

4

Industry efficiency, capacity and capability

Australia's social and economic infrastructure sectors account for around 21% of national Gross Domestic Product (GDP),¹ and every dollar of value we create is reliant on infrastructure in some way.

Australia's infrastructure needs will continue to grow over time as a result of population and economic growth. Rising demand for new infrastructure services has pushed our infrastructure to be bigger and more complex. While large-scale projects are becoming common place, they are also stretching the capacity of industry and government. At the same time, planning is siloed and poorly integrated, funding options are underdeveloped, projects face procurement issues and network maintenance is often an afterthought.

Australia's infrastructure sector – including the construction and design industries, service providers and operators, financiers, regulators, and policy and decision makers

– is well-established and has delivered high-quality infrastructure to support Australian communities and economic growth. While progress has been made since 2015 in building capacity and improving how we plan, fund and deliver infrastructure, there is still some way to go before best practice is routinely and consistently applied.

We cannot simply build ourselves to future success, and so getting the operation and efficiency of infrastructure services is crucial. Changing customer needs, risks from a global economy, the pressures of climate change and growing community concerns mean that infrastructure projects must meet new standards of sustainability, security and resilience. Incorporating these elements requires new approaches to procurement, building and planning.

This chapter discusses how the sector is responding to changing pressures and demands and how it can meet best practice.





Next steps

Water

Telecommunications

Energy

Social infrastructure

Transport

Industry

Users

Future trends

Introduction

Executive summary



4.1 Introduction



The state of the industry

By global standards, Australian infrastructure industry capacity and capability is relatively strong, and the efficiency of the sector is high. Australia ranks higher than average for developed countries across a range of measures of infrastructure governance, planning and delivery.²

Each decision to build or upgrade infrastructure can impact on taxpayer and user bills for generations. Every dollar of public infrastructure investment can generate GDP increases that can add up to \$4 of value over the life of the asset.³ It is essential we get these decisions right to improve the quality, affordability and access to our infrastructure.

How we plan, fund and deliver infrastructure has improved since the 2015 Audit, however Australia is not consistently achieving best practice. While both the public and private sectors generally perform well, the sector is characterised by a patchwork of capacity constraints and

outdated regulation and policy. Planning is siloed and poorly integrated, funding options are underdeveloped, projects face procurement issues and network maintenance is often an afterthought. The challenges and opportunities associated with funding sources, using grants and subsidies and funding the maintenance backlog, all impact the quality and access to infrastructure and to the economy as a whole.

Infrastructure projects are increasing in size and complexity, and will require new approaches if they are to be effectively delivered. How the public sector make decisions, handle procurement, select contract models and handle risk will have significant impacts on the functionality and efficiency of our infrastructure. Alongside these changes, new demands for sustainability, resilience and security will provide opportunities to achieve better outcomes. However, this makes the planning and management of industry capacity more complex.



Changes since the 2015 Audit

The 2015 Audit did not specifically examine the efficiency, capacity and capability of the infrastructure sector. However, in light of the scale of investment and construction underway in the sector, it has become clear that it requires close examination. It is important to understand the challenges and opportunities faced in planning, funding and delivering infrastructure, in order to ensure Australia is well positioned for future needs.

Since 2015, Australia's infrastructure sector has increased in complexity and national prominence. There has been an increasing number of mega-projects funded by state and territory governments in response to our rapidly growing population. The private sector plays an important role in delivering and planning these projects, and providing experience and skilled labour. This role will be tested over the course of the next ten to fifteen years. Recently, substantial financial losses on some projects and high volumes of work have caused the market to push back on a range of project risks, particularly on large projects, compounding challenges to market depth. It is vitally important that industry, policy makers and infrastructure workers have the necessary capacity and capability to meet these new challenges.

Since the last Audit, Infrastructure Australia's Reform Series papers have focused heavily on the changing capability needs of the sector. Our analysis and the work of others has resulted in important industry reform. In particular, the increased focus on population policy, improved data collection, scenario modelling and reporting, and the emergence of new governance models for major urban infrastructure have contributed to improved capability within the sector. Despite this progress, and the considerable work from leaders within the industry, there remains room for improvement.

How we plan, fund and deliver infrastructure is evolving

As illustrated in the Future Trends chapter, a range of forces influence how we use infrastructure, and how services are provided. In this context, decisions on infrastructure investments and reforms have had to address a growing set of complex factors, all of which introduce uncertainty to projections about future growth and change.

