will be needed in the future. In the short term, the NSW Government should prioritise delivery of a rapid bus network to support connectivity with the Central River City and improve access between key centres within the Western Parkland City.[53] The option to deliver a mass transit network for the Western Parkland City should be preserved through targeted land acquisition and corridor protection.

3.2 A more efficient Greater Sydney freight network

The efficient movement of freight is fundamental to supporting NSW's productivity and export competitiveness. The NSW Government should prioritise investments aimed at increasing the productivity of existing international gateways, while also planning for long-term freight movement demand as new precincts and industry needs emerge.

Increasing freight rail mode share

Increasing the proportion of freight movement by rail presents an opportunity for productivity gains. Greater economies of scale from rail freight movement compared to movement by heavy vehicles will place downward pressure on the cost of goods and services. Congestion on roads restricts truck speeds and efficient freight movement, particularly in urban settings.[54] With no change to the current modal split between rail and road, and strong growth forecast for freight moving through NSW ports, the number of trucks on Sydney's road network is estimated to double by 2030, further deteriorating the efficiency of road freight movement and overall network performance.[55]

Increased rail freight mode share could alleviate some of this congestion from the avoided number of heavy vehicles otherwise used to transport freight by road. A 2020 report for the Australian Railway Association highlighted that every 1% of road freight that transitions to rail generates around $72 million of benefits to society a year due to reduced missions, improved population health and reduced accidents on the road.[56]

However, meeting Sydney and the State's projected growth in freight demand will require a program of investments and government initiatives. This includes augmentation to the freight rail network's capacity, enhancing the intermodal network, addressing pinch points and optimising arrangements where rail infrastructure use is shared with passenger trains.

Protecting and managing freight corridors for future use

Historically, the availability of industrial lands – where freight activity largely takes place – in the Eastern Harbour City has decreased due to land being rezoned for residential use.[57,58] A similar trend has been observed in the Central River City, where there are pressures for land rezonings to prioritise residential development to meet Sydney's population growth and associated demand for housing.[59,60] Similar pressures are being experienced in the Western Parkland City.

Constraints on the availability and use of industrial land poses significant risk to the efficient movement of freight and, in turn, adds to the cost of goods and services.[61] In addition to protection and management of existing industrial lands across Greater Sydney, strategic planning must also prioritise the preservation of corridors for future freight infrastructure.

Key freight corridors identified in the 2018 SIS and Future Transport 2056 should remain priorities of the NSW Government, including:

- **Western Sydney Freight Line** – there is currently no freight rail serving the Western Sydney Employment Area adjacent to the new Western Sydney International (Nancy-Bird Walton) Airport. With a projected volume of freight movement to and from Western Sydney expected to at least double from 18.5 million tonnes in 2014 to 41 million tonnes in 2041,[62] a dedicated freight rail link between Port Botany

and the Western Parkland City is essential to maintain a competitive State supply chain while avoiding congestion on the road network.[63]

- The next stage of the **Northern Sydney Freight Corridor**. The completed Stage 1 of the corridor augmentation has increased its capacity to accommodate growth in rail freight demand up until 2028. Planning and augmentation should be progressed to avoid bottlenecks to the network in the medium term.[64]
- **Lower Hunter Freight Corridor** dedicated freight rail. Delivery of a dedicated freight rail by bypassing the Newcastle area will reduce network congestion on the rail network across Newcastle, while improving travel times and reliability for both rail freight and passenger rail services.[65]

Moreover, as highlighted in the 2018 SIS, new commercial and residential development in the Western Parkland City will rely on the continuous supply of bulk freight, such as building materials, which will require an efficient bulk handling network.[66] To enable the efficient movement of bulk construction materials by rail to Western Sydney, it may be necessary to consider allocating further land to receive these bulk products.[67]

Importantly, for both freight corridors preserved for future use and existing industrial lands used for freight, development controls and planning restrictions should not unduly curtail the economic activity needed to maintain a globally competitive NSW supply chain network. Protecting these lands from the encroachment of incompatible uses – such as pressures to rezone to residential land – is fundamental to meeting the State's projected growth in freight demand (see Chapter 10 for more).[68]

Leveraging Sydney's international gateways

Ensuring the efficiency of the Sydney Airport to Port Botany international gateway is a first order priority (see Box 3.1). Delivery of WestConnex, Sydney Gateway and the Australian Government's Port Botany Rail Duplication will significantly improve freight movement in the short to medium term.

However, as these projects reach completion, focus should shift to improving the missing link between Sydney Gateway and Port Botany (the Sydney Gateway Extension), including delivery options that involve private sector funding. A direct and fast road link between Sydney Gateway and Port Botany would improve efficient and reliable access between the port, surrounding industrial lands and key distribution locations in Western Sydney.[69] Planning and delivery of this missing link should remain a key priority of the NSW Government.

Box 3.1

Sydney Gateway to Port Botany economic corridor

Sydney houses two of NSW's key international gateways at Port Botany and Sydney International Airport. Port Botany is the largest container port in NSW and handles a significant amount of the State's bulk liquid, gas and chemicals. Analysis undertaken for NSW Ports suggests that Port Botany directly contributes an estimated $10.7 billion towards NSW's Gross State Product (GSP) per year.[70] Sydney Airport handled over 44 million passengers in 2019 and over 500,000 tonnes of air freight – directly contributing $11.2 billion to the economy.[71]

These international gateways are fundamental to an efficient NSW supply chain network. Through coordinated planning and investment in the right infrastructure, the NSW Government can leverage these existing corridors to drive future productivity growth.

Strengthening the intermodal network and addressing pinch points

Moving more freight by rail will require complementary investments, such as those aimed at improving heavy vehicle access to existing intermodal terminals, and the expansion of Sydney's intermodal network more broadly. As highlighted in Future Transport 2056, the 850 hectares of industrial land at the Mamre Road Precinct is one example that, upon project completion, will improve the capacity and efficiency of Sydney's freight and intermodal network.[72,73] Planning for Mamre Road Precinct is well progressed, with rezoning taking place in June 2020 and the Development Control Plan adopted in November 2021.[74] Delivery of key infrastructure to activate this precinct should remain a NSW Government priority.

The Government should also pursue investments to overcome existing and projected pinch points and bottlenecks in freight supply chains across Greater Sydney. Some high priority projects previously identified in the 2018 SIS remain to be delivered, including:

- **Moorebank Intermodal Terminal (MIT) road connection upgrades** – to address congestion along the M5 corridor connecting the MIT and Port Botany.[75]
- **Parramatta Ring Road bypass** – to improve north-south connectivity while protecting Parramatta's CBD from traffic intrusion.[76]

Regulatory and policy opportunities

Infrastructure investments should be supported by policy and regulatory initiatives aimed at increasing rail freight mode share. For example, the *Transport Administration Act 1988* currently stipulates that transport agencies should give 'reasonable priority' to passenger trains for the purpose of timetabling and network control on shared lines in Greater Sydney. This requirement limits the proportion of freight movement by rail. For example, ACFS Port Logistics – who is managing and operating the St Marys Freight Hub – has reported that this limitation means that the 300,000 TEU handling capacity available at the St Marys Freight Hub will not be fully utilised.[77]

The 2021 NSW Auditor-General's Report on *Rail freight and Greater Sydney*[78] highlighted the risk that transport agencies do not have a consistent understanding of what 'reasonable priority' means in practice, resulting in the term being inconsistently applied to the network's operation. In this regard, simply maintaining the number of existing train paths risks freight rail capacity falling behind demand, which will continue to grow in line with the State's population.

The Auditor-General recommended that transport agencies give priority to the following matters:

- delivering freight-specific strategies including clear articulation of accountabilities, targets and key performance indicators for freight rail outcomes
- improving collection and sharing of freight data to facilitate analysis of train movements to support future planning, operation and policy decisions for an efficient freight network
- developing and implementing key performance indicators for inter-agency agreements between transport agencies.

Delivering on these recommendations will complement investments in freight infrastructure and, accordingly, they should be pursued as priorities by the NSW Government.

Meeting the needs of new and emerging industries in Sydney

To support future economic diversity and growth in Sydney, the NSW Government is planning new precincts focused on high growth knowledge-based and capital-intensive industries. Growth in these emergent industries is supported by technological advances in automation, artificial intelligence (AI) and 3D printing, alongside a highly skilled workforce. Current plans include:

- **Tech Central:** to establish Sydney at the forefront of digital technology, fintech, e-health and creative industries[79]
- **Macquarie Park:** a technology and knowledge industry cluster with a world-class university, a key regional hospital and a high-tech employment hub. Further investment is underway to capitalise on the nearby new Sydney Metro station and transform Macquarie Park from a successful suburban business park to a vibrant commercial centre[80]

- **The Westmead Health and Education Precinct:** to bring together major higher and further education institutions and health infrastructure, creating a knowledge and research-intensive cluster of economic activity
- **Parramatta CBD:** to capitalise on infrastructure investment in the area, including Parramatta Light Rail Stage 1 and Sydney Metro West
- **Bradfield City Centre and its surrounding Aerotropolis:** to leverage the development of the Western Sydney International (Nancy-Bird Walton) Airport, commitments in the Western Sydney City Deal and other major infrastructure. Investment attraction efforts are focused on aerospace and defence, advanced manufacturing, agricultural technology and a host of knowledge-intensive and population-serving industries.

Planning for the delivery of these precincts and growth corridors is well underway and so is much of the major transport infrastructure. Some of these precincts are in already well-established areas and their infrastructure needs will differ. For example, Tech Central sits in the most connected transport hub in Sydney and infrastructure needs are likely to focus on improving digital connectivity and precinct activation, both of which can be largely delivered by the private sector.[81]

Major infrastructure investment is committed or already in delivery across the Parramatta CBD and Westmead. As both commercial and residential development gathers pace in these precincts, further transport connections and other infrastructure needs can be considered, sequenced efficiently with land use planning.

The more challenging development will continue to be the Bradfield City Centre, its surrounding Aerotropolis and the broader Western Parkland City. The scale of development and the long duration of both the land use and infrastructure program will test the resolve of government and the private sector, as it will take several decades to deliver on these ambitions.[82] The 2022 SIS recommends that the NSW Government continues to apply a long-term lens to the strategic planning of the Western Parkland City, taking a careful approach to the timing of investment so it aligns closely to emerging demand (see Chapter 10 for more).

Success will also rest on targeted non-infrastructure policies, such as skills and investment attraction, and industry development that will drive growth in demand for the planned infrastructure. Clear targets and accountabilities for the Department of Enterprise, Investment and Trade, alongside the Western Parkland City Authority and Investment NSW, will play a significant role in securing the success of the Bradfield City Centre and broader Western Parkland City.

3.3 Greater integration of major metropolitan cities

Historical industrial and settlement patterns have meant that, unlike many OECD countries, NSW's most populous cities remain separated by large non-metropolitan land areas and long journeys. As a result, the economies of the cities are less integrated than could be the case, opportunities arising from scale may be foregone and the options open to businesses and households are more limited.

The Greater Cities Commission has been tasked to develop an approach for greater integration of a metropolitan region of "Six Cities" that includes:

- the Eastern Harbour City
- the Central River City
- the Central Coast City
- the Lower Hunter and Greater Newcastle City
- the Western Parkland City
- the Illawarra-Shoalhaven City.

While history may have set the cities apart geographically, they each offer valuable assets and skilled populations. For example:

- Newcastle and Wollongong provide major international trade gateways: the Port of Newcastle and Port Kembla

- together with Greater Sydney, the Central Coast, Lower Hunter and the Illawarra account for around three-quarters of the NSW population,[83] projected to grow by around 15% over the next 20 years – faster than the rest of NSW[84]
- the infrastructure originally built to service heavy industries and mining can be repurposed for emerging export focused industries, including advanced manufacturing, critical minerals processing and hydrogen
- there are housing and services capable of supporting a growing population.

These attributes can be leveraged more effectively through better integrated planning and infrastructure investment within and between cities. More flexible use of these assets across a broader range of businesses, industries and population has the potential to increase productivity of the whole region and each individual city. An efficient transport network for the movement of goods, services and people is a necessary foundation for these cities to be productive and thriving economies.

From an infrastructure perspective, the primary barrier to increased integration and productivity is travel time between the cities. Journey times were acceptable when each city rested on its own local economic base. However, greater integration and the pursuit of efficiency requires that the transport of both people and goods today is faster and more commensurate with competitor regions in other countries.

The metropolitan centres can benefit from better transport links, internally and to Greater Sydney, to leverage their assets, including international gateways. Planning for the second container terminal at Port Kembla when Port Botany reaches capacity, including enhanced links to the emerging industries in the Western Parkland City, would present further economic opportunities. Current projections of the State's freight volume growth suggest the second container port will be required between 2045 and 2050.[85]

A staged approach to inter-city connectivity through Fast Rail

Connection between the metropolitan centres could be strengthened significantly through the *NSW Fast Rail Strategy*, which aims to improve passenger travel time across the key cities. However, there is no quick fix to overcoming travel time between these cities and Greater Sydney. The Fast Rail Strategy program will require a long-term, resolute approach and an ability to keep a keen focus on the benefits of integration. It should be delivered via a staged program, which could commence in 5 to 10 years but will likely be delivered over multiple decades (see Box 3.2).

Over time, Fast Rail investments could generate new housing supply opportunities outside Greater Sydney and offer new economic opportunities for the metropolitan cities by attracting businesses and workers.[86] In particular, better links between Wollongong and the new Western Sydney International (Nancy-Bird Walton) Airport and fast-growing surrounding areas presents mutual opportunities for businesses and workers.

The immediate need is to determine the priorities and staging for corridors and packages, and for the NSW Government to start the process of committing regular annual funding for what will be a long-term program.

Box 3.2

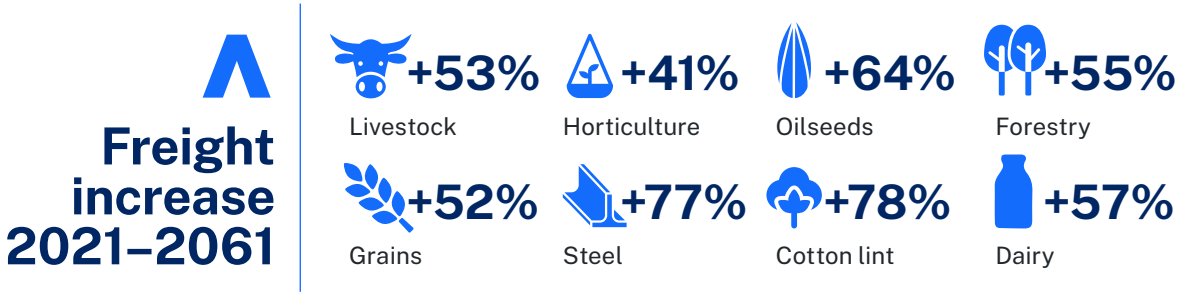
NSW Fast Rail Strategy[87]

Fast Rail is being investigated along four key corridors, linking Sydney to Newcastle, Bomaderry, the Central West and Canberra. It would provide better links for NSW's metropolitan cities and regional centres with speeds of up to 250 km/h for new and dedicated lines. Improvements to the existing system would also enable trains to reach speeds of 160km/h for those sections.

Given the scale of the task, the NSW Government is exploring an incremental approach to investments and upgrades to be delivered over the next two to three decades.

The Government's commitments to Fast Rail will need to be accompanied by an holistic strategy that considers complementary infrastructure and non-infrastructure policies, including transport connectivity to Fast Rail within these metropolitan regions, land use planning, skills development, and business and investment attraction. Transport alone is rarely sufficient in delivering optimal economic development outcomes.

Figure 3.4 – Freight will need to meet increasing demand from industries



Source: Infrastructure NSW, based on TfNSW Strategic Freight Model and Regional Freight Model projections (2021).

3.4 A thriving regional NSW is fundamental to the State economy

In regional NSW, primary and secondary industries and the visitor economy remain dominant, accounting for half of total regional NSW economic output. However, the share of population-serving industries, such as health, education and social care, is increasing as key drivers of jobs growth in regional centres.[88]

The contribution of capital-intensive industries to the NSW economy remains significant, although employment in these industries continues to decline.[89] These industries – which include agriculture, forestry and fisheries, and mining – directly contribute 5.5% of the State's output. That relatively modest direct contribution to output masks their importance to the NSW economy; goods produced through mining and agriculture account for over half of NSW's exports and these industries provide a solid local economic base for many long-established regional towns.[90] Professional and technical services supporting these sectors also contribute to the economy.

The future performance of capital-intensive industries, including agriculture, mining and manufacturing, will be heavily influenced by the cost, quality and security of available freight, energy and water networks, alongside access to agricultural land (see Figure 3.4).

Leveraging existing strengths in regional NSW

The NSW Government's *20-Year Economic Vision for Regional NSW* (Regional Economic Vision) outlines the State's overarching plan for driving sustainable, long-term economic growth in regional NSW. It sets out a plan and framework for how the NSW Government will establish foundations for businesses to invest in regions.

To support the Regional Economic Vision, the Government has established the $4.2 billion Snowy Hydro Legacy Fund aimed at delivering critical infrastructure and priority initiatives in regional NSW. The Fund focuses on initiatives in the following five domains:[91]

- **Special Activation Precincts (SAPs)** aimed at increasing business activity and investment through coordinated land use planning, and provision of common use infrastructure (see Box 3.3)
- **freight link enhancements** to maintain and improve the competitiveness of goods produced in regional NSW, through efficient last-mile connections and connections to export facilities
- **rail and road passenger transport connectivity** to make travel between/within regional centres and with metropolitan areas faster and more convenient
- **water security** in priority catchments through investment in catchment-scale infrastructure such as pipelines, weirs and dams
- **digital connectivity** in regional locations through shared infrastructure to increase digital access, and improving mobile coverage and options to enhance high-capacity data links to Sydney.

Opportunities associated with SAPs should remain a priority of the NSW Government, particularly where the Australian Government's investment in Inland Rail can be leveraged. This includes strengthening the reliability and capacity of

regional freight road and rail networks, taking a strategic approach to land use planning, and delivering enabling infrastructure to facilitate housing supply for local workers (see Chapter 4 for more). Ensuring accessibility to essential services, such as health and education, will be key to attracting workers and investment to these areas.

Other regional centres, such as Orange, Port Macquarie and Bathurst, are important hubs for economic activity in regional NSW. Opportunities in the agriculture, healthcare, transport and logistics, and education and training sectors are expected to drive future growth.[92] With fast population growth in these centres, long-term planning will be important to ensure these areas have the right infrastructure and services.[93]

Beyond the SAPs and existing regional hubs, corridor-wide improvement programs to overcome safety and reliability issues that impact freight and supply chains are needed to support regional growth and liveability.

Transport for NSW has developed corridor strategies that will address these challenges in part – including strategies for the Princes Highway and the Golden Highway, among others. Complementary priorities include improving first-and last-mile connections on local roads, augmentation of pinch points and corridor-level enhancements that allow for the safe and efficient use of High Productivity Vehicles (HPVs).[94] These incremental improvements should remain a priority of the NSW Government.

Box 3.3

NSW Special Activation Precincts[95,96]

A Special Activation Precinct (SAP) is a dedicated area in a regional location identified by the NSW Government to become a thriving business and industrial hub. The following SAPs have been identified within NSW:

- **Moree SAP:** a business and intermodal hub specialising in high-value agriculture, logistics and food processing
- **Narrabri SAP:** an energy hub that targets existing and emerging industries such as value-added production, manufacturing, and freight and logistics
- **Parkes SAP:** a hub that leverages its strategic location within NSW's freight and logistics network to establish Australia's largest inland port, with up to 3000 jobs created across a range of industries, including advanced manufacturing, renewable energy and recycling
- **Snowy Mountains SAP:** a year-round tourism hub that drives improvement for regional amenity and access, and grows the region into a national training base for snow sports
- **Wagga Wagga SAP:** a hub that will capitalise on its strategic location servicing the Riverina-Murray agricultural region. Estimated to create between 3000 and 6000 new jobs across freight and logistics, advanced manufacturing, recycling and renewable energy industries
- **Williamtown SAP:** centred around the Royal Australian Air Force base, and expected to support the creation of 4300 jobs, primarily in the defence and aerospace industries.

Regional Job Precincts (RJPs), an extension of the SAP program, seek to deliver faster planning approvals to drive growth, investment and development opportunities. RJPs are currently planned in Albury, Richmond Valley, South Jerrabomberra and Namoi Region.

There is also significant opportunity associated with the State's transition towards a Net Zero economy. The NSW Government's commitment to achieve Net Zero emissions by 2050 and the adoption of the *Electricity Infrastructure Roadmap* presents challenges and opportunities for regional economies – particularly for locations designated as Renewable Energy Zones (REZs). Managed well, the transition to renewable energy generation, transmission and storage has the potential to create new jobs, increase private sector investment and lead to new economic opportunities. Harnessing these opportunities requires a long-term plan involving local communities and industry, and reskilling of the workforce over time (see Chapter 6 for more).

Water security is also crucial for regional NSW economies that rely on primary industries such as agriculture and forestry. For example, over recent decades the Central West has had to adapt to climate change impacts that have heightened water security issues, including increased frequency of droughts.[97] For regional economies where water security is fundamental to economic growth, strategic land use planning and infrastructure investment need to be supported by initiatives and regulation that lead to efficient management, allocation and use of the limited water supply available (see Chapter 7 for more).

Efficient and convenient transport networks for regional communities

In regional NSW, growth in population-serving industries such as health and hospitality is held back by labour shortages. This is a significant concern for larger regional centres that serve as hubs for people to access jobs and services. Government can facilitate labour availability by improving public transport links to employment and service centres to, and within, large regional centres and providing infrastructure that supports growth in housing supply.

This includes housing for the workforce directly engaged in delivering essential public services such as teachers, police and health workers in circumstances where the private market is constrained (see Chapter 4 for more).

The availability of transport options within and between regional centres, beyond private vehicles, is important. Transport for NSW is progressively delivering the 16 Regional Cities Services Improvement Program, aimed at improving regional bus services to provide better connections for people in regional communities travelling to work, school, health services and social and recreational activities.[98] Identified as a priority initiative in *Future Transport 2056*, the program has been delivered to two out of the 16 regional cities. Delivery of the program to the remaining regional cities should remain a priority of the NSW Government.

3.5 A competitive visitor economy supported by cultural and sporting facilities

Cultural and sporting infrastructure help mould the State's identity and contribute to the State's economy and competitiveness by attracting skilled workers and visitors (see Box 3.4). The visitor economy contributed $38 billion to the Gross State Product (GSP) and supported almost 300,000 jobs prior to the COVID-19 pandemic. The NSW Visitor Economy Strategy 2030 target is to grow total visitor expenditure to $65 billion by 2030 and return visitor numbers and expenditure to pre-COVID levels by 2024.

Investments in cultural and sporting infrastructure have been guided by Infrastructure NSW's 2016 Cultural Infrastructure Strategy,[99] Create NSW's Cultural Infrastructure Plan 2025+,[100] NSW Stadia Strategy 2012[101] and the Office of Sport Strategic Plan 2020-2024.[102]

Many projects identified in earlier cultural and sporting strategies have been implemented or are in delivery. Significant cultural infrastructure projects delivered and underway include the Art Gallery of NSW – Sydney Modern, Walsh Bay Arts Precinct, the Powerhouse Museum Program (Parramatta, Ultimo and Castle Hill) and upgrades of the Australian Museum and the State Library.[103,104] Major stadium and sporting investments have also been delivered or are underway, with the Western Sydney Stadium completed in 2019 and Sydney Football Stadium

due to be completed in 2022. Planning and investigation is underway for the new Penrith Stadium, announced by the NSW Government in 2021.

The Government has also supported infrastructure at a local and regional level through cultural funding programs such as the Creative Capital and Regional Cultural funds, and community sport facility funds such as the Greater Cities and Regional Sport Facility Fund, Multi-Sport Community Facility Fund and, more recently, WestInvest.[105]

With many projects now completed or underway, a review of progress against earlier strategies is warranted. The evolution of the new Six Cities approach to strategic regional planning also means that a needs analysis is required for assets not identified previously and those that could serve broader purposes across the six cities. This review should recognise the interdependence between sporting and cultural facilities and the visitor economy, including opportunities to invest in regional NSW to enhance the visitor economy outside metropolitan centres.

Ongoing investment should target:

- any remaining significant gaps in the State's portfolio of cultural, sporting and tourism assets
- alignment with population growth patterns, including investment alongside future growth in Sydney's Central and Western Parkland Cities, and regional hubs
- representation and accommodation of diverse cultures and communities, including NSW's rich Aboriginal heritage and contemporary culture
- greater engagement through new local and digital access opportunities
- renewal and maintenance of existing infrastructure, as well as the development of new fit-for-purpose facilities.

Box 3.4

Infrastructure to support the visitor economy

Infrastructure to support the visitor economy can include transport and strategic assets (like key gateways and utilities), accommodation, venues, attractions (including cultural infrastructure) and amenities such as parklands and parking. These assets are spread throughout regional and metropolitan areas and a wide range of public and private sector organisations are responsible for them.

As recommended in the 2018 SIS, the NSW Government has been working to develop a 20 Year Visitor Economy Infrastructure Strategy to outline how all levels of government, the community and private sector can collaborate to achieve great outcomes for visitors. This includes coordinating and aligning with regional place strategies, developing a visitor infrastructure pipeline of specific projects and priorities, and growing the data and evidence to support better policy and infrastructure planning for the visitor economy.

3.6 Recommendations

Recommendations in this section of the 2022 SIS are focused on the transport sector, which is only one of the key elements for boosting productivity and competitiveness. Recommendations relating to other sectors are set out in Chapters 4 to 11.

No	Recommendations	Implementation timeframe	Lead agency
1	**Invest in public transport networks to support the growth of Greater Sydney**		
	a. Deliver rapid bus networks that service key centres and corridors across Sydney, with a priority focus on Parramatta Road and Victoria Road.	Immediate Priority	Transport
	b. Invest in programs to lift the capacity, reliability and operational efficiency of existing Sydney Trains networks including the More Trains More Services (MTMS) program and the Digital Systems Program component of the MTMS.	Immediate Priority	Transport
	c. Preserve corridors needed for future extensions to the Greater Sydney metropolitan rail network, with an initial focus on links to improve connections between Parramatta to Epping and Parramatta to Kogarah.	Immediate Priority	Transport
	d. Improve public transport within the metropolitan cities of Newcastle, Central Coast and Wollongong.	Extended Program	Transport
2	**Produce detailed prioritised lists of smaller improvement and optimisation works** for existing metropolitan road and rail networks for inclusion in the upcoming Services and Infrastructure Plans: – specific detail on pinch points, technology upgrades, asset hardening and other improvements that have been prioritised for action – basis for prioritisation – timing and delivery strategy.	Immediate Priority	Transport
3	**Progressively deliver the Western Parkland City Transport Program to meet emerging and long-term demand from Western Sydney International (Nancy-Bird Walton) Airport and the Aerotropolis**		
	a. Deliver the enabling road network for the Aerotropolis, including Elizabeth Drive upgrade, Eastern Ring Road and Fifteenth Avenue.	Immediate Priority	Transport
	b. Deliver a rapid bus network (including new fleet, services, technologies and infrastructure) between the Western Sydney International (Nancy-Bird Walton) Airport and key metropolitan centres of Liverpool, Campbelltown and Penrith.	Immediate Priority	Transport

No	Recommendations	Implementation timeframe	Lead agency
	c. Preserve corridors to protect long-term options for a future mass transit network to and within the Western Parkland City. Initial priority corridors include: – Sydney Metro West extension from Parramatta to Western Sydney International Airport – Sydney Metro North West to Sydney Metro Western Sydney International Airport connection – Sydney Metro City and South West from Bankstown to Liverpool – Sydney Metro Western Sydney International Airport extension to Campbelltown-Macarthur – Rail line linking Bradfield City Centre, Leppington, Liverpool, and Parramatta.	Extended Program	Transport
4	**Progressively fund and deliver the Fast Rail Strategy based on a prioritised and staged program of network enhancements**		
	a. Define stages and sequencing for the delivery of the Fast Rail Strategy that take into account demand and economic development objectives.	Immediate Priority	Transport
	b. Fund a long-term annual investment program at a level that ensures a sustained program of work.	Extended Program	Transport
	c. Finalise a detailed delivery strategy that considers the staging/sequencing as well as network operations, possessions and procurement approach.	Extended Program	Transport
5	**Deliver next stages of the 16 Regional Cities Services Improvement Program to enhance regional NSW connectivity,** including additional public bus, active transport and on-demand service options for greater customer convenience	Extended Program	Transport
6	**Plan and deliver projects to increase the efficiency and reliability of freight networks in regional NSW**		
	a. Develop a prioritised and actionable investment program to enhance the regional freight network through: – better local connections, in particular first- and last-mile connections on local roads – corridor-level enhancements to improve connectivity, safety, network resilience and accessibility for High Productivity Vehicles (HPVs), including augmentations to alleviate key pinch points such as road and bridge capacity upgrades, level-crossing removals and addressing inadequate road geometry – options to capitalise on the Australian Government's Inland Rail project and its associated programs.	Immediate Priority	Transport
	b. Plan for the next stages of the Northern Sydney Freight Corridor augmentation before demand for rail freight between Newcastle to Sydney reaches capacity within the next decade.	Medium Term Need	Transport

No	Recommendations	Implementation timeframe	Lead agency
7	**Support the growing Greater Sydney freight task through investments and initiatives that leverage existing and emerging international gateways**		
	a. Pursue previously identified pinch points and bottlenecks, including: – strategic road network enhancements at the Moorebank intermodal precinct, the M5 and the Liverpool CBD bypass – Parramatta Outer Ring Road and Parramatta CBD bypass.	Immediate Priority	Transport
	b. Optimise efficiency along the Sydney Gateway to Port Botany international gateway corridor through: – strategic land use planning and transport network enhancements – investigation of options to augment the missing link between the Sydney Gateway and Port Botany, including opportunities for private sector co-funding.	Immediate Priority	Transport & Planning and Environment
	c. Preserve corridors to enable future delivery of dedicated freight rail lines, including the: – Western Sydney Freight Line – Lower Hunter Freight Corridor.	Immediate Priority	Transport
	d. Develop and implement initiatives to boost freight efficiency and capacity of the metropolitan shared rail network, consistent with findings of the *2021 Auditor-General's Report on Rail freight and Greater Sydney.*	Immediate Priority	Transport
8	**Undertake strategic land use planning and corridor protection to enable efficient movement of both container and bulk freight in the future**, including:		
	a. Expansions to Greater Sydney's intermodal network such as the Mamre Road Precinct, and effective management of surrounding land uses and transport network.	Immediate Priority	Transport
	b. Define shortlisted options to protect land for a future bulk freight receivable site in Western Sydney.	Immediate Priority	Transport
	c. Undertake transport network planning to support the future second container port at Port Kembla, including road and rail linkages to major logistic hubs such as Western Parkland City.	Extended Program	Transport
9	**Review progress of cultural and sporting infrastructure strategies and investigate new investment opportunities to support the visitor economy**	Immediate Priority	Enterprise, Investment and Trade

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Service growing communities

04

Barangaroo Reserve, Infrastructure NSW

IN THIS SECTION

Strategic directions

- Deliver housing in great neighbourhoods for all parts of the community
- Improve access to efficient, quality services through better use of assets and a better mix of physical infrastructure and technology-enabled solutions
- Continue NSW's investment program in sectors that require renewal, with a focus on TAFE and Justice

Infrastructure delivers fundamental human services, underpins community liveability and supports positive social and economic outcomes for NSW citizens.[106]

The NSW Government also has a vision to attract and retain skilled people and investment in talent-based industries from around the world.[107] Those people will relocate to NSW if services and infrastructure support a good quality of life.

4.1 NSW should plan for ongoing population growth

One in three people living in Australia resides in NSW.[108] However, historical levels of population growth have been interrupted as a result of the COVID-19 pandemic, with travel restrictions resulting in a significant drop in migrant arrivals.

Annual population growth in NSW slowed from 1.1% in the 12-month period ending March 2020, prior to the pandemic, to 0.3% in the 12-month period ending June 2021.[109,110] As a result, the NSW population projections have been revised down from 10.6 million by 2041 to 9.9 million in the Q2 2022 update developed by the Department of Planning and Environment (DPE), as shown in Figure 4.1.[111]

The last two years saw people moving from the major metropolitan centres, like Sydney, to regional areas. However, Sydney is still expected to grow and remain the dominant centre for population growth in all scenarios.[112]

At the time of this Strategy's release, there is greater than usual uncertainty around population projections as the long-term impact (if any) of the pandemic on migration flows cannot yet be determined. DPE has been updating its population projections on a quarterly basis, using a scenario-based approach, to reflect future uncertainties during this period.

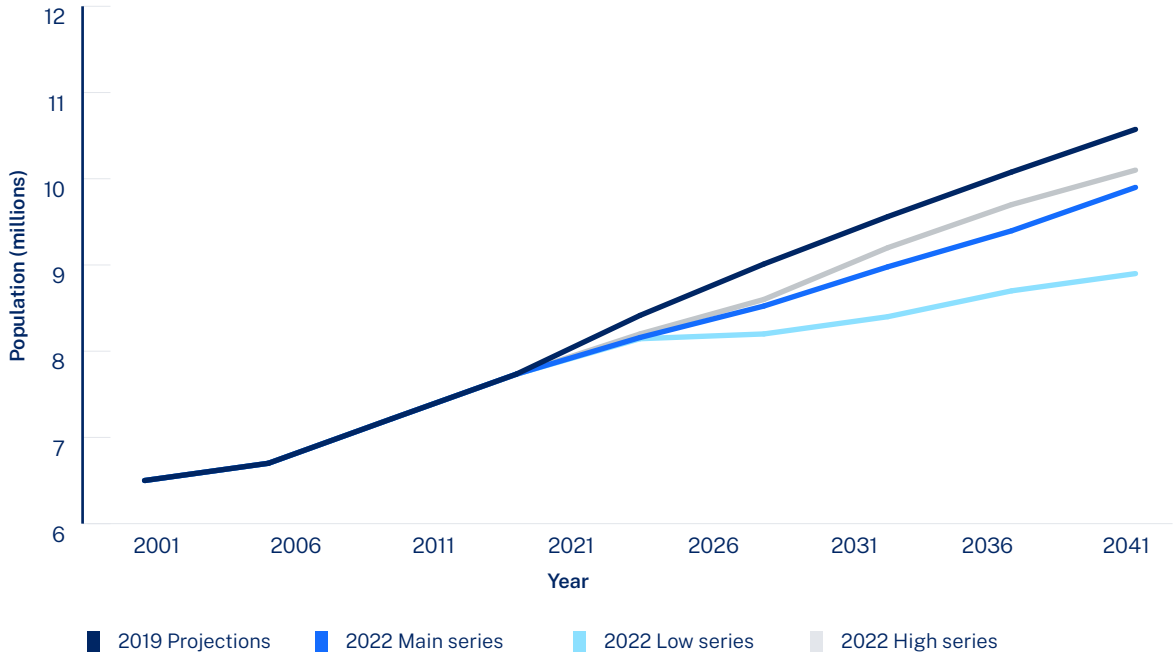
Several factors will affect whether lower than trend growth persists. First, the extent of hybrid and remote work over the long term could encourage people to relocate outside Greater Sydney.[113,114] Second, the speed at which cross-border migration recovers to pre-pandemic levels will affect the State's population growth and demographic profile.

Broader global dynamics and uncertainties will also shape population growth and the attractiveness of NSW as a destination of choice by migrants. These include:

- impacts of political instability overseas, and potential climate change disruptions
- competition for skilled labour, particularly around STEM capabilities in knowledge industries
- falling fertility rates across both developed and emerging economies, as well as increasing life expectancy as a result of improved healthcare.

Faced with these uncertainties, it is prudent to adopt a flexible approach to long-term planning whereby central assumptions are tested regularly to inform future investment decisions. However, with 'lumpy' infrastructure (where there are large up-front costs), it is better to be a little ahead of demand than behind. NSW should therefore plan and prepare for ongoing growth.

Figure 4.1 – NSW population projections to 2041[115]



Source: DPE Common Planning Assumptions (Q2 2022)

4.2 Access to housing is critical for a flourishing community

Access to housing supports participation in work, education and the community[116] and is essential to wellbeing and prosperity. It also influences future demand for health and social services.[117] The NSW Government has a role in housing to:

- facilitate general housing market supply to enable households with median incomes to buy or rent housing
- facilitate supply of affordable rental housing for eligible households on lower incomes or facing disruption, including workers involved in providing essential services (for example, food and essential groceries, caring services, sanitation and fuel supplies)
- supply and manage social housing for households on persistently low incomes, often with full or partial reliance on social security payments, and those seeking crisis housing such as victims of domestic violence
- support housing for workers who provide essential frontline public service delivery (such as teachers, healthcare workers and police) in regional and remote locations where there are barriers to an efficient private housing market.

Housing supply and affordability remain a challenge and a priority for the NSW Government. House prices have risen sharply through 2020 and 2021.[118] The homeownership rate is projected to decline from 66% today to 58% by 2060-61. If those who retire without owning a home require social housing at a similar rate to today's retirees, this will increase demand for social housing by 68,000 households by 2060-61 and cost an additional $12.1 billion (2019-20 dollars).[119]

The NSW Government has released the *NSW Housing Strategy: Housing 2041*, which aims to drive housing supply, diversity, affordability and resilience. It looks to achieve this by:

- using data and evidence-based decision making to increase transparency and coordination of the housing and enabling infrastructure delivery
- implementing planning and regulation reforms to facilitate faster planning assessments and reduce rezoning timeframes
- leveraging government-owned land, investment and assets, including continued investment in social housing and support for the supply of suitable housing for essential workers.[120]

In 2019, DPE projected that Greater Sydney would require 1 million additional homes by 2041. It was also expected that 3.5 million people may live in regional NSW, requiring an additional 290,000 homes.[121] These projections did not fully reflect the impact of the COVID-19 pandemic, the long-term impact of the 'Black Summer' bushfires and the 2022 floods, but they highlight the scale of the demand for housing over the next 20 years. Meeting this demand will require the Government to deliver an ongoing program of investments and complementary initiatives.

Coordinating infrastructure delivery with new housing supply

Adequate housing supply requires timely provision of infrastructure aligned with rezonings and approvals. The State provides infrastructure to support new homes including road upgrades, public space and some community facilities, which are often developed in cooperation with local government and private sector developers. While commonplace, the rate at which such infrastructure is confirmed and provided is a significant influence on the capacity of the private sector to plan, finance and implement their own investment program. On this front, issues have been reported across numerous locations of the State, including Western Sydney, the Hunter region and parts of regional NSW – many of which are greenfield. The highest greenfield priorities for new housing and infrastructure are in North West and South West Sydney, Greater Newcastle and the Hunter, and in regional centres where Special Activation Precincts and Regional Job Precincts will create demand for homes. These areas should be prioritised for infrastructure delivery.

There are more general initiatives designed to improve the coordination of infrastructure delivery. In Greater Sydney, DPE has established the Urban Development Program (UDP) to monitor housing and employment land supply and to facilitate infrastructure coordination.[122] The UDP seeks to provide more transparent, detailed and accessible data on housing and land rezonings to all stakeholders, promote broader and earlier

industry and government engagement, and improve coordination of infrastructure service delivery needed in greenfield and brownfield areas where housing is delivered by the private sector. There are plans to enhance the UDP Dashboard, which brings together housing data into a central repository on DPE's website.

For regional areas, the NSW Government has established the Regional Housing Taskforce to investigate regional housing issues and planning barriers. The taskforce has identified enabling infrastructure as a key requirement to support growth in housing supply.[123] Measures to promote the coordination of planning and infrastructure are discussed in Chapter 10, but some recommendations are provided in this chapter on infrastructure investment programs required to support existing rezoned land (greenfield and infill).

The Regional Housing Taskforce has also found that there is need for increased availability of diverse and affordable rental housing in regional and rural areas to attract and retain essential workers (Box 4.1). This includes those who deliver critical frontline public services such as education, healthcare and emergency services.[124]

Box 4.1

Housing supply is critical to attracting workers and investment

Access to affordable and quality housing is a key enabler for prosperous and thriving communities. Workers often avoid accepting employment in areas where appropriate housing is unavailable. This can disrupt business activity and the provision of critical frontline public services like policing, health and education. This poses a risk to NSW agencies' goals of providing equity of access to services regardless of location.[125]

This is a particularly prominent issue in regional NSW, given that regional house prices rose by 29.8% in the year to December 2021 compared to Sydney price rises of 25.3%.[126] Rental vacancy rates in regional NSW have experienced a sharp decline.[127] Lack of access to housing is a significant impediment to attracting staff to regional NSW. Ensuring an adequate and diverse supply of housing will be critical to addressing skills shortages, particularly in areas that are a focus of government investment, such as the SAPs.

The Regional Housing Taskforce recommended the NSW Government:

- facilitate the strategic use of government-owned land to provide improved housing outcomes, including identifying priority sites for housing and the removal of policy barriers that prevent utilisation of existing government land and property assets for housing
- establish an ongoing program to deliver new and renewed social and affordable rental housing in the regions through partnership between government housing providers, local government and the community housing sector
- review incentives and planning controls for affordable and social housing
- reduce barriers to Public Private Partnerships (PPPs) that deliver social and affordable housing, and housing for essential workers
- prioritise diverse and affordable housing through regional and local strategic plans.[128]

The Department of Regional NSW is working with the Regional Housing Taskforce and DPE to deliver Regional Housing Delivery Plans in the second half of 2022. These plans will provide place-based solutions to support housing supply for regional areas.

Align funding approval processes with the nature of works

Some sources of funds in the NSW Government have particularly high levels of rigour and staged decision making, often involving several agencies. This is warranted where there are competing demands on earmarked funds or high levels of complexity and risk. However, it is not so well suited to more routine and incremental infrastructure that supports housing supply.

For example, funds from Restart NSW have been used to support housing supply, including around $767 million for the Housing Acceleration Fund (HAF). However, funding allocations from Restart NSW involve significant degrees of evaluation and administration with business cases, stages of approvals and funding deeds, despite efforts to streamline these processes.

Programs of more routine State infrastructure may require funding sources and processes that are proportionate to the complexity of the infrastructure, the rolling nature of investment and the timeframes required to support private sector investment.

Delivering social and affordable housing for those in need

The 2018 State Infrastructure Strategy called for a greater focus on social housing. Since then, as a result of tight housing market conditions, demand for social housing has increased. Between 2012 and 2020, the number of social housing dwellings increased by 5% in NSW, from 146,199 to 153,877.[129] However, this has not been enough to keep pace with demand or to maintain quality standards:

- Over the 12 years to 2021, unmet demand for priority social housing assistance increased by 77%.[130]
- Lack of capital is a major constraint to social housing development, as public social housing supply is funded from tenant rents and sales of other social housing dwellings.
- As at 30 June 2021, more than 100,000 people were waiting for social housing, which equates to over 50,000 extra homes.[131]
- 90% of these people wait 10 years, on average, to be allocated social housing.
- Over 2400 women are estimated to have returned to living with a violent partner because of a lack of an affordable alternative, with a further 2410 becoming homeless after fleeing domestic violence, as at October 2021.[132]
- Much of the portfolio is under-occupied – about 77% of all applicants require smaller homes, while almost half of Government social housing is larger properties with three or more bedrooms.[133]
- Unmet demand for Aboriginal housing is expected to result in an undersupply of more than 12,500 homes by 2031, more than twice the current stock.[134]

Across NSW, while properties meet the Residential Tenancies Act 2010 housing quality requirements, 10% of government-managed social housing sits below the Land and Housing Corporation's own quality standards.[135] It is estimated that without funding injections, the Government could lose more than 3000 social housing properties over the next 10 years due to untenantable properties, write offs and disposal.[136]

The 2020-21 economic downturn placed further pressures on social housing, increasing the risk of homelessness and demand for temporary accommodation.[137,138] Priority households on the social housing register increased by 29% between 2019-20 and 2020-21. Social and affordable housing pressures in regional NSW have been an ongoing issue due to factors including planning issues, limited land availability, low value land, lack of capital and the size and expertise of the development sector in regional NSW.[139,140] However, the spike in demand over 2020-21 amplified declining rates of vacancy and affordability, with private market rents increasing by 10% and vacancy rates falling below 1% in some regional communities.[141]

In addition, impacts of natural disasters are often disproportionately felt by the most socially and economically vulnerable people and households. These are often the largest consumers of government services; therefore, the greatest gains in wellbeing can be achieved by prioritising investment to reduce risk for these communities.[142] Well-located social housing, improved maintenance and, where required, upgrades of social housing assets should ensure that tenants are safe and protected from shock events, including from under- and over-heating and flood exposure.[143, 144] There are well-established benefits for tenants from designing and maintaining social housing to modern standards and integrating social housing in mixed tenure communities that are resilient and well-connected to services and infrastructure.[145, 146]

NSW agencies are examining how current and emerging social housing funding models can stimulate additional supply and higher quality.[147] Agencies are examining the impacts of current development approval processes and how improved partnering with local councils, community housing providers and the private sector can increase supply. The Regional Housing Taskforce has recommended reviewing funding and financing arrangements for regional NSW due to the scale of social and affordable housing challenges.[148] Given the considerable undersupply and critical enabling role that stable housing provides, identifying and implementing a revised funding model should be prioritised. A revised funding model should:

- stimulate supply in locations of greatest need, and for a range of land values
- support cost margins that enable mixed tenure, rather than perpetuating concentrations of social housing
- leverage upfront investment for shared community and commercial benefits.

4.3 Great neighbourhoods with open spaces and amenities

Community wellbeing is supported by access to open and recreational spaces, such as parks, sporting and cultural facilities, as well as infrastructure that supports walking and cycling (active transport). Every kilometre walked or cycled helps to improve health by raising physical activity levels and reducing the burden of non-communicable diseases, as well as supporting improved mental health.[149,150] Active transport also helps to reduce congestion on other modes of transport.[151] The importance of open and recreational space was highlighted throughout the pandemic and is expected to increase as urban density rises.

Active transport infrastructure should be planned and considered alongside education, sporting and cultural facilities. Access to infrastructure that supports active and healthy lifestyles must be embedded in development approvals for new residential communities and for urban renewal projects. Integrating open space and active transport infrastructure into existing assets is one of the key design principles highlighted by the NSW Government Architect.[152] It creates opportunities for existing infrastructure to support multiple purposes. Linear transport infrastructure, such as transport corridors and waterways, can provide better links for existing assets. The public realm of new vertical infrastructure, such as hospitals, schools, aged care facilities and social housing, can also support the creation of more open space.

However, there are serious barriers. Insufficient local infrastructure contributions have, in some cases, meant that councils do not have adequate funding to purchase land in the early phases of development. In response to funding shortfalls and rising community demand, DPE launched the Public Spaces Legacy Program and Streets as Shared Spaces program to provide grants to convert underutilised streets into green urban spaces.

Box 4.2

Public Spaces Legacy Program

DPE is delivering a $250 million NSW Public Spaces Legacy Program as part of ongoing work to protect the health of the community, provide economic stimulus in response to the COVID-19 pandemic and deliver a legacy of safe, quality public and open space.[153]

The program, launched in August 2020, provides grant funding for public space improvements, giving local councils an incentive to accelerate their assessments of development applications (DAs) and rezonings to create new development capacity and meet demand for housing and employment over the next decade.

Projects in over 60 local government areas have been approved as part of the program. Projects include a diverse range of public open spaces including new and improved walking and cycle paths, parks, trails and boardwalks, lookouts, foreshores and riverfronts, play spaces, civic plazas, and outdoor event and performance spaces.

4.4 Partnering with Aboriginal communities

Many opportunities exist to engage and partner with Aboriginal communities to improve access to infrastructure, services and employment. Combined with the right approach to collaboration, these opportunities can enable the achievement of better outcomes for Aboriginal people.

For example, DPE's Roads to Home program seeks to improve quality of life and local economic opportunities for Aboriginal communities through upgrades to essential roads and associated infrastructure that improves access to emergency services, waste collection, postal delivery and community transport. Currently, the Roads to Home program is supporting 33 of the 61 discrete Aboriginal communities across NSW.[154]

Beyond providing access to basic services, the delivery of essential infrastructure can allow Aboriginal communities to leverage the economic opportunities presented by their land holdings.

Overcrowding and poor-quality housing in remote Aboriginal communities is an ongoing challenge.[155] Targeted funding for new supply and maintenance of Aboriginal housing can improve living conditions and help reduce homelessness and overcrowding. However, the recent round for funding applications from the Aboriginal Community Housing Infrastructure Fund suggests there is a backlog of maintenance and investment needs for Aboriginal housing.[156]

Tackling overcrowding and inadequate housing – which contribute to economic and social disadvantage through impacts on health and educational outcomes[157] – are key objectives of the National Agreement on Closing the Gap (see Box 4.3).[158]

The priorities of the NSW Government are to deliver high quality services, improve social outcomes and break the cycle of disadvantage for NSW citizens. To support these priorities, infrastructure planning needs to focus on facilitating wellbeing outcomes by targeting specific community needs and ensuring that quality services are available to all NSW citizens, including vulnerable and Aboriginal people.[159]

Infrastructure planning must also include meaningful engagement with communities, particularly Aboriginal communities, to ensure the right needs and evidence-based aspirations are identified. To develop their *Strong Family, Strong Communities* housing strategy, the Aboriginal Housing Office undertook 'Listen and Yarn' engagements across the state to co-design solutions that meet the needs and aspirations of Aboriginal communities.

Box 4.3

Infrastructure's role in the National Agreement on Closing the Gap

Signed in July 2020, the National Agreement on Closing the Gap commits all State and Territory governments to achieve better life opportunities and wellbeing for all Aboriginal people.

There are implications for infrastructure across all identified priority reform areas. Priority Reform 5, specific to NSW, seeks to empower Aboriginal people to access pathways to education, training and employment that align with their aspirations, and enable Aboriginal businesses to grow and flourish. Infrastructure is an enabler for training and educational services and an integrated approach to procurement across the NSW Government will offer opportunities for government to better engage with Aboriginal businesses (see Chapter 11 for more).

Among the 17 socio-economic outcomes and corresponding targets set to measure progress on Closing the Gap, those relevant to infrastructure are:

- **Outcome 9 target:** to increase the proportion of Aboriginal people living in appropriately sized (not overcrowded) housing to 88% by 2031, supporting appropriate, affordable housing that is aligned with their needs
- **Outcome 17 target:** for Aboriginal people to have equal levels of digital inclusion by 2026, enabling participation in informed decision making regarding their own lives.

4.5 Meeting future demand and modernising social services

As the State population grows, so too will demand for government services. At the same time, changing demographics, technology, customer preferences and community needs mean that government services will need to continuously adapt.

Government approaches to service planning, design and delivery will need to consider affordability, efficiency and innovative delivery models. Greater adoption of innovative service delivery including use of digital and technology solutions was one of the key directions of the 2018 SIS, and it is even more relevant for this Strategy. The rapid acceleration in take up of digitally-delivered government services during the pandemic brought forward a level of acceptance that would not have previously been thought possible.

There are many opportunities across the NSW Government for adopting digital solutions in service delivery. This includes home-based virtual care, disability services, remote learning and digital courts. Administrative services delivered by government also present significant opportunities through digitisation, such as registrations, licence renewals, development approvals and land valuation (see Chapter 9 for more).

Infrastructure planning should be done on the basis that a larger proportion of government services can be delivered through digital means and support this outcome.

Complementing more digital services, physical government facilities need to be modernised and potentially relocated for better service delivery. In some cases, existing assets are not in locations aligned with demand. Even if they are in the right locations, some facilities are outdated and no longer suitable to meet modern service needs. Regional courts are examples where existing assets are ageing and no longer fit for purpose; in many places, courts are located in old buildings that can't be retrofitted with equipment and engineering – such as digital connectivity – to meet modern service needs.

Co-location of physical government facilities and services can streamline customer experiences and reduce complexity for citizens. In regional and rural areas, with lower population density, citizens would benefit from greater co-location of services so that infrastructure can be used for multiple purposes.

Where assets are poorly located or unable to support modern digital services and co-location opportunities, divestment of these assets should be considered. Sale of assets can support greater benefits by generating revenues for investment in new local assets, and divested assets also have the potential to be repurposed by the private sector. There are many instances in which heritage assets have been refurbished and repurposed by the hospitality sector; for example, old sandstone government buildings have been converted into hotels or restaurants that support the visitor economy.[160]

Box 4.4

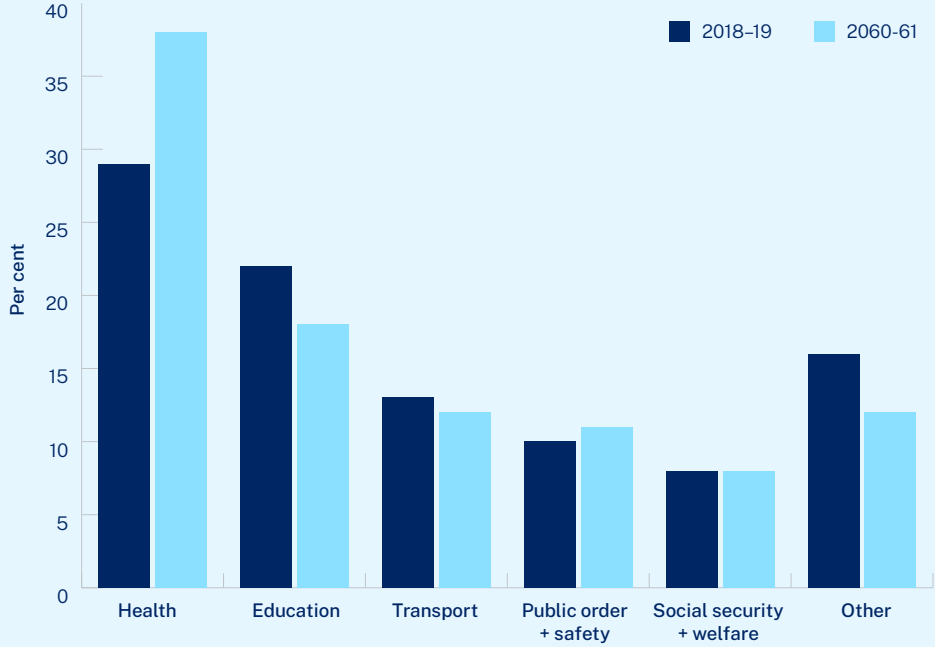
Projected growth in NSW Government spending on services

According to NSW Treasury's *2021 Intergenerational Report*, NSW Government's recurrent spending (that is, spending on non-capital expenses to deliver services – such as salaries for teachers and nurses, and other day-to-day costs incurred with service delivery) is projected to grow faster than the pace of the economy.

In 2018-19, total government recurrent spending represented 12.5% of Gross State Product (GSP). This number is projected to increase to 14.5% of GSP by 2060-61, if no changes are made to government policy settings and the way in which services are delivered.

As shown in Figure 4.2, spending on health services is projected to be the biggest component of government expenses by 2060-61, representing nearly 40% of total recurrent expenditure.

Figure 4.2 – Recurrent expenses by service area as a share of total recurrent expenses



Source: NSW Treasury 2021[161]

4.6 Stay the course on sector-specific strategies

Health and Education infrastructure strategies are well underway

NSW Health's *20-Year Health Infrastructure Strategy and eHealth Strategy* outline the NSW Government's approach to planning, modernising and investing in the State's health services. These strategies have a greater focus on virtual and digitally enabled care in non-hospital settings such as home-based care. Maintaining and making better use of existing built assets, complemented by initiatives to reduce demand such as the *NSW Healthy Eating and Active Living Strategy*, are also highlighted as priorities.

A focus on innovative service delivery models enabled by digital solutions should remain NSW Government priorities. Meanwhile, investment in new built health infrastructure should align with geographic needs and projected growth in demand.

In 2016, the Department of Education prepared the *School Assets Strategic Plan* outlining long-term infrastructure and funding needs to meet projected growth in school enrolments to 2031. Following this, NSW Government funding for new and upgraded schools increased significantly from $2.4 billion in 2016-17 to $4.2 billion in 2017-18. Since its 2017 establishment, School Infrastructure NSW (SINSW) has overseen this significantly larger program of investments, including prioritising projects based on community demand and needs.

However, the 2021 NSW Auditor-General's Report on *Delivering school infrastructure* highlighted that there is scope for SINSW to strengthen its practices in relation to project prioritisation, options development (including design options), investment appraisals and project cost management. Prioritisation of SINSW's capital program should align with geographic needs and projected population-based demand. Coordination with other government agencies – particularly the Department of Planning and Environment and Transport for NSW – is essential and should be actively pursued to ensure there is strong alignment and shared awareness of strategic planning priorities across the State (see Chapter 10 for more).

Courts and Justice infrastructure priorities are an ongoing focus

The forthcoming Department of Communities and Justice (DCJ) 20-year Infrastructure Strategy outlines infrastructure priorities for the cluster. While many of the programs delivered by DCJ do not require physical assets (for example, out-of-home-care services delivered by not-for-profit service providers), the cluster manages an estimated $8.9 billion asset portfolio. This includes assets owned by DCJ (primarily courts), leased by DCJ (such as premises leased to provide services to young people in the community) and owned by DCJ but commissioned out to third parties to operate (such as prisons managed through a Public Private Partnership model).

Similar to directions being pursued by other NSW Government agencies, the DCJ strategy has a strong focus on efficient use of existing assets through proactive maintenance, digitisation of services and operations, outcomes-led planning and applying a portfolio-based approach to strengthen planning and prioritisation of investments.

Growth in service demand will require a particular focus on two types of assets: courts and correctional services. The growing State population continues to put demand pressures on court services. The existing network of courts has insufficient capacity to meet the increasing caseload, particularly in fast growing areas such as South West Sydney. A review of and planning for options to provide modern, fit-for-purpose court facilities in the Sydney CBD is also a short-term priority.

Concurrently, across Greater Sydney, demand pressures on correctional services continue to grow. While the Government's Prison Bed Capacity Program delivered an additional 6000 prison beds between 2016 and 2021 to address short-term constraints, the growing population and associated demand for prison beds means investment in a new correctional facility within Greater Sydney will be needed.[162]

In planning for a new correctional facility, the NSW Government should consider locations, design and complementary programs that best support the *Premier's Priority* of reducing recidivism in the prison population. Visits by family and friends are known to significantly improve outcomes for offenders during their time in prison, and once released. In this regard, the accessibility of a correctional facility for family and friends matters significantly.

TAFE NSW investment should be prioritised

Training and skilling the NSW workforce to meet changing community and industry needs is fundamental to a thriving economy and society. TAFE NSW continues to enrol an increasing number of students, including through blended (virtual and in-person) delivery models. In response to the pandemic, nearly 500,000 students had access to virtual learning and training.[163]

To ensure programs on offer remain relevant, accessible and fit-for-purpose, the *20-year TAFE NSW Infrastructure Strategy* seeks to optimise the existing TAFE asset portfolio through digitisation and upgrades, while ensuring experiential learning is provided through existing and new facilities. Strengthening partnerships and exploring collaboration opportunities with industry is also a key focus. TAFE NSW should be supported to implement the strategy by developing an actionable and prioritised plan that can be achieved over the medium term.

4.7 Recommendations

No	Recommendations	Implementation timeframe	Lead agency
10	**Fund and deliver enabling infrastructure to support approved or pending housing supply**. The initial focus should be on: – North West Growth Areas and South West Growth Areas in Sydney – Greater Macarthur including Wilton, and Greater Penrith to Eastern Creek – Greater Newcastle and Hunter Region new housing areas – regional areas affected by growth in Special Activation Precincts (SAPs) and Regional Job Precincts (RJPs), and areas identified in the forthcoming review by the Regional Housing Taskforce.	Extended Program	Planning and Environment & Transport
11	**Fund and deliver a prioritised active transport infrastructure program to support liveability and 15-minute neighbourhoods** including a connected metropolitan cycling network for Greater Sydney and major regional centres	Extended Program	Planning and Environment & Transport
12	**Establish a financially sustainable social housing and related infrastructure program**		
	a. Deliver a planned and preventative capital maintenance program to improve the quality and extend the life of homes, including properties used as domestic and family violence refuges and for transitional housing.	Immediate Priority	Planning and Environment & Stronger Communities
	b. Deliver a housing program that delivers new and diverse social, affordable and market housing supply to meet demand in partnership with the community housing and private sectors.	Extended Program	Planning and Environment
	c. Develop a sustainable long-term housing funding model that leverages Land and Housing Corporation (LAHC) land, private sector investment and National Housing Finance and Investment Corporation (NHFIC) financing through community housing partners.	Medium Term Need	Treasury & Planning and Environment
	d. Ensure strategic land use plans consider social and affordable housing developments in locations well-connected to key infrastructure, services and amenities, and promote mixed tenure and diverse community outcomes.	Extended Program	Planning and Environment

No	Recommendations	Implementation timeframe	Lead agency
13	**Deliver Aboriginal housing and enabling infrastructure programs in partnership with local communities**, including:		
	a. Recommit to the Roads to Home program.	Extended Program	Planning and Environment
	b. New supply and housing upgrades through current and future rounds of the Aboriginal Housing Office capital works program and Aboriginal Community Housing Investment Fund (ACHIF). Initial priorities in remote areas include Cobar, Broken Hill and Bourke.	Extended Program	Planning and Environment
	c. Initiatives to enhance the Roads to Home Program and the ACHIF to meet basic infrastructure and health needs of remote Aboriginal communities including potable water, electricity, and internet connection.	Extended Program	Planning and Environment
14	**Improve efficiency and service quality in the social infrastructure sectors through co-location, and divestment of legacy assets**		
	a. Pursue opportunities for divestment and adaptive reuse of assets and facilities that no longer meet modern service standards, including those constrained by heritage requirements. Divestment proceeds should be reinvested to deliver local infrastructure and services.	Extended Program	Planning and Environment & Stronger Communities
	b. Explore co-location opportunities to improve customer service and efficiency at key decision points such as new investments and upgrades.	Extended Program	Health, Education & Stronger Communities

No	Recommendations	Implementation timeframe	Lead agency
15	**Establish a prioritised program of investments for Justice and TAFE NSW infrastructure services, and identify options to complement initiatives outlined in the 20-year health and education sector infrastructure strategies**		
	a. Justice sector priorities include: – increasing the operational capacity and capability of courthouses in key locations across regional NSW, including through digitisation and augmentation – providing modern, fit-for-purpose court facilities in the Sydney CBD – delivering additional correctional capacity within Greater Sydney to address existing and projected prison bed capacity issues – developing the investment case for additional court capacity in South West Sydney.	Extended program	Stronger Communities
	b. Progress planning and delivery of key investments consistent with the forthcoming *20-year TAFE NSW Infrastructure Strategy.*	Extended program	TAFE NSW

State Infrastructure Strategy
2022–2042

Embed reliability and resilience

05

Jagumba NSW, photo by Jeff Dowsing

IN THIS SECTION

Strategic directions

- Apply a structured and systematic approach to resilience across multiple asset types, multiple risks and the infrastructure asset lifecycle
- Establish a rigorous and funded program to identify and remedy assets most likely to cause service failure
- Deliver assets that reduce the risk and impact of major natural hazards and shocks

Many infrastructure assets have long lifecycles and need to be resilient to withstand shocks and stresses that compromise performance. Recent experiences have illustrated the pressures that can be placed on infrastructure systems by:

- natural hazards such as severe weather events and changing environmental conditions
- public health crises
- cybersecurity threats and systems failure.

NSW Treasury estimates the 2019-20 bushfire season alone resulted in at least $1.8 billion in direct economic damages and $4.4 billion in costs to the State budget over five years to 2023-24.[164] The floods of 2022 in Northern NSW and the Hawkesbury are too recent to accurately quantify the losses, but they have been devastating for thousands of people, businesses and communities.

The potential impacts of climate change compel the NSW Government to be more alert, more proactive and more thorough in planning, preparing, maintaining and upgrading public assets.

5.1 A whole-of-system approach to resilience

Proactive preparedness and resilience requires a whole-of system, all-hazards approach that addresses both the resilience of individual assets and the contribution of these assets to the resilience of the overall system.[165] This requires:

- identification of weak links and interdependencies in infrastructure systems to bolster likely points of failure by redundancy and asset hardening
- clear accountability across State organisations responsible for infrastructure resilience
- prioritisation of asset maintenance and upgrades as a critical element of the investment program
- collaboration and partnership with asset owners in local government, non-government agencies, the private sector, and local communities that contribute to system resilience.

Strong progress has been made since 2018 in applying lessons from the events experienced by the State to better prepare NSW for the future, as shown in Table 5.1.

Table 5.1 – Key resilience initiatives from the NSW Government since 2017

Strategy and Policy	Standards and Guidance	Investment Programs / Funding	Other
▸ NSW Critical Infrastructure Resilience Strategy[166] ▸ NSW Government Cyber Security Strategy[167] ▸ Asset Management Policy for the NSW Public Sector[168]	▸ Design and Place State Environmental Planning Policy (SEPP)[169] ▸ Planning for a more resilient NSW: Strategic Guide to Planning for Natural Hazards[170] ▸ Guidelines for Resilience in Infrastructure Planning: Natural Hazards[171] ▸ A Pathway to Infrastructure Resilience Joint INSW/IA Advisory Papers[172]	▸ Critical Communications Enhancement Program (CCEP) ▸ Infrastructure Betterment Fund ▸ Safe and Secure Water Program	▸ Establishment of Resilience NSW ▸ Climate Risk Ready NSW ▸ Establishment of Cybersecurity NSW ▸ Independent NSW Bushfire Inquiry ▸ Cross-Dependency Initiative (XDI) NSW Project ▸ NSW and ACT Regional Climate Modelling (NARCliM) Regional Climate Projections ▸ NSW Climate Data Portal

The 2022 SIS outlines an approach that consolidates the progress made to date and recommends the following:

- establish a register of primary hazards and vulnerable locations across the State
- prioritise adaptation of assets and services within these locations that are:
  - most vulnerable to primary hazards
  - most significant in prevention, response and recovery
- develop place-based resilience and adaptation strategies for vulnerable locations across NSW
- targeted asset hardening and adaptation leading to:
  - a program of responses for assets most at risk
  - a comprehensive program of asset management investments and requirements.
- a program of investment in new assets to address primary hazards, including items that have already been assessed, such as Hawkesbury-Nepean Valley flood mitigation and water security projects
- improved accountability for prevention of, response to and recovery from impacts to infrastructure from hazards
- a funding and financing facility to deliver and encourage investment in infrastructure resilience.

5.2 Frequency and severity of impacts are likely to increase

Climate events and natural hazards are varied, becoming more frequent and severe

Not surprisingly, much of the recent attention on climate-induced events has focused on droughts, floods and bushfires, with well-demonstrated impacts on communities, local economies and infrastructure. These events have caused considerable suffering across NSW in just the past three years. However, other climate risks have implications for infrastructure, particularly coastal hazards and extreme heat.

Eighty five percent of the NSW population lives within 50km of NSW's coastline.[173] Approximately half of this is comprised of open-coast sandy shoreline[174] and exposed to significant erosion and flood risk.[175,176] This is compounded by Australia's sea level already rising at a faster rate than global averages.[177] The 2021 and 2022 Eastern Australia floods demonstrated the danger of storm surges combined with extreme rainfall events. Impacts included inundation of homes, stranded communities, disrupted supply chains, damage to coastal defences and major erosion of iconic beaches.

Extreme heat also presents a challenge for critical infrastructure across NSW. This is particularly relevant to urban settings such as Western Sydney, where the urban heat island effect can add two degrees to local warming, in contrast to surrounding vegetated areas.[178,179] One consequence of extreme heat is the high demand placed on energy systems, primarily because of the increased use of air conditioning and cooling systems. Peaks in energy demand can result in system outages, with cascading consequences for commercial and industrial buildings, communications, and transport systems.

The health and economic impacts of heatwaves are profound. Since 1900, heatwave events have been responsible for more premature deaths in Australia than all other natural hazards combined.[180] As a result of climate change, more intense heatwaves are projected to occur more often and last longer: up to 3.5 days more on average by 2070.[181] By 2061, between 700,000 and 2.7 million additional days of work are projected to be lost annually due to more frequent and intense heatwaves.[182] Extreme heat and other natural hazards can also create acute demand pressures on health infrastructure, as current disaster planning processes undertaken by hospitals may not be adequate to meet increased demand during these events.[183]

In the coming decades, NSW's changing climate is expected to result in a greater likelihood and severity of natural disasters.[184,185] NSW Treasury has estimated that the economic costs of more frequent and severe natural disasters could cost the State between $15.8 billion and $17.2 billion a year on average by 2060-61 (real 2019-20 dollars). This is up from $5.1 billion in 2020-21, more than a three-fold increase.[186] These economic costs come in the form of business disruption, lower productivity and damaged infrastructure.

Analysis indicates that a large proportion of NSW's most socio-economically disadvantaged local government areas also experience significant numbers of disaster events.[187] Impacts can be more severe in these communities given their reduced capacity to absorb and adapt.[188] For example, reduced access to services, including adequate housing, health and food services in some Aboriginal communities increased vulnerability to COVID-19 and other health conditions.[189]

Public health crises require increased capacity

The COVID-19 pandemic has demonstrated the value of resilience planning that factors in low likelihood, high impact events. The pandemic continues to place significant stress on health infrastructure and expose vulnerabilities in supply chains, while demonstrating the value of contactless ways of working. It has revealed that policy responses to a specific public health crisis can have flow-on effects for the rest of the economy.

NSW's strong management of the health crisis protected the economy from a more severe recession, in contrast to comparable jurisdictions where health systems failed to keep up with the spike in demand for services.[190] Nevertheless, the Australian and State governments have incurred significant additional expenditure to provide income support and respond to higher demand for social infrastructure and services.

The pandemic response has taught government and infrastructure managers key lessons in resilience. These lessons have demonstrated that:

- Health infrastructure requires a strategic reserve capacity that can be mobilised at short notice, meaning ongoing maintenance, documentation, practice and skills are essential.
- Highly contagious airborne pathogens require new design approaches that incorporate access to fresh air ventilation, circulating clean air and mechanical air systems that can create negative pressure zones – this could apply in many types of public infrastructure including hospitals, schools and public transport.
- Telecommunications infrastructure may experience sudden and sustained spikes in demand from home working.
- Local access to green infrastructure is vitally important, especially public open space and green spaces that support mental and physical health during lockdowns.
- By contrast, some forms of infrastructure, such as airports, public transport and event infrastructure, require an ability to be put on low operational footing, with implications for design, automation and financing arrangements.
- Critical infrastructure requires a capacity for contactless, smart operation and maintenance.
- Supply chain disruption, and disruption to the movement of skilled people, is a delivery and operating risk at international and interstate levels and even between local government areas.
- Needs for personal data systems may be greater than otherwise warranted for contact identification, tracing, demographic characteristics and vaccination status.
- Increased demand for social infrastructure and housing can exacerbate vulnerability among disadvantaged communities, with wider impacts for all communities.
- Continuity in construction delivery requires methods to ensure minimal on-site transmission, as well as detection and control of movement of people working on construction sites.

Digitisation of the economy and infrastructure networks increasing cyber-risks

Infrastructure systems have become more vulnerable to cyber-attacks as the technological sophistication of assets improves.[191] This reflects increased digitisation of infrastructure operations alongside a rise in geopolitical tensions.[192] Recent examples of significant international attacks on infrastructure include attacks on the Colonial Oil Pipeline and Florida City's water supply in the United States in 2021.[193,194] Cyber-attacks can significantly disrupt economic activity and threaten community safety. Cyber security and infrastructure are discussed further in Chapter 9.

5.3 Evidence-based assessment of risks and vulnerabilities is essential

Improving capability to understand risk

Management of risks is improved by comprehensive data on the shocks and stresses to which infrastructure networks might be exposed. This information is critical at the asset planning phase so that risks and resilience measures are identified early in the infrastructure lifecycle.

Collection and application of natural hazard data currently occurs in a fragmented way across a range of national, state and local government authorities.

Integration of data will allow a statewide, place-based risk assessment that also considers future climate scenarios. This would identify high risk zones across NSW and the key assets and services most vulnerable, or most important, in each high-risk location – enabling development of a prioritised, efficient and effective whole-of-system resilience response. Hazard and asset data should be integrated into a common model on a publicly accessible platform and should be supported by regularly updated guidance material.

Place-based strategies

Each area identified and prioritised as high risk requires place-based strategies developed in partnership with local governments, regional organisations and affected communities.

Consistent with the NSW Critical Infrastructure Resilience Strategy and other recent best practice, place-based approaches should take a system-wide view and consider infrastructure, organisational and community resilience responses. These approaches should also consider the role that nature-based assets (such as forests) and solutions (such as constructing wetlands to absorb stormwater runoff) can play in increasing the State's resilience.