While uncertainty has grown, so too has the cost of building, maintaining and operating many forms of infrastructure. This raises the stakes for infrastructure investment, and makes robust, evidence-based decision making increasingly important.



Increased risks from changes in the global economy and environment are also increasing the need for infrastructure that is resilient to long-term changes and shocks and extreme events. Embedding these principles in decision-making requires an ongoing effort to identify risks, and develop mitigation strategies that are effective and efficient. Increasingly, infrastructure is going to be called on to meet Australia’s international commitments, including finding ways of reducing emissions, helping us to meet our Paris Agreement obligations, and working towards the United Nations Sustainable Development Goals by 2030.

Australia is a leader but best practice is not universal

Infrastructure projects can improve people’s quality of life, increase productivity and kick-start economic development. However, to achieve these outcomes, projects need to be carefully assessed, designed and timed. Getting our infrastructure decisions right is crucial to our future success.

There have been substantial improvements to governance, decision making, transparency and collaboration. However, progress is not uniform. Governance and planning have improved, creating greater stability and certainty for investment and innovation. The rigour and quantity of decision making has also improved. The creation of government infrastructure agencies has provided a deeper evidence base, more transparency and enhanced interstate collaboration, which has helped guide governments towards better outcomes for users.

Despite improvements in planning, the project pipeline remains lumpy, which hinders the ability of industry and government to manage workforce capacity and skills effectively. There also remains room for improvement in decision making. Early announcement of infrastructure projects, prior to effective problem identification and robust assessment, narrows choices and excludes the possibility for more efficient and less expensive

solutions. Alongside this, the public service is undergoing a transition, which requires new skills and an increased focus on project management, contracting and procurement.

Funding options are underdeveloped and projects face procurement issues

The selection and execution of a procurement model often overshadows the characteristics and intended purpose of the project itself. This can also result in projects being selected without the long-term cost consequences being well understood. This is not in the best long term interests of users or taxpayers.

Big capital fixes often take undue priority over smaller and more frequent maintenance spends. This is often the by-product of a lack of clear long-term policy objectives across our infrastructure networks. This problem is exacerbated by funding occurring from one-off grants for construction. As a result, planning for the total lifespan of these assets is challenging. Often, users and taxpayers are left to fund the future high costs associated with asset maintenance renewal. Regional areas in particular have trouble funding routine maintenance for roads, bridges and water pipes, causing safety risks, and adding to the cost of using these assets.

Optimising current assets and networks is often a more efficient and cheaper method of meeting future needs than constructing expensive, long-lived assets. However, this option is often overlooked. Governments can use technology to increase efficiency and the operational capacity of networks. There are also a variety of policy solutions that can manage demand, such as providing users with price signals that match supply and demand in a more efficient way. Making correct decisions requires a best practice approach that eliminates bias, increases transparency and optimises project selection.

Mega-projects have become a default, however they are stretching industry and government

The size, scale and complexity of new infrastructure projects is changing. Procurement and planning are correspondingly more complex. Underdone planning and rushed procurement can lead to lasting shortcomings in infrastructure performance. This is compounded by a much needed increased focus on sustainability, security and resilience expectations.

The volume and scale of infrastructure construction, particularly in New South Wales and Victoria, has grown considerably, consuming and in some cases exceeding industry capacity. This has led to reduced competition and ability of governments to achieve value for money outcomes. Alongside this, our infrastructure also faces unprecedented risk from technology, the economy, evolving user preferences

and climate change. These new risks suggest that our approach to resilience, security and sustainability will need to adapt. These need not come at an additional cost to the economy. Planning appropriately for these changes can benefit Australians.

Currently, Australia's infrastructure sector lacks clear, publicly available information on how to manage, construct and plan for greater resilience. Often the whole-of-life benefits associated with managing risks and costs are overlooked, resulting in ineffective designs, specifications and operating procedures.

Consideration of emerging risks will be an increasing challenge for infrastructure policy makers and providers. Assessing risks, such as climate change, can improve resilience while saving costs for users and taxpayers over the asset's life. New approaches to sustainability can also benefit current and future Australians, while providing businesses with expertise and innovation.

In this chapter

4.2 Planning and decision making calls out infrastructure planning and decision making that falls short of consistent best practice, including community engagement, regulation and governance that leaves room for improvement across most sectors.