Work on the Hawkesbury-Nepean Valley Flood Risk Management Strategy (see Box 5.1) provides a benchmark for the application of placed-based strategies in other locations across NSW.

Box 5.1

Hawkesbury-Nepean Valley Flood Risk Management Strategy[195, 196]

The Hawkesbury-Nepean Valley has the highest riverine flood exposure risk in NSW due to its unique geography and substantial population. *The Hawkesbury-Nepean Valley Flood Risk Management Strategy* is a place-based long-term plan that the NSW Government is implementing for improved flood resilience. The strategy comprises a mix of infrastructure interventions complemented with a range of non-infrastructure flood risk management actions to mitigate, better prepare, respond to and recover from major flood events.

Actions include: infrastructure interventions, regional flood risk coordination, monitoring and evaluation under an adaptive management framework, integrated regional land use, transport and emergency planning, contemporary flood risk information and a community resilience awareness and preparedness program.

Clearly defining accountability can improve resilience

Taking a whole-of system approach to resilience requires the involvement of many stakeholders, including all levels of government, infrastructure asset owners and operators, communities, businesses and the non-government organisations (NGOs) that deliver critical emergency and social services.[197] There are clear benefits from better integrating and aligning strategic resilience considerations and defining clear ownership of and accountability for resilience-related responsibilities. Taking such an approach will improve NSW's ability to plan for resilience in the long term.

Building on the significant work already underway, there is an opportunity for a whole-of-government assessment of resilience-related responsibilities and use of data. This would support the delivery of reforms designed to enhance and clarify current arrangements.

The development of the first State Resilience Strategy (SRS) by Resilience NSW provides an opportunity to commence this work and drive improvements in this area.

Box 5.2

NSW State Resilience Strategy

As a recommendation of the NSW Bushfire Inquiry, Resilience NSW will develop a State Resilience Strategy (SRS) to embed disaster resilience across the State, and to target and prioritise future investment in risk mitigation and capability development.

The SRS will establish a vision and statewide objectives for Resilience NSW, while aligning with key international and Australian Government disaster frameworks. It will acknowledge the need to engage with regional voices from across government, business, and local communities.

5.4 Resilient infrastructure demands greater investment in asset management

New infrastructure investment is exciting. Investment in asset management is not. Rarely is the public imagination captured by maintenance planning and design, asset condition assessments, asset augmentations, systems upgrades or the development of skills and capabilities in asset management skill. However, when infrastructure and services fail, it is often because good management practices have not been routinely applied; these are mundane activities until suddenly there is a catastrophic event.

In 2019, the NSW Government introduced the Asset Management Policy for the NSW Public Sector to drive better asset management practices.[198] Under the Policy, agencies are required to develop Asset Management Plans and Strategic Asset Management Plans. Preparation of these plans presents an opportunity to methodically improve service reliability across the Government's asset portfolio.

Agencies are at varying levels of maturity in complying with the new Asset Management Policy; consequently, reporting on risk exposures of their assets is inconsistent. Better data, standardised risk assessment approaches and ongoing improvement in asset management practices across the entire asset lifecycle could provide a greater understanding of the risks and interdependencies of state assets. With this understanding, asset planning can prioritise service reliability and contingency planning under shock and stress scenarios.

Leveraging digital and technology platforms provides a better understanding of performance, vulnerability, interdependencies and risk exposures of infrastructure. For example, the Cross Dependency Initiative (XDI) being managed by DPE establishes arrangements to share data on asset exposure and vulnerability between various asset owners. This will enable public and private sector asset custodians to make better informed decisions about infrastructure service delivery risks under a range of shocks and stresses. The efficacy and broader application of data platforms that consolidate hazard and asset information should be explored by the NSW Government.

5.5 Building back better

Damaging events have happened before and will happen again – and more frequently. When these shocks occur and damage is incurred, replacement assets need to be designed to withstand the pressure they may be exposed to over their operational lives and to fulfil the changing role they may play in system-wide resilience. This may involve adopting design standards now that build resilience to events that currently seem improbable, but are increasingly likely under changing climate conditions. Assets that are being renewed, upgraded or replaced should also incorporate digital technology as a matter of course. This can enable greater insights into and support decisions about how best to manage the asset, as well as enabling remote operations for routine maintenance and in times of shock or stress.

Funding improved resilience has been a challenge. Often, asset maintenance and renewal result in a 'like-for-like' replacement of assets, which may be unsuitable for the changing risk profiles over their operational lives. This is also the case for disaster funding and insurance arrangements, which typically replace assets on a 'like-for-like' basis or to existing design standards.

Investment in 'building back better' – also known as betterment – can deliver significant whole-of-life avoidance costs for infrastructure assets,[199] as well as ensuring that communities experiencing distress have more reliable infrastructure and services. In recognition of this, the NSW Government, together with the Australian Government, has established the NSW Infrastructure Betterment Fund to build back infrastructure assets affected by the 2019-20 bushfires and 2021 storms and floods to a more resilient standard.

This is a worthwhile step but investing in betterment and service reliability will need to be more comprehensive and more proactive. Attention is naturally high after disaster events, but investment in betterment is best done proactively, ahead of disasters, year in and year out. Government at all levels should be prioritising investment in improved asset management capabilities, as well as funding maintenance and management that achieves improved resilience.

5.6 Interdependencies and integrated risk mitigation

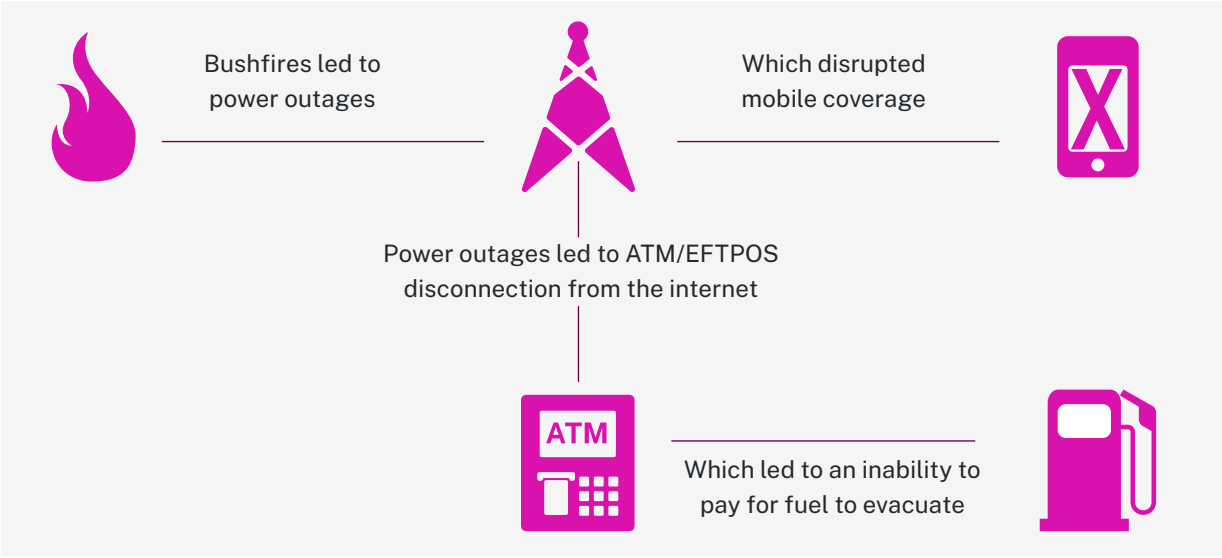
Managing systems interdependencies across infrastructure assets

Critical interdependent links in infrastructure asset systems can also require back-up or contingency management to prevent cascading system failures. Recent climate-related events in NSW demonstrated the cascading system failures that can result from low levels of resilience and redundancy in telecommunications, road and rail infrastructure (as shown in Figure 5.1). Floods and fires have illustrated that when one part of the network is unavailable, multiple assets could be compromised.

The 2019–20 bushfires highlighted critical interdependencies between infrastructure assets. Damaged powerlines caused power outages to mobile telecommunications towers, which then disrupted mobile coverage. Of the 888 telecommunication outages between December 2019 and January 2020, 779 (88%) were caused by mains power outages.[200,201]

The power outages also affected ATMs and EFTPOS machines, which became disconnected from the internet, resulting in people being unable to pay for the fuel they needed to evacuate the immediate vicinity of the bushfire.[202]

Figure 5.1 – System interdependencies between infrastructure assets affected by bushfires



Source: Infrastructure NSW (2022)

The NSW Government works closely with private sector infrastructure operators in times of disruption to ensure 'critical' infrastructure is quickly restored but State Government agencies should also consider these inter-relationships in their own continuity planning and disaster response protocols. Some jurisdictions, such as the UK, have devised assurance and regulatory requirements for private sector asset operators to meet minimum standards for response and recovery.

Transport corridors play a key role in disaster response

Recent events have also reinforced the importance of the transport network in supporting evacuation, which is a primary response strategy to many climate and human-induced emergencies. Road network planning needs to take account of mass evacuation capacity for major events. The Hawkesbury-Nepean flood evacuation model simulates how populations in the Valley evacuate to safe locations on a defined evacuation road network under a range of different floods and conditions. The 2019-2020 bushfires highlighted the challenges of moving large numbers of people on roads, with people isolated in their cars for many hours by the extensive fire fronts across the NSW road network.

In other jurisdictions such as New Zealand and the United States, transport agencies conduct regional vulnerability assessments. These assessments give decision-makers network-level visibility of the security of a corridor, alternative routes and their respective capacities.[203]

An assessment should be undertaken to plan and prioritise across the State where similar natural hazard risks are high, where the population has grown around hazards and legacy roads, or where adaptive capacity is low, such as the flood-exposed roads that connect remote and Aboriginal communities with services.

The assessment should be at a network scale, factoring in asset and network-level interdependences. The scope of the evacuation modelling should also include the road network owned and operated by local government and, in the case of some regional and rural areas, privately-owned roads. This could help to identify which future investments in transport network resilience measures should be given priority and provide the opportunity to explore and develop adaptive capacity systems.

5.7 Infrastructure assets for community resilience

Where organisational and community resilience responses alone will not be adequate to protect communities,[204] new or improved infrastructure may be required. 'Resilience assets' are classes of infrastructure assets specifically designed to improve resilience to shock events and chronic stresses. For extreme rainfall events, this could include flood mitigation infrastructure, such as the proposed dam wall raising at Warragamba Dam, as well as road and drainage upgrades to reduce impacts of flooding. For severe droughts, resilience infrastructure can include rainfall-independent sources of water supply or the capacity to draw upon, treat and sanitise alternative sources of water, which has been particularly important in regional towns. For fires, it may include constructed fire breaks and hazard reduction preparations, fire stations and control centres. For pandemics, it could include redundant capacity in hospitals or facilities that can be readily converted to health purposes.

The reasons for investments in resilience assets are different to those for infrastructure assets in daily use. Resilience assets are designed to mitigate the worst consequences of high impact, low frequency events. The best outcome is that they are never or rarely called upon. For these reasons, identification and evaluation of resilience assets require different tools. These include a willingness to evaluate probabilistically, use of scenario and real options analysis (ROA), and consideration of any trade-offs or flow-on effects from new infrastructure on natural systems. Resilience asset planning requires well-developed principles on funding, including contributions from different levels of government, households and business beneficiaries.

Not all resilience infrastructure is specialised or highly technical. Community facilities and multi-use assets such as showgrounds, community halls, schools and other local scale assets can play an important role in the prevention, preparedness, response and recovery from

shock events. However, these assets have not historically been viewed as critical infrastructure assets. Community facilities that seem mundane in normal times can become the rallying point for a community under threat. They allow people to gather when evacuated or when they have lost their homes and provide a place for emergency responders to meet and work with the community. Priorities for these assets should be developed with each local council and community.

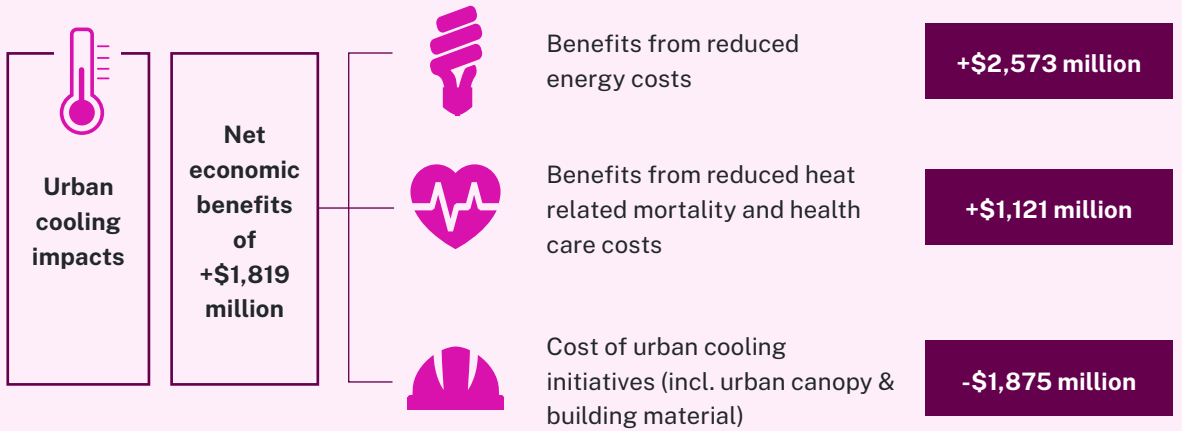
Finally, nature-based adaptation solutions are now supported as a mainstream adaptation response across the world. There is scope for their wider application in NSW.[205] Natural or blue-green infrastructure responses are cost-effective but less immediate (see Box 5.3 on South Creek in the Western Parkland City). Combining these infrastructure responses with measures to improve community resilience has proven effective in cities like Singapore, Taipei and Chicago.[206] Applying traditional ecological knowledge of blue-green infrastructure can reduce hazard risks to infrastructure and also build community resilience.

Box 5.3

South Creek Wianamatta – Economic benefits from urban cooling initiatives

The 2018 Western Parkland City (South Creek Catchment) Land and Water Use Strategic Options Business Case assessed different urban design options to achieve urban cooling effects.[207] The analysis found that changes to the design of residential and commercial buildings and the provision of parks and tree canopies through urban planning could generate net economic benefits. For example, benefits could be realised directly through reduced energy consumption (such as use of air-conditioning) and indirectly from avoided heat-related mortality and healthcare costs (such as heat strokes).

Incremental net benefit of the Western Parkland City with Integrated Water Cycle Management (IWCM)



Source: Infrastructure NSW (2018)

5.8 Funding resilience initiatives

Prioritising funding for investment into infrastructure resilience, including physical and green infrastructure responses, has proven to be a challenge. Investment that avoids the costs from low likelihood but high impact events is often difficult to justify when compared to traditional investment in assets with more certain economic returns.

This is compounded by:

- a mismatch between those who typically benefit from investment and those who typically bear the costs
- difficulty accounting for project value (typically avoided cost and risk reduction benefits, as opposed to economic productivity or revenue benefits)[208]
- a lack of financial partnership models to enable shared responses to risk (such as with the private sector)[209]
- low levels of capability and capacity to fund and deliver the appropriate responses (particularly at the local government level where much of the resilience investment is needed).

In line with other jurisdictions experiencing similar challenges (see Box 5.4), dedicated multi-year funding and financing facilities can help to overcome these impediments.

The NSW Government has taken similar approaches in the past, developing policy-specific funding and financing mechanisms that are accessible only when potential applicants can demonstrate they achieve policy-specific outcomes. For example, low-interest financing facilities have been provided by the NSW Government for councils to drive housing supply.[210]

Specific funding approaches like the examples in Box 5.4 can help to deliver the infrastructure investment needed to reduce the State's exposure (alongside the Australian Government) as the default insurer of last resort.

Various options, differing in the extent of fiscal resources required and the roles of local government, the private sector and non-government agencies, should be explored to fund the delivery of infrastructure to build resilience.

Box 5.4

Funding for resilience initiatives

Infrastructure Canada, Disaster Mitigation and Adaptation Fund

The Government of Canada launched a CAD 2 billion Disaster Mitigation and Adaptation Fund to invest in structural and natural infrastructure projects to increase the resilience of communities to current and future climate-related risks and disasters. that are impacted by natural disasters triggered by climate change. The Fund supports the construction or modification of infrastructure that will prevent, mitigate or protect against the impacts of climate change, disasters triggered by natural hazards and extreme weather.

New Jersey Energy Resilience Bank

The State of New Jersey developed a public finance facility to proactively build resilience against major power outages due to events such as tropical storms, hurricanes and ice storms. The Energy Resilience Bank provides grants and low-interest loans for distributed energy resources at critical facilities, such as water and wastewater treatment facilities and hospitals and related healthcare facilities. These resources, such as solar panels, battery storage and small turbines, make the facilities – and the communities they serve – less vulnerable to severe weather events and other emergencies.

5.9 Recommendations

No	Recommendations	Implementation timeframe	Lead agency
16	**Adopt a whole-of-system approach to enhance risk identification and assessment**		
	a. Confirm responsibilities and outcomes for a comprehensive whole-of-government resilience approach.	Immediate Priority	Stronger Communities
	b. Integrate natural hazard risk data from across government/s and develop a statewide natural hazard risk model.	Immediate Priority	Treasury & Stronger Communities
	c. Adopt climate, pandemic and other risk scenarios within the standard suite of Common Planning Assumptions.	Immediate Priority	Planning and Environment & Treasury
	d. Conduct a statewide hazard risk assessment to identify the locations and infrastructure assets most at risk across NSW.	Immediate Priority	Treasury & Stronger Communities
	e. Develop a publicly accessible digital platform for natural hazard risk and infrastructure asset data.	Medium Term Need	Treasury & Customer Service
17	**Develop place-based resilience and infrastructure adaptation strategies that assess local risk and incorporate infrastructure and non-infrastructure solutions for vulnerable locations across NSW**	Immediate Priority	Planning and Environment & Regional NSW

No	Recommendations	Implementation timeframe	Lead agency
18	**Fund and deliver an investment program designed to improve the resilience of the State's most vulnerable and critical assets** a. Adopt consistent and standard approaches to understand and measure hazard risk across the NSW asset portfolio. b. For vulnerable assets, require service reliability and contingency planning under shock and stress scenarios. c. Use asset management routines and reporting to prioritise investment in asset maintenance, upgrades, renewal and adaptation in each place and in each agency. d. Develop and apply digital approaches to collect and share asset data and asset interdependencies. e. Incorporate 'build-back better' outcomes into asset management plans, investment policies and funding mechanisms.	Immediate Priority	Treasury, Infrastructure NSW & Planning and Environment
19	**Establish a program of prioritised resilience infrastructure and accelerate project delivery**		
	a. Warragamba Dam wall raising	Immediate Priority	Planning and Environment
	b. Local road improvements in the Hawkesbury Nepean Valley	Immediate Priority	Transport
	c. Regional water security and resilience investments	Extended Program	Planning and Environment
	d. Wianamatta South Creek integrated land use and water cycle management.	Extended Program	Planning and Environment
20	**Improve transport network response and recovery performance through service continuity planning, investment in evacuation and alternative routes, and infrastructure upgrades, guided by place based strategies**	Extended Program	Transport
21	**Propose new funding models for ongoing and reliable investment in resilience infrastructure and asset hardening**	Immediate Priority	Treasury & Stronger Communities

State Infrastructure Strategy
2022–2042

Achieve an orderly and efficient transition to Net Zero

06

Daramu House at Barangaroo, image courtesy of Lendlease

IN THIS SECTION

Strategic directions

- Ensure that the clean energy transition is orderly and cost effective
- Preserve a market-based approach to investment in electricity generation, transmission and retail to minimise the need for government subsidies
- Support a new wave in transmission infrastructure in a manner consistent with community expectations
- Pursue cost-effective initiatives to reduce emissions from State assets and infrastructure

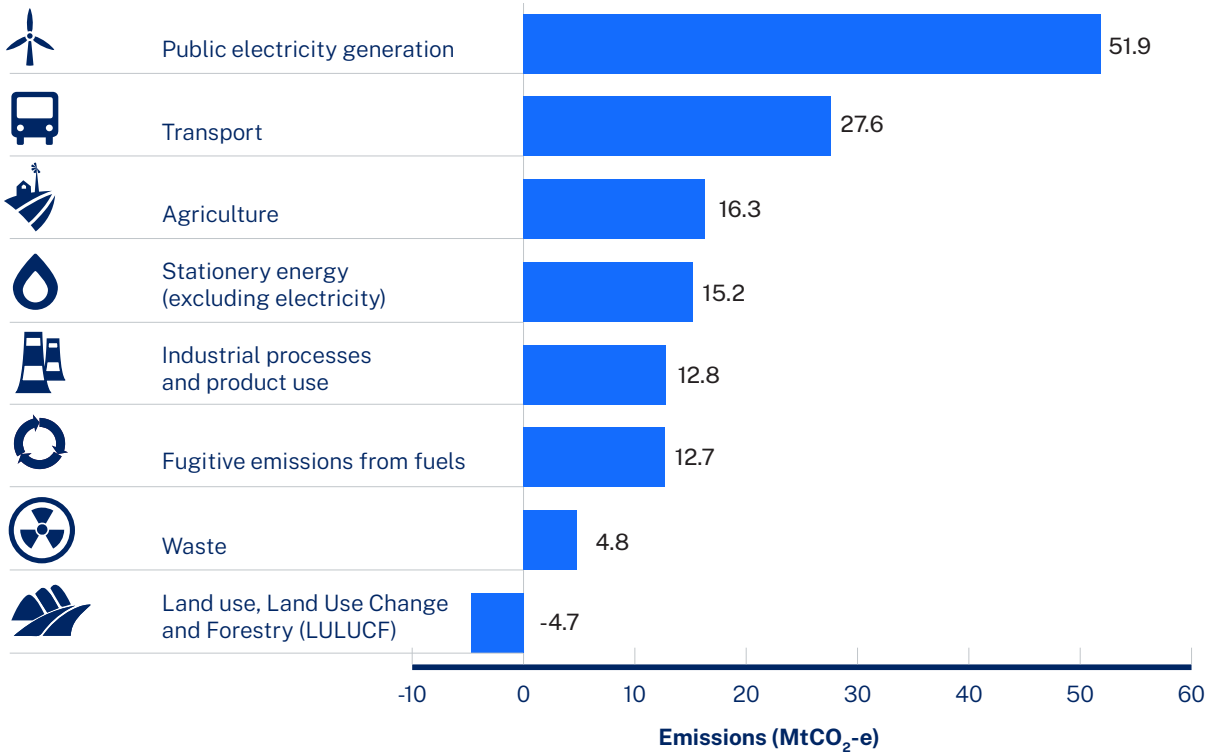
The NSW Government has adopted a goal of Net Zero emissions across the whole NSW economy by 2050 and a 50% cut in emissions below 2005 levels by 2030. Infrastructure has a key role to play in this transformation, due to the embodied, operating and enabled emissions generated throughout the infrastructure lifecycle. Transport and stationary energy (direct combustion of fuels in mining, industrial, commercial and residential applications), together with on-grid electricity generation, account for around 70% of NSW's greenhouse gas emissions.

Transition within the electricity sector will be an important part of the effort to achieve the desired reduction in emissions by 2050, but change will also be required in other infrastructure sectors and industries (see Figure 6.1).

Previous State Infrastructure Strategies have not recommended State investment or support for the electricity sector. Maintaining a market-led approach relies upon continued and timely private sector investment in essential replacement generation, storage and distribution infrastructure, requiring government support for and underwriting of essential new investments. Facilitation of private investment must be managed carefully to avoid making large future calls upon scarce government funding better used elsewhere.

To address the challenge, NSW has adopted the 2020 Electricity Infrastructure Roadmap (the Roadmap). In the current context, the Roadmap is the right course – it is technology neutral, initially focused on renewable generation and long duration storage, and uses well established market mechanisms. However, it will be important for the Government to stay the course on this approach and do so for decades.

Figure 6.1 – NSW emissions by sector in 2019 ($MtCO_2$-e = Megatonnes of carbon dioxide equivalent)



Source: Infrastructure NSW, based on NSW Government data (2019)

6.1 The electricity sector's central role

A transition to cleaner electricity will enable decarbonisation across the whole state economy as the 'electrification of everything' is potentially the quickest decarbonisation pathway for many carbon-intensive uses, such as transport and stationary energy.[211]

As 75% of the State's electricity supply reaches its end of technical life in the next 15 years,[212] the timing and opportunity for setting the energy transition pathway to renewables is becoming clearer.

The challenge for the NSW Government is to ensure an orderly transition that addresses cost and reliability issues of the electricity sector over the next two decades, while preserving the role of markets and the private sector in energy generation, transmission and retail.

Medium-term challenges remain

Investment in renewables has progressed rapidly through a combination of government schemes and a dramatic decline in the cost of solar generation and, to a lesser extent, wind generation. Penetration of solar and wind is likely to continue, through both large-scale projects and household rooftop solar panel installations. However, continued effort is still required to ensure that ongoing investment occurs at the level required to deliver sufficient capacity in time

to replace retiring firm sources of generation. It is essential that the community, businesses and investors have high levels of confidence in the stability and reliability of market arrangements and the security of transmission connections.

However, legacy baseload generation faces risks of earlier-than-planned closures, threatening the stability of the grid. This can be addressed in part by closure mechanisms. The Energy Security Board (ESB) has recommended enhancements to existing closure mechanisms to improve transparency and predictability while preserving strategic power reserves. Even with such measures, the continued rapid shift to renewables will create a need to accelerate investment in replacement firming capacity – generally gas peaking generators, batteries and pumped hydro facilities.

Government should support market approaches

New investment in generation, storage and firming services can be undermined by a number of risks. Investor confidence has been weakened by incessant policy instability at a national level, as well as direct government interventions and participation in the market. Investment in long-term assets is challenged by price risks as well as market access concerns, with many of NSW's prospective renewable resources located where grid capacity is low. Finally, rapid declines in the cost of some types of technology can create a propensity to defer investment, for fear that future costs of production would not be recovered from wholesale electricity markets.

Market redesign and government-led competitive bidding processes seem likely to be required to secure investment at scale in firming infrastructure. NSW has adopted a proactive and market-based approach to this challenge that acknowledges electricity is one of the few sectors that has been successfully reformed to create a market system with private ownership and commercial incentives. The NSW Electricity Infrastructure Roadmap seeks to retain those characteristics as far as possible and drive integrated and coordinated investment in new electricity infrastructure.

A key aspect of the Roadmap is the establishment of an independent Consumer Trustee (AEMO Services Limited) who is responsible for introducing and overseeing competitive contracting arrangements called Long-Term Energy Services Agreements (LTESAs) to meet the objectives of the Roadmap.

LTESAs seek to:

- provide a market-based mechanism with commercial terms designed to encourage competition between market participants
- support renewable energy generation, long duration storage and firming projects in a technology neutral way.

AEMO will monitor the Energy Security Target, a measure of system reliability, and will only offer firming-focused LTESAs if directed by the Minister for Energy.[213] The Consumer Trustee was appointed by the Minister to protect the long-term financial interests of NSW energy consumers and released its first Infrastructure Investment Objectives Report (IIOR) in 2021, outlining its 10-year tender plan and 20-year development pathway.[214]

Effective and consistent deployment of the Roadmap's market-based and competitive features must remain a focus to support the continued efficient functioning of the market and investor certainty. A concerted effort will be required to ensure these features are protected and are 'front of mind' throughout detailed and long-term planning and implementation of the Roadmap.

6.2 Challenges with scaling up the clean energy sector

The Roadmap is expected to attract up to $32 billion in private investment for regional energy infrastructure by 2030. The NSW Government has committed to invest $380 million to implement the Roadmap and new Renewable Energy Zones (REZs). The Energy Corporation of NSW (EnergyCo) will ensure the coordinated planning of the network infrastructure in each REZ and the Consumer Trustee will plan the level of investment in generation, storage and firming required in NSW over time.

Much of this infrastructure will be delivered in five dedicated REZs located in regional NSW, rich in renewable energy sources.[215] While their selection

considered proximity to existing transmission infrastructure and community, and environmental and heritage land use constraints, each REZ presents unique implementation challenges.

NSW's existing generation and transmission took over 30 years to plan and deliver.[216] The scale and complexity of the new projects needed to successfully deliver the Roadmap will require a step change in capacity and capability across the sector in a much shorter timeframe.

Transmission service providers will be a critical part of the Roadmap's implementation. The transmission network is anticipated to see a near tenfold increase in the average size of projects in comparison to those that have been recently delivered.

Transmission services are delivered by private operators that bear much of the risk associated with this investment once core pricing and cost parameters are set. The NSW Government has a clear public interest in the successful and timely delivery of the transmission network and, initially, the shape of the new network will be led by EnergyCo prior to the appointment of a transmission network operator. Industry will need support in scaling its capability and capacity as appropriate, applying lessons from the broader infrastructure program in NSW and Australia. In February 2022, the NSW Government announced a Transmission Acceleration Facility to support early development activities and fast-track investment in transmission assets to support new Renewable Energy Zones.

Rapidly uplifting capability and capacity of the skills and resources required to deliver the Roadmap is a significant challenge. Recent work by Infrastructure Australia, examining the capacity of the market, identified that labour and skill shortages may become a significant factor for the build-out of renewable generation and transmission infrastructure, especially in regions with tight labour markets.

This will be compounded by the already high demand for skilled trades and professionals, labourers, machine operators, and technicians, as a result of ongoing high levels of investment in public infrastructure and in the property and mining sectors.[217] As other States progress similar reshaping of their electricity networks, the risk of shortages in materials and skilled labour may slow or raise the costs associated with delivery.[218]

Within the framework established by the Roadmap, most of the detailed implementation risks are borne by the private sector delivering new assets. However. the NSW Government will ultimately bear the reputational risk and economic and social consequences for failures to deliver the infrastructure needed in the Roadmap and secure an orderly transition.

To mitigate this risk, there are many lessons in managing planning, funding and financing, and community risk that could be applied from the significant increase in size and scope of the infrastructure program in NSW over the past 10 years. This includes opportunities to draw on experience from NSW infrastructure delivery agencies and Infrastructure NSW's own oversight and assurance routines, as well as to apply lessons from the Construction Leadership Group – a cross-government initiative to improve productivity in the construction sector while ensuring NSW Government is a 'best in class' client for infrastructure delivery.

The NSW Renewable Energy Sector Board was established to advise on and monitor a plan to ensure NSW small and medium enterprises have opportunities to participate in the construction and operation of infrastructure and that local employment and new industry development opportunities are maximised.

It will be important to engage early with contractors to understand their needs and potential shortages across skills and supply chains, and to provide transparency on the pipeline of works. NSW and Australian Governments can support the development and delivery of skills and accreditations but must balance pre-empting contractor requirements with the need to ensure local workforces are prepared for the significant opportunities.

Social licence and public confidence are critical

The NSW Government (and EnergyCo in particular) will need to work closely with communities, including Aboriginal communities, to address any concerns about the impacts of new transmission corridors and infrastructure,

and to ensure that generation and storage infrastructure projects benefit host communities. With new generation sources and hundreds of kilometres of transmission network to deliver, community opposition to the delivery of electricity infrastructure represents a key risk to an orderly and efficient transition. Initially, EnergyCo will lead processes to establish social licence as part of deploying the Transmission Acceleration Facility subsequent operators of this infrastructure will have an equal responsibility to work with communities to uphold goodwill and social licence. This will require best practice in engaging transparently with communities.

Compounding these challenges are the implications of the energy transition for regional communities that have traditionally relied on legacy power industries, such as those in the Hunter and Illawarra regions (both of which are identified as future REZs). Declining domestic and international demand for coal, coupled with earlier-than-planned closure of coal-fired power stations, will impact existing workforces.[219] Forward planning and economic diversification are required to ensure that coal-dependent communities have access to alternative industries, skills, education and training.[220] In addition, the legacy infrastructure in these areas may also form the basis for building future new industries that support a Net Zero economy, and re-use of this infrastructure should be actively pursued. Major economic transitions usually only succeed where those most adversely affected are considered and supported.[221]

EnergyCo is working with communities to ensure the benefits of investment from the Roadmap are equitably shared within host regions. This requires early and ongoing community and stakeholder engagement, and implementation of initiatives that lead to local economic development and employment. Importantly, the unique needs and aspirations of each community impacted by the transition must be considered. This includes transition to renewable energy that impacts Aboriginal-owned land. Any work to progress this must ensure local decisions are underpinned by principles of self-determination to ensure Aboriginal communities have a genuine voice in determining what and how services are delivered to their communities. Government will need to engage extensively to achieve close collaboration with communities and display awareness of cultural protocols and cross-cultural communications.

Seek consistency with national policy direction

National energy ministers have agreed to the ESB's recommendation that further work be undertaken to develop a mechanism that specifically values capacity in the National Electricity Market (NEM). This is distinct from how the NEM is currently established – as an energy only market. In an energy only market, suppliers of firm capacity earn revenue by dispatching energy. They do not receive income for their available capacity, although it is possible for peaking generators to establish a steady revenue stream by selling caps and options.

The NSW Government is continuing to consult and work with the ESB on the development and implementation of its post-2025 market reforms, in line with the decision of National Cabinet in October 2021. This includes further developing the design of national reforms to network access and considering how these can be aligned with NSW REZ access schemes. Similarly, clarity over the role of government in the early stages of the transition is essential. Technological advancement is rapid, while rooftop solar and decentralised energy are becoming increasingly more viable with the right policy and regulatory settings. Technology will impact on the more efficient use of energy, which is also being promoted through the NSW Energy Security Safeguard. These considerations are represented in various modelled 'pathways' by the Consumer Trustee in its IIOR. Updates to this analysis on a bi-annual basis are legislated to mitigate the risk that government intervention and underwriting private sector investment costs taxpayers and/or consumers in the long term through an 'overbuild' of transmission and grid infrastructure.

6.3 Hydrogen may offer new opportunities

New technologies are emerging that could help achieve an affordable and firmed renewable electricity grid. Green hydrogen production, storage and transportation networks could deliver dispatchable energy to augment renewable sources and provide alternatives for remote areas or microgrids that may have previously relied on diesel back-up generators. Green hydrogen also has potential applications across transport, gas and electricity networks, and in industrial sectors.

During the interim period as other technologies are emerging, it will remain important that the State maintains a supply of gas for ongoing peaking generation that is stable, reliable and affordable. This may involve both local production and distribution, as well as an ability to import gas from other jurisdictions.

The NSW Government has developed the NSW Hydrogen Strategy, which provides up to $3 billion in support for the industry through waivers on government charges, exemptions from network charges and direct investment. The strategy outlines coordinated support for research, development and commercialisation of a technology with significant potential to decarbonise the State's highest emitting sectors.

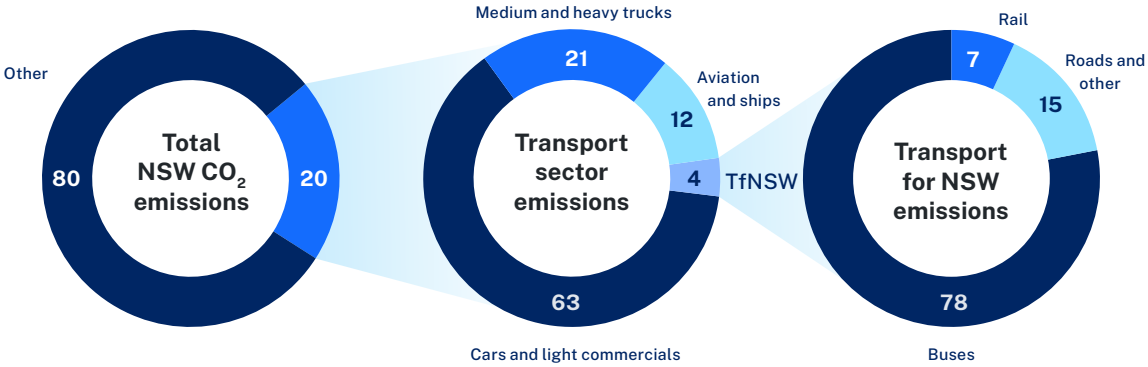
The strategy outlines investment in hydrogen hubs in the Hunter Region and the Illawarra Region. These locations can leverage existing endowments in related industries, access to the necessary natural resources and connectivity to energy, transport and port infrastructure. Both regions will be affected by the global transition away from a fossil fuel economy and development of a green hydrogen industry can help secure their futures.

During the initial years of implementation, the NSW Government's role is to enable industry development, lay the foundations for market forces and provide scaling incentives to deliver a hydrogen economy. The costs and regulatory barriers to access and develop these networks and future consumer markets will require review, while maintaining a technology neutral and globally attractive environment for investment.

6.4 Transition in the transport sector

In the absence of other changes, transport will be the largest emitting sector by 2030 (see Figure 6.2 for a breakdown of current emissions across transport modes in NSW). Vehicle emissions policy extends well beyond infrastructure considerations, but the NSW Government's approach to transport infrastructure should support efforts to reach Net Zero. This is particularly important as most emissions from this sector are influenced by how public infrastructure assets – the road and rail networks – are powered and used.

Figure 6.2 – Breakdown of transport sector emissions in NSW (in percentages)



State economy	Transport sector	Transport for NSW modes
Transport is one of the largest contributors to emissions in NSW	Comprises private vehicles and public transport	Transition to Net Zero emissions of trains and buses is underway

Source: Infrastructure NSW, based on TfNSW data (2021)

The NSW Government has plans to decarbonise its fleet and operations, helping to reduce emissions, but Transport for NSW emissions only comprise 4% of the total sector emissions, meaning much more needs to be done.

Light vehicles alone account for 63% of transport emissions, and transitioning the NSW motor vehicle fleet from internal combustion engines to zero emissions vehicles, coupled with strategies for reducing and managing demand for private vehicle use, will potentially have the largest impact on transport-related carbon emissions over time. However, modelling undertaken by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) suggests that to achieve Net Zero emissions in the transport sector, 100% of new vehicle sales would need to be electric vehicles (EVs) by 2035, and the entire fleet would need to have transitioned to EVs by 2045.[222]

The release of the NSW Electric Vehicle Strategy demonstrates the NSW Government's commitment and intent to decarbonise the transport sector. This was followed by the NSW Government's pledge at the United Nations Climate Change Conference to boost EV uptake.[223] The strategy aims to grow EV sales of light vehicles from current levels of less than 1% to 52% of the market by 2030-31 and to see most new car sales being EVs by 2035. In this context, Transport for NSW is working towards transitioning all NSW buses to zero emission buses over time.[224] These actions will potentially achieve a further reduction of 6% in total transport emissions.

However, more will be required to meet the CSIRO benchmark. Under current settings and even with better than projected adoption rates, the transition of the NSW fleet of vehicles to EV is a protracted task with a long tail, and emissions reductions are reliant on the broader successful transition to renewable energy generation.

More will need to be done to close the gap between the emissions reduction achieved from the fleet transition supported by the NSW EV Strategy and NSW's Net Zero emissions target. This gap should be clearly articulated and practical options for closing it should be prepared for consideration by the NSW Government. This may include accelerating the fleet transition through greater incentives and flattening vehicle travel through a range of initiatives, such as incentives to owners to use their vehicles more efficiently and improving public transport and rail alternatives.

Transport for NSW's *Future Transport Strategy: A 40-year vision* outlines the need to stabilise and manage road traffic growth across Greater Sydney, Newcastle, Wollongong and the Central Coast. This is part of its approach to achieving Net Zero objectives, as well as delivering 15-minute neighbourhoods and 30-minute cities. Implementing traffic stabilisation measures can also help reduce congestion, which is a significant handbrake on economic growth and productivity. Infrastructure Australia forecasts that the annualised cost of road congestion for Sydney, the Hunter and Illawarra will increase from $8.0 billion in 2016 to $15.7 billion in 2031,[225] even with the significant public transport network investment underway.

As well as measures outlined above, there may be near term opportunities to support and provide incentives for new refuelling infrastructure for hydrogen-fuelled heavy vehicles, which may become competitive alternatives for long haul freight. Other potential policy changes, such as emissions and fuel standards, are primarily Australian Government responsibilities and these are not expected to change in the near term.[226]

There are few easy options. Success in any approach requires time for adjustment, building community goodwill and measures to minimise adverse impacts. Changes are unlikely to succeed where they do not recognise the circumstances of different communities and regions, require citizens to adjust quickly or impose inconvenience or costs without viable alternatives. Any approach must balance community expectations and economic and fiscal objectives with environmental outcomes. NSW can build on lessons from other jurisdictions that have developed similar initiatives.

Table 6.1 – Travel demand management initiatives from other jurisdictions and countries

Land Use Strategies	Regulatory	Investment Programs / Funding	Voluntary Schemes
▸ Better integration of land use and transport by focusing growth in public transport corridors and established areas with high public transport accessibility[227,228,229]	▸ Introduction of maximum parking supply standards into development controls[230, 231] ▸ Reallocation of road space to public and active transport networks[232,233] ▸ User charges and restrictions (for example, zero/low emission vehicle zones/lanes)[234]	▸ Establishing whole-of-network targets for public transport, active transport and private vehicle use to guide investment and operational decision making[235,236] ▸ Prioritising capital investment and operational expenditure in public transport initiatives (including frequency, capacity, reliability and safety)[237] ▸ Prioritising investment in active transport networks and facilities[238,239] ▸ Focusing investment in motorway and major road projects only on high productivity uses rather than increased private vehicle use[240,241,242]	▸ Green travel plans and facilities for workplaces and institutions[243] ▸ Consumer facing schemes to calculate and offset emissions (for example, voluntary offsets at registration)[244] ▸ Car-share and travel-share schemes[245,246]

6.5 Reducing the carbon impact of infrastructure projects

As the transition gains pace, there will be more appetite for low carbon- and zero carbon-ready infrastructure from the public and investment community. However, the infrastructure pathway to Net Zero is not yet clear. This is made more challenging by the construction of infrastructure, where the materials used and processes are still carbon-intensive.

Establishing a sector-specific roadmap to Net Zero and reducing embodied emissions from infrastructure construction are two important ways forward.

Accounting for and reducing emissions from infrastructure use

Whole-of-NSW and sector-by-sector emissions estimates are developed and reported in accordance with National Greenhouse Accounts.[247] However, in relation to infrastructure, it is not currently routine to measure or report progress against Net Zero on a project-by-project or sector-by-sector basis. This makes it challenging to ascertain how infrastructure-related decisions contribute to the State's total emissions and remaining carbon budget –that is, the remaining amount of carbon the State can emit as part of global efforts to limit warming to 1.5 degrees.

With the NSW Government setting clear Net Zero targets, public infrastructure planners and managers need to identify critical pathways to contribute to these objectives, adopt global best practice and embrace industry-standard approaches to carbon accounting, disclosure and management.

NSW Government agencies are improving their ability to measure emissions under their control and from their assets, particularly where there is a cost implication. There is a growing need to expand these measures to account for the emissions that are 'enabled' or generated by others as a result of using these assets. This can help agencies to identify potential transition risks in line with global best practice.

The NSW Government can support the transition to low carbon and zero carbon infrastructure by quantifying, valuing and disclosing the carbon contribution of infrastructure. This requires the adoption of standardised approaches across government for:

- carbon measurement and reporting (including carbon offsetting)
- management and accountability frameworks for Net Zero targets
- investment decision making and prioritisation.

Industry practice is more mature than government in accounting for carbon and managing transition risk in infrastructure (see Box 6.1) and typically aligns with comprehensive, globally consistent, sustainability disclosure standards. Any standards the Government adopts should be uniformly applied and integrated with economy-wide modelling and disclosure practice already adopted by DPE.

Box 6.1

Transurban Case Study

Toll road operator Transurban presents several annual progress summaries for various indices including the Science Based Targets initiative (SBTi), the Dow Jones Sustainability Index (DJSI), the Global Real Estate Sustainability Benchmark (GRESB) for infrastructure, the Morgan Stanley Capital International CI ESG and the Task Force on Climate-related Financial Disclosures (TCFD). Transurban's reporting has likely been driven by the changing expectations of the community and its executive, board, investors and shareholders. This reporting transparency can help to attract financing and improve operational flexibility.

Infrastructure construction is emissions-intensive

Embodied carbon emissions of materials are estimated to be approximately 5% to 10% of Australia's total emissions[248] – a frequently overlooked and under-measured part of the Net Zero discussion. Record levels of infrastructure investment will create additional need to reduce embodied carbon in infrastructure and the built environment in a fast-emerging low carbon solutions market.[249]

For example, it is estimated the building sector accounts for 39% of global carbon emissions: 28% from building operations and 11% from embodied carbon in building materials and construction.[250] While promising applications of cement substitutes are increasing in major projects like Sydney Metro,[251] these are not yet widely used. Cement production currently accounts for 8% of global CO2 emissions.[252]

Increased utilisation of existing assets, for example through renovation or re-use, is an important first step to reduce the emissions that would be created through a new build.[253] Once construction is underway, there may be other opportunities to reduce emissions through the co-location of materials production, storage and distribution, as well as the use of rail rather than road transport where possible. This could apply where new precincts are being developed in Greater Sydney or the regions.

The NSW Net Zero Plan and the Resource Efficiency Policy outline current policies and plans to reduce emissions through the procurement of goods and services – and this extends to the NSW Government's infrastructure program. Analysis by the NSW Chief Scientist notes that there are many construction-related technologies in advanced stages of technical, industry and commercial readiness, which the Government could lead by example in adopting. For example:[254]

- substituting high emissions construction material with cost-effective, low emissions material
- embedding technologies and services that increase electrification, energy generation and storage and energy efficiency into the built environment
- ensuring global best practices in the design, construction and operation of Net Zero industrial, commercial and residential precincts, and public infrastructure.

6.6 Recommendations

No	Recommendations	Implementation timeframe	Lead agency
22	**Steadfast implementation of the NSW Electricity Infrastructure Roadmap in support of reliability and affordability** a. Promote steady and reliable investment in new renewable and firming capacity and/or long duration storage to match demand and replace retiring plants. b. Limit cost impacts on consumers and the risk exposure of the NSW Government by achieving the best possible long-term agreements (and forgoing proposals in periodic tenders that are unlikely to be efficient in the longer term). c. Balance long-term investment certainty with the transitional nature of the scheme, with a view to returning to a market that can thrive. d. Support a technology neutral approach to the energy transition through adoption of the most efficient low carbon innovations across the energy sector.	Extended Program	Treasury (Energy)
23	**De-risk the planned delivery of a large program of new transmission infrastructure** a. Adopt best practice approaches to engaging transparently with local communities on electricity infrastructure corridors to secure social licence and minimise planning risk across the delivery of new transmission network infrastructure. b. Mitigate planning and environmental risk in the development and delivery of transmission infrastructure by drawing on the practices of NSW Government agencies experienced in major infrastructure delivery. c. Support capability and capacity building with private sector partners tasked with delivery of network infrastructure – both technical skills as well as program oversight practices.	Medium Term Need	Treasury (Energy) & Infrastructure NSW
24	**Uplift capability and capacity across government and industry partners to secure delivery of the infrastructure needed in the NSW Electricity Infrastructure Roadmap** a. Raise the capacity of the NSW Government to manage the risks associated with the large-scale infrastructure required to implement the Roadmap. b. Develop and foster industry level forums with delivery partners to canvass and mitigate delivery challenges, similar to the approach taken with the Construction Leadership Group. c. Work with the Renewable Energy Sector Board to develop a Renewable Energy Sector Skills and Training Strategy that addresses key short-term and long-term skills and labour gaps in the market. d. Secure Federal-State co-funding to establish a nationally recognised training program for target skills (for example, transmission infrastructure construction) and/or accreditations. e. Coordinate the delivery of infrastructure across regions where specialist labour is anticipated to be in high demand.	Medium Term Need	Treasury (Energy) & Infrastructure NSW

No	Recommendations	Implementation timeframe	Lead agency
25	**Share the benefits of the Electricity Infrastructure Roadmap with the regions hosting infrastructure and with communities in transition** a. Build skills and economic development to allow maximum participation in opportunities for affected communities. b. Pursue the re-use of existing infrastructure endowments in areas affected by the transition. c. Provide opportunities for Aboriginal economic development from the transition to renewable energy, including hosting infrastructure on Aboriginal owned land. d. Apply place-based approaches to identify and prioritise investment in strategic service and infrastructure priorities needed to support communities affected by the transition.	Extended Program	Treasury (Energy) & Regional NSW
26	**Finalise a roadmap to meet emissions reduction targets in transport, beyond forecast fleet transition** a. Determine the most feasible and cost efficient emissions reductions through private fleet turnover and transition. b. Propose options for the Government's consideration on how to close the gap between trajectory and target, including further accelerating private fleet transition, increasing the availability and desirability of public transport, pursuing updated vehicle emissions standards in partnership with the Australian Government and providing incentives for managed and efficient traffic levels.	Immediate priority	Transport & Planning and Environment
27	**Develop a roadmap for NSW public infrastructure to achieve Net Zero** a. Identify cost-efficient, practical and implementable pathways to Net Zero for public infrastructure. b. Adopt industry best practice approaches to emissions reporting and disclosures for infrastructure across government. c. Account for Net Zero targets in government infrastructure-related service delivery and future investment decisions. d. Boost adoption of low-emissions building materials and practices for public infrastructure using NSW Government procurement levers.	Immediate Priority	Planning and Environment, Treasury & Infrastructure NSW

State Infrastructure Strategy
2022–2042

Enhance long-term water security

07

Wianamatta South Creek, Greater Cities Commission

IN THIS SECTION

Strategic directions

- Increase water security through demand management, water and wastewater recycling, and rainfall-independent supply
- Improve management of water in regional communities in partnership with local authorities
- Embed integrated water cycle management approaches, including stormwater harvesting and recycled water projects, as standard practice in land use planning, precinct development and major projects

In both metropolitan and regional areas, the water sector is faced with the fundamental challenge of managing increasing demand for an essential resource that is becoming more variable due to a changing climate and that is constrained by existing infrastructure and policies.

The 2018 State Infrastructure Strategy (2018 SIS) recommended the NSW Government develop and adopt a NSW Water Statement – a transparent, strategic framework for the allocation, conservation, management and control of water resources across NSW. This would guide the development of catchment-by-catchment Regional Water Strategies that identify an integrated package of policy, planning, behavioural, regulatory, technology and infrastructure solutions for each catchment. This policy architecture is vital to setting NSW up to successfully respond to the challenges and opportunities facing the sector.

The NSW Government has progressed these actions, and other key water-related initiatives since the 2018 SIS, as outlined in Table 7.1.

Table 7.1 – Key water initiatives from the NSW Government since 2018

Strategy and Policy	Plans	Investment Programs / Funding	Other
NSW Water Strategy* Draft Metropolitan Water Strategies for Greater Sydney and the Lower Hunter Draft Regional Water Strategies (covering 12 NSW catchment regions)	Water Reform Action Plan for the Murray-Darling Basin 20 Water Resources Plans for the Murray-Darling Basin Water Sharing Plans	Sustainable Diversion Limit Adjustment Mechanism Safe and Secure Water Program Town Water Risk Reduction Program	Establishment of Water Infrastructure NSW Establishment of Natural Resources Access Regulator

Note: *The NSW Water Strategy is the NSW Water Statement referred to in the 2018 SIS

7.1 Current water resources and infrastructure are insufficient to meet future demand

Demand for water to support a growing population is increasing, as is demand from existing and new industries, and to support urban greening and cooling aspirations.

In just the past two decades, NSW has experienced profound and statewide droughts – most recently the 2017 to 2020 drought and the earlier Millennium drought in the 2000s. NSW has always had a variable climate, with cyclical periods of wet and dry periods. If, as projected by the NSW and ACT Regional Climate Modelling (NARCliM), extreme conditions happen more frequently, the availability of water to meet demand from NSW's growing population will be put to the test – unless investments and initiatives are delivered to mitigate the demand and supply gap.

The 2018 SIS acknowledged the significantly different challenges faced in each catchment east and west of the Great Dividing Range, as well as the specific challenges in major cities like Greater Sydney.

In 2020-21, DPE undertook new scientific analysis to better understand the impact of climate variability on long-term water availability, and to project future climate conditions at the local level across the State.[255] The analysis involved stochastic modelling using historically observed climate variability data and paleoclimate data, combined with the latest climate projections from the NSW Government's NARCliM model. It concluded that NSW's dependency on rainfall alone for water supply is insufficient to meet demand across both metropolitan and regional areas with current approaches to policy, management and infrastructure.

7.2 Infrastructure alone will not address the State's water challenges

Infrastructure solutions cannot resolve all water supply issues. Existing assets such as dams, pipes, reservoirs, storage tanks and treatment facilities are essential assets, but the management, allocation and use of the State's water resources is equally important. Accordingly, the 2018 SIS and the subsequent NSW Water Strategy and forthcoming Regional Water Strategies recognise the need to develop bespoke packages of policy, regulatory, technology and infrastructure solutions for each catchment.

Compounding the challenge is the fact that infrastructure solutions, especially major projects such as desalination plants or dams, can take significant time and capital to plan and deliver. Drought conditions deplete water supply, and if they endure, infrastructure projects may not be complete in time to augment supply. Even if dams and pipelines can be built in time, they cannot store or transfer water that is not in the catchment in the first place.

In the State's major urban centres, it will be essential to augment water supply with rainfall-independent sources such as desalination and, importantly, recycled water. These initiatives, especially purified recycled water for drinking, will require significant time and investment to achieve community support, an essential pre-condition to project development and delivery.

Completing strategic planning for each catchment across the State should remain an important priority of the NSW Government. The Government should also begin to plan in earnest for each new infrastructure project it identifies. It is essential that the Government progresses implementation of the State, metropolitan and regional water strategies to improve water security before the next drought occurs.

7.3 Strategies for Greater Sydney

The need for rainfall-independent water supply

Greater Sydney relies predominantly on rainfall-dependent water supply. Only 23% of Sydney's drinking water demand is currently met by rainfall-independent sources.[256] If the 2017-2020 drought had lasted another two years, Greater Sydney would have exhausted its available water supplies, which would have had severe social and economic implications.[257]

With a minimum lead time of 4 to 6 years to deliver new rainfall-independent water infrastructure, such as desalination or water recycling plants, there is no infrastructure solution that could be built in time to address such severe water supply issues should a similarly prolonged drought occur in coming years.

Existing desalination plants can provide only 15% of Greater Sydney's current water needs. In contrast, Melbourne – which has the next lowest level of rainfall-independence in Australia – can meet 34% of its current water supply through desalination.[258]

Proactively planning for and investing in rainfall-independent supply augmentation, in addition to water conservation and demand management practices, is vital to secure Greater Sydney's future water supply. This includes investigating projects to increase desalination capacity and interconnections to enhance supply and resilience. The Greater Sydney Water Strategy sets out a range of rainfall-independent water supply options to safeguard water supply.[259]

The increasing need for rainfall-independent supply is also being highlighted by other Australian jurisdictions. Infrastructure Australia acknowledges that a reliance on rainfall-dependant water no longer 'makes sense', given climate change is likely to shift rainfall patterns, and calls for the adoption of all water supply options.[260] Similarly, Victoria's Infrastructure Strategy 2021-2051 seeks to progress toward an integrated model of water cycle management, with a key priority to progress the better use of stormwater and recycled water to augment existing water supply.[261]

Water recycling and re-use

Water recycling and reuse is a proven, cost-effective technology and meets stringent safety standards. It should continue to be explored and developed as an option. There is significant opportunity for NSW to pursue purified recycled water for drinking and non-drinking purposes, as a wastewater management tool and water supply solution.[262] This need has been acknowledged in recent years by Infrastructure Australia,[263] the Productivity Commission,[264] the State, regional and metropolitan water strategies and industry bodies.[265]

Adopting purified recycled water for drinking can involve 'direct' or 'indirect' augmentation of supply. Direct augmentation involves discharging purified wastewater directly into the reticulated water supply. Indirect augmentation involves the release of purified wastewater into an 'environmental buffer', such as a river. This water is then re-extracted and treated for drinking.[266] Several NSW communities already indirectly reuse water. For example, wastewater from the Southern Highlands is purified, discharged back into the Wingecarribee River which then flows into the Warragamba Dam and is used in Sydney's water supply.[267]

Purified recycled water for drinking is a common approach globally and is already adopted in Perth, Singapore, London and Los Angeles.[268] Perth residents have been using purified recycled water for drinking since 2017 through the city's Groundwater Replenishment Scheme, accounting for 4% of the city's water supply.[269] In Singapore, 30% of the nation's water needs is sourced from recycled water,[270] including as drinking water in dry periods.[271]

To increase adoption in NSW, barriers will need to be overcome, including negative public perceptions,[272] fragmented governance responsibilities and wastewater pricing policies.[273] In particular, it will be important for the community to be informed candidly about the compelling need for greater water security, and to demonstrate the effectiveness of purification technology to increase community acceptance of purified recycled water in the medium to long term.[274] Building on lessons from other jurisdictions, it can take significant time to build community support and trust. Therefore, a roadmap for the adoption of purified recycled drinking water should be developed, building on work already undertaken by water utilities.[275] This roadmap should include measures to build community support, in addition to progressing a demonstration plant for purified recycled water.[276]

Box 7.1

Lessons on adopting purified recycled water for drinking from other jurisdictions

The Water Services Association of Australia, the peak industry body representing the urban water industry, prepared a report in 2019 which highlighted 10 lessons from other jurisdictions to inform the adoption of purified recycled water in Australia:

Jurisdictions that have successfully implemented purified recycled water for drinking have built trust and buy-in from communities. Key to building and maintaining trust is ensuring transparent and open information sharing and early, grassroots education and engagement with the community. Given that other jurisdictions have taken nearly a decade to deliver purified recycled water, it is important to start planning and engagement early.

In addition, investment in a demonstration plant with educational facilities, such as a public tour program and visitor program, can significantly build community awareness and support.

Finally, another key to success is collaborative and transparent engagement between government and regulators. This will ensure an effective regulatory framework.

Recycled water for non-drinking purposes also presents a significant opportunity to reduce the need for new supply, provide water for public green spaces, return water to river ecosystems and reduce major capital investment needed for conventional sewerage expansion.[277] Work underway to develop the Upper South Creek Advanced Water Recycling Centre in the Western Parkland City demonstrates this approach.

Rainfall-independent sources will also be needed to contribute to meeting water demand from the increased green space and tree canopy cover needed to offset the effects of urban heat (see Chapter 5, Box 5.3 on urban cooling in South Creek). Demand for water to service green space and tree canopy is projected to increase from around 20 GL per year in 2020-21 (around 4% of Sydney's total annual demand) to around 68 GL per year by 2035.[278,279]

Aside from investment in new infrastructure, improved water security over the long term will also require ongoing initiatives to conserve water, manage demand and leverage technological solutions to better monitor water use and the water system's efficiency.

7.4 Opportunities and challenges in regional NSW

Regional water challenges

Many towns and cities in regional NSW face even greater and more severe risks to water security than Sydney. In late 2019, more than 50 regional NSW towns including Dubbo, Cobar and Narromine, experienced significant stress as a result of the recent drought. Numerous towns and communities resorted to carting water, among them Euchareena and Guyra. Many others had 6 to 12 months of supply, such as Tamworth. In some towns, water quality was declared unsafe, resulting in boil water alerts.[280]

These severe conditions threaten the economic viability of some regional towns, as key industries in these locations, such as agriculture, are heavily reliant on water availability.

Regional water challenges are further exacerbated by limited operational scale. Water provision in regional NSW is provided by 93 local water utilities (LWUs), predominantly council-owned, which service 1.8 million people. There is significant variability in the geographic coverage and population of each LWU's area of operation. For example, areas serviced can range from 285 to over 50,000 square km, while populations can range from only 1000 to over 300,000. Remoteness can contribute to skills shortages, including in specialist water engineers and operators needed to maintain town water infrastructure. There is also

an insufficient rate base in many communities. These limitations mean that LWUs can struggle to independently fund services, as capital and operating costs can exceed revenue from user and service charges.

It is critical that water resources are shared equitably and responsibly to ensure economic growth in regions without compromising the health and resilience of natural water systems. Water infrastructure projects and future industries must still work within the sustainable diversion limit requirements in relation to the protection of planned environmental water and the Australian Government's obligations on extraction.[281]

Work underway and opportunities for regional communities

Several initiatives are underway to address these issues. Twelve regional water strategies are being prepared by DPE, delivering on the commitment made by the NSW Government in its response to the 2018 SIS. These strategies will set out long-term, tailored water management solutions for regional communities – including region and catchment-specific infrastructure investment and policy interventions –using an evidence-based options assessment process.[282] [283]

To be successful, each strategy will require strong government support, close collaboration with stakeholders and a commitment to sustaining the delivery of solutions over a long time period.

From an infrastructure perspective, following investigation, analysis and community consultation, the strategies will incorporate a range of infrastructure solutions that could include inter-regional connections, dams and dam raisings, weir upgrades, regional desalination plants, water treatment facilities and two-way water transfer.[284]

The NSW Government has already identified dams and dam wall raisings, and it is likely the emerging regional water strategies will canvass additional dams for consideration. It is crucial that appraisal of these projects maintain the strong discipline in strategic options assessment and economic assessment that is a hallmark of other sectors. This is particularly important given the complexity and costs of delivering dam infrastructure, their long build times, as well as the potential for significant environmental, social and cultural impacts.

The importance of maintaining this discipline has been highlighted by the Productivity Commission. The Commission's 2021 White Paper noted that options proposed in NSW's emerging water strategies should be evaluated through rigorous cost benefit analysis. All available options should be considered, including infrastructure, non-infrastructure and centralised and decentralised sources of supply as well as changes to water sharing arrangements. In addition to options analysis, due diligence is needed to ensure individual investment decisions are based on high-quality business cases.[285]

In 2019, NSW Government announced development of major dam projects in the Peel, Lachlan, and Border Rivers catchments - new Dungowan dam, Wyangala Dam wall raising and Mole River dam. Those announcements were subject to further analysis and the dam proposals should be re-evaluated alongside alternatives. Alternative options, including rainfall-independent water supply options, should be exhaustively pursued given the likelihood of their cost and delivery times increasing beyond reasonable expectations and potential for environmental, social and cultural impacts. Options analysis should include baskets of options as well as single source solutions.

The regional water strategies will support and are complemented by actions being taken by the Department of Regional NSW, through Future Ready Regions, to diversify regional economies. In addition, the Aboriginal Communities Water and Sewerage Program works with local water utilities to raise the standard of service to improve water supply and sewerage services in eligible Aboriginal communities.[286]

The NSW Government has also implemented the Safe and Secure Water Program which is investing in upgrades to infrastructure (such as bores, pipelines and treatment plants) that will assist LWUs with the provision of safe and reliable water for regional communities. In certain cases, this work is supported by the Public Works Advisory to ensure community needs and public health are protected.[287] Following a review of the program and completion of a business case, provision of

further funding may be critical to ensure LWUs can plan and deliver infrastructure and services that will reduce public health risks and ensure the viability of regional towns and economies.

Through the Town Water Risk Reduction Program (see Chapter 11, Box 11.7 for more), the Government is working with local councils and LWUs to improve management of town water risks. This includes investigating alternative funding arrangements for local water utilities, including customer service obligations (CSOs).

Aside from these steps to help achieve minimum service level standards in regional communities, a review of LWUs should examine:

- DPE's regulatory framework in partnership with the local water utility sector
- continuation and extension of the Safe and Secure Water Program to reduce public health and water security risks to an acceptable level
- working with local water utilities to improve asset management
- investigation of a needs-based community service obligation (CSO) funding model
- establishing a sustainable market for training in water operations to build capability and skills.

Finally, the NSW Government supports ecological outcomes for the Murray-Darling Basin through the Sustainable Diversion Limit Adjustment Mechanism (SDLAM) projects. These projects aim to deliver strong ecological outcomes while improving availability of water for households, industry and agriculture. NSW is involved in 21 of the 36 SDLAM projects that aim to recover 605GL per year of water, more than the entire capacity of Sydney Harbour.[288] Twelve of these projects are in place and delivering outcomes. Delivery of the remaining SDLAM projects is critical to ensure NSW achieves its Basin Plan outcomes while supporting regional economies, in particular the Murray, Murrumbidgee and Darling River catchments where these projects are located.[289]

7.5 Capitalising on the value of wastewater in NSW

Increasing demand for water ultimately generates more wastewater. This typically requires treatment and disposal, putting pressure on the health and quality of receiving waterways. In Greater Sydney, this is anticipated to create a need to upgrade and renew aging wastewater assets.[290] The 2018 SIS recommended Sydney Water develop a 20-year Strategic Capital Investment Plan for Sydney's water and wastewater systems. This plan has now been finalised and outlines metropolitan wastewater infrastructure needs.[291]

Despite this good work, the fact remains that treatment and disposal of wastewater is fundamentally an inefficient use of a valuable resource. With 80% of Sydney's wastewater being treated and discharged into the ocean, there is the opportunity to invest instead in wastewater recycling for multiple water uses.[292]

This is consistent with principles outlined in the NSW Water Strategy. The Strategy contains an action to foster the circular economy in cities and towns, and to promote and improve integrated water cycle management. Integrated water cycle management takes a whole-of-system, multidisciplinary approach to the provision of water, wastewater and stormwater services and can improve water quality in receiving waterways.

Regional and metropolitan water strategies are expected to adopt a more integrated water cycle management approach, but there is the opportunity to further embed these principles within all future developments in NSW. The Wianamatta South Creek project (see Chapter 5 for more) outlines a leading approach on a sub-regional scale, but applications are also feasible on a precinct and individual site scale.

7.6 Recommendations

No	Recommendations	Implementation timeframe	Lead agency
28	**Increase the resilience of Greater Sydney's water supply through a full range of options, including better conservation and more diverse sources**		
	a. Increase investment in water conservation programs in partnership with public and private sectors.	Immediate Priority	Planning and Environment
	b. Progress planning and development for rainfall-independent water supply projects, including desalination, recycled water and interconnections.	Immediate Priority	Planning and Environment
	c. Adopt integrated water cycle management approaches across the development of all NSW Government-led precincts and major projects.	Immediate Priority	Planning and Environment
	d. Incorporate stormwater harvesting and recycled water projects as standard practice of land use planning.	Immediate Priority	Planning and Environment
29	**Develop a roadmap for the adoption of purified recycled drinking water, including measures to build community support and demonstrate the efficacy of the technology**	Immediate Priority	Planning and Environment
30	**Improve water security and quality in regional NSW** Complete the suite of Regional Water Strategies and progress investigations and planning for new water infrastructure identified within each catchment.	Immediate Priority	Planning and Environment
31	**Investigate and propose alternatives to the delivery of major dam projects in the Peel, Lachlan and Border Rivers catchments**	Immediate Priority	Planning and Environment & Regional NSW

No	Recommendations	Implementation timeframe	Lead agency
32	**Bolster long-term funding and capability to support financial sustainability of Local Water Utilities and ensure minimum service levels are achieved**		
	a. Review DPE's regulatory framework in partnership with the local water utility sector.	Immediate Priority	Planning and Environment
	b. Establish a specific and ongoing program to improve asset management methods, routines and skills in local water utilities.	Immediate Priority	Planning and Environment
	c. Investigate extension of the Safe and Secure Water Program to reduce public health and water security risks to an acceptable level.	Immediate Priority	Planning and Environment & Regional NSW
	d. Investigate alternative funding arrangements, including a needs-based community service obligation (CSO) funding model, to ensure all communities have access to water that meets quality standards.	Immediate Priority	Planning and Environment
	e. Establish a sustainable market for training in water operations to build capability and skills.	Immediate Priority	Planning and Environment & Education

State Infrastructure Strategy
2022–2042

Protect our natural endowments

08

Sydney Park St. Peters, Destination NSW

IN THIS SECTION

Strategic directions

- Foster sustainable use of natural resources and construction materials through reuse and recycling
- Embed a strategic and practical approach to managing biodiversity
- Capitalise on blue-green infrastructure opportunities

Infrastructure decisions made today will have a tangible, enduring impact on NSW's ability to meet environmental priorities now and into the future. While the transition to Net Zero has taken centre stage, it is only one part of a broader set of closely interlinked environmental challenges involving resource use, waste and the natural environment.

Infrastructure that is environmentally sustainable protects and enhances the natural environment. It enables the efficient use of resources, mitigates pollution and contributes to liveable and resilient places. The State's infrastructure can contribute to environmental sustainability by:

- meeting environmental and sustainability standards and benchmarks in delivery
- enabling environmental sustainability outcomes such as waste reduction or biodiversity conservation.

Environmental sustainability has often been a secondary consideration when developing and delivering infrastructure, but this is changing rapidly. Higher community expectations, increasing environmental pressures and the potential impacts of a changing climate mean that environmental sustainability must be elevated among NSW infrastructure delivery priorities.

8.1 Sustainable infrastructure development

Investor interest in sustainable infrastructure is increasing, driven by environmental, social and governance (ESG) expectations and demands for high performing assets. Sustainable assets typically attract commercial premiums and often have lower whole-of-life costs.[293]

There is also increasing demand for sustainable finance. The first TCorp issue of the NSW Sustainability Bond Program was oversubscribed and other Australian jurisdictions are following suit. Green and sustainability bonds can make an important contribution to financing future infrastructure needs and lowering borrowing costs.

Adopting industry-standard sustainability metrics

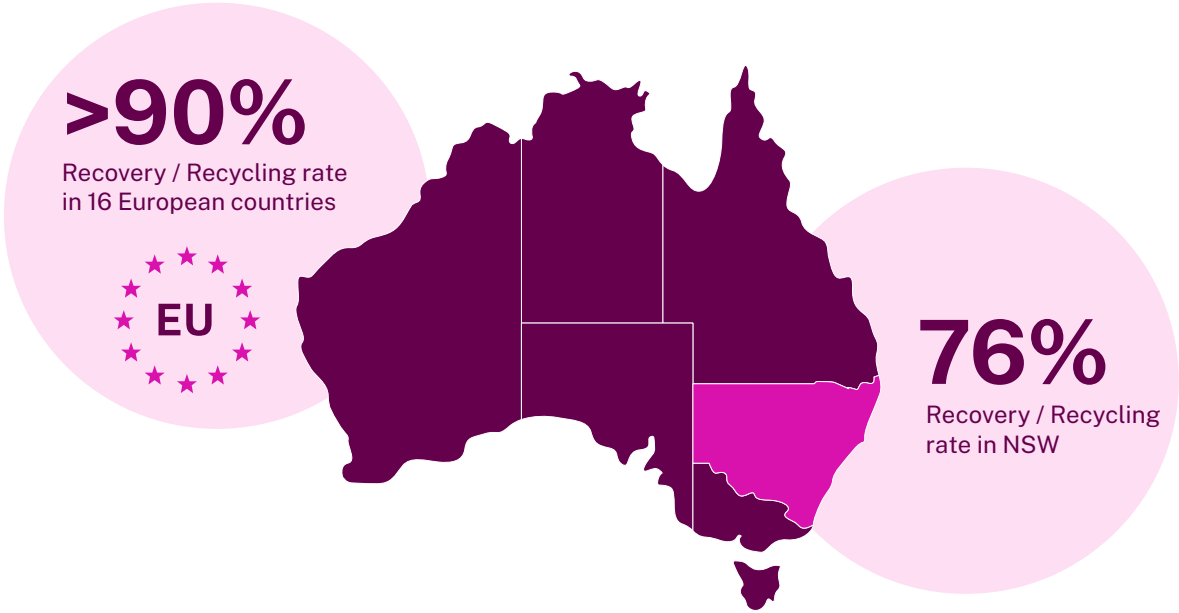
Infrastructure and building sustainability standards, ratings and benchmarks have increased the uptake of sustainable and low carbon building materials and improved energy efficiency, in addition to reducing water use and waste materials. Higher upfront costs traditionally associated with these initiatives are becoming less material, with the NSW Chief Scientist noting the construction cost differential between a 6-star Green Star rated building and a 5-star one is approximately 1.5%.[294] Several projects in NSW, such as Parramatta Light Rail, have already achieved high sustainability standards.

The routine adoption of industry-standard sustainability metrics will improve asset performance and investment attraction. These include Infrastructure Sustainability Council's IS Ratings, Green Star Ratings, the National Australian Built Environment Rating Scheme (NABERS) and GRESB (the global ESG benchmark for financial markets).[295] These metrics objectively measure and enable consistent reporting of sustainability performance of infrastructure assets, and are used by private sector investors to make investment decisions.