4.3 Funding and financing looks at understanding costs from the perspective of governments, service providers and investors. This finds that there are challenges with Australia's scale and diversity, funding tools are not applied consistently across sectors, and community service obligations (CSOs) play a large role in supporting equitable outcomes, but often lack transparency.

4.4 Market depth and skills highlights improvements in the visibility of the near-term pipeline does not appear to have resulted in better coordination of projects entering the market. The capacity for industry to deliver is limited by the size and nature of projects coming to market, including the risk to sharing arrangements.

4.5 Procurement and contracting identifies outcomes for users are strongest where whole-of-life considerations are acknowledged upfront and are supported by appropriate contract models, and timeframes for procurement and delivery.

4.6 Security, resilience and sustainability explores the mounting risks for Australian infrastructure from changes in technology, the economy, user preferences and the environment, and calls out many resilience strategies that do not provide adequate guidance. Sustainability of infrastructure will be important to meeting our aspirations and emissions reduction commitments

Performance of the sector

Access

NSW and Victoria now account for half of all definite project investment, up from **15%** in late 2012 ⁴



Quality



In 2018, **90%** of potential investors were 'highly likely' to invest in Australia, up from **70%** in 2017 ⁵



Cost

45% of industry identify cost of bidding as an inhibitor to participating in the market ⁶



Access

NSW and Victoria account for around **33%** of planned project activity ⁷

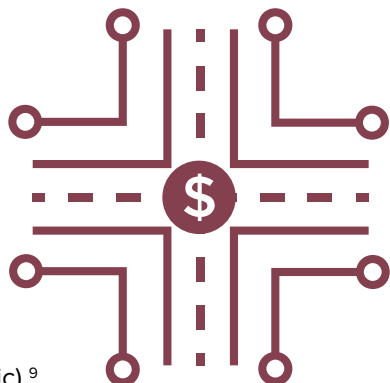
Quality



In 2018, **96%** of industry identified Australia as a 'better infrastructure market' ⁸

Cost

Since the last Audit, transport infrastructure investment has totalled **\$100.9 billion** (\$73.2b private, \$27.7b public) ⁹



Quality

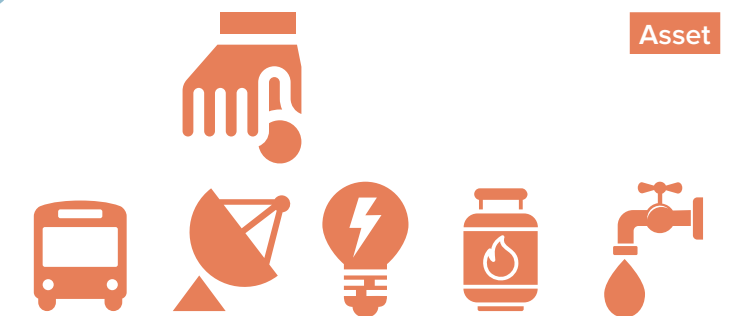
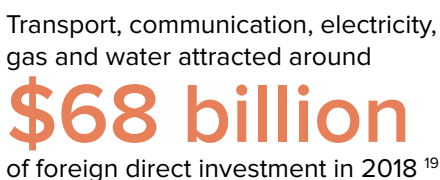
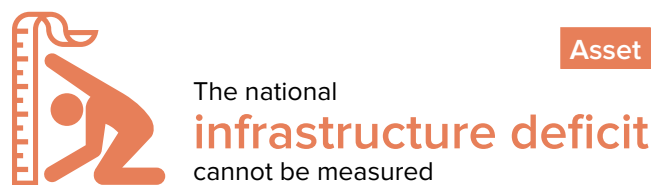
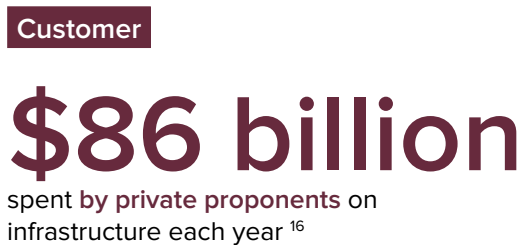
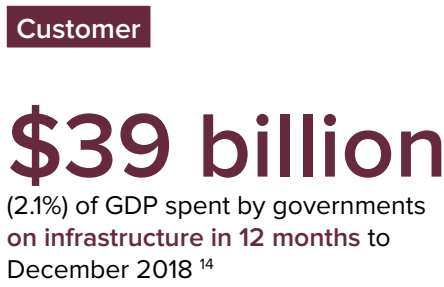
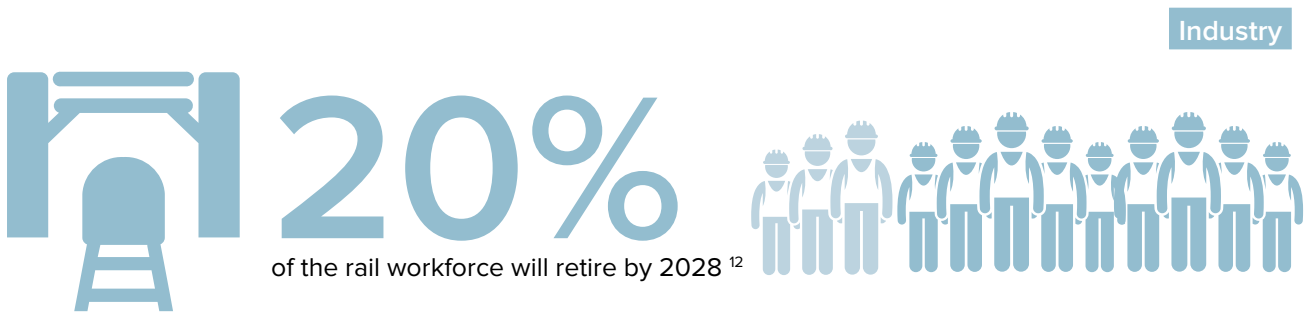
17 post-completion reviews completed in last 4 years ¹⁰