The NSW Government will benefit from improving the sustainability performance of infrastructure assets through increased investment attraction, higher asset performance and reduced operational expenses and should adopt industry standards where feasible. For example, new or retrofitted sustainably designed social housing will have improved energy efficiency, thermal performance and water use – reducing operational expenses for government, as well as reducing financial pressures on tenants.[296]

Adoption of sustainability metrics in project development and delivery is not standard NSW practice. This should change, and the use of these metrics should become standard practice for all major infrastructure projects, as well as NSW's social housing stock. Standards should prescribe measurable outcomes rather than methods, design or materials, and allow for certification of innovative approaches on a flexible basis.

Figure 8.1 – Recovery/ recycling rates in Australian and European construction and demolition sectors



Source: Infrastructure NSW, based on NSW Environment Protection Authority (2021) and NSW Government (2020) data

Supporting a sustainable infrastructure industry

Infrastructure is resource-intensive. While the construction and demolition sectors in NSW (which include infrastructure) have relatively high recovery/recycling rates,[297] many countries in Europe, including the UK, report considerably higher rates, as shown in Figure 8.1.[298] The construction sector is the single largest contributor to waste in NSW, with waste volume growing by almost 6% a year between 2016 and 2020.[299] Current levels of recycling are inadequate to support NSW's transition to a circular economy.

Sustainability challenges associated with infrastructure projects include:

- carbon intensive building materials and construction processes
- levels of resource consumption/re-use
- amount of waste production
- management of hazardous materials and linear supply chains
- complex and expensive construction and demolition waste diversion
- avoiding, mitigating and offsetting impacts on biodiversity.

The Government Resource Efficiency Plan already commits the NSW Government to demonstrate sustainability outcomes in its infrastructure program in the procurement of related goods and services. The need for this is reinforced by advice from the NSW Chief Scientist who has noted the important role governments can play by using procurement levers to drive the development and adoption of sustainable infrastructure, both within government and by industry. This includes measures to:[300]

- grow the market for efficient and modular designs that are more resource efficient and incorporate sustainable materials
- grow local supply chains in sustainable, reused and recycled construction materials
- increase re-use and recycling of building materials and construction and demolition waste
- foster new markets for ecosystem services and sustainable land use practices.

Increased utilisation of existing assets, for example through renovation or re-use, can reduce the resources that would otherwise be needed through a new build.[301] In addition, there is increasing recognition and adoption of circular economy concepts in infrastructure business cases, such as the adoption of renewable energy and resource use in waste management systems.[302]

There are also solutions emerging through new technology (such as blockchain-enabled material passports) that can verify the origin of construction materials, better track and measure their performance and foster exchange and re-use of materials between projects.

There is emerging leadership in this area. The NSW Government has joined industry partnerships such as the Materials & Embodied Carbon Leaders' Alliance (MECLA). NSW Government infrastructure agencies are also engaging with their supply chains on ways to incorporate sustainability measures as standard practice through contracting arrangements. Private sector delivery partners are also increasingly improving the sustainability of their own supply chains due to investor-driven ESG considerations.

With recent strategies, the NSW Government is committed to embedding circular economy principles in decision making and can lead the nation in increasing the sustainability of infrastructure projects.[303]

8.2 Waste policy for a circular economy

The NSW Government recently published the NSW Waste and Sustainable Materials Strategy (NSW Waste Strategy) 2041 which establishes short- and long-term targets to be achieved over the next 20 years.

The key objectives of the NSW Waste Strategy are to:

- meet future infrastructure and service needs
- reduce carbon emissions through better waste and materials management
- build on existing work to protect the environment and human health from waste pollution.

The NSW Waste Strategy and related documents establish a framework to target key waste streams, guides infrastructure investment to meet demand for residual waste management and recycling, and achieve zero emissions from organic waste by 2030.

Waste management creates circular economy opportunities

NSW generates around one-third of Australia's total waste. In 2019–20, total waste generated per capita in NSW was 2.65 tonnes.[304] Over the next 20 years, NSW waste volumes are forecast to grow from 21 million tonnes in FY2021 to nearly 37 million tonnes in FY2041 (see Figure 8.2).

Figure 8.2 – Waste volumes in NSW

2.65 tonnes
of waste was produced **per person** in NSW in **2019**

21m tonnes
of waste produced in NSW in **2021**

37m tonnes
of waste projected in NSW by **2041**

Source: Infrastructure NSW, based on NSW Environment Protection Authority data (2021)

The Australian Government commenced a ban on waste exports on 1 January 2021. By July 2024, bans will be in place for glass, mixed plastics, used tyres, single resin/polymer plastics and mixed unsorted paper and cardboard. The materials on the export ban list represent 32% of the 4 million tonnes of waste exported each year from Australia.

Managing the waste that was previously exported presents a significant challenge but also opportunities to adopt circular economy solutions.

The circular economy presents opportunities to build NSW's material waste self-sufficiency. This has the potential to promote manufacturing waste self-sufficiency. For example, a large part Australia's exported waste is metal, including metals from wiring and e-waste, which comprises copper, gold, platinum and nickel.[305] In 2019-20, it is estimated that more than $500 million worth of precious and semi-precious metals was exported as waste.[306] This waste could be re-used locally giving rise to new industries that would support the Net Zero transition.

With enough scale and efficiency, recycling of critical materials can reduce the need for new materials, replacing them with materials already in circulation.

Future demands for waste infrastructure

Even with increased rates of waste reduction and landfill diversion under a circular economy, future landfill capacity will be needed.[307] For example, in Greater Sydney, at the current rate of waste generation and recycling, the putrescible (waste containing organic matter) landfills will reach capacity by 2036, and non-putrescible landfills will reach capacity in 2028.[308]

While improving waste reduction and landfill diversion may delay the need for imminent investment, a strong pipeline of investment in waste-related services and infrastructure will be needed to cater for a growing State.

With the waste sector predominantly serviced by the private sector,[309] the NSW Government should continue to play a role in ensuring that investments are made in the right place and at the right time. Accordingly, the NSW Government should, as noted in the NSW Waste Strategy, take a more active role in strategic planning to identify and reduce planning risk on sites for future waste infrastructure. The location and timing of waste infrastructure should align with the Greater Sydney Region Plan and District Plans, as well the Industrial Lands Policy Review, and may require preserving land in the near term for use in the long term.

8.3 Planning for energy from waste

Energy from waste could play an important role in the future in NSW, as it does in other locations worldwide. Consistent with the circular economy principles outlined in the NSW Waste Strategy, NSW Government policy is that recovering energy from waste, while a better alternative to disposal to landfill, should be explored only after options to avoid, reduce, reuse and recycle have been exhausted.[310]

Within this context, and to provide near term certainty for communities and proponents of energy from waste facilities, in 2021 the NSW Government released an updated Energy from Waste Policy Statement. This outlines the latest advice on the environmental and emissions standards with which energy from waste facilities must accord to ensure that NSW's air emissions standards meet and exceed global best practice.

The policy statement also sets out the framework for the operation of new purpose-built facilities and other existing facilities and governs the NSW Government's assessment of energy from waste proposals. This statement provides the policy certainty needed for proponents of energy from waste facilities to understand their environmental performance objectives and the NSW Government's approach to assessing any new proposals.

NSW EPA analysis suggests that there will be a need for strategically located energy from waste infrastructure in NSW but that communities need to be well informed and consulted on how social, economic and environmental needs are being met. Initial locations under investigation include the West Lithgow Precinct, Parkes Special Activation Precinct (SAP), Richmond Valley Regional Jobs Precinct and the Southern Goulburn Mulwaree. Various other proposals in different locations across NSW are also under consideration by the NSW Government.[311]

In the longer term, as other pathways are fully developed, energy from waste may play a greater role. As new technologies and environmental monitoring regimes advance, confidence in and acceptance of energy from waste infrastructure may improve. As with the location of any waste infrastructure, strategic consideration should be given to the proximity of waste generation and receival locations, as well as transport routes. In addition, as with any significant shift in practice or technology transition, an effort to engage with and inform the community will be essential.

Regional Special Activation Precincts present opportunities

A key opportunity outlined in the NSW Waste Strategy is the co-location of complementary industries, particularly the opportunities offered by regional precincts located on arterial transport routes. These have the potential to become circular economy precincts. For example, a network of energy from residual waste, water recycling and other resource recovery activities could create jobs and drive innovation.

Regional precincts may also have decentralised industries, energy and water sectors that can benefit from using local resources to minimise transport costs.

The Parkes SAP has been identified as a potential site to host a circular economy precinct, and market sounding has commenced. The precinct has the potential to become Australia's first United Nations Industrial Development Organisation (UNIDO) eco-industrial precinct.

Overall, a circular built environment could save 3.6 million tonnes of CO2 per year across Australia and deliver $29 billion in direct economic benefits to NSW per year by 2040.[312]

8.4 Managing biodiversity impacts of new infrastructure

Like the elevation of climate risks to the global policy agenda, the economic and social risks of biodiversity loss are becoming a more prominent concern.[313] This includes Australia's commitment to halt and reverse forest loss and land degradation by 2030.[314] In addition to the natural environment's intrinsic worth, biodiversity and blue-green infrastructure provide financial and cultural benefits.

NSW's system of managing biodiversity impacts has an established legislative framework through the *Biodiversity Conservation Act 2016*. The Act has an objective to maintain a healthy, productive and resilient environment – natural capital – for the greatest wellbeing of the community, now and into the future, consistent with the principles of ecologically sustainable development.

The loss of biodiversity is examined as part of standard project planning and assessment practice in NSW. This includes considering an individual project and cumulative impacts[315] across both infrastructure delivery and operation. Biodiversity impacts can be avoided or minimised though sensitive design features and increasingly, there are ways to ensure that infrastructure is nature positive (see Box 8.1 below).

NSW has a mature system of managing biodiversity impacts; however, in practice the system is proving somewhat mechanistic and is increasingly creating outcomes that may be unnecessarily expensive. The NSW Biodiversity Offsets Scheme provides a way of measuring biodiversity loss and gain as part of a transparent and robust system that applies throughout NSW. It is applied at all scales, from small sites through to large infrastructure projects. Infrastructure proponents use the Biodiversity Assessment Methodology to understand and avoid impacts as part of project approval documentation. If approved, offset obligations are set out in development approvals.

Private and public sector infrastructure proponents can meet offset obligations by:

- purchasing credits on the market established by landholders who enter 'in perpetuity' biodiversity stewardship agreements to manage land for conservation
- transferring credit obligation to the Biodiversity Conservation Trust by paying into the Biodiversity Conservation Fund (BCF)
- creating biodiversity stewardship agreements on land directly owned by the proponent.

However, the current supply of credits does not meet the scale of offsets needed for major projects in NSW. The supply of offsets could potentially be addressed by more strategic purchasing and by addressing supply constraints in advance of projects to increase liquidity, reduce costs and reduce delays to infrastructure delivery.

There are other challenges identified by stakeholders:

- The calculation of credits in the Biodiversity Offsets Payment Calculator, and their application to different species and subregions, can be quite complex.
- The costs of offsets and barriers to individual projects can be prohibitive, even where there are highly compelling reasons to pursue the project.
- The options available to acquit biodiversity offset obligations may be too restrictive. In particular, the potential to enrich and expand National Parks may be overlooked as a source of offsets.

These challenges have resulted in several major projects generating significant biodiversity offset costs which, in certain cases, were as much or higher than the estimated construction costs. In many cases, the viability of otherwise worthy projects is put at risk. It is also often the case that biodiversity offset costs are not known until the later stages of project planning. A more timely and strategic approach to biodiversity management would lead to better outcomes.

Protecting natural capital while bringing certainty to project costs and timelines

Responding to these concerns, DPE is scoping options to increase credit availability, liquidity and confidence to support market development and reduce risk to producers and consumers of offsets (including for government projects). This will be underpinned by a strategic approach to biodiversity management. An investable fund could provide a bank or inventory of 'advance' biodiversity credits to meet expected demand from the forecast future pipeline of infrastructure investment. DPE is exploring how this could be part-financed by proponents and institutional investors. This could increase the natural capital stock available while supporting NSW infrastructure to achieve a nature positive outcome (see Box 8.1).

Upfront investment in a bank of biodiversity credits could streamline offsets for a future pipeline of major projects, with main benefits being:

- offset efforts targeted in areas that will help to achieve better biodiversity outcomes – and opportunities for funding new National Parks using capital expenditure
- faster, easier and potentially lower cost ways for major projects to meet offset obligations
- increased certainty for landholders establishing Biodiversity Stewardship Agreements (certainty over demand for credits)
- increased credit supply for major projects, while also generating interest in the scheme to increase supply for other types of development
- a more strategic approach to targeting investment in green infrastructure.

Box 8.1

Case study: UK commitment for Nationally Significant Infrastructure Projects to achieve biodiversity net gain

In response to the UK Treasury-commissioned Dasgupta Review on The Economics of Biodiversity, the UK Government has committed to the delivery of a 'nature positive' future. This requires all new Nationally Significant Infrastructure Projects to provide a net gain in biodiversity and habitats for wildlife. This includes all future transport and energy projects.

A nature positive approach enriches biodiversity, stores carbon, purifies water and reduces pandemic risk. In short, a nature positive approach aims to enhance the resilience of the planet and societies.

Through DPE's work to review approaches to biodiversity management practice, there is the opportunity to explore taking a similar approach in NSW where infrastructure projects can increase net biodiversity, rather than only offsetting impacts.

These proposals are at an early stage, Infrastructure NSW supports the approach proposed by DPE but notes that past reforms in biodiversity policy have been protracted in delivery. Success will require a focus on program design with significant private sector input and a tight timeframe for finalising arrangements, as well as clear objectives in terms of reliability and cost of credits for projects and ongoing evaluation to ensure benefits are being realised. If successful, development of this market-based approach could be applied to other nature-related markets – such as those that provide resilience benefits in wetlands or coastal dune environments (such as the Reef Credits Scheme in Queensland – see Box 8.2).[316]

This worthwhile initiative could also be part of broader changes to increase the options for meeting biodiversity goals, especially where a project is particularly compelling from a community needs perspective.

Box 8.2

Reporting nature-related risks

Globally, the Taskforce on Nature-related Financial Disclosures (TNFD) has been set up to build on the work of the Taskforce on Climate-related Financial Disclosures (TCFD) and provide decision-grade data that can support investment, lending and compliance activities in financial markets. The TNFD is due to complete its work and begin piloting its approach in 2023.[317]

Work is already underway in the NSW Government through the Biodiversity Conservation Trust to determine how natural capital can be valued and subsequently incorporated into standard financial decision practices.

Integrating this work with global movements in financial markets and applying it to the infrastructure sector may provide opportunities to develop natural capital markets (such as the Reef Credits Scheme[318] – an innovative market-based approach for water quality management at the Great Barrier Reef), create net-positive infrastructure and take a natural environment conservation leadership role.

8.5 Blue-green infrastructure can support biodiversity and the natural environment

Blue-green infrastructure and other nature-based assets (see Box 8.3) can complement traditional 'grey' infrastructure (such as roads, rail and buildings) to support biodiversity and environmental outcomes. Blue-green infrastructure serves multiple ecosystem, economic, liveability and resilience benefits. These can include:

- atmospheric cooling effects through tree canopy and waterways in urban areas
- integrated water cycle management from natural waterways in urban areas
- improved air quality and carbon sequestration and storage.

Box 8.3

What is blue-green Infrastructure?

Blue-green infrastructure is the network of green spaces, natural systems and semi-natural systems. This includes waterways and wetlands, bushland, tree canopy and green groundcover, parks and open spaces that are strategically planned, designed and managed to support biodiversity, natural systems and broader liveability.

Benefits from blue-green infrastructure are greatest when delivered as a network of related assets, corridors and ecosystems. This can be achieved by improving government land and open space, partnering with local government and linking private landowner assets. 'Grey' infrastructure can also serve as links and nodes within a network of blue-green infrastructure assets.

Integrating blue-green infrastructure into new 'grey' infrastructure assets is not typically a primary consideration during project planning and design, but should be explored in the future. In doing so, there is the potential to reduce the impacts of linear infrastructure (such as transport corridors) and vertical infrastructure (such as hospitals, schools and housing) on biodiversity loss.

There may also be other opportunities to enhance blue-green networks in unused or minimally used transport corridors that often present issues with land management, including pest management. A costly maintenance process for transport could become an opportunity for natural assets in the hands of other parties.

It will also be essential to enhance blue-green infrastructure networks though initiatives such as streetscape revitalisation, public open space improvements, precinct and place-based development, and local and regional plans.

Finally, land owned by local Aboriginal land councils may present blue-green infrastructure opportunities that could play a role in delivering important ecosystem outcomes, including carbon offsets, biodiversity outcomes, coastal and wetland regeneration, and local community development, among others.[319]

Taking a strategic, statewide approach to planning and delivering blue-green infrastructure – as is routinely the case with other infrastructure asset classes – is important and necessary to achieve these network outcomes. This should include setting strategic priorities and measurable targets for blue-green infrastructure outcomes (such as canopy targets or urban cooling objectives).

Work underway by DPE that includes expanding key aspects of *A 50-year Vision for Greater Sydney's Open Space and Parklands* on a statewide basis and development of the Valuing Green Infrastructure and Public Spaces Sector Specific Valuation Framework to accompany the NSW Cost Benefit Analysis Guidelines are good foundations for a more strategic, whole-of-state approach. Along with providing certainty of funding on a year-to-year basis, having a statewide strategic approach in place will ensure that government capability increases, a pipeline of projects is developed and beneficial projects are delivered.

8.6 Recommendations

No	Recommendations	Implementation timeframe	Lead agency
33	**Improve sustainability throughout the infrastructure lifecycle** a. Adopt sustainability standards for major infrastructure projects developed and/or delivered by the NSW Government. b. Support industry development in sustainable construction materials and practice through project procurement.	Immediate Priority	Planning and Environment
34	**Expedite development of a NSW Biodiversity Strategy and Biodiversity Holding Fund to strategically manage NSW biodiversity assets and improve the offset system**	Immediate Priority	Planning and Environment
35	**Promote the development of a blue-green infrastructure network across NSW** a. Develop blue-green infrastructure strategies as a fundamental part of place-based initiatives. b. Incorporate blue-green infrastructure as an integral part of the delivery of linear and vertical infrastructure, and convert unused transport corridors to blue-green infrastructure where possible.	Extended Program	Planning and Environment & Transport
36	**Identify and plan for future waste infrastructure needs as part of the Greater Sydney Region Plan and Regional Plans**	Immediate Priority	Planning and Environment

State Infrastructure Strategy
2022–2042

Harness the power of data and digital technology

09

IN THIS SECTION

Strategic directions

- Ensure secure high-speed digital connectivity in key precincts
- Prioritise the application and use of data and digital technology across all aspects of service delivery throughout the infrastructure asset lifecycle
- Modernise legacy infrastructure and government systems, while retaining agility to avoid asset redundancy

The benefits of combining digital technology with physical infrastructure are increasingly clear. The right digital applications can increase the productivity, efficiency, flexibility and safety of physical infrastructure assets and networks.

Digital technology can enhance infrastructure and service delivery:

- as **an enabler** that allows new and efficient ways to plan, coordinate, prioritise and design infrastructure at early stages of the asset lifecycle. Examples include the NSW Spatial Digital Twin (SDT), Digital Engineering (DE) frameworks and Building Information Models (BIM). When combined with other technology solutions – such as digital licensing and tracking and approvals systems (such as ePlanning) – there is potential to generate even greater efficiencies, insights, and transparency
- by **supporting** the efficient operation and management of assets using digital tools and platforms, and data insights gained from a digitally connected network. For example, smart cities with the appropriate sensors and devices in place can operate real-time traffic management systems, while artificial intelligence (AI) software can improve the efficient operation of utilities
- as **infrastructure in its own right**, with both physical and software platforms creating links between networks and establishing pathways to connect people and communities with services. This includes telecommunications and connectivity infrastructure, data centres and service centres, and digital platforms that provide citizen experiences and virtual services.

Digital technology solutions can be alternatives to physical infrastructure in delivering desired outcomes – potentially reducing, delaying or avoiding the need for, and costs of, fixed physical infrastructure.

The depth and speed of digital transformation across infrastructure sectors will be influenced by citizen needs and expectations, technology availability, data governance, efficiency dividends and cyber security capability. The progress of regional or international competitors in creating digital economies is likely to shape demand for information and communications technology (ICT) infrastructure networks, digital service domains and ‘smart city’ assets.

The Australian Government, through its *Digital Economy Strategy 2030*, is setting a direction for modernising and building resilience into the national economy as industry, business and service delivery continue to transform with digital technology. Monitoring sector trends at a national and global scale will be critical to benchmarking progress and new opportunities.

In the same way that government investment in economic infrastructure underpins efficient markets and creates public benefit, coordination and investment in public digital infrastructure is also necessary to enable business-led growth and improved social outcomes. While the private sector will continuously seek market opportunities and provide innovative services, government has a role in unlocking the full benefits of digital connectivity and technology deployment. This includes facilitating digital technology take-up and use by businesses and enabling private sector investment where possible.

It is essential that the NSW Government takes a targeted and strategic approach to building the necessary digital connectivity, while embracing technology-enabled ways of constructing, delivering, operating and maintaining infrastructure. There are three ways NSW could improve its digital competitiveness in this regard:

- ensuring high standards of digital connectivity are built into new government precincts and infrastructure projects
- completing the digitisation of infrastructure planning, delivery and operations
- preferencing digital service models over building new physical infrastructure.

9.1 Competitive high-speed connectivity is fundamental to economic and social outcomes

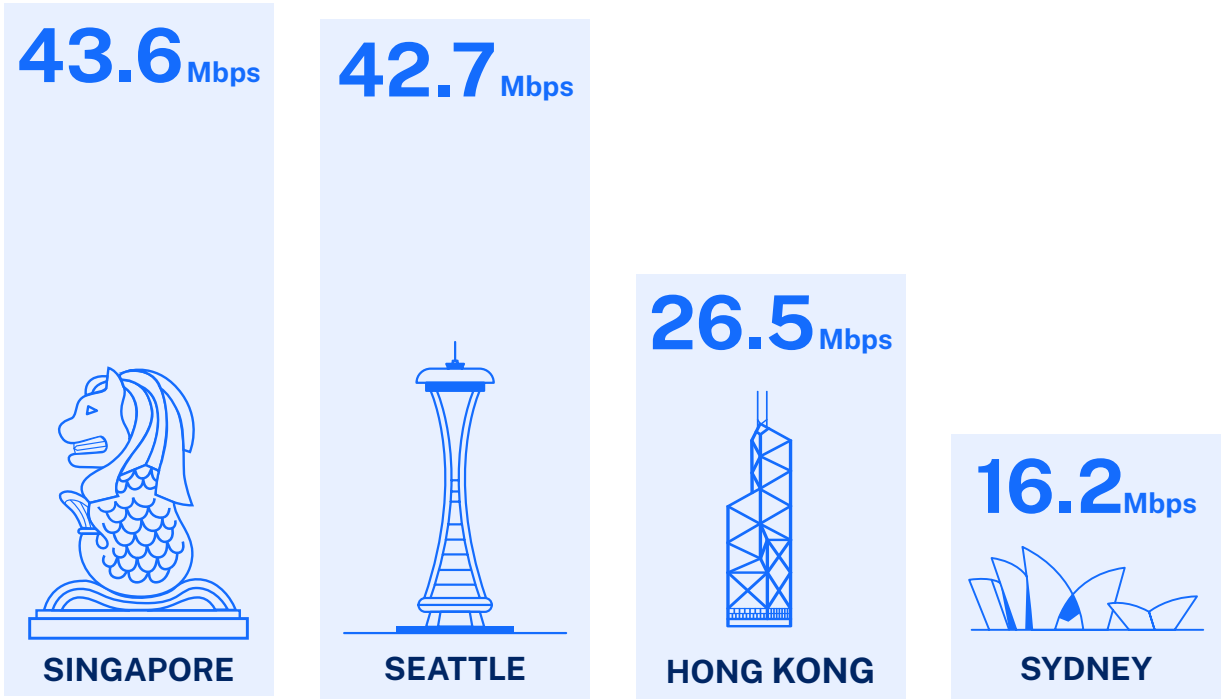
Household and business demand for fast and large volumes of data transfers continues to increase rapidly. The availability of high-speed public and emergency broadband is also critical for timely responses to crises and building community resilience.[320]

To remain globally competitive, NSW's broadband, mobile and internet of things (IoT) connectivity needs to keep pace with the performance of other jurisdictions. NSW and Sydney consistently rank lower than international comparators on average speed and penetration of broadband connectivity (see Figure 9.1). Sydney averages speeds of 16.2 Mbps (below the 2018 SIS targets of 25 Mbps), which compares unfavourably with Hong Kong (26.5 Mbps), Seattle (42.7 Mbps) and Singapore (43.6 Mbps).[321] Only 17% of National Broadband Network (NBN) connections are at 100Mbps or above, whereas in New Zealand 17% of fibre broadband customers are already on plans of 1Gbps or above.[322]

While over 99% of the national population has access to NBN services, this does not equate to broadband use. The ABS reported in 2017 that over 2.5 million Australians were not online due to affordability issues, their location or lack of digital literacy. Geographic coverage challenges remain for rural and remote areas and continue to disproportionately affect Aboriginal communities.[323] Two-thirds of Australia's land mass does not have mobile reception. This includes transport corridors often used by freight vehicles and farmlands outside regional towns.[324] Where there is option for NBN satellite coverage, the current speeds and reliability preclude some of the highest productivity uses, such as video conferencing.

Appropriate regional and outer metropolitan coverage and high-speed connectivity is vitally important in generating economic opportunities outside major cities. Communities without access to essential and increasingly digitised government and private sector services risk lost opportunities and restricted options for work, education, healthcare and social connection.[325]

Figure 9.1 – Average speed of broadband connectivity for Sydney's international comparators



Source: Infrastructure NSW, based on the Committee for Sydney and the Business of Cities data (2020)

Whole-of-government approach to connectivity

One challenge is that telecommunications is the responsibility of the Australian Government. In NSW, telecommunications has been managed in a limited way by the NSW Government to address its needs. Through various initiatives and the establishment of the departments for Customer Service (DCS) and Regional NSW, the State has increased its involvement in and coordination of telecommunications since 2018. Further benefits will flow from a concerted program that is coordinated and driven by a lead portfolio, as envisaged by the NSW Telco Authority (NSWTA) within DCS.

NSWTA's whole-of-government Connectivity Strategy identifies opportunities for better coordination, prioritisation and implementation of connectivity initiatives across NSW Government agencies. The strategy aims to complete an assessment of statewide mobile and fixed connectivity experience (including coverage, speed and quality) and set appropriate statewide connectivity targets to inform investment priorities and address critical gaps.

The Connectivity Strategy could also explore ways for private sector involvement in expanding statewide connectivity by leveraging state-owned infrastructure. Through its procurement of connectivity for cross-agency 'hubs' (for example schools, hospitals and justice facilities) the NSW Government could facilitate private sector investment in surrounding community 'spokes'.

Box 9.1

Shared infrastructure to enable connectivity

Shared infrastructure is one way to support wider and more inclusive digital connectivity by reducing deployment costs. It can also improve the visual amenity of digital connectivity infrastructure. Shared infrastructure can be owned or leased by a government, government agency or the private sector.

Shared infrastructure is defined by the Telecommunications Act 1997 but has not been streamlined to account for different processes and needs emerging across state and local government. It grants mobile carriers specific powers and immunities to deploy telecommunications infrastructure quickly in a nationally consistent way but leaves local government and/or place owners largely unable to influence the deployment, unless there are heritage implications or other special circumstances. This has implications for how smart places and precincts are implemented.

The Western Sydney 5G Strategy outlines the need for Shared Infrastructure in Principle and outlines actions for all three levels of government in the Western Sydney City Deal to work with the telecommunications industry, with the objective of using shared sites for 5G infrastructure in the Western Parkland City.[326]

The NSWTA should also engage with linear infrastructure owners, such as Transport for NSW, to identify opportunities to coordinate whole-of-government connectivity along major corridors. By engaging early and coordinating planning and design, such an approach could deliver digital connectivity more efficiently.

The NSW Government is exploring how further coordination with commercial providers can help to facilitate faster, cheaper and better digital connectivity coverage through shared infrastructure (see Box 9.1). Shared infrastructure arrangements should be adopted as far as practicable, along with alternative ways to achieve digital connectivity.

The emergence of the Low Earth Orbit Satellite (LEOSat) sector is one such example. The Australian Government's 2021 Regional Telecommunications Review highlights the potential role of LEOSat, among other emerging technologies, in supporting regional high-speed broadband connectivity.[327] Identifying opportunities and developing the required policy environment to support multiple co-existing technologies across priority regions and under-served communities should form part of the NSW Government's long-term connectivity strategy.

The Western Sydney City Deal illustrates the benefits of cooperation between the NSW and Australian governments to meet connectivity objectives. Co-investment opportunities should also be pursued with the NBN and private sector providers where this aligns with the NSW Government's strategy.

9.2 Embedding digital technology throughout the infrastructure lifecycle

Application and use of digital technology throughout all stages of the infrastructure lifecycle can deliver significant benefits. Productivity benefits can be achieved by seamless transitions between project lifecycle stages, and digital technology can help to integrate tasks that are often disjointed across the planning and infrastructure value chain (see Figure 9.2).

Spatial digital twin and digital engineering tools can enhance infrastructure planning and delivery outcomes

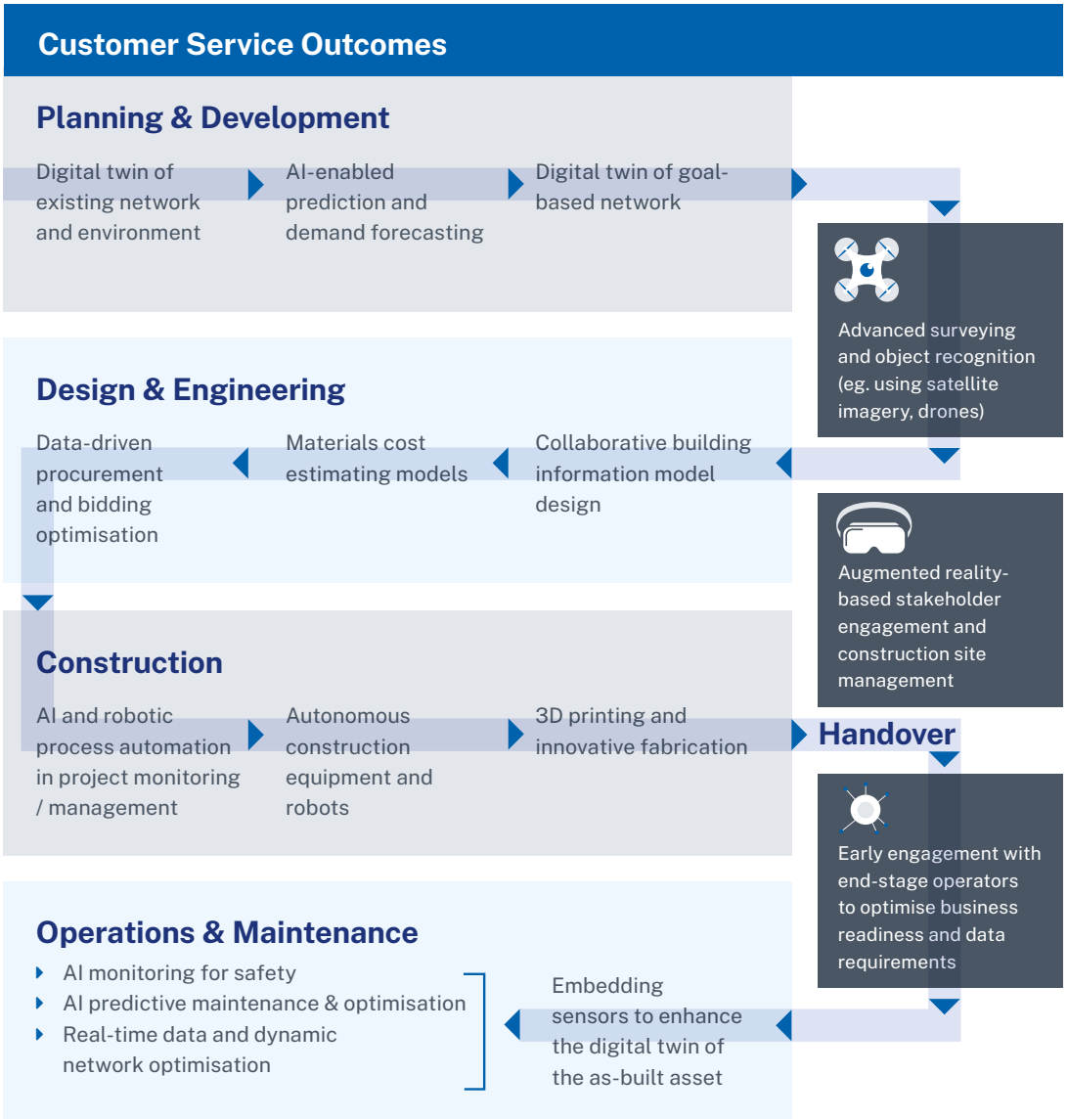
'Digital first' approaches to the planning, delivery and operations of infrastructure require the adoption of new platforms and processes such as digital twins and digital engineering (DE).

As the NSW Spatial Digital Twin and Live.NSW platform mature and reach sufficient adoption, they will enable better informed decision making and also improve infrastructure coordination and

prioritisation (see Box 9.2). Digital platforms can also be used to enhance government engagement with citizens, a particularly important aspect of prudent infrastructure planning and delivery. Insufficient public engagement at the planning and design phases of the infrastructure lifecycle often leads to project delays down the track when communities resist investment proposals.

At a project-level, DE approaches, including BIM, drive better business, project and asset management outcomes by reducing delay and cost risks in the design and delivery of projects.[328, 329] However, a lack of consistency in DE, data standards and the requirements enforced by government procurement rules has meant widespread use of and benefits from BIM in public projects have been limited. A *Digital Built NSW Program* is under development to support a phased uplift in capabilities across the NSW Government, noting that agencies have differing levels of maturity and experience. The return on investment of DE approaches is frequently positive upon completion of delivery but these benefits accumulate significantly, as digitised assets start their operating lives with greatly enhanced data collection and monitoring abilities.

Figure 9.2 – Potential digital technology applications for infrastructure



Source: Infrastructure NSW (2022)

Box 9.2

NSW Spatial Digital Twin

The 2018 SIS recommended the preparation of a business case to upgrade NSW's Foundational Spatial Data Framework from a two-dimensional map to a four-dimensional model (3D + time).

The NSW Spatial Digital Twin is a 3D model of the State's physical environment, capable of recording past conditions and visualising future scenarios. Its initial proof of concept showcased how such a platform can integrate DE information, live data feeds and 3D aerial imagery with the State's digital records on land use. Transport, utilities, planning, natural resource management, environmental management and emergency management data are being progressively added, along with the functionality to support data sharing and collaboration, as well as integration with public engagement tools such as Live.NSW.

While originally conceived to support infrastructure planning and delivery, this platform has benefits for all levels of government, for industry and for the community.

Other jurisdictions, such as the UK, have achieved greater adoption rates of DE by mandating its use in public infrastructure delivery, and have documented productivity dividends from its wider use.[330] Taking lessons from other jurisdictions, a coordinated and phased approach to DE requires clear and interoperable standards and guidelines, engagement with industry and commensurate procurement requirements.

A roadmap for the NSW Government is needed to achieve widespread adoption and use of DE tools. In turn, this will ensure that the State can seize productivity-enhancing opportunities to automate and streamline the future planning, delivery and operation of assets.

9.3 Smart infrastructure, places and cities

Technology-enabled infrastructure and technology upgrades are among the highest pay-off investments available to the State. They should be a significant element in future investment programs as NSW pivots to multi-year programs designed to improve the capacity, reliability and resilience of existing assets and networks.

The NSW 2020 *Smart Places Strategy* highlights how technology can collect and leverage spatially enabled data to support higher quality evidence-based decisions (see Figure 9.3).

Figure 9.3 – Smart Places – where physical and digital environments converge

Smart Places are where the physical and digital environments converge. They integrate technologies in the built environment to capture and convey data insights. The embedded technology captures information on the asset or local environment.

The data is then analysed to help people and government make better, evidence-based decisions about how to improve the productivity, liveability and resilience of cities, towns and communities.

1. Embedding sensors and communications technology in infrastructure

2. Capturing, safely storing and making government-acquired data available

3. Communicating information and insights

NSW Government, *Smart Places Strategy*

The *Smart Places Strategy* provides foundations for enhanced infrastructure performance. It promotes the use of sensors and devices embedded in the built environment to collect and share data across multiple systems; for example, smart CCTV, smart lighting, predictive analytics and emergency systems.

Greater deployment of these technologies can also drive efficiency, operational and customer improvements in the State's transport networks (see Box 9.3). Sydney's Coordinated Adaptive Traffic System (SCATS), smart traffic signalling and real-time route planning to reduce traffic congestion all require a seamless and efficient digital ecosystem created in Smart Places. Real-time intelligent sensors to monitor vehicle movements and automated tracking are other potential opportunities. One such example is the multimodal Digital Smart Kerbs trial being piloted in Liverpool, which aims to make the best use of limited kerb space.

Detailed 'as-built' digital models of infrastructure can also enable more targeted and prioritised responses by asset managers. Drone imagery, sensors and real-time or near-real-time data can be combined with these models to document historical needs and identify preventative, and even automated, maintenance opportunities. These technologies have tangible customer benefits through enhanced service availability and reliability, as well as helping to build the resilience of assets and services to unplanned events.

Box 9.3

Driving customer and operational improvements through transport digital technology

Transport for NSW has made technology central to its mission to enhance customer services and lift productivity. This includes investing in operational and safety improvements with significant benefit to cost ratios, such as:

- **Digital Rail Systems:** New Automatic Train Protection (ATP) technology and digital signalling systems installed along Transport for NSW's rail network provide enhanced information and safety compared to legacy systems. These systems will also enable intelligent management of network congestion and freight integration, and reduce service disruptions.
- **Smart Motorways:** Smart traffic management systems such as automated ramp signalling and lane management can smooth traffic, ease congestion and improve road safety. These investments also enable better utilisation of existing infrastructure assets. Combined with sensors, real-time and other advanced data analysis, smart motorways can dynamically adjust to changing conditions across all transport modes or shift priorities to certain vehicles like freight or emergency services. A review of the M4 Smart Motorway since its opening reported a 40% reduction in accidents while reducing travel times by 20%.

Transport for NSW has also released the second edition of its *Future Transport Technology Roadmap 2021-2024*, which highlights opportunities to deliver statewide, regional, metropolitan and freight outcomes. This includes further use of Digital Twins to support the construction and operation of transport infrastructure, readying the State's infrastructure for connected, automated and electric vehicles, and delivering sensors and data to improve the efficient movement of freight across the State.

While implementing Smart Places is a challenge in precincts due to the range of stakeholders, regulation, coordination and policy considerations, the *Smart Places Strategy* should remain a high priority for the NSW Government. This means adhering to related policies and guidelines.

For example, the NSW *Smart Infrastructure Policy*[331] and *Internet of Things (IoT) Policy*[332] set minimum requirements for smart technology to be embedded in all new and upgraded infrastructure from 2020 onwards. They also provide guidance on standards and obligations for NSW Government agencies and local governments when planning for new infrastructure.

These and related policies aim to ensure interoperability between devices and data produced by IoT-enabled infrastructure projects. It is essential that these policies are applied consistently across agencies and embedded in infrastructure investor assurance processes. The importance of interoperability of systems and data is discussed further in Section 9.4.

Piloting and then expanding technology initiatives will be important to drive Smart Places outcomes, starting with opportunities in greenfield environments, newly emerging precincts and major infrastructure where there are fewer physical constraints and greater capacity for government to coordinate and curate technology requirements and installation, with participation from the private sector.

The Smart Western City Program outlines Smart Place solutions that will be needed to make the Western Parkland City a connected and digitally enabled city. The Western Parkland City and other suitable precincts can be used as 'test beds' for trialling Smart Places initiatives to establish appropriate smart foundations and commercial models that can be adopted at larger scales. Pilots can also drive innovation and facilitate knowledge transfer through industry partnerships, as discussed in Chapter 10.

9.4 Consistent and coordinated data standards and practices

The full potential of digital tools and platforms cannot be realised without shared, consistent and quality data. The diligent application of standards, classifications and data management practices across all aspects of the infrastructure lifecycle is critical.

Design and procurement policies to support interoperability need to ensure that different 'hardware,' such as multiple types of sensors and devices, can together provide insights in one 'software'. Interoperability also applies to broader systems that may not integrate readily with others because they are in different sectors or government agencies.

For example, the NSW Government would benefit from the further digital integration of planning system legislation and instruments, such as ePlanning, with software used for infrastructure planning and design.

Interoperability of data is also an enabler of more cost-effective and customer-focused service delivery. Better structured data can enable collaboration between agencies or be made open and accessible to attract and build business and academic partnerships that yield new insights and value.[333]

Without coordination and consistency, the benefits of digitisation can be diminished due to interoperability issues. For this reason, agencies engaged in infrastructure planning are increasingly looking to embed digital ways of working. For example:

- Transport for NSW has a Transport DE Framework and is developing a Digital Twin program
- Health Infrastructure has a BIM framework and is piloting Augmented Reality / Virtual Reality technology to support stakeholder engagement
- Schools Infrastructure uses EagleEye as a platform for spatial service and infrastructure planning.

Across the NSW Government, key digital initiatives should be progressed, in conjunction with DCS, to ensure relevant data and technology-related policies and requirements are met. This includes the *NSW Infrastructure Data Management Framework* (IDMF), released in 2020.

Equally, it is important that NSW work toward nationally consistent standards in partnership with the Australian Government. For example, the National Freight Data Hub has been developed to make data available to industry, government and others to improve the efficiency, safety, productivity and resilience of the freight sector.[334]

Jurisdictions leading the way in infrastructure digitisation are characterised by clarity around who develops and facilitates implementation of relevant policies and standards for any new,

planned or retrofitted build. Work to progress this should proceed in NSW, in collaboration with the Australian Government and other jurisdictions to ensure consistency.[335]

9.5 Making digital solutions the norm

Across sectors, COVID-19 has shown that many service needs can be met and managed better through digital tools and platforms. Opportunities for digital applications are emerging across all infrastructure sectors and government services. Enhanced digital service delivery has positive benefits for the capacity and performance of the State's physical infrastructure and can provide alternatives to building new physical infrastructure.

Since the 2018 SIS, several NSW Government agencies have developed long-term infrastructure strategies identifying technology that will further enable digital services; for example, the *NSW Schools Digital Strategy and NSW Health Infrastructure Strategy.* More broadly, DCS's Beyond Digital strategy sets out the NSW Government's overarching aims to support the digital economy and enhance the use of data and digital technology in service delivery.

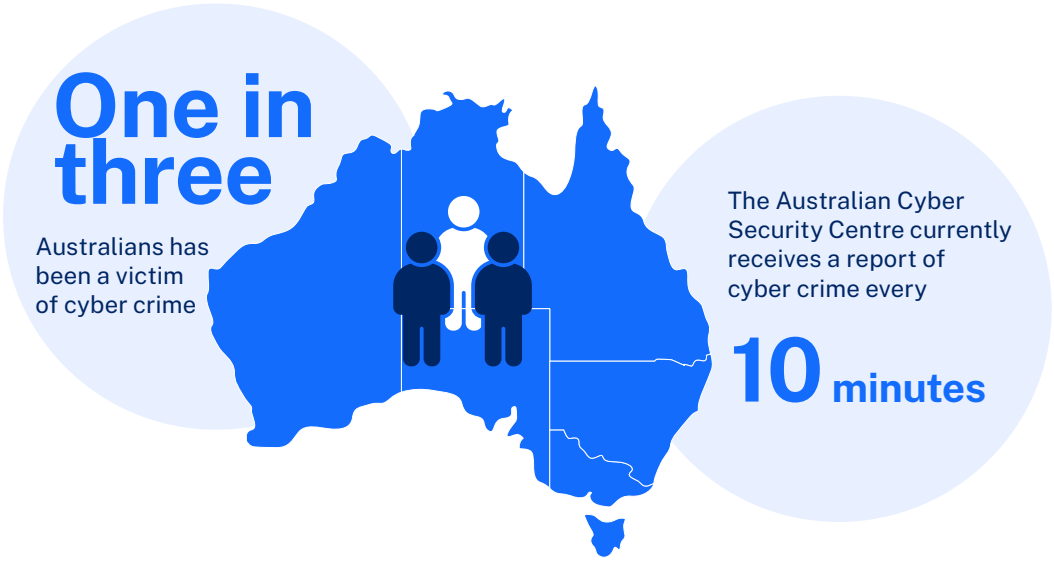
The benefits of data and digital technology are maximised when considered at the planning stage of government services and infrastructure. For the NSW Government, the digitisation of infrastructure and services requires several key considerations:

- **setting targets and aligning digital policies for infrastructure** – set explicit targets for digital service delivery, publish a clear statement on how these targets will be delivered and align with the Smart Infrastructure Policy and Infrastructure Data Management Framework
- **exploring digital (no build) options** – require all Strategic Business Cases (SBC) to include 'if-not-why-not' options to utilise digital technologies as an alternative to new physical infrastructure, either through digital service provision or through augmentation of existing physical assets
- **establishing a digital pipeline** – commit to a long-term digitisation pipeline, with a funding allocation to match, with an initial focus on:
  - enhancements to existing systems that can apply to multiple agencies
  - COVID-19 proven virtual models that can be further enhanced to deliver better services, such as virtual care and learning supports
  - data and system upgrades that support service delivery model reforms, such as new digital justice system pathways and consolidated community services hubs
- **procurement and market delivery** – run market-based processes to deliver investments that have sufficient scale, proof of concept and long-term funding sources
- **public sector capability** – define and require capability requirements for digital service delivery in all infrastructure agencies.

The NSW Government will need to strategically invest in and progressively upgrade its legacy information systems and cyber security. Back-office hardware and platforms support better cross-government data sharing, analytics and decision making.

The NSW Digital Restart Fund (DRF) is already providing investment in this area across government. However, the current allocated funding is unlikely to meet the backlog of upgrade requirements identified.

Figure 9.4 – Prevalence of cybersecurity threats for Australians



Source: Infrastructure NSW, based on Parliament of NSW (2021)

9.6 Building cyber resilience

As infrastructure services become increasingly embedded with digital technology, a corresponding increase in cyber security awareness and investment will be required.

Currently, cybercrime is frequent and prevalent in Australia, as shown in Figure 9.4. Future threats are expected to become more automated, intelligent, disruptive and destructive, according to expert submissions to the NSW Cyber Security Inquiry, especially when targeting critical infrastructure systems.[336]

Increasing geopolitical tensions and competition are likely to multiply cyber risks. However, the future scale of cyber espionage operations used for intellectual property theft and infrastructure disruption operations against government services is unclear, creating challenges for cyber security procurement and infrastructure investment.

In 2019, the NSW Government adopted the NSW Cyber Security Policy, which applies to all NSW Government agencies.[337] The policy establishes a risk management and cyber maturity framework to help agencies protect their most operationally sensitive and valuable systems and strengthen cyber security controls. This includes agencies complying with 25 mandatory requirements for cyber security.

Building effective cyber resilience requires a system-wide approach that combines strong governance, transparent reporting mechanisms, a commitment to capacity building and incident response. Equally important is engaging with the broader cyber security community across all levels of government, academia and industry.[338]

Cyber risks should be addressed comprehensively as part of an 'all hazards' risk management approach (discussed in Chapter 5) to capture the growing interdependencies between online systems and other critical infrastructure. Cyber security spending as a proportion of total asset investment should also be monitored and benchmarked against best practice. Improving cyber security maturity reporting and meeting maturity level targets should be prioritised in line with the recent Audit Office of NSW report on *Compliance with the Cyber Security Policy.*[339]

High risk and critical infrastructure systems require ongoing attention to security but the potential entry points for malicious actors within smaller, adjacent government infrastructure agencies must also be considered. Incident reporting requirements must be streamlined and harmonised at the State level, noting that the Australian Government's notification rules have been strengthened for critical infrastructure entities under the *Security Legislation Amendment (Critical Infrastructure) Bill 2021.*

9.7 Recommendations

No	Recommendations	Implementation timeframe	Lead agency
37	**Accelerate investment in digital connectivity in State sponsored precincts**		
	a. Adopt a targeted and sequenced State digital connectivity enablement investment program commencing with high-priority precincts: – complete the shared infrastructure model trials in Western Sydney to support greater and faster roll-out of 5G connectivity – deliver globally competitive digital connectivity plan for the Sydney Innovation and Technology precinct (Tech Central) – deliver enhanced connectivity in regional SAPs and along major transport corridors.	Immediate Priority	Customer Service
	b. Explore planning and regulatory options that enable greater shared infrastructure arrangements within precincts and major transport projects and corridors.	Immediate Priority	Customer Service & Transport
	c. Ensure project business cases consider investment requirements to support delivery of the Whole-of-Government Connectivity Strategy.	Extended Program	Multiple
	d. Facilitate private participation and competition through new delivery and commercial models in State-led connectivity initiatives.	Extended Program	Customer Service
38	**Adopt the use of digital technology in infrastructure planning, delivery and operation**		
	a. Develop a roadmap for widespread use of digital planning and engineering tools such as spatial digital twins and Building Information Modelling (BIM) throughout the infrastructure lifecycle, aligned with the Live.NSW Program and Digital Built NSW Program.	Immediate Priority	Customer Service & Transport
	b. Drive efficiencies through the integration of land use planning-related systems, platforms and instruments into the Spatial Digital Twin and Live.NSW Programs.	Immediate Priority	Customer Service
	c. Build capability across government asset managers to accelerate adoption of digital engineering tools.	Immediate Priority	Customer Service & Infrastructure NSW

No	Recommendations	Implementation timeframe	Lead agency
39	**Prioritise and invest in technology upgrades to improve efficiency of passenger and freight transport networks as a core part of rebalancing and diversifying the infrastructure program**		
	a. Partner with the Australian Government's National Freight Data Hub to standardise freight data, and investigate the merits of the Freight Community System in enhancing freight supply chain productivity and efficiency.	Immediate Priority	Transport
	b. Accelerate Smart Motorways and other Intelligent Transport Systems (ITS) applications on motorways and major roads in metropolitan and regional centres.	Immediate Priority	Transport
	c. Ensure interoperability of existing and new data repositories and platforms to enable a coordinated approach that supports evidence-based and customer-centred government service planning and delivery.	Extended Program	Customer Service & Transport
40	**Prioritise digital service delivery over building new physical infrastructure where the goals of the initiative can be feasibly achieved in that manner**		
	a. Review and update the Business Case Guidelines, ICT and Infrastructure Investor Assurance Frameworks such that infrastructure business cases are required to include 'if-not-why-not' options to use digital technologies where feasible as an alternative to new physical infrastructure capacity, either through digital service provision or through augmentation of existing physical assets.	Immediate Priority	Treasury & Infrastructure NSW
	b. Ensure appropriate digital infrastructure and systems (including digital identity) are reused and leveraged to support delivery of critical government services.	Extended Program	Customer Service
41	**Deliver an investment program to digitise government services and infrastructure**		
	a. Pursue immediate opportunities for digitisation of critical frontline systems including Virtual Care, Clinical Systems, Telehealth, Remote Learning and Digital Courts.	Immediate Priority	Multiple
	b. Establish a prioritised investment program and a long-term, sustainable funding model for digital and ICT investment that could include smart infrastructure, digital platforms and cyber security.	Immediate Priority	Customer Service
42	**Uplift cyber security capabilities and practices in infrastructure planning, delivery and operation**		
	a. Continue to invest in cyber security capabilities and practices to effectively mitigate the risks associated with increasing digitisation of infrastructure and service delivery.	Extended Program	Multiple
	b. Agencies should ensure 'Secure by Design' principles are adhered to in technology-enabled investments and monitored through updated ICT and Infrastructure Assurance Frameworks.	Immediate Priority	Customer Service & Infrastructure NSW
	c. Agencies should target appropriate maturity and funding levels to increase cyber security capability, informed by reporting on and analysis of compliance with the NSW Cyber Security Policy.	Immediate Priority	Multiple / Customer Service

Integrate infrastructure, land use and service planning

10

Newcastle Light Rail, Hunter and Central Coast Development Corporation

IN THIS SECTION

Strategic directions

- Coordinate infrastructure, land use and service planning to meet future housing, employment, industry and community needs
- Increase private sector participation in the delivery of government-led precincts
- Regularly update planning regulation and land use controls to reflect current circumstances

The simultaneous release of the *2018 State Infrastructure Strategy* (SIS), 20-year Greater Sydney Regional Plan and *Future Transport 2056* in March 2018 was an important milestone for the NSW Government in better linking strategic land use planning with infrastructure planning. Coordinated strategic planning enables the NSW Government to ensure that jobs, services and housing growth are supported by the right infrastructure at the right time and in the right places.

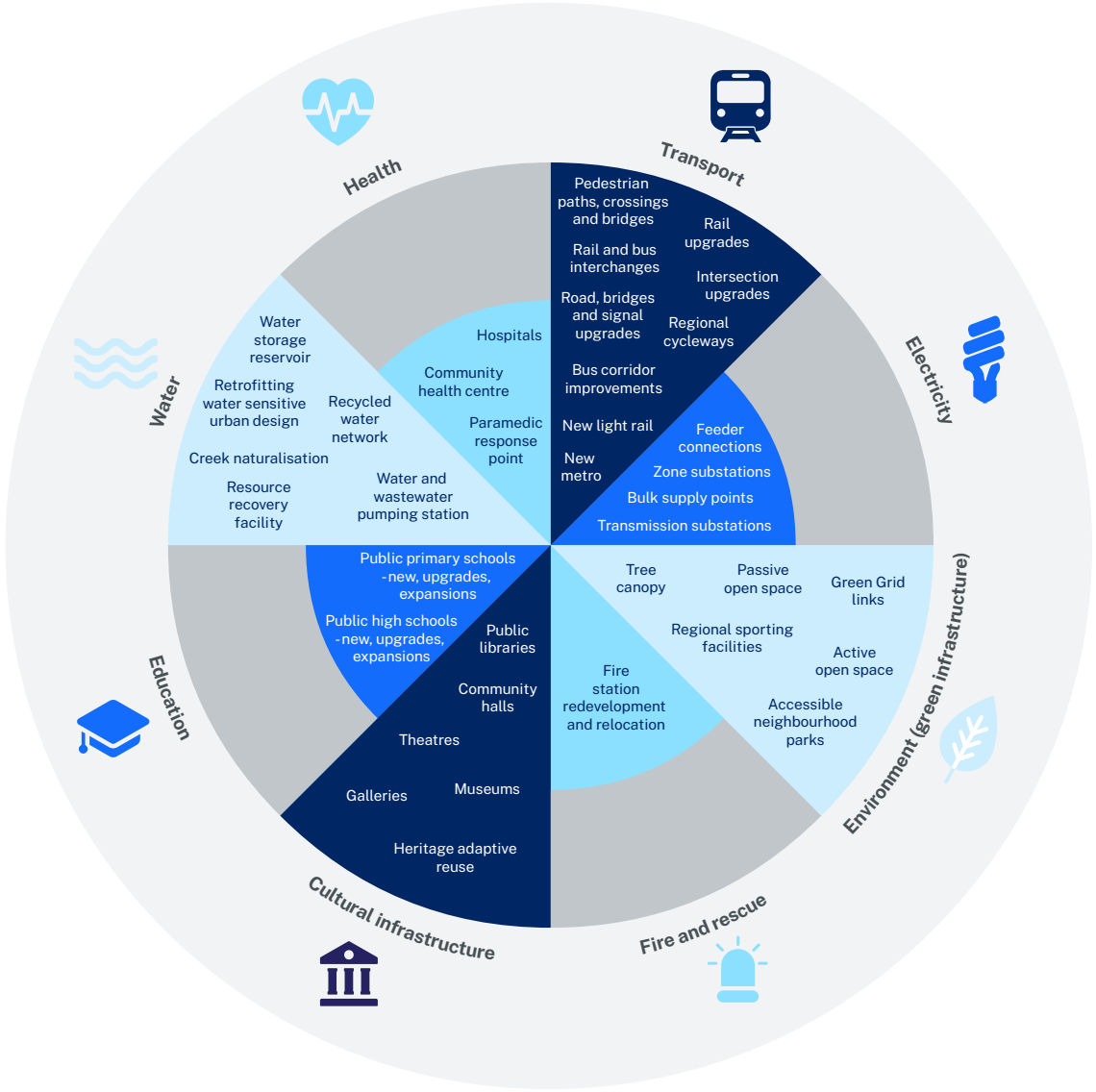
The 2018 SIS recommended piloting a 'place-based' approach to infrastructure and land use planning. The pilot was delivered through the Place-based Infrastructure Compact (PIC) and place-based Strategic Business Case for the Greater Parramatta and the Olympic Peninsula (GPOP) area. Many of the lessons from the pilot have been applied to assess the sequence and priority of infrastructure and land use needs for the Western Parkland City.

Lessons from the pilot have also informed the recent NSW Government's Precincts Strategy: Practitioner's Guide, which provides guidance and tools for agencies tasked with delivering better precinct outcomes.[340]

While the NSW Government has made progress in taking a place-based approach to integrated planning, there remain significant opportunities to refine, formalise and embed the practice more broadly. In preparing and delivering place-based plans, the NSW Government should seek to:

- optimise use of major infrastructure – such as passenger rail and stations – where there is capacity, to ensure assets and government services are utilised efficiently
- better coordinate prioritisation and sequencing of infrastructure and precincts delivery, in line with growth between and within identified new development areas and precincts
- leverage new precincts across NSW to enable wider adoption of digital technology and deliver circular economy, Net Zero emissions, resilience and liveability outcomes.

Figure 10.1 – Services supporting well-functioning cities and places



Source: Infrastructure NSW, based on Greater Sydney Commission (2019)

10.1 Optimise land use where infrastructure capacity exists

More than half of NSW's infrastructure program is committed to major transport projects. The NSW Government is increasingly focused on connecting people with jobs, services and amenity by planning for growth and development around public transport infrastructure, such as passenger rail stations, interchange hubs and freight routes.

Priority should be placed on using the capacity of the existing and planned transport network. The *NSW Productivity Commission White Paper 2021* notes that the existing transport network and planned investments hold development potential – for example:

- T4 Eastern Suburbs Line, which runs at substantial spare capacity in the morning peak
- Sydney Metro City and Southwest
- Sydney Metro Northwest (noting that housing development along the line has fallen short of expectations due to restrictions on housing density)
- near the Eastern Economic Corridor.[341]

Higher productivity, such as reduced road congestion and shorter travel times, can be achieved by rezoning transport corridors to accommodate more housing. In doing so, appropriate standards for development are important to minimise adverse amenity impacts and risks of future land use conflicts.

Optimising existing networks saves costs by delaying the need for investment in new major public infrastructure and by driving higher patronage on public transport routes, which reduces subsidies. The pilot GPOP PIC analysis found that the cost of delivering infrastructure to support housing and jobs growth in areas with well-established infrastructure is lower than those with limited pre-existing infrastructure (see Box 10.1).[342]

The choices NSW citizens make about where they live and how they travel are influenced by convenient access and seamless connections between mobility modes, as well as first- and last-mile travel options. Good connections expand the radius of residential developments, increase housing supply and better connect people to jobs and services.

Box 10.1

Pilot Place-based Infrastructure Compact model and place-based Strategic Business Cases

The 2018 SIS recommended piloting a Place-based Infrastructure Compact (PIC) and place-based Strategic Business Case (SBC) for the Greater Parramatta Olympic Park (GPOP) area to guide NSW Government investment decisions around the sequencing and delivery of infrastructure to meet projected service demand (recommendations 1 and 2). At its core, the pilot GPOP PIC reaffirmed the need to:[343]

- understand the type, level and timing of infrastructure required for an area, based on capacity available from existing and planned infrastructure
- estimate the costs associated with providing necessary infrastructure to service the planned growth and identify who should be contributing to its funding
- sequence land use changes so that rezoning meets market demand but doesn't outpace the capacity of government and the market to fund and deliver services and infrastructure
- place greater focus on realising the potential of selected precincts before moving on to others
- align the investment and assurance process with land use planning.

In December 2020, the NSW Government responded to the recommendations of the Greater Sydney Commission (GSC) PIC model with a direction to the Department of Planning and Environment (DPE) and the GSC to prepare a guide to inform where and when a PIC should be employed in the future, as a PIC will not be appropriate in all circumstances and is ideally suited to places where there are complex, large-scale land use planning processes involving multiple agencies. Work is underway to assess the PIC model for scalable and transferable elements for smaller growth locations and precincts.

In addition, a Central River City Program Coordination Office has been established to oversee the delivery of the projects across the Central River City, including GPOP.

10.2 Corridor preservation and efficient planning rules

NSW's international gateways and economic corridors support the State's economic competitiveness, secure and generate employment opportunities, and sustain critical supply chains for the State's industries (see Chapter 3 for more). Industrial and urban services land zones that underpin these corridors enable economic activities that support businesses and consumers in the cities and regions of NSW.

Industrial and urban services land in some parts of Sydney is already highly limited, and in some instances economic activity is constrained due to encroachment from competing and incompatible uses, such as residential zones. Complaints about noise and pollution can lead to restrictions on land use activity, such as curfews.

There is strong competition for space from commercial, residential and mixed-use developers that seek proximity to Sydney Airport, Port Botany, the Sydney CBD and numerous existing health and education precincts. While residential, mixed use and commercial land uses must be supported and preserved in a service-oriented modern economy, ensuring adequate capacity for industrial and essential urban services is important to meet the needs of the growing population.[344]

The Sydney Airport and Port Botany facilities, both in highly settled areas of Sydney, serve the bulk of the State's freight needs which are projected to increase over the next 20 years.[345] To manage this growing freight task, infrastructure and land use planning need to ensure the efficiency of freight corridors and that industrial and logistics activity is not compromised by the encroachment of incompatible land uses. This is particularly the case where there is scope to continue leveraging established major economic gateways.

This issue is acknowledged at a national level as well. The *National Freight and Supply Chain Strategy* developed by the Australian Transport and Infrastructure Council seeks to protect freight assets and networks from residential development encroachments in integrated land use and transport planning.[346] This includes making sure that future freight corridors are identified and protected.

The Greater Sydney Commission's Industrial Lands Policy Review - December 2021 Review Update highlighted the value and need to secure industrial capacity to meet the State's industrial needs today and in the future, while also acknowledging that in some circumstances industrial lands could transition to alternative uses.[347] The next update of the Greater Sydney Regional Plan should incorporate the need for industrial and urban services land at the Greater Sydney Region level, and consider the implications for statewide supply chain networks in the long term.

Ensuring land use controls keep pace with modern needs

The NSW Government has progressed planning reform initiatives to improve land use planning and infrastructure outcomes for communities and businesses.[348] The planning system is established to balance and mitigate the impacts of land use on other parts of the community and that should, and will, remain the core focus of the system. However, efforts to review and reform outdated regulation and restrictions should remain a continuous priority of the Government as industry and community needs evolve.

State and local governments place restrictions at times on the use of infrastructure and surrounding land to balance competing interests. Such restrictions often remain in place for a long time, rarely being revisited for their efficacy.

One recent example is the range of planning rules that were eased temporarily during the COVID-19 pandemic. Restrictions on trading hours for businesses and supermarkets, and deliveries and non-trading activities on industrial lands, have long been believed to be necessary and have remained in place unchallenged. However, the temporary easing of these restrictions during the pandemic demonstrated the value and public benefit of retaining the eased restrictions permanently.[349]

Another example is the *Liquor Amendment (Night-time Economy) Act 2020* introduced in December 2020 to address the issue of planning consent and licence conditions unnecessarily limiting music and live performances at hospitality venues. The amendment was introduced to support the ability of local councils to facilitate a vibrant, safe and modern night-time economy.

In addition, the *Local Government Act 1993* was amended to allow councils to establish 'special entertainment precincts' within their local government areas. Where a special entertainment precinct has been approved and designated as part of local land use plans, consent authorities will be unable to refuse development consent based on noise caused by the playing or performance of music, if they are satisfied the noise can be managed and minimised to an acceptable level.[350]

In this regard, there is scope to review restrictions on some of the State's cultural infrastructure and sporting assets.[351,352] Freight infrastructure assets, such as industrial estates and port terminals, also face ongoing operational restrictions due to government approval conditions that limit throughput and operational activity and efficiency.[353,354,355]

The NSW Government should identify and review planning restrictions – both general and specific to certain locations and infrastructure – that may have outlived their initial purpose and are hindering the efficient use of public and private infrastructure and surrounding lands. The Government should progressively revise restrictions where the costs of these become disproportionate to the benefits.

Managing land use conflicts in regional NSW

A similar challenge exists in regional NSW where there is increasing awareness of land use conflicts involving agricultural operations. A 2021 report released by the NSW Agriculture Commissioner highlighted two main sources of conflict – increasingly intensive agricultural production practices and an expanding urban footprint to accommodate population growth in certain regional communities.[356] The report outlines measures to improve planning outcomes for the agricultural sector while increasing certainty for nearby residents and communities through strategic and statutory planning levers, among others.

As regional communities grow, the potential for land use conflict will increase. Fragmentation of land parcels can diminish economies of scale, particularly where agricultural activity is involved. Strategic planning and future reforms to the planning system should do more to mitigate such conflicts and reduce the risk of infrastructure assets being stranded or underutilised.

Importantly, there are other land use conflict challenges in regional NSW that need to be balanced, beyond agricultural operations. The State's scarce water resources need to be managed effectively to ensure the economic growth of regions can be achieved without unduly compromising other outcomes, such as safe, secure and sustainable water supplies for communities and the protection of environmental assets, habitat and biodiversity (see Chapters 7 and 8 for more).

Map 10.1 – NSW major international gateways, freight routes and intermodal terminals

Source: Infrastructure NSW (2022)

Map 10.2 – Greater Sydney major international gateways, freight routes and intermodal terminals

Source: Infrastructure NSW (2022)

10.3 Prioritise precincts and sequence investments in enabling infrastructure

The NSW Government has announced many new priority precincts since the 2018 SIS. A few of these precincts and other locations to support growth, such as GPOP, were highlighted in the 2018 SIS, Greater Sydney Regional Plan and *Future Transport 2056* (2018 SIS recommendations 1 and 2).

To deliver value for money and ensure infrastructure delivery is aligned with population growth and service demand, the NSW Government needs to prioritise and sequence investments.

Focus on a limited number of priority precincts

Sequencing and prioritisation of precincts and growth locations should consider the pace at which the market can absorb new development, including residential, industrial and commercial space, to avoid creating excess supply and under-utilised capacity for services and infrastructure.

This is true both at a precinct level, but also when planning for a growth location, and at a regional and/or district level, and between regions.[357] It is neither feasible nor efficient to progress all identified 'precincts' simultaneously across NSW. Instead, the NSW Government should define and focus on a limited number of priority precincts in Greater Sydney for coordinated planning and investment. For regional NSW, the focus should continue to be on the six Special Activation Precincts (SAPs) (see Box 3.3).

This is not to say that private proponents should be constrained from pursuing other initiatives if they see fit, but the NSW Government's commitment of funds should be targeted at those deemed to deliver the greatest public benefit.

A consistent approach to integrated planning, infrastructure and service delivery

The current situation presents an opportunity for the NSW Government to:

- **prioritise and sequence identified growth locations and precincts** based on the NSW Government's Common Planning Assumptions and services and infrastructure capacity analysis, so that the most viable and strategic precincts become the focus of government land use and infrastructure planning. This requires oversight by a coordinating agency to develop and apply a consistent framework for prioritising precincts while overseeing the implementation progress for selected precincts
- **prepare a servicing plan,** including staging and sequencing of investments to service incremental growth, as well as arrangements for contributions by developers and occupants for precincts identified as priority. This should leverage digital tools and collaboration approaches such as the NSW Spatial Digital Twin and related government land use and property data for efficient coordinated planning outcomes
- **ensure State-based planning cascades to regional and local planning** – for instance, the Greater Cities Commission has engaged with local councils across Greater Sydney to ensure that District Plans and Local Strategic Planning Statements are aligned. This approach to improving strategic alignment is also relevant across regional NSW to ensure integrated delivery of services, infrastructure and land use planning. It should progress in line with identified priorities outlined in key strategic documents, including the 20-Year Economic Vision for Regional NSW and the Regional Economic Development Strategies (REDS)
- **establish governance for selected precincts** to coordinate different tiers of government, industry and community stakeholders. Examples of well-functioning governance structures to deliver precincts previously established by the NSW Government include:
  - Central River City Program Coordination Office to deliver outcomes for GPOP and the Central River City
  - Western Parkland City Authority, which brings together three tiers of government to collaborate with industry and community stakeholders

- the Greater Cities Commission, which is leading the delivery and coordination of four key innovation precincts in Greater Sydney
- Department of Regional NSW, which has collaborated with local councils to develop strategies for SAPs and Regional Job Precincts (RJPs).

Managing corridors preserved for the future

Long-term strategic planning includes protecting and, in some cases, acquiring land where future infrastructure needs are identified. Preservation of infrastructure corridors can potentially reduce the future cost of delivery and avoid community and environmental disruption if preserved corridors are managed effectively.

Planning and prioritisation of investments and land use decisions should consider corridor preservation needs, including funding mechanisms, over the long term. Equally important is effectively managing the value of reserved corridors in a staged manner until they are needed for infrastructure.

Both the acquired land and surrounding lands need to be considered to ensure the intended use for protected corridors is not compromised over time due to encroachment of conflicting uses of adjacent land, including residential development. As interim uses, corridors can provide temporary storage facilities and deliver early placemaking benefits or construction efficiencies.[358]

10.4 Leveraging opportunities presented by precincts

Planning at the precinct level provides opportunities for the NSW Government to achieve many of the objectives and strategic directions outlined in the 2022 SIS. This includes opportunities to:

- embed innovative and efficient approaches to reduce carbon emissions in the built environment
- adopt solutions that lead to more efficient use of water and reduction in waste
- build in the necessary levels of digital connectivity and speed to support future demands
- embed smart infrastructure, such as IoT sensors and digital billboards, into the urban fabric
- provide local amenity through open and recreational space
- plan, locate and deliver government services efficiently.

The greatest opportunities exist in State-significant government-led precincts. However, there are several challenges to overcome in order to fully leverage precincts.

Challenges to getting more out of precincts

The combination of infrastructure and property in precincts creates opportunities to deliver integrated solutions that surpass those developed in isolation. However, the complexity in precincts presents significant challenges, including conflicts between public objectives and private commercial interests. Some of these challenges stem from the:

- difficulty in reconciling innovation with government reference designs, parallel planning processes, challenging timeframes and meaningful engagement with developers, investors, contractors and occupiers
- ambiguity in criteria used for good design, such as adaptability, access, environment, connectivity, stewardship, identity and experience
- difficulty aligning government budget approvals and delivery with market demand and private sector commercial priorities
- complexity associated with developers combining teams with different risk profiles, capabilities and investment criteria; for example, infrastructure construction contractors and property developers. Consortia need time to form, resolve internal commercial risk allocation and develop proposals iteratively as proposals mature.

Box 10.2

Greater London Authority's *Opportunity Areas Planning Framework*[359]

Opportunity Areas are identified in the London Plan as significant locations with opportunities to accommodate new homes, jobs and infrastructure. They are generally linked to existing public transport plans and typically have capacity for at least 5000 new jobs and/or 2500 new homes. The Mayor of London is responsible for designating these places.

The *Opportunity Areas Planning Framework* sets out minimum targets for new jobs and housing that should be accommodated in these areas, alongside a set of minimum environmental, affordability, density, connectivity and land use standards. Examples of current Opportunity Areas in London include:

- Old Oak and Park Royal, in the North West of London, benefiting from new major investments in Crossrail and High Speed 2, with a capacity to accommodate a minimum of 65,000 jobs and 25,000 new homes
- City Fringe, in the Eastern part of the City of London, which is centred around Tech City, and has capacity to accommodate at least 53,000 jobs and 15,000 new homes.

While the Greater London Authority, local councils and other stakeholders drive the planning process, the expectation is for private proponents to present schemes that meet minimum employment and housing targets alongside environmental, public realm and open spaces, technology, biodiversity and other standards.

The challenges are magnified by the fact that no two precincts are the same, with approaches to delivery needing to be adapted to the specific challenges in each precinct. This makes it difficult to prescribe a framework that can be applied across the board.

An outcomes-based approach to precinct planning and delivery

One approach for precincts is to specify a set of outputs and outcomes that government expects to achieve.

London's *Opportunity Areas Planning Framework* provides a potential approach that can be adapted to reflect the legislative environment in NSW (see Box 10.2). This approach would set the minimum standards and outcomes expected across a set of government objectives, with private proponents responding to tenders by specifying how their designs and approaches would meet these standards and deliver the required outcomes.