Cost

Community service obligations are significant and 39% are not transparent:
 Transport - \$18.7 billion
 Energy - \$6.7 billion
 Water - \$1.9 billion
 Telecommunications - \$1.8 billion ¹¹

Scale of the sector



4.2 Planning and decision making

At a glance

Getting infrastructure decisions right is vital for our success. But while governance and planning have improved in some ways, we still fall short of consistent best practice:

- Inadequate community engagement means our plans do not reflect user needs.
- Inconsistent governance frustrates users and will likely lead to higher costs.
- Future trends will require new or modified regulation to avoid risks and capitalise on change.

Getting infrastructure decisions right is vital for our success

Australians expect their leaders to make robust, transparent and accountable decisions on infrastructure. We expect limited public funds to be spent prudently, markets to provide services that match user needs at affordable prices, and bring improvements in quality of life and productivity.

Public infrastructure is an important catalyst for economic growth and development.²⁰ Economy-wide estimates suggest that every dollar of public infrastructure investment can generate GDP increases that can add up to \$4 of value over the life of the asset.²¹ But for infrastructure to play this role, projects need to be rigorously assessed, carefully designed and appropriately timed.²² The outcomes of infrastructure reforms or investment depend on the quality of planning and decision making.

Governance and planning have improved in some ways

By global standards, Australia's infrastructure governance is relatively strong. Our institutions and regulatory systems are well established, and have performed reasonably well by ensuring affordable and efficient services for users. We have a stable and attractive environment to operate, invest and innovate in infrastructure, and we provide greater certainty to investors, operators and users than in many other countries. Australia ranks higher than average for developed countries across a range of measures of infrastructure governance, planning and delivery.²³

Since the last Audit, there have been significant steps across the Australian Government and state and territory governments to improve project planning and selection. The proportion of projects for which business cases have been undertaken has increased, and the rigour of most of these business cases has improved over recent years. Also, most state and territory governments and a number of local governments have published long-term infrastructure plans. These include Infrastructure Victoria's *30-year Infrastructure Strategy*,²⁴ and the third iteration of *The*

State Infrastructure Strategy from Infrastructure New South Wales.²⁵

Governments in most states and territories have created infrastructure agencies to provide guidance to their respective governments on transparency in planning and governance, and to support greater collaboration on similar challenges and opportunities within and across state borders. While detailed functions vary, the agencies have all been established to improve the rigour of infrastructure decision making. These agencies include:

- Infrastructure New South Wales (2011)
- Infrastructure Victoria (2015)
- Infrastructure Tasmania (2015)
- Building Queensland (2015)
- Infrastructure South Australia (2018)
- Infrastructure Western Australia (2019).

There remains substantial room for improvement in decision making

Despite the relative strengths of our infrastructure governance, not every infrastructure intervention is as effective as it could be. Projects have been announced without a detailed assessment of needs and an analysis of the range of potential solutions being undertaken. Where they are undertaken, business cases are not always published to allow for public consultation and scrutiny. Post-completion reviews are rarely undertaken, providing limited insight as to whether intended benefits have been realised.