To be effective, an outcomes-based approach to precinct planning will require procurement policies and processes to be updated so the tender evaluation framework gives weight to flexibility and innovative designs that achieve specified precinct outcomes. Other considerations include:

- planning for longer tender periods and early-stage gateway reviews aimed at prioritising design innovation in the procurement processes

- expanding tender interactive sessions to include more structured engagement with councils or planning authorities
- reimbursing some design tender costs where intellectual property is submitted prior to being awarded exclusivity for the project
- allocating more realistic time to allow for design development/discussions and greater weight in the final tender evaluations given to precinct design innovation that goes beyond the public reference design.

The NSW Government's *Precincts Strategy: Practitioner's Guide* is a significant step in providing public sectors planners with a methodological approach to precinct development. The Guide will require further engagement with private sector stakeholders for the next phase of work and should assist in identifying gaps in existing policies and processes in precinct planning, design and procurement.

10.5 Land, place and infrastructure

Infrastructure and civic structures shape the social, environmental and economic performance of a place. In turn, this helps communities form a sense of place and civic pride. As a result, it is important to ensure infrastructure reflects Country, local community identity, culture and history.

Big statements and small mercies

Favoured places are often marked by celebrated structures. Sydney Harbour is as famous for its buildings and civil engineering as it is for the natural environment, which combine into a complex and unique landscape. In regional cities, there are hallmark structures that mark impressive endeavours in civil engineering, while long-built structures often announce the products or character of a city.

Opportunities arise for infrastructure to better reflect history, community identity and place. At present, there are opportunities in high-profile locations such as Barangaroo (including the Cutaway), Sydney Metro stations, Bradfield City Centre, Sydney Fish Markets and as part of Australian Government projects such as the Western Sydney International (Nancy-Bird Walton) Airport and Snowy Hydro 2.0.

Done well, these new structures and precincts can contribute to the culture and identity of NSW. Investments in regional towns and suburbs of cities should not only lift amenity and liveability; they should also create a distinct sense of place and civic pride. Design, public art and community identity should not be afterthoughts when these opportunities arise at a school, road, station, court, prison or hospital.

History – ancient and modern

Infrastructure presents an opportunity to acknowledge and celebrate the living history of Aboriginal communities in NSW. It also provides an opportunity to 'restitch' large gaps in the memory of a place before colonisation, caused by disruption to Aboriginal landscape, people and cultural practices.[360]

The built environment can better recognise Australia's earliest infrastructure, made by Aboriginal people on the land and waterways, such as the Brewarrina Fish Traps. Acknowledgement of the history of modern Australia with Aboriginal people's stories can enrich, inspire or be painful and jarring.

NSW's Aboriginal cultures are rich in knowledge and lore that can be incorporated more regularly into the design of infrastructure and precincts to articulate the importance of a place. The NSW Government Architect's draft *Connecting with Country Framework* seeks to achieve this. The Framework provides an approach to developing connections with Country that can inform the planning, design and delivery of built environment projects.

10.6 Recommendations

No	Recommendations	Implementation timeframe	Lead agency
43	**Optimise the use of industrial and urban services lands through integrated strategic land use planning with infrastructure investment** a. Consider long-term requirements to maintain an efficient statewide supply chain network. b. Review the efficacy of planning constraints placed upon the use of industrial and urban services lands, recreational facilities and associated infrastructure.	Extended Program	Planning and Environment & Transport
44	**Deliver more housing, jobs, amenities and services in locations where there is spare capacity in existing and planned infrastructure**	Immediate Priority	Planning and Environment & Transport
45	**Preserve and strategically manage protected corridors for future use** a. Ensure corridor preservation needs for NSW are considered in the sequencing and prioritisation of infrastructure delivery and land use decisions. b. Effectively manage preserved corridors with appropriate and staged 'meanwhile use'. c. Manage lands adjacent to preserved corridors to avoid encroachment of incompatible use through strategic and statutory planning.	Extended Program	Planning and Environment & Transport
46	**Increase private sector participation, co-design and co-investment in State-sponsored precinct delivery** a. Update the *Precincts Strategy: Practitioner's Guide* with input from industry to ensure consistent practice across NSW Government agencies. b. Develop a flexible outcome- and output-based approach that can deliver key government growth, economic, environmental and social objectives. c. Engage early with the market to increase private sector participation in and the deliverability of government-led precincts.	Immediate Priority	Planning and Environment & Infrastructure NSW
47	**Actively reflect history, culture and heritage in places and infrastructure** a. Reflect Aboriginal people, culture, history and Country in the design of infrastructure and precincts to recognise and celebrate the living history of Aboriginal communities. b. Reinforce civic purpose wherever possible in new assets, including local infrastructure, by recognising the 'best of the best' and providing advice. c. Use the expertise of NSW arts, culture and creative institutions to support infrastructure and its use as civic assets. d. Capitalise on digital forms to enliven buildings and structures with civic identity.	Extended Program	Planning and Environment & Transport

State Infrastructure Strategy
2022–2042

Design the investment program to endure

11

Inner Sydney High School, School Infrastructure NSW

IN THIS SECTION

Strategic directions

- Reconsider megaprojects and invest in existing infrastructure through augmentation, digitisation and maintenance
- Diversify funding sources to deliver future investments
- Ensure the construction market has the capacity, capability and productivity to meet increasing demands
- Consolidate a robust process for investment prioritisation, project sequencing and investment appraisal

Future demands on the NSW Government budget will continue to be significant. Many important new projects remain to be funded and investment in the maintenance of existing assets is set to increase. To build an enduring infrastructure investment program, the 2022 SIS recommends tipping the balance of spending towards technology upgrades, augmentation of existing assets and networks, and structured maintenance as the NSW asset base matures.

Many investments have been enabled by funding from asset recycling during the past 10 years.[361] Investments in critical assets such as transport, schools and hospitals have delivered better services for communities across the State. However, apart from the most recent sale of WestConnex, the proceeds from past asset recycling have now largely been allocated. The NSW Government should continue to pursue opportunities for recycling mature State-owned assets to fund new infrastructure investment.

However, new funding sources will be needed to both service future investment and maintain the growing asset base in NSW.

Over the long term, investment in infrastructure is projected to return to a steadier growth trajectory. The NSW Treasury Intergenerational Report (IGR) projected that General Government capital expenditure as a share of Gross State Product (GSP) will fall gradually from 2.6% in 2018-19 to 1.8% by 2060-61,[362] bringing it more in line with other OECD countries.

The IGR also found that, unless corrective measures are taken, the NSW Government faces a rising fiscal gap in coming decades.[363] This is partly due to the projected increase in maintenance costs, reflecting the marked growth in the NSW asset base and ageing of the existing asset base.

Accordingly, future infrastructure investments should be planned with consideration to:

- boosting economic productivity leading to an expanded tax base
- getting the greatest value for citizens from public investment through effective management and use of existing assets
- avoiding the concurrent delivery of large numbers of megaprojects that stretch capacity to deliver
- making sound investment decisions that deliver the best service outcomes
- finding new long-term funding sources, through taxation reform, user and beneficiary contributions, better arrangements with the Australian Government, and generating additional commercial revenues from government assets
- enabling private sector investment in assets and services, where the sector is well positioned to do so.

11.1 The forward investment program should be carefully planned

The NSW infrastructure program is large by any modern standard. It includes several projects that are themselves rightly described as 'megaprojects' and a large number of mid-sized projects and programs.

Delivering an ambitious and complex infrastructure program presented many challenges

The acceleration of the NSW Government's infrastructure program over the past decade, combined with the unprecedented size and complexity of projects, has presented significant delivery challenges. The largest infrastructure projects in the 2000s, such as the $1.1 billion Lane Cove Tunnel, now appear small relative to current projects. There are several $10 billion or more projects underway in NSW, such as Sydney Metro City & Southwest, Sydney Metro West and WestConnex.

The 2018 SIS flagged concerns about the capacity and capability of both the public and private sectors to continue to deliver these investments. Similar concerns were also raised by Infrastructure Australia in its 2019 Audit. Lack of capacity has been exacerbated by declining productivity and low innovation in the construction sector, which are affecting cost, quality and profitability in the sector. These concerns have already led to significant variations in budgets and delivery timelines on several major projects.

The recent experience with some NSW projects is like that in other jurisdictions. There is much evidence assembled by industry and academic experts of significant delays and cost variances on megaprojects, indicating that this is the norm, rather than the exception. Lessons have been learned from the many successfully delivered projects, as well as those projects that have experienced time delays and cost overruns.

Significant reforms to drive more effective and efficient project delivery and better asset management

The NSW Government has implemented reforms to drive faster project delivery and better value for money. For example, reforms in NSW planning processes for major projects have led to a significant reduction in average processing times: from 298 days in 2014 to 163 days in 2016-17 to 130 days in 2020-21. Processing time is a key concern for industry and a driver of cost.

Since the publication of the 2018 SIS, several important initiatives have been progressed:

- **Ten Point Commitment to the Construction Industry:** now well established and subject to periodic reports on its implementation, as recommended by the 2018 SIS
- **The NSW Government Major Infrastructure Projects Pipeline:** routinely updated
- **Bid Cost Contributions Policy:** published, implemented and regularly updated as required
- **The Oversight Framework:** a framework to ensure effective management of High Priority High Risk Projects
- **Timely Information on Infrastructure Projects:** addresses one of the common problems of projects that experience stress: premature determination and announcement of program and budget
- **The Infrastructure Skills Legacy Program (ISLP):** the program aims to boost the number of skilled construction workers and create pathways to employment across the State
- **Female and Youth Workforce Participation:** actions for a more inclusive culture across the construction sector and to encourage greater participation by women and young people
- **Procurement for Large, Complex Infrastructure Projects:** procurement practices to support the successful delivery of megaprojects
- **Commercial Principles for Construction:** during the construction shutdown in July 2021 arising from the outbreak of COVID-19, commercial principles were developed and released to minimise long-term impact on projects and the industry. They have been developed further since then to address barriers to competition and participation

- **Asset Management Policy and Assurance Framework:** aims to realise value from the State's asset portfolio and better identify investments that meet the needs of NSW communities.

Although some reforms are relatively recent, others are already improving project delivery outcomes, with further positive impacts expected. The test of the reforms will come with projects that are yet to be procured, and more reforms are required.

Delivery of megaprojects should be sequenced to match industry capability

Megaprojects are bespoke in design and complexity. They are often brownfield projects that disrupt communities, require extensive property acquisition, are often overlaid on centuries (if not millennia) of settlement and intersect with existing critical operating assets. In some cases, they can only be delivered by a limited pool of contractors and place especially high demand on limited skilled engineering and project management resources. These projects can be transformational for cities and regions, but they are also higher in risk.

NSW has successfully delivered many such projects over the past decade and there are more nearing completion. Others are only now commencing. The NSW forward pipeline includes some complex megaprojects that have not yet reached the stages of final business case, investment decision or main-works procurement.

It is good practice for the NSW Government to regularly consider the rate and sequence at which these projects should proceed – even where timeframes have already been announced or projects are proceeding with investigation and 'no-regrets' early works, business case development and even planning consents.

Some megaprojects in the NSW pipeline are likely to face significant delivery challenges in the near to medium term as they proceed alongside other megaprojects already in delivery or procurement. This was already the case prior to the impact of COVID-19 outbreaks in 2021. The situation has now been exacerbated by shortages in specialised technical, design and project management professionals, as well as supply chain backlogs and unpredictable interruptions. The projects most vulnerable to those impacts have common features:

- large scale and complex in delivery
- a limited field of contractors with technical and financial capability/appetite
- higher than average demand on specialist engineering investigation and design
- highly reliant on large or bespoke orders from international supply chains.

Several projects in the pre-procurement stage exhibit these features – Beaches Link, the M6 Motorway Stage 2, Parramatta Light Rail Stage 2, the central tunnel for the Great Western Highway-Katoomba to Lithgow upgrade, further stages of the Sydney Metro or rail projects (Sydney CBD to Zetland, Western Sydney International Airport to Leppington or Campbelltown) and regional major dam projects (New Dungowan, Wyangala). The NSW Government should reconsider the urgency of these projects. Projects that proceed should be sequenced and commence procurement only when other existing megaprojects are stable and in mature delivery.

That rate at which these (and other) projects can proceed in the future will depend upon the effective delivery of existing projects, as well as the successful implementation of practices that enable large, complex projects to de-risk, reduce the costs of participation and increase the State's ability to draw on the resources of tier 2 and tier 3 contractors, as well as new entrants to the contractor market.

In general, the questions that should be asked of these megaprojects are:

- Is the project ready to proceed to the next stage or would it benefit from further time in planning and development?
- In the overall portfolio of upcoming investments, is the project the most valuable to the public?
- Do other projects already in delivery or procurement create resourcing pressures that mean deferral of the project is warranted to minimise risks and achieve value for money?

In this 2022 SIS, Infrastructure NSW has recommended that Warragamba Dam Wall Raising should proceed (see Chapter 5 for more). This is a megaproject but it has been the subject of extensive options analysis and business case development, has undergone early contractor engagement to develop design solutions and cost estimates, is part-way through the planning determination process and, most importantly, addresses a pressing and severe flood risk in the Hawkesbury Nepean Valley. For other megaprojects, Infrastructure NSW recommends that their timing and priority be reconsidered but that long-term options planning and corridor preservation continue.

Many valuable projects and programs can be delivered with current State and industry capability

All parts of the Australian economy are experiencing supply constraints. Even without these constraints, industry and public sector capability is greatest for projects that are less complex, incremental in nature and of a scale capable of being delivered by many players in the market. Within the construction sector, this can mean different tiers of the market (including smaller local firms), while technology projects often draw from a completely different pool of firms and resources. Fortunately, these projects often have high payoffs to the community, as they can address longstanding bottlenecks and points of failure, modernise ageing and outdated assets or make phased additions to existing groups of assets to respond to gradual growth in demand.

This is the 'bread and butter' of most infrastructure agencies. Individually, these projects are less transformative than megaprojects, but they are almost always required to create optimal value from major new assets in a network. For example, major motorways require network integration works on feeder roads, and the Sydney Metro City and Southwest project is supported by the More Trains More Services program. These projects often go hand-in-hand with sound asset management approaches.

11.2 High service standards require investment in existing assets

Meeting the expectations of citizens and NSW businesses requires a sharper focus on the reliability, safety and functionality of public assets.

To reverse historic underinvestment, the past decade saw a step change in the scale of the State's infrastructure asset base. This work is not complete, with several major projects in procurement or development. With a large and growing asset base, value from public expenditure is more likely to be found by rebalancing from new greenfield assets to asset augmentations.

Augmentation of existing assets includes measures such as technology upgrades, additions to existing networks and adaptations to improve reliability, safety, functionality, capacity and resilience. To help shift the focus to value-adding investment in existing assets, the NSW Government introduced the Asset Management Policy for the NSW Public Sector in 2019 (see Box 11.1).

Box 11.1

NSW Government Asset Management Policy

The NSW Asset Management Policy supports high-quality service provision to NSW communities through:

- increasing asset management capability
- improving asset use and resilience
- strengthening financial sustainability
- targeting effective investments in existing assets.

NSW Government agencies are working to increase their capacity to achieve these outcomes. This will optimise the benefits from existing and new assets through better use of technology and data, driving asset adaptability and the adoption of predictive whole-of-life cycle approaches to maintenance.

The need to shift the focus of investment to asset augmentation and management has been experienced by other jurisdictions following significant new infrastructure investments. In 2021, infrastructure maintenance was included among the G20's top priorities. The G20 Policy Agenda on Infrastructure Maintenance says a shift in perspective in asset management is critical to achieving long-term economic and community benefits.[364]

Well-maintained infrastructure is key to reliable service and asset resilience

Effective asset management is critical to ensure that services continue to be delivered during disruptive events and, when interrupted, promptly restored. This requires infrastructure to be built, adapted and maintained to be resilient to shocks and stresses.

Resilience in asset management requires awareness of demand patterns, interdependencies between systems, potential exposure to hazards, an understanding of the condition of existing assets and the standards necessary for effective adaptation.

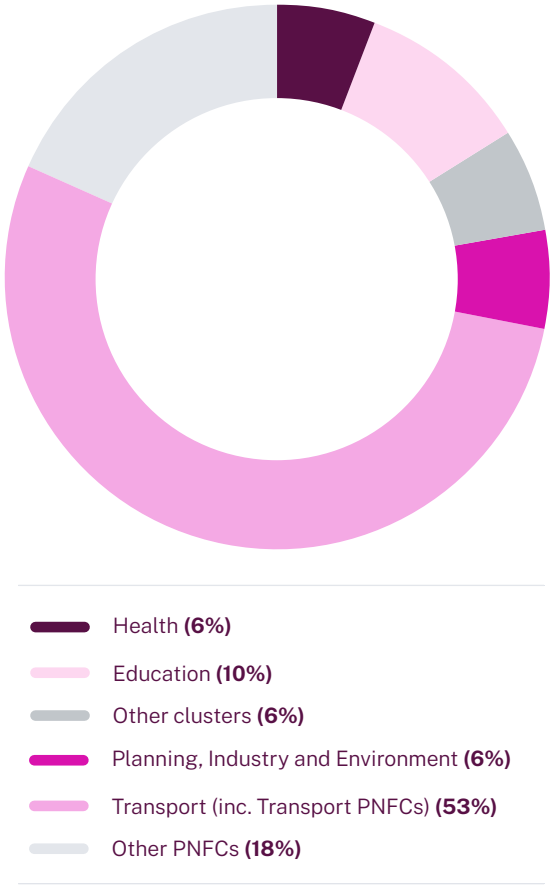
The NSW Asset Management Policy requires that agencies undertake an assessment of resilience and vulnerability to climate change, natural disasters and human-related threats and develop proposed mitigations. Such assessments should be incorporated in the Asset Management Policy's assurance process, as outlined in Chapter 5.

Optimising expenditure on maintenance and renewals

Making the most of existing assets means knowing how to maximise their useful life. This can be achieved through maintenance activities designed to preserve an asset's utility and value, or through more extensive interventions that adapt the asset to changing service needs.

Government agencies use a variety of methods to assess maintenance priorities and renewal opportunities. This creates challenges in directing expenditure for maximum impact. Best value for money will be achieved by applying a consistent approach to prioritising maintenance and investment in existing assets. This will enable the Government to evaluate competing demand on funds and provide a better understanding of the proportional investment needed across sectors, which varies greatly in terms of asset portfolio value, as shown in Figure 11.1.

Figure 11.1 - Asset portfolio value by cluster (as at 30 June 2021)



Source: NSW Treasury, based on revised 2020-21 data as per the 2021-22 Budget

Digital technology can enhance asset management capability

Digital technology offers opportunities to inject smarter, predictive approaches to asset maintenance that can improve efficiency, utilisation, reliability and safety.

Digital technology applications for infrastructure can generate real-time data to inform asset management decisions. Remote site monitoring using cameras and sensors is already possible using existing technology, and widely deployed in some areas. The rich data collection and analysis can inform operators about asset condition in ways that were previously not possible. Maintenance and renewals can be better planned to minimise costly service disruptions to customers and reduce safety incidents.

The private sector should be leveraged in addressing infrastructure maintenance needs

The combined maintenance needs from the existing asset base and from new infrastructure will have a significant impact on current and future State Budgets. To ensure value for money, the NSW Government should consider:

- **leveraging the benefits of private sector innovation** to maintain State assets, such as capitalising on systems that are already available for real-time, remote monitoring of asset condition (see Box 11.2 for examples)
- **achieving efficiencies** through longer-term, outcomes-focused asset maintenance contracts that adopt whole-of-life preventative and predictive maintenance approaches
- **improving the visibility of major maintenance and asset renewal programs** on a forward infrastructure pipeline to increase contestability and competitiveness. For example, New Zealand's Infrastructure Commission includes projects for major upgrades on its infrastructure pipeline,[365] and the UK publishes 5-year investment and maintenance plans for rail and roads.

Alongside a transparent and visible pipeline of major maintenance and asset renewal plans, innovative contracting approaches will also give the private sector confidence to invest in people, processes and technologies.

Box 11.2

Examples of successfully leveraging private sector experience in maintenance contracts

Newcastle Transport

Newcastle Transport is an integrated transport provider running buses, ferries, light rail and the multi-modal Newcastle Interchange. It is operated by a service provider (Keolis Downer) through a 10-year contract with the NSW Government. The contract includes minimum service standards and Key Performance Indicators (KPIs), including financial incentives to grow patronage, giving Keolis Downer a strong incentive to improve customer service and deliver transport services locals want.

Achieving these results involves Keolis Downer making improvements to the long-term management of assets to ensure safety and reliability, and driving down maintenance costs while achieving zero or negligible maintenance backlogs.

The New Schools Privately Financed Project

The NSW Department of Education and Training established two major Public Private Partnerships (PPP) contracts to provide schools in new urban release areas. The contracts required the private sector to finance, design and construct the schools and provide cleaning, maintenance, security, safety, utility, furniture, equipment and grounds maintenance and other services until the end of the contract when these school buildings will be handed over to the NSW Government.

A performance audit of the New Schools Privately Financed Project found that the contracts were established and let in a way that greatly assisted their potential for delivering value for money.[366] Schools were delivered earlier, and maintenance services were provided to a level higher than specified.

Department of Communities and Justice Infrastructure Support Services Contract

DCJ's Infrastructure Support Services Contract is an innovative and collaborative contract that specifies minimum outcomes to be achieved by the service provider for a broad range of services. The contract aligns with the Asset Management Policy as it requires the development of whole-of-lifecycle asset planning systems that achieve environmental and financial sustainability, and the development of data-driven, evidence-based maintenance programs.

The contract is also aligned to the department's objectives to reduce recidivism, increase participation of Aboriginal people, use Disability Enterprises and engage with regional and small-medium enterprises within a 125km radius of assets.

11.3 Infrastructure funding approaches need to broaden

Most public infrastructure is funded through general NSW Government taxation revenue, including GST transfers. Regardless of the efficiency gains from better asset management, achieving better customer outcomes means that additional funding will be needed for new assets, asset augmentation and maintenance. Pressures on future NSW Budgets will remain high.

More sustained co-funding arrangements with the Australian Government are required

A significant funding source for State projects is direct contributions from the Australian Government. This means that building an enduring future investment program will require the NSW Government to continue to work effectively with the Australian Government.

It is common for project budgets, funding commitments and completion dates to be announced very early in the lifecycle of a project. These estimates are often premature, particularly for large, complex engineering projects. While the NSW Government has taken steps to alleviate this issue,[367] Australian Government practice has not kept pace. This increases risk to NSW projects and can compromise investment programs.

NSW is changing its procurement of large, complex projects to include more recognition that some risks cannot be reliably quantified prior to commencement of construction. As part of this approach, steps are taken to de-risk projects, to the extent possible, prior to main works and to identify risks that may require risk sharing mechanisms. This approach is supported by the Australian Government and co-funding arrangements should reflect the fact that final outturn costs (the actual total costs of construction) are less certain. Greater sharing of cost risk between the NSW Government and the Australian Government may also imply greater involvement from the Australian Government across the project development stages and in associated decision making.

User and beneficiary contributions should become broader and more dynamic

Apart from NSW and the Australian Government directly funding projects, user contributions have been a common feature in infrastructure. The telecommunications and utilities sectors, for example, are mostly funded by users. However, this has been more challenging for other sectors, particularly transport and social infrastructure, which largely rely on public subsidies, with some partial contributions from landowners and developers in greenfield areas.

Infrastructure NSW advocated for pricing reform in the transport sector in the 2018 SIS. This acknowledged the inequity in current approaches to fixed use pricing (such as registration and stamp duty), as well as the important role pricing reform can play in improving accessibility and reducing congestion, carbon emissions, and air and noise pollution. In addition, pricing reform is a pathway to a more fiscally sustainable approach to the provision and maintenance of infrastructure and services.

More recently, the NSW Government has introduced reforms to its road charging strategy, which included providing stamp duty subsidies and introduction of an alternative distance-based Road User Charge (RUC) from mid-2027 or when EVs make up 30% of all new car sales.[368] This alternative form of revenue will contribute funding for the ongoing operation and maintenance of the road network.

This reform is a welcome development but should be considered as the first stage of a longer term and more holistic reform for the transport sector, as recommended in the 2018 SIS. Building on the existing EV road user charging reform, the NSW Government should consider the best approach to gradually replace the fixed RUCs with variable user charges.

In the longer term, pricing reform should also consider changes in public transport fares. Currently, there are no explicit links between the benefits to users from investment in the public transport network (such as increased capacity, improved journey times and overall customer experience) and the cost of this investment.

While Transport for NSW continually pursues alternative approaches to contribute funds to the provision of infrastructure and services, transport farebox recovery is typically around 20% to 30% of the cost of services. This means the cost and burden of investment is shared across taxpayers, regardless of whether they use the infrastructure and services.

The immediate challenge is the safe return of passengers to the public transport network, post COVID-19. Reforms to public transport fares may not be an immediate priority but should be a consideration for the future, once demand returns to pre-COVID levels.

Public transport pricing reform should aim to better reflect the real cost of trips on the network, integrate with pricing reform in the road system and reflect the investments government is making to the network and the overall benefits users and society receive from the accessibility the public transport network provides.

In other sectors, there are often groups that benefit financially from new infrastructure, and opportunities for those groups to contribute over time should be explored. This is the case when new major public transport is delivered, as well as when land becomes more valuable through infrastructure that mitigates the impact of natural events.

Contributions from indirect beneficiaries of public infrastructure investment should also be considered. The NSW Government is currently implementing reforms to the infrastructure contributions system to address some of these challenges (see Box 11.3).

Box 11.3

Productivity Commissioner's Review of Infrastructure Contributions in NSW

The NSW Government recently accepted all 29 recommendations from the NSW Productivity Commissioner's Review of Infrastructure Contributions in NSW.[369] The reforms are intended to provide a more simple, efficient and sustainable approach for infrastructure funding. The review recommended:

- introducing a broad, simple and relatively modest Regional Infrastructure Contributions (RICs) system in the Greater Sydney, Central Coast, Hunter and Illawarra-Shoalhaven regions. The RIC will support NSW Government priorities and commitments related to housing, jobs, investment and infrastructure delivery outlined in the strategic plans for each region
- adopting a direct land contribution that requires landowners who benefit from rising land values following a rezoning to contribute towards the provision of land for local infrastructure. This can improve the efficiency and certainty of funding for land acquisition
- amending the local government rate peg to reflect population growth to allow councils to maintain per capita rates revenue as their communities grow. The additional rates revenue raised will cover the increasing maintenance and operational costs of councils' expanding asset bases to service their growing communities.

The outcomes of the Productivity Commissioner's Review will support capital funding for State and local governments and ensure councils have enough recurrent funding to meet service needs. DPE have been tasked with implementing these reforms, along with NSW Treasury.

Where opportunities arise for specific contributions for projects with a discrete group of beneficiaries, these should be considered on a case-by-case basis.

Further opportunities to unlock commercial value from State-owned assets should be pursued

The NSW Government should explore further opportunities to unlock value from physical and digital assets. This can be through generating commercial revenues or further asset recycling where assets are commercially viable and there is no policy or strategic imperative to retain these assets in government ownership.

Several agencies have demonstrated success in unlocking commercial revenues (see Box 11.4). It should become a standard requirement for agencies to explore the optimal use of physical and digital assets for revenue generation and/or recycling, including land, buildings, natural assets, linear assets (such as rail and roads), fleet and data.

Box 11.4

Commercial revenue generation through the Western Sydney Parklands Trust[370]

The Western Sydney Parklands is the largest urban park in Australia and one of the largest in the world. The Western Sydney Parklands Trust is a NSW Government statutory authority that is tasked with expanding public access to the Parklands and securing a strong funding base for ongoing operations, maintenance and improvements.

The Parklands' Plan of Management includes a strategy to use 2% of the estate for business hubs to create a long-term income stream to manage the remainder of the Parklands.

11.4 Concerted effort and focused policies are required to harness private sector investment

The increased role of the private sector in infrastructure over recent decades demonstrates that there are many opportunities for private sector investors to deliver new infrastructure. Much private investment originated in purchasing already operational public assets, such as airports, seaports, motorways, telecommunications and energy. Those assets typically already had built facilities and established revenue streams.

There has been less appetite for greenfield investment. However. this may be changing as institutional investors compete to invest in scarce, long-lived infrastructure assets. WestConnex was sold as a project in development and is being completed by the new asset owners. Also, privately owned operators have increasingly taken development risk on new expansions and extensions of assets, confident in a stable and supportive regulatory environment and the potential for commercial returns.

The demand for infrastructure investment remains strong. The challenge typically lies in establishing the right balance between risk allocation and value for money. While this is an increasing area of focus for the NSW Government, a concerted effort is required to develop and embed policies that leverage increased private capital deployed to major infrastructure assets.

Defining the future role of government in infrastructure markets would provide increased private sector certainty

To attract private sector investment, clarity and consistency on the regulatory and operating environment is required. Some aspects of the role of government in infrastructure markets are well-established, such as the regulation of natural monopolies or the delivery of essential services. However, direct participation by government in previously privatised sectors, like energy and telecommunications, has increased uncertainty about its role in markets and the stability of the policy environment.

Sectors in transition, such as energy, sometimes require support to maintain ongoing investment. The same can be true in emerging industries where there is a clear public need but a limited commercial track record. There is a question of whether and to what extent the NSW Government should de-risk private sector investment where this aligns with its priorities. Where investment has been de-risked, a question also arises on the extent to which the NSW Government should share in returns earned by private operators invested in the market.

Defining the future role of government in infrastructure markets will be important to provide investors with certainty to participate in the delivery and operation of infrastructure assets and services.

Further partnership opportunities with the private sector need to be explored

The NSW Government should actively explore opportunities to partner with the private sector and to develop commercial models to fund infrastructure to deliver on its agenda. Some key approaches that could be explored include:

- **lease or sale of brownfields assets** with commercial revenues to traditional infrastructure investors, such as superannuation funds, that have shown a capacity to meet community expectations in long-term management of assets

- **complementary development of assets** that improve services and public benefit and offset the costs of public infrastructure. This includes co-development of private and social housing, development over train stations and the development of precincts, such as Barangaroo
- **development of infrastructure where there is a direct operating cost benefit to operators** and commensurate commercial opportunities, such as rail, ports and intermodal facilities that support the freight industry
- **consideration of packages of private investment to upgrade, augment and maintain public assets,** such as improving technology penetration and resilience hardening. This will require further development of commercial models underpinned by, for example, sharing in cost savings to taxpayers and/or improving services
- **active development of infrastructure assets in a manner suitable for PPP procurement** to facilitate increased engagement and innovation from the private sector and attract private financing. This should also consider more collaborative arrangements in PPPs, such as alliance models
- **increasing use of technology, digitisation of infrastructure and emerging data assets** to enable greater private sector participation and new commercial delivery models.

All approaches will require mature commercial models, the creation of structured opportunities for investors, and strong and clear arrangements for cyber security where digital assets are involved.

11.5 Evolving priorities need to be reflected in investment appraisal

The NSW Government's business case guidance and investment appraisal frameworks have been at the heart of disciplined infrastructure decision making. After strategic planning, developing a business case is a fundamental step in informed decision making that leads to efficient resource allocation outcomes. This includes the selection of effective intervention options (investment in physical infrastructure or otherwise) and the successful realisation of anticipated benefits through early planning of program delivery.

NSW Treasury has also pioneered outcome-based budgeting which has been driving infrastructure decision making. The use of robust business cases and economic appraisal of identified government intervention options should continue to be central to the NSW Government's approach to making prudent funding decisions, as this maximises the value for taxpayers' dollars spent and contributes towards achieving outcomes that benefit the people of NSW.

There are opportunities to improve guidelines and practices across government to drive better funding decisions and outcomes where infrastructure planning or delivery is involved. This includes reflecting the following realities:

- **NSW Government strategic objectives:** infrastructure investments do not proceed in a vacuum. They operate in the context of broader strategies: economic, social and environmental. Various government strategies also target economic diversification which challenges traditional investment appraisal frameworks. The Government's strategic objectives should be built into investment decision making even if these objectives are not typically included in the usual cost-benefit assessment frameworks
- **investment logic mapping** promotes robust upfront discussion and analysis, resulting in sound problem definition and options identification on build and non-build intervention options. Greater emphasis on front-end planning means subsequent resources for detailed feasibility analysis and planning will be allocated to options that are genuinely expected to deliver intended benefits and outcomes. Any proposed investment needs to be tested and confirmed for its evidence-base against a well-defined problem or opportunity
- **risk and scenario planning:** future uncertainties, shocks and stressors will require a better approach to scenario planning and considerations of low frequency but high-risk events in investment decision making. The Department of Premier and Cabinet's Shaping

Futures team has undertaken significant work to develop an evidence-based Trends Atlas and scenario planning framework to embed in investment decisions. Quantitative methods such as Real Options Analysis (see Box 11.5) can also provide tools to decision makers[371]

- **commerciality and deliverability analysis** should be fundamental considerations as part of the options identification and development process. Insufficient consideration and planning for construction procurement and delivery at early stages of the business case process could result in projects that are unable to be delivered within the original funding allocation
- **discount rates:** the current social discount rate used in economic appraisal has remained at 7% (in real terms) for over three decades, despite market interest rates having declined to historic lows.[372] An artificially high discount rate underestimates the merits of projects with long-term benefits, such as environmental and social housing investments. The discount rate and the methodology used for estimating it should be reviewed
- **post-program evaluations:** evaluation of government-funded programs can be useful to inform future decision making, improve existing programs and share learnings. Developing program evaluation plans as part of the business case process can also enable adaptive decision making that responds to changing circumstances and conditions over the course of an investment. This is particularly important where proposed investments are large in scale, involve long timeframes to implement or where the program benefits are yet to be clearly understood (for example through pilot investments and programs).

NSW Treasury is updating its business case and investment appraisal guidelines during the next two years. The review may benefit from an independent expert advisory panel to provide oversight and advice. This would be in line with international best practice and would strengthen credibility, innovation and independence in the investment appraisal guidelines used by the NSW Government.

Box 11.5

Using Real Options Analysis to respond to uncertainty

Real Options Analysis (ROA) is an investment evaluation and decision-making framework that specifically recognises the value of flexibility in project design and delivery, and supports embedding flexible approaches into an investment strategy to better structure and manage projects that are significantly impacted by uncertainty. ROA can support government development of infrastructure investment strategies that are adaptable and able to meet evolving community needs.

ROA uses a broad range of methodologies and tools to consider and address uncertainty through all stages of an investment's lifecycle. Essentially, it involves a series of actions that start with identifying the key sources of future uncertainty and possible responses to this uncertainty, and move progressively towards developing a strategy that maximises the expected value of the project by dealing with uncertainty effectively.[373]

More information about the performance of current infrastructure in NSW will assist future investment decisions. The Gate 6 Review process, under the Infrastructure Investor Assurance Framework (IIAF) already requires delivery and operating agencies to review projects and ensure mechanisms have been set up to collect information on project benefits. NSW Treasury's Evaluation Framework also supports collecting more systematic information on how projects have performed relative to business case forecasts.

As more projects become operational, these review processes will provide a rich source of data to inform the development of future projects and overall decision-making frameworks.

As outlined in Chapter 8, there is growing demand for sustainable financing and associated climate- and sustainability-related disclosures. These market trends are driving the need for accelerating environmental, social and governance (ESG) outcomes across government in a coordinated manner. In this context, the NSW Government should consider establishing an overarching framework that defines the roles and priorities of government in supporting sustainable finance outcomes, to provide greater clarity for infrastructure delivery agencies and the private sector.

11.6 Delivery can be improved by greater innovation and capability development in the construction industry

Delivery of an investment program requires a thriving construction industry. The Global Infrastructure Hub's InfraCompass tool ranks Australia 9th out of 76 countries for infrastructure procurement.[374] However, the scale of the current investment program in NSW and the size and complexity of individual projects are leading to concerns about the capacity and capability of both public and private sectors to continue delivering these infrastructure investments.

The 2018 SIS highlighted that quality skills shortages and low levels of innovation in the construction industry contribute to sluggish productivity growth. These trends continue. Recent ABS data show that the construction industry ranks poorly when it comes to R&D expenditure.[375] This influences the industry's profitability and performance. There is an opportunity to build on the successful use of innovative construction methods (see Box 11.6) to uplift innovation in the construction sector. Innovation is an important priority of the NSW Government, with the new R&D NSW established within the Department of Enterprise, Investment and Trade in response to the 2021 *Accelerating R&D in NSW Action Plan.*[376] R&D NSW has been tasked with driving and overseeing delivery of the R&D Action Plan to position NSW as Australia's R&D leader.