Failure to get infrastructure governance right has eroded some public support for broader large-scale investment programs. Reserve Bank Governor Philip Lowe highlighted this point in reference to issues with delivery of the Sydney Light Rail project as an example.²⁶ However, these issues are by no means isolated to transport. There have been ongoing governance challenges across all sectors, with clear examples over recent years in the National Electricity Market, the Murray-Darling Basin and the National Broadband Network.

Across many parts of the country, decision making is falling short of best practice. Best practice was identified by Infrastructure Australia in the *Infrastructure Decision-making Principles*, published in June 2018. This document laid out clear expectations for nationally significant, publicly funded projects across the project lifecycle – from problem identification to post-completion review.²⁷

However, of the 39 projects that have been assessed by Infrastructure Australia over the past three and a half years, none has met all 11 principles (Figure 1). There are five broad issues in project decision-making that require improvement:

- Transparency of decisions across all stages of the project lifecycle, including public release of business cases and analysis underpinning planning processes.
- Consideration of all options for solving a problem identified through long-term plans, including potential solutions that make better use of existing infrastructure.
- Rigorous analysis of potential solutions through completion of a business case before commitment to a project, including consideration of future risks to demand and supply.
- Engagement with communities on potential solutions in project development to integrate feedback in decisions on options assessment, project design or delivery.
- Preparation and publishing of post-completion reviews for projects to ensure that expected benefits were realised, and lessons learnt through planning and delivery can be applied to future decisions. As illustrated in Figure 2, there is a dearth of published post-completion reviews and little evidence of sharing of lessons of experience.

Lessons from the nbn

Rigorous analysis and engagement prior to implementation provide checks and balances to ensure risks are identified early, and the final decision is the right one. The clearest illustration of the importance of these processes is provided by the National Broadband Network (nbn), Australia's largest public infrastructure investment since the Snowy Mountains Scheme. Ten years on from the establishment of nbn in 2009, this project provides clear lessons for future infrastructure decision making.

An implementation study for the nbn was commissioned and released in 2010. It found that the nbn would have a strong business case, generate returns to cover borrowing costs and be constructed for less than the \$43 billion that had been budgeted (in 2009 dollars).²⁸ A full cost benefit analysis (CBA) for the nbn was not commissioned by the government. Consequently, options for delivery were not transparently assessed according to their relative net benefits, and a number of risks and challenges were not addressed before rollout commenced.

The scope of the nbn has changed substantially during its rollout. Each of these stages presented a further opportunity to ensure appropriate decisions were being reached through the development of a business case, including a CBA. Similarly, other major projects that experience significant changes in scope, such as WestConnex in Sydney, have also not undergone updates to their business case following scope changes.

Notwithstanding the desirability of new business cases, it is likely that a well-considered business case could have helped to avoid changes to scope and mitigate issues that have subsequently emerged. A more comprehensive assessment and transparent disclosure of all decision making on this project during the planning and development phase would have likely reduced delivery costs and time. This process may have helped to establish broader agreement within governments and industry on the project's scope, reforms required to facilitate rollout, and how risks should be managed.

Figure 1: Infrastructure Australia’s *Infrastructure Decision-making Principles*



Source: Infrastructure Australia (2018)²⁹

Figure 2: Few post-completion reviews have been undertaken since the last Audit



Source: Grattan Institute (2018)³⁰

20. Challenge

Decision-making processes across many jurisdictions and sectors are not meeting best practice standards, including application of the *Infrastructure Decision-making Principles*. Failure to improve project decision making is likely to reduce the potential productivity and quality of life improvements of infrastructure investments.

When this will impact:

0-5

5-10

10-15

15+

Where this will impact:



Project selection does not always align with quality of life objectives

The creation of independent infrastructure bodies, such as Infrastructure Australia, has helped to lift the quality of project selection by governments, improve investment efficiency, increase the effectiveness of solutions, and ensure investments support the health of the economy.

The key tool used in Australia, including by independent infrastructure agencies, to support the assessment and selection of infrastructure projects is cost benefit analysis (CBA). It aims to 'identify and express, in monetary terms, all the gains and losses (benefits and costs) created by an initiative to all members of society and to combine the gains and losses into a single measure of net benefit (benefits minus costs)'.³¹ A benefit-cost ratio (BCR) greater than 1.0 indicates that the benefits of the project outweigh the costs.

CBA is particularly useful in circumstances where:

- a clear objective is identified
- problems can be clearly defined and quantified over the life of the asset (or have satisfactory substitutes or proxies)
- solution identification has begun³²
- economic efficiency and wealth creation is a central goal
- there are large populations and more developed economies.³³

CBA has its origins in the United States in 1936 as a tool for assessing transport projects. It has subsequently become the benchmark standard for comparing alternative solutions to a public policy need in major project selection processes both domestically and overseas. The methodology has also been adopted by the World Bank, the Asian Development Bank and the European Commission.³⁴

CBA provides the community with a transparent mechanism to assess investment decisions.

This analysis-driven approach is a substantial improvement from past processes which drew primarily on the industry knowledge of a select few, or worse, were based on uninformed estimates or political whims. The increasingly widespread adoption of CBA and improvements in business case development, particularly where they are published in advance of decisions being made, has helped to ensure finite taxpayer dollars are spent more wisely.

A strength of CBA is its 'evaluative standpoint', the implied ability to effectively undertake a single assessment on behalf of a collective, or group of individuals.³⁵ To that end, CBA is a robust and insightful input to support decision making, allowing the comparability of projects by the community, particularly regarding economic efficiency and wealth creation.³⁶ It is particularly useful as a relative benchmarking tool, when comparing different solutions to a given problem or opportunity that share the same assumptions.

CBA is an important tool for assessing the economic, social and environmental merit of infrastructure projects. However, it is not adequate to be the sole determinant of a decision to invest. Rather, it is a tool that supports decision making.

Some social outcomes, such as those related to quality of life, are more intangible and difficult to quantify in CBA. These outcomes may therefore only receive consideration at the qualitative level in business cases. Projects focused on such outcomes could then be placed at a comparative disadvantage to other projects when competing for scarce funding resources.



Infrastructure Australia’s consultation with local, state and territory jurisdictions has identified opportunities to enhance infrastructure decision making in Australia, many of which have also been identified by industry and academic research. Decision making can be strengthened by better assessing:

- alignment between stated assessment outcomes and *truly* desired community policy outcomes³⁷
- project contributions to broader social outcomes, such as addressing poverty or entrenched disadvantage³⁸
- indirect, long-term benefits that infrastructure services can unlock³⁹
- pioneering development, research and innovative or new industries⁴⁰
- project investments that front-run growth or provide additional capacity⁴¹
- aesthetic characteristics⁴²
- the impacts of changing inputs, such as population projections, and methodologies.⁴³

These opportunities are largely related to considering the indirect, long-term benefits that infrastructure services can unlock.⁴⁴ Despite their importance and significance to infrastructure, the assessment of these impacts can be difficult to effectively assess and definitively ascribe to an infrastructure investment using traditional models.⁴⁵

At the same time, the quality of the use and application of CBA in Australia is subject to the skills and knowledge of the individuals using the tool. The potential for under-estimation of costs and the over-estimation of benefits, so-called optimism bias, has become a risk to the appropriate use of CBA, as noted by the Productivity Commission,⁴⁶ and by international jurisdictions including the UK.⁴⁷ The potential for these factors to inflate a BCR and net present value result undermines good decision making.

However, importantly, the application of CBA is also not static. CBA is an evolving process that can be improved over time with more rigorous application, more robust inputs and a wider consideration of impacts.⁴⁸ As policy priorities are more specific and measurable, allowing better consideration of intended project outcomes and broader policy context, and additional data becomes available to support assessment, there will be considerable opportunity to build upon the existing strengths of CBA.

The Infrastructure Australia *Assessment Framework* requires proponents to present consideration of the strategic merit of projects and an assessment of their deliverability.⁴⁹ The alignment between the strategic merit of projects and the findings of CBA has improved, strengthening the tool and decision making. Consideration of the policy goals and strategic context for a proposed project can ensure project decisions are better founded and justified.⁵⁰

Evolving the application of CBA to give greater regard for intangible benefits could meet some current gaps. For example, in the UK, Social CBA and Social Cost-Effectiveness Analysis are used to evaluate the social welfare impacts of different investment options.⁵¹ The use of other tools may also be necessary to supplement CBA and ensure the full range of infrastructure objectives can be fulfilled.⁵² The consideration of wider economic benefits and other tools, such as multi-criteria analysis, could compliment traditional use of CBA, particularly during options assessment. However, these tools themselves have known limitations.⁵³ No single tool is an adequate replacement for CBA, however an increased strategic view of the role of projects in progressing national objectives is vital within business cases.⁵⁴