Box 11.6

Innovative construction methods in NSW public school delivery[377]

Jordan Springs Public School, completed in July 2020, became the first NSW public school delivered using the Design for Manufacture and Assembly (DfMA) construction method.

DfMA is a design and construction process that combines the manufacture of building components, such as wall systems and facades, in a safe, clean and efficient factory environment, with on-site construction assembly. Its benefits include:

- time savings, with potential to reduce on-site construction assembly time by up to 30%
- minimising impact on schools, including less noise, traffic and pollution compared to traditional construction methods
- upskilling the workforce, with demand created for new jobs in manufacturing, including production line management, logistics management, digital systems and quality assurance
- improved sustainability, with the opportunity to reduce carbon emissions, water and material waste by more than 30%
- opportunity to reduce costs over time, as the industry becomes more familiar with DfMA.

In addition to on-the-ground skills for project delivery, successful execution of large and complex projects requires careful decision making and oversight throughout inception, business case, scoping and design, and then delivery. This oversight and accountability cannot be handed off and generally sits with a small group of people within the NSW Government and industry. There is a limit to the number of projects that can be supervised at one time. In short, funding is not the only constraint to a successful infrastructure program.

To further address market capacity constraints, NSW would benefit from more international construction firms entering the domestic market, particularly those from neighbours in the Asia-Pacific region, such as Japan and South Korea.[378] This will require both overt work to attract the interest of these firms and a willingness to value the capabilities and experiences of international players.

Many of these firms are already active internationally and are industry leaders in sustainability and the deployment of cutting-edge technology, such as artificial intelligence (AI) and robotics. Greater participation of these firms could further catalyse industry productivity and support digital transformation in the construction industry in NSW. The recent *Premier's Memorandum on Procurement for Large, Complex Infrastructure Projects* introduced a provision aimed at recognising the international experience of international contractors and key personnel. Tracking and monitoring the implementation of this provision will be an important way to further foster competition and innovation in the market.

Targeted initiatives can lift industry capability and opportunity

A busy delivery program provides much opportunity for construction industry professionals and workers, but leaves little scope for capability development. More recently, government and industry capacity has been absorbed with managing the increased task load of the current pipeline and dealing with the impacts of COVID-19 on infrastructure projects. This has left limited time and resources to focus on implementing new policies and practices, and amending traditional ways of working that will increase efficiencies.

With comparatively small and targeted funding and resourcing of key initiatives, the NSW Government can better realise the social and economic benefits of the current pipeline, as well as increase the speed of pipeline delivery, create extra capacity, improve project performance and significantly reduce delivery risk.

There is an opportunity to increase capacity in the labour market, while supporting local and regional economies. Capacity and capability challenges within regional NSW are of particular concern to the NSW Government. There is also a need to invest in local council capacity and capability to better operate and maintain critical public assets and infrastructure (see Box 11.7 for an example); in particular, to uplift capability in the following areas:

- business case development and strategic planning activities for critical economic and service infrastructure
- project management / project assurance / procurement for infrastructure delivery
- effective asset management planning to support the operation and maintenance of government investments.

Box 11.7

Case study: Town Water Risk Reduction Program

Through the Town Water Risk Reduction Program, the NSW Government is partnering with local water utilities (LWUs) in regional areas and the wider water sector to develop and implement a new approach of working together. This new approach will enable LWUs to manage risks and priorities in town water systems more strategically and effectively and, as a result, reduce water risks in regional NSW communities over time.

The overarching goal for this program is to work collaboratively with LWUs and other partners to build a town water sector where:

- stakeholders, including the Department of Planning and Environment, work together in partnership, sharing data and knowledge, consulting and collaborating with one another, and supporting each other where applicable
- LWUs are supported to manage safe, secure and sustainable water supply and sewerage services in an efficient and customer-focused manner
- the regulation of LWUs is focused on outcomes, based on risk and the maturity of each LWU, and is fair and transparent. Regulators are accountable and well-coordinated.

The program is working with Training Services NSW, alongside the training and water sectors, to increase the skills of existing water operators, attract more operators into the sector and increase employment in regional NSW. The program aims to provide access to training for up to 200 water operators in regional NSW seeking accredited training each year.

Based on this work, the NSW Government has released an action plan investing $1.175 million for 200 new trainee places each year in NSW to tackle critical skills shortages in the water operations sector. The plan will establish a sustainable training market, develop high-quality resources for training providers and boost funding for remote and regional student training places.

Training Services NSW (TSNSW) has a range of programs to uplift skills as part of the NSW Government's infrastructure investment spending.[379] These programs provide pathways to traineeships, apprenticeships and permanent employment opportunities. The Infrastructure Skills Legacy Program (ISLP) is mandated on all major government infrastructure projects, requiring projects to meet skills, training and diversity targets. Strong performance has been demonstrated against ISLP targets and consideration should be given to applying the ISLP to smaller projects.

The NSW Government's Aboriginal Procurement Policy (APP) seeks to build capacity and increase the Aboriginal community's economic participation,[380] consistent with Closing the Gap commitments.[381] There is opportunity to lift agencies' capacity and capability to improve data collection on the application of the APP. Approaches to achieve this include knowledge sharing through the Procurement Leadership Group, the Construction Leadership Group and the APP Community of Practice. In addition, where relevant and of interest to communities, agencies should be transparent and share data and information with Aboriginal communities to support business partnerships.

Agencies have implemented strategies to achieve these outcomes.[382,383] These strategies, co-designed with the Aboriginal community, training organisations and businesses, outline actions to build capability, capacity and increase Aboriginal business participation in partnership with industry and government. For example, Transport for NSW's Regional Rail Project, which will replace the ageing regional train fleet at the new Mindyarra Maintenance Centre in Dubbo, includes an Aboriginal Working Group in its governance structure. This will ensure ongoing participation of local Aboriginal businesses, stakeholders and the community throughout the life of the project.

Water Infrastructure NSW is piloting several initiatives that that could be adopted more broadly, particularly in regional areas.[384] These include:

- a project with TAFE NSW and Aboriginal-led training organisations to ready Aboriginal students for the training certifications needed for upcoming projects
- breaking down large projects into smaller components that allow Aboriginal businesses, which are often smaller in scale, to meaningfully participate
- publishing local project pipelines to provide transparency about future skills demand to support planning by individuals and businesses.

As Water Infrastructure NSW explores these initiatives, there will be an opportunity to leverage the lessons and consider how they might be applied beyond the construction phase into operations and maintenance to provide longer-term benefits. To be successful, initiatives to build capability and increase capacity must include engagement with local communities.

11.7 Recommendations

No	Recommendations	Implementation timeframe	Lead agency
48	**Reconsider the timing and sequence of future megaprojects to diversify the State's investment program and mitigate delivery risks** a. Reconsider the urgency, need and timing of megaprojects in the State's forward pipeline and focus on those with the greatest benefits and need. b. In the foreseeable future, sequence megaprojects to ensure their best chance of success, ideally once existing projects are in stable delivery. c. In the sequencing exercise, reconsider the timing and need for Beaches Link, the M6 Stage 2, Parramatta Light Rail Stage 2, the central tunnel for the Great Western Highway - Katoomba to Lithgow upgrade, further stages of the Sydney Metro or rail projects (Sydney CBD to Zetland, Western Sydney International Airport to Leppington or Campbelltown) and regional major dam projects (New Dungowan, Wyangala). d. Refocus the investment program by bringing forward programs of smaller to mid-sized projects identified by portfolio agencies. e. Resolutely apply procurement practices for large complex projects that de-risk projects, reduce the costs of participation for bidders and increase participation by tier 2 and tier 3 contractors and new entrants.	Immediate Priority	Infrastructure NSW & Treasury
49	**Make asset maintenance and augmentation a high priority for the future infrastructure program** a. Implement a whole-of-government approach to asset maintenance and renewals. b. Foster the adoption of technology-driven, predictive maintenance methods.	Immediate Priority	Infrastructure NSW & Treasury
50	**Adopt data-enabled asset management and investment decision making across the NSW Government, including:** a. Continued focus on delivering cross-government asset data structures and asset information platforms. b. Centralised collection of essential asset data into a register, including performance, location, and condition. c. Uplift of data capabilities to drive technology solutions for smarter, effective asset management.	Immediate Priority	Customer Service, Infrastructure NSW & Treasury
51	**Publish a pipeline of major asset maintenance, upgrade and renewal opportunities as part of the NSW Major Projects Pipeline, and promote the use of innovative, outcome-based asset management service contracts**	Immediate Priority	Infrastructure NSW
52	**Partner with the Australian Government to achieve sustainable co-funding arrangements** a. Request Australian Government compliance with *Timely Information on Infrastructure Projects* on co-funded infrastructure projects. b. Support procurement practices that suit large, complex projects, including early engagement on risks, scope and design solutions, and open book approaches.	Immediate Priority	Treasury & Infrastructure NSW

No	Recommendations	Implementation timeframe	Lead agency
53	**Develop a roadmap for long-term reform of user contributions across the road and public transport networks**	Extended Program	Treasury & Transport
54	**Utilise all viable commercial models and approaches to enable additional opportunities for private sector investment in infrastructure, including:** a. Leases or sales of commercial brownfield assets to traditional infrastructure investors. b. Complementary development of assets that deliver additional services and benefit to offset the public infrastructure costs. c. Development of infrastructure with direct operating cost benefits to operators. d. Packages of private investment for public asset augmentation and maintenance. e. Development of infrastructure assets in a manner suitable for PPP procurement. f. Use of emerging data assets from the increasing digitisation of infrastructure to underpin new commercial delivery models.	Immediate Priority	Treasury & Infrastructure NSW
55	**Update investment planning and decision-making frameworks to improve options identification, scenario analysis and test deliverability of projects** In the next round of the refresh of business case guidelines, the following should be considered: a. Formally incorporate scenario planning into investment decision making that extends beyond the standard sensitivity analysis currently used in business case development. b. Explore the use of Real Options Analysis (ROA) to support greater flexibility to deal with uncertainty, such as high impact and low frequency events. c. Strengthen upfront thinking, sound problem definition and benefits realisation testing to ensure a range of compelling investment options that lead to intended benefits. d. Require early engagement with industry on commercial viability and program deliverability (including market sounding) to inform options. e. Ensure alignment of investment proposals with government strategies and outcomes in a measurable and evidence-based manner. f. Review the methodology for estimating the appropriate discount rate to reflect current conditions. g. Periodically review assumptions underpinning infrastructure planning and delivery, including accounting for uncertainties and disruptive events.	Immediate Priority	Treasury & Infrastructure NSW

No	Recommendations	Implementation timeframe	Lead agency
56	**Support innovation in construction through productivity initiatives jointly sponsored with industry** a. Develop agreed methods to encourage innovation in project procurement and delivery. b. Provide seed and pilot funding to drive forward infrastructure-related digital transformation. c. Partner with industry and academia to pilot new technologies, such as through Cooperative Research Centres (CRCs).	Immediate Priority	Infrastructure NSW
57	**Develop new skills and capabilities required for infrastructure projects, and widen opportunities for communities to participate through targeted actions in training and employment initiatives** a. Enhance training and development for infrastructure delivery agencies, particularly in the areas of commercial skills for large projects (bidding, pricing, contract administration, procurement, evaluation) and Project, Program and Portfolio leadership. b. Deliver joint government and industry certification and training for staff engaged in large, complex project development and delivery. c. Work with the construction industry to co-design training for projects, from entry level to project management. d. Improve regional NSW local council capability in business case development, strategic planning, project management and assurance and asset management. e. Where possible, provide information on the pipeline of infrastructure work for the regions so that local communities and businesses can better prepare for employment and business opportunities. f. Work with local Aboriginal communities and businesses to support employment opportunities and business growth by: – forming partnerships between Aboriginal-led training organisations, TAFE NSW, infrastructure delivery agencies, businesses and local communities – improving agencies' data collection with regard to the application of the Aboriginal Procurement Policy, including through cross-agency knowledge sharing.	Extended Program	Infrastructure NSW

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Appendix A – Acronyms and abbreviations

Acronym	Description
AANSW	Aboriginal Affairs NSW
ABS	Australian Bureau of Statistics
ACHIF	Aboriginal Community Housing Investment Fund
AI	Artificial intelligence
APP	Aboriginal Procurement Policy
ATP	Automatic Train Protection
BCF	Biodiversity Conservation Fund
BIM	Building Information Models
Capex	Capital expenditure
CBD	Central Business District
CCEP	Critical Communications Enhancement Program
CICT	Construction Industry Culture Taskforce
CLG	Construction Leadership Group
CO2	Carbon dioxide
CPA	Common Planning Assumptions
CRC	Cooperative Research Centre
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSO	Customer Service Obligation
DE	Digital engineering
DfMA	Design for Manufacture and Assembly
DJSI	Dow Jones Sustainability Index
DRF	Digital Restart Fund
ERB	Energy Resilience Bank
ESB	Energy Security Board
ESG	Environmental, Social and Governance
EV	Electric vehicle
Gbps	Gigabytes per second
GCC	Greater Cities Commission

Acronym	Description
GDP	Gross Domestic Product
GHG	Greenhouse gas
GL	Gigalitre
GPOP	Greater Parramatta and the Olympic Peninsula
GRESB	Global Real Estate Sustainability Benchmark
GSC	Greater Sydney Commission
GSP	Gross State Product
GSRP	Greater Sydney Region Plan
GST	Goods and Services Tax
GVA	Gross Value Added
HPV	High Productivity Vehicle
IA	Infrastructure Australia
ICT	information and communications technology
IDC	Infrastructure Delivery Committee
IDMF	Infrastructure Data Management Framework
IGR	Intergenerational Report
IIAF	Infrastructure Investor Assurance Framework
IIOR	Infrastructure Investment Objectives Report
IMT	Intermodal terminal
INSW	Infrastructure NSW
IoT	Internet of Things
ISLP	Infrastructure Skills Legacy Program
ITS	Intelligent Transport Systems
KPI	Key Performance Indicator
LEOSat	Low Earth Orbit Satellite
LTESA	Long-Term Energy Services Agreement
LWU	Local water utility
Mbps	Megabytes per second
MECLA	Materials & Embodied Carbon Leaders' Alliance

Acronym	Description
MIT	Moorebank Intermodal Terminal
NABERS	National Australian Built Environment Rating Scheme
NARCliM	NSW and ACT Regional Climate Modelling
NBN	National Broadband Network
NEM	National Electricity Market
NGF	NSW Generations Fund
NGO	Non-government Organisation
NSWTA	NSW Telco Authority
OECD	Organisation for Economic Co-operation and Development
PIC	Place-based Infrastructure Compact
PPP	Public Private Partnership
REZ	Renewable Energy Zone
RIC	Regional Infrastructure Contribution
RJP	Regional Job Precinct
ROA	Real Options Analysis
RUC	Road User Charge
SAP	Special Activation Precinct
SBC	Strategic Business Case
SBTi	Science Based Targets initiative
SCATS	Sydney's Coordinated Adaptive Traffic System
SDLAM	Sustainable Diversion Limit Adjustment Mechanism
SDT	Spatial Digital Twin
SEPP	State Environmental Planning Policies
SIS	State Infrastructure Strategy
SME	Subject Matter Expert
SRS	State Resilience Strategy
STEM	Science, Technology, Engineering and Mathematics
SWRL	South West Rail Link
TAFE NSW	Technical and Further Education NSW
TCFD	Taskforce on Climate-related Financial Disclosures
TEU	Twenty-foot Equivalent Unit
TNFD	Taskforce on Nature-related Financial Disclosures
TSNSW	Training Services NSW
UDP	Urban Development Program
UNIDO	United Nations Industrial Development Organisation
WEF	World Economic Forum
WPC	Western Parkland City
WSIA	Western Sydney International Airport
XDI	Cross Dependency Initiative

NSW Government departments

Acronym	Description
DCJ	Department of Communities and Justice (part of the Stronger Communities Cluster)
DCS	Department of Customer Service
DoE	Department of Education
DEIT	Department of Enterprise, Investment and Trade
DPC	Department of Premier and Cabinet
DPE	Department of Planning and Environment
DRNSW	Department of Regional NSW
TfNSW	Transport for NSW

Appendix B – Glossary

15-minute neighbourhood
An organising principle that prioritises people's ability to meet day-to-day needs locally. It seeks to activate local places and improve travel choices by prioritising placemaking, walking, cycling, micromobility (the use of small, lightweight vehicles operating at low speeds) and last-mile freight within 15 minutes of precincts and other important local destinations.

30-minute city
A planning concept for a city in which people can easily access the places they need to visit on a daily basis within 30 minutes travel from where they live. In the Greater Sydney context, the focus is on access to the nearest centre within 30 minutes by public transport, walking or cycling.

A

Active transport
Transport that requires some individual physical effort to provide mobility. Active forms of transport for personal travel include walking, use of a wheelchair or other mobility aid, cycling using a traditional bicycle (without power assistance) and power-assisted micromobility (such as e-bikes and e-scooters). Active forms of transport for freight delivery include both pedal-powered and electric power-assisted cargo bikes.

Agglomeration benefits

Benefits of improved productivity derived from greater density of employment, input and labour markets which offer firms and organisations greater choice, and greater access to knowledge and technology of other firms and organisations.

Asset recycling
The sale of assets to return the capital to invest in new assets or revitalise existing assets.

B

Baseload generation
Steady (but relatively inflexible) electricity generators that supply constant, on-all-the-time base electricity. In Australia 'baseload' generators have usually been large, coal-fired power stations.

Blue-green infrastructure
Green infrastructure is the network of green spaces, natural systems, and semi-natural systems that support sustainable communities and includes bushland; tree canopy and green ground cover; parks; and open spaces that are strategically planned, designed, and managed to support a good quality of life in an urban environment.

Blue infrastructure is water elements, like rivers, canals, ponds, wetlands, floodplains, and water treatment facilities.

Building Information Model (BIM)
A digital representation of the physical and functional characteristics of an asset or facility that is linked to a project database where it can be shared to inform decision-making during the facility's lifespan.

C

Central Coast City
See *Six Cities*

Central River City
See *Six Cities*

Circular economy
An economic system aimed at minimising waste and promoting the continual reuse of resources. The circular economy aims to keep products, equipment and infrastructure in use for longer, thus improving the productivity of these resources.

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.

Climate change adaptation
In human systems, adaptation is the process of adjustment to the actual or expected climate and its effects to moderate harm or exploit beneficial opportunities. In natural systems, the process of

adaptation is adjustment to the actual climate and its effects; human intervention may facilitate adjustment to the expected climate and its effects.

Common Planning Assumptions
The agreed information assets (data sets, parameters and assumptions, models and analytical tools) used by the NSW Government to prepare policy and infrastructure proposals, business cases and strategies. It includes long-term projections for the State's population, demographics, housing trends, and economic conditions including workforce and employment patterns.

Cooperative Research Centres
An Australian Government initiative established in 1990 that funds industry-led collaborations between industry, researchers and end users. The Cooperative Research Centres Program links researchers with industry and government with a focus on research application, and offers support through grants.

Construction Leadership Group (CLG)
A NSW Government cross-agency group chaired by INSW that brings together infrastructure delivery, planning and policy agencies. The CLG drives reform across government in the development, procurement and delivery of infrastructure and building projects and works closely with construction industry partners.

Corridor preservation
The process to reserve land for future public infrastructure use. The corridor preservation process identifies and secures land needed for future infrastructure, such as easements for roads, railway and transmission lines that might be built in the long term.

Cost Benefit Analysis
An appraisal and evaluation technique that estimates the costs and benefits of a project or program in monetary terms.

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.

Critical minerals
Metals and non-metals that are considered vital for the economic wellbeing of the major and emerging economies, yet whose supply may be at risk due to geological scarcity, geopolitical issues, trade policy or other factors. Among these are metals and semi-metals used in the manufacture of mobile phones, flat screen monitors, wind turbines, electric cars, solar panels and other high-tech applications.

D

Decentralised energy
Refer to 'distributed energy'.

Digital connectivity
The capacity for interconnections between digital platforms, systems and applications.

Digital Engineering (DE)
A collaborative way of working using digital processes to enable more productive methods of planning, designing, constructing, operating and maintaining assets through their lifecycle.

Effective digital collaboration includes integrated development and use of scalable Digital Twin technology, from the monitoring of a single asset or facility to a 3D visualisation of an entire precinct, city or place, which can be further enhanced with real-time information through smart connected Internet of Things devices.

Digital Twin
See *Spatial Digital Twin*.

Distributed energy
The types of resources/assets including small and medium scale distributed generation (such as solar photovoltaics), energy storage (such as small and medium-scale batteries and electric vehicles that can deliver energy from the vehicle to the power system) and controllable loads (such as air conditioners, electric storage hot water systems, pool pumps, and electric vehicle supply equipment) that connect to the distribution system.

E

Eastern Harbour City
See *Six Cities*

ePlanning
A digital online service that enables users such

as applicants, state agencies and developers to lodge, track and assess planning applications via the NSW Planning Portal. The Portal also includes the ePlanning Spatial Viewer to help identify relevant planning controls that may apply to a particular parcel of land to guide users during the application process.

F

Firming capacity
Generation technologies that can provide electricity on demand when variable generators (e.g. wind and solar) are unable to satisfy demand.

First and last mile
A term for the first and final stage of a journey; for example, the trip between a train station and someone's home.

G

General Government Sector
Includes all government-controlled entities that perform regulatory functions, redistribute income and wealth and deliver non-market goods and services (e.g. policy advice, regulatory and service delivery functions).

Greater Parramatta and the Olympic Peninsula
The Greater Parramatta and the Olympic Peninsula (GPOP) area 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.

Greater Sydney
The region comprising the local government areas within the boundary shown on the map in Schedule 1 of the Greater Sydney Commission Act 2015.

Green Bond
Any type of bond instrument where the proceeds or an equivalent amount will be exclusively applied to finance or re-finance, in part or in full, new and/or existing eligible Green Projects.

Green infrastructure
See *Blue-green infrastructure*

Gross State Product
The total market value of final goods and services produced within a state.

H

High Productivity Vehicle
Vehicles that can carry more payload than a B-double vehicle.

'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

Illawarra-Shoalhaven City
See *Six Cities*

Industrial and urban services land
Land including employment zoned land that allows for business and industrial uses in NSW, such as:

- Major freight, industry and heavy manufacturing
- Light manufacturing
- Urban services
- Light industry
- Mixed light industry, new economy or creative uses
- Industrial and urban services wholesale.

Information and Communications Technology (ICT)
All devices, applications and systems that, combined, allow people and organisations to interact in the digital world.

Infrastructure Data Management Framework
A set of guidelines, procedures and standard approaches to support consistent management of infrastructure data across the NSW Government sector. The Infrastructure Data Management Framework is aligned with the NSW Information Management Framework, which provides more general guidance on the management of government data and information.

Infrastructure Investor Assurance Framework (IIAF)
The NSW Government policy framework that provides an independent risk-based assurance process for the State's capital projects to identify

the level of confidence that can be provided to the NSW Cabinet that the State's capital projects are being developed effectively and delivered in accordance with the Government's objectives.

Intelligent Transport Systems (ITS)
The application of modern computer and communication technologies to transport systems to increase efficiency, reduce pollution and other environmental effects of transport, and increase the safety of the travelling public.

Intermodal terminal
An intermodal terminal is an area of land used to transfer freight between at least two modes of transport. It is typically used to describe the transfer of international shipping containers from road to rail and vice versa.

Internet of Things
A development of the internet in which everyday objects have network connectivity, allowing them to send and receive data.

Interoperability
A characteristic of a product or system to work readily with other products or systems, at present or in the future.

L

Land use planning
The organisation of land, resources, facilities and services with a view to securing physical and economic efficiency, social inclusion, the protection of environmental values, amenity, and health and wellbeing outcomes for urban and rural communities.

Live.NSW
A NSW Government interactive tool that helps people find information, services and initiatives planned across NSW now and into the future.

Lower Hunter and Greater Newcastle City
See *Six Cities*

M

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.

Mixed tenure housing
Generally refers to mixing market housing (bought, sold and leased on the open market) with subsidised housing of various types. Mixing tenure is typically used as a proxy for mixing household income groups.

N

National Electricity Market (NEM)
The wholesale market of generators that supply electricity to retailers in real time under the control of the system operator (Australian Energy Market Operator). 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 many generators and retailers participating, this is a highly competitive and 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.

Net Zero
Net Zero emissions are achieved when anthropogenic emissions of greenhouse gases to the atmosphere are balanced by anthropogenic removals over a specified period.

O

Outcome-based budgeting
A performance management approach focused on the outcomes that the NSW Government is pursuing. A key benefit of this management approach is it examines whether policies have evidence of achieving targets, alongside their cost.

P

Peaking generation
Power generators that are more flexible and dynamic as to when they produce electricity. These generators can quickly ramp up or down to

match changes in demand, and are usually based on hydro or gas.

Pinch points
Traffic congestion points, intersections or short lengths of road at which a traffic bottleneck exists slowing down the broader network. They cause a build-up of traffic and travel delays at these spots and on the wider road network.

Place-based Infrastructure Compact
A collaborative planning model that focuses on bringing together government agencies, local councils and utility providers to consider holistically what infrastructure and services are needed in a place before it can grow.

Precinct
A specific geographic area within a city or a region where the NSW Government intends to intervene – through infrastructure investment, changes to planning controls, business attraction and/or other levers – to attract facilities, services, businesses and other organisations to co-locate and unlock 'agglomeration benefits' or to drive economic, environmental, social and cultural value.

Public non-financial corporation sector (PNFC)
Covers all government-controlled entities that provide market goods or services and have a relatively higher share of own-source revenue.

Public Private Partnership (PPP)
The creation of an infrastructure asset through private sector financing and private ownership for a concession period (usually long term). Government may contribute to the project by providing land or capital works, through risk sharing, revenue diversion or purchase of the agreed services.

R

Rapid bus network
Fast and frequent bus services using high-quality dedicated fleet and stops to provide an enhanced customer experience. Services operate with consistent stopping patterns and extended operating hours 7 days a week with priority infrastructure to ensure reliability. Rapid Bus services are currently branded B-Line.

Redundancy
Redundancy is the adaptability of an asset or network to cope with loss of individual components (e.g. a hospital with two physically-separate water supplies).

Regional Job Precincts (RJP)
An extension of the Special Activation Precinct program, these precincts will provide planning support in targeted locations to help fast-track approvals to drive growth, investment and development opportunities in regional NSW.

Regional NSW
All of NSW with the exception of Eastern Harbour City, Central River City, Western Parkland City, Newcastle, Wollongong and Central Coast.

Renewable Energy Zones (REZs)
Zones nominated in the NSW Government Electricity Infrastructure Roadmap that combine renewable energy generation such as wind and solar, storage such as batteries, and high-voltage poles and wires to deliver energy to the homes, businesses and industries that need it.

Resilience
Resilience is the capacity to withstand disruption, absorb disturbances, act effectively in crisis and deal with climatic variability. For infrastructure to be resilient, it should be able to withstand disruption, operate in crisis and deal with and adapt to shocks (such as natural disasters, including bushfires and floods) and stresses (such as the vulnerability of ageing infrastructure).

Resilience assets
Classes of infrastructure assets specifically designed to improve resilience to shock events, for example flood mitigation infrastructure.

S

Shared infrastructure
Arrangements where multiple providers access or build common network infrastructure to provide a separate service. Shared infrastructure can be owned or leased by a government, government agency or the private sector.

Common network infrastructure can include one or more of the following: antennas, transmission, power, poles/towers, radio infrastructure and shelters.

These arrangements can be passive or active, depending on the level of cooperation and co-investment to deliver services.

Six Cities
A new approach to regional planning that extends the metropolis of three cities vision for Greater Sydney to a metropolitan region of six cities that includes:

- the Eastern Harbour City
- the Central River City
- the Central Coast City
- the Lower Hunter and Greater Newcastle City
- the Western Parkland City
- the Illawarra-Shoalhaven City.

Smart places
Smart places integrate technologies into the built environment to capture and convey data and insights. The embedded technology helps to capture information on the asset or local environment. The information is then analysed to help people and governments make better, evidence-based decisions about how to improve the productivity, liveability and resilience of cities, towns and communities. NSW has a Smart Places Strategy.

Smart infrastructure
Infrastructure that uses data gathered through sensors and technologies that are embedded in the infrastructure or surrounding environment. NSW has a Smart Infrastructure Policy.

Smart motorways
Motorways that use embedded sensors, analytics and customer feedback tools to actively manage congestion and safety and respond to traffic incidents.

Social housing
Rental housing provided by not-for-profit, non-government or government organisations to assist people who are unable to access suitable accommodation in the private rental market. Social housing includes public, Aboriginal and community housing, as well as other services and products.

Spatial Digital Twin (SDT)
Digital model of cities and communities that can visualise infrastructure, services and environments in 3D and 4D to facilitate better planning, design and modelling for NSW's future needs.

Social discount rate
Discount rate that aims to reflect the opportunity cost of resources for society as a whole in the long term. Social discount rates are used in economic appraisal and evaluation to recognise that resources allocated to one initiative have other potential uses, which are forgone.

Special Activation Precinct (SAP)
A dedicated area in a regional location identified in the NSW Government's 20-Year Economic Vision for Regional NSW to become a thriving business hub. Special Activation Precincts will bring together planning and investment to focus on growing jobs and economic activity in an area in line with the area's competitive advantages and economic strengths.

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.

Sustainability bond
Any type of bond instrument where the proceeds or an equivalent amount will be exclusively applied to finance or re-finance a combination of green and social projects.

T

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.

Transmission infrastructure / network
The high voltage lines and infrastructure that are used to transmit electricity from generators to substations.

W

Western Parkland City
See *Six Cities*

Western Sydney Aerotropolis
Commercial core of the Western Parkland City centred around the Western Sydney International (Nancy-Bird Walton) Airport. The Aerotropolis contains 10 precincts, as defined in the Western Sydney Aerotropolis Plan.

Appendix C – Expert Advisory Panel

To support the development of the 2022 State Infrastructure Strategy, Infrastructure NSW appointed a panel of external advisors from different fields to provide guidance and independent advice.

The panel included some of Australia's leading academic, business and infrastructure experts, with experience in the fields of infrastructure planning and delivery; environment, resilience and sustainability; social and cultural wellbeing; technology and innovation; and economics, business and investment.

Guidance and input provided by these experts assisted Infrastructure NSW in identifying long-term strategic challenges and opportunities faced by NSW, and the role of infrastructure in delivering outcomes for NSW communities.

Input and advice from panel members was provided in an independent capacity and as matters of personal opinion based on their expertise. Their advice has not been, or should be, considered as representative of any institute with which they are affiliated.

Infrastructure NSW and its Board are solely responsible for the content of the 2022 State Infrastructure Strategy.

Expert Advisor Profiles

Professor Emeritus Colin Duffield
Professor and Senior Fellow (Melbourne Law Masters), Melbourne School of Engineering, University of Melbourne

Colin is Professor Emeritus of Engineering Project Management within the School of Engineering at The University of Melbourne and a Senior Fellow of the Law School. He has held a range of executive positions within the university and industry. For example, he is a recent past Director of Infrastructure Australia and a current Director of the Australian Certification Authority for Reinforcing and Structural Steels (ACRS).

He is a recognised international thought leader in the efficient procurement of public infrastructure and the incorporation of private finance as a mechanism for achieving value for money outcomes.

Colin has extensive experience in the governance of long-term contracts and the interaction between policy, technical matters, risk management, financing and contractual arrangements. This expertise has been gained through an involvement in infrastructure delivery for public and private clients (both as a practitioner and researcher); work on policy via secondment to the Victorian Department of Treasury and Finance; as an adviser to projects on risk and project structuring; as an expert witness; and as an independent reviewer and researcher of major engineering contracts.

Siobhan Toohill
Chief Sustainability Officer, Westpac

Siobhan has worked in corporate sustainability leadership roles for more than 15 years. As Chief Sustainability Officer at Westpac, she shapes sustainability strategy and reporting, and advises on sustainability risk including action on climate change and human rights. Her role encompasses the Group's community and Indigenous engagement programs, and the Westpac Foundation and Westpac Scholars. Prior to working in finance, Siobhan held a range of sustainability, urban design and architectural roles in the property sector, government and in private practice.

Siobhan also contributes through a wide range of external governance roles – including Co-Chair of the United Nations Environment Programme Finance Initiative's (UNEP FI) Banking Board, which oversees the UN's Principles for Responsible Banking; Director, Greater Sydney Parklands Board; and former Deputy Chair, Green Building Council of Australia.

Joanna Quilty
CEO, NSW Council of Social Service

Joanna is the CEO of the NSW Council of Social Service (NCOSS), the peak body for the community sector in NSW.

Since joining the non-government (NGO) sector in 2013, she has held various leadership and change management roles. These include Deputy CEO of NCOSS, leading the roll-out of the NDIS for mental health organisation Flourish Australia and, as Director of Operations at Relationships Australia NSW, driving rigour and results in service delivery for survivors of institutional abuse, families impacted by domestic violence and those where there are child protection risks.

Prior to the NGO sector, Joanna had an extensive career in the public sector spanning social policy and research, regulatory reform, infrastructure planning and delivery, and operations.

Her focus at NCOSS is on developing the evidence base to contribute to sound and equitable public policy; raising awareness of the extent of poverty and disadvantage in NSW, the experience of vulnerable groups and the interventions that will make a difference; and ensuring a strong, valued community sector that is well placed to provide frontline support and collaborate with government for a fairer, more equitable NSW.

Professor Hugh Durrant-Whyte
NSW Chief Scientist and Engineer, NSW Department of Planning, Industry and Environment, University of Sydney

Hugh is NSW Chief Scientist and Engineer and Commissioner of the Natural Resources Commission. He is on leave as a Professor in the Faculty of Engineering at the University of Sydney. From 2010-2014, he was CEO of National ICT Australia (NICTA), and from 1995-2010 Director of the ARC Centre of Excellence for Autonomous Systems and of the Australian Centre for Field Robotics (ACFR). He has won numerous awards and prizes for his work, including being named the 2010 NSW Scientist of the Year. He is an honorary fellow of the Institute of Engineers Australia (HonFIEAus) and a fellow of the Institute of Electrical and Electronics Engineers (FIEEE), the Royal Academy of Engineering (FREng), the Australian Academy of Science (FAA) and the Royal Society of London (FRS).

Ilona Millar
Board member, NSW Natural Resources Access Regulator / Partner, Gilbert + Tobin

Ilona has worked for the past 20 years on climate law and finance, including the development of law and policy and its implementation by governments and the private sector.

Ilona is recognised as one of the world's leading climate change lawyers, with extensive experience in advising on carbon market transactions and helping government agencies and corporations respond to climate risks and opportunities.

Ilona currently serves as a board member of the Natural Resources Access Regulator (NRAR), an independent body overseeing natural resources compliance in NSW. She is a former member of the NSW Independent Planning Commission, which reviews and determines state significant development proposals.

Professor Ian Harper AO
Professor of Economics; Dean Melbourne Business School, University of Melbourne

Ian is Dean and Director of the Melbourne Business School and Co-Dean of the Faculty of Business and Economics at the University of Melbourne. He is also a member of the Board of the Reserve Bank of Australia.

Ian is a professional economist best known for his work in public policy. During his 40-year career, he has worked with governments, banks, corporates and leading professional services firms at the highest level.

From March 2011 to March 2018, Ian was a partner at Deloitte Touche Tohmatsu and then a Senior Advisor to Deloitte Access Economics. He chaired the Australian Government's Competition Policy Review, a 'root and branch' review of Australia's competition policy, laws and regulators, from March 2014 to March 2015.

From December 2005 to July 2009, Ian served as inaugural Chairman of the Australian Fair Pay Commission and from January 2011 to February 2012, he was one of three panellists chosen to review Victoria's state finances.

Ian was elected a Fellow of the Academy of Social Sciences in Australia in 2000 and a Fellow of the Australian Institute of Company Directors in 2009. In 2016 he was elected a Distinguished Public Policy Fellow of the Economic Society of Australia and received a Vice-Chancellor's Alumni Excellence Award from the University of Queensland.

Ian was appointed an Officer in the Order of Australia in the 2020 Queen's Birthday Honours List with the citation 'For distinguished service to education in the field of economics, and to public and monetary policy development and reform'.

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Infrastructure NSW

For enquiries please contact **mail@insw.com**