Community engagement in decision making is inadequate

Government and operator engagement with customers and the broader community on project and operation decisions, is lacking across most sectors and jurisdictions. This issue was highlighted in the previous Audit and Infrastructure Australia’s *Infrastructure Decision-making Principles*.⁵⁵

Meaningful engagement on infrastructure decisions requires that service providers talk with people and businesses directly impacted by decisions. It also requires governments to consult on policies and plans with the wider community. In a broader context, governments have a role to engage and seek feedback on the scale and pace of change and how individual changes will impact their broader town, suburb, city or region, and whether this reflects the community’s vision of the future.

However, engagement on projects is often limited to the requirements specified by planning agencies. Policy enquiries or reviews are often limited to seeking submissions in response to a draft report. Unsurprisingly, the number of submissions is often small, and the submissions are usually from individuals or organisations with a deep interest in the particular policy question. Wider public or user opinion is rarely tapped into, and the views of the majority are often subsequently unknown.

Engagement with communities and businesses can also help to establish a social licence for projects by providing a means of hearing from stakeholders and incorporating their feedback through project planning and delivery. A failure to engage can carry substantial costs to projects. For example, it is estimated that around \$20 billion worth of infrastructure projects was delayed, cancelled or mothballed due to community opposition over the past decade.⁵⁶

As identified in *Planning Liveable Cities*, in many cases, community engagement is occurring too late in the process to influence decisions, if it occurs at all.⁵⁷ In particular, engagement tends to focus on projects, not strategic land-use plans. As a result, the decision to proceed may have been made long before consultation occurs.

Access to more data on current or potential users may enable more rigorous analysis of future demand. However, better data does not replace the need for engagement. Rather, enhancements in information on users should enable governments and industry to engage more deeply with the most relevant stakeholders. Over time, this may make it easier to ask the right people the right questions to develop a targeted approach to delivering infrastructure, and to explain the sometimes difficult policy and spending trade-offs that are inevitable in infrastructure decisions.



21. Challenge

Many decisions are being made without meaningful engagement, and without the means for comment and stakeholder feedback to inform project planning and delivery. By not adequately engaging, governments and proponents miss the opportunity to address stakeholders’ concerns, ensure projects and reforms meet their needs, establish social licence and build trust in decisions.

When this will impact:



Where this will impact:



Regulation and governance of Australia's infrastructure is a patchwork

Appropriate regulation, robust governance arrangements, and sound decision making all play a crucial role in securing productivity improvements, lowering costs and increasing the quality of infrastructure services.

However, the role, function, ownership and objectives of our infrastructure markets vary greatly. This means that the appropriate role of policy makers and regulators also varies across each sector. Regulatory sophistication also differs across jurisdictions and sectors. Much of this variation is due to market developments since the 1980s and 1990s, when some sectors were deregulated and government businesses were corporatised.

Reporting against outcomes that are valued by users has been lacking in some sectors. Even when services are performing relatively well, this lack of

clarity can undermine community confidence in service delivery or oversight, and relatively minor incidents can cause community frustration around perceptions of inflated prices or declining service quality. Infrastructure Australia has previously provided detailed analysis of these issues in urban water,⁵⁹ but similar problems exist in other infrastructure sectors.

While some regulators publish objectives that relate to users' interests, many users believe that decisions fail to reflect what they want, and their capacity and willingness to pay. In the energy sector, for example, a perceived disconnection between users' interests and the actions of industry and regulators has caused growing frustration.⁶⁰ Similarly, the complexity of pricing arrangements has discouraged some customers from actively managing their bills, leading to higher costs for loyal customers.⁶¹ Consequently, only a third of energy consumers believe the market is working in their interests.⁶²

Regulatory complexity poses challenges for community understanding

Regulation and oversight in the electricity sector is exceptionally complex, with at least half a dozen separate bodies and agencies bearing responsibility for the wholesale, network, retail and other aspects of the sector. While our national system of regulation is among the world's most sophisticated, this has introduced substantial complexity that makes it difficult for users to understand why their bills have risen, or whether reliability has deteriorated.

In telecommunications, although the ACCC has recently undertaken a number of enforcement actions and other initiatives in relation to broadband speeds and mobile coverage,⁵⁸ a perceived lack of oversight has led to many users feeling that they are not receiving the service they were promised by retailers. Some perceptions of declining performance and rising costs have not always reflected reality.

In contrast, roads are inconsistently regulated. The construction, operation and maintenance of roads are almost exclusively undertaken by or for different levels of government. As a result, service quality differs greatly by region and by type of road. The link between what users pay and the costs they incur and impose on other road users is weak and, as in other sectors, transport-related CSOs across the country are opaque.

22. Challenge

Across many infrastructure markets, regulatory principles are complex, inconsistent, do not sufficiently protect the long-term interests of users, and reporting does not always align with user outcomes. A lack of clarity on user-focused objectives is likely to lead to worse outcomes for many users, and frustration with the perceived complexity of markets and decision making.

When this will impact:

0-5

5-10

10-15

15+

Where this will impact:





Increased complexity and uncertainty will require a change in oversight

In the past, infrastructure sectors tended to be more clearly delineated than they are today, with separate networks, markets and rules. However, the increase of complex, interconnected trends will require greater coordination between individual infrastructure sectors in order to achieve positive outcomes. The links between sectors are likely to grow in scale and complexity. For example:

- Road networks are increasingly dependent on telecommunications for navigation and safety, and this trend will accelerate with the advent of connected and automated vehicles and 5G technology over the coming years.
- The relationship between transport and energy will become more complex as uptake of electric vehicles increases. Various governments, including New South Wales,⁶³ and Victoria,⁶⁴ have identified this trend and set out a framework for managing this transformation.

- Prevention of chronic disease will not be solely undertaken within the health sector. It will be reliant on access to green, blue and recreational infrastructure as well as active transport facilities that enable healthy lifestyle choices.
- Water is becoming increasingly reliant on telecommunications and remote energy technologies for monitoring, improving efficiency and connecting directly with users.
- Social infrastructure services – particularly in health, education and justice – are increasingly leveraging developments in telecommunications to improve service efficiency and quality – particularly by avoiding the need for physical proximity and travel.

These changes provide a challenge to regulators and policy makers, to ensure they adequately mitigate risks and capitalise on rewards of change, as well as ensuring decisions taken today are resilient to a range of future scenarios.

23. Challenge

How infrastructure is provided and used will transform over coming decades, meaning laws and regulations will need to be reviewed, removed or updated. Failing to anticipate and adapt to change will undermine Australia's global competitiveness, stifle innovation and reduce the benefits of productivity-enhancing technologies.

When this will impact:

0-5

5-10

10-15

15+

Where this will impact:



4.3 Funding and financing

At a glance

Australia's size and varied population density create funding challenges. There are clear signs of the need for increased capital and maintenance investment across many sectors, however it is impossible to quantify a national infrastructure funding gap.

This section discusses:

- different needs between jurisdictions, and how funding methods vary by sector and region
- growing budget pressure from grants and subsidies
- a lack of transparency and effectiveness in community service obligations
- risks from ageing assets and underinvestment in maintenance
- opportunities in optimising our existing networks and using funds more efficiently.

There is an infrastructure funding deficit, but it cannot be measured

Australia's scale and geography have contributed to perceptions of an infrastructure funding deficit. Rising congestion, electricity blackouts, mobile blackspots and water shortages – among many other infrastructure problems – are often quoted as evidence of past failures to invest in the right infrastructure of a sufficient scale. This funding shortfall has previously been acknowledged by Infrastructure Australia, particularly in regard to maintenance funding.⁶⁵

However, it is not possible to meaningfully and comprehensively quantify the infrastructure funding gap. Unless all options to all problems and a range of potential solutions have been considered through comprehensive cost-benefit assessments, to ensure the most efficient solutions are selected, including potential non-capital solutions, it is impossible to quantify a total deficit. Also, this analysis would soon be obsolete, as problems evolve, demand projections change and new options become available. Any estimate of a 'funding gap' is only a snapshot at a point of time.

No single figure can capture the intricacies of the various outcomes delivered by all classes of infrastructure. In place of a single figure, a more informed discussion would better reflect measures of infrastructure outcomes for users. Within this Audit we have sought to consider the deficit both in terms of the assets themselves, but also through considered user perceptions of the services they received. Other

measures that provide useful insights to infrastructure services could include assessments of the quality of the assets we have, such as through:

- achievement of performance standards
- the proportion of Australians with access to infrastructure services
- levels of investment in renewing and maintaining assets.

We know that more money is required – problems can rarely be fixed for nothing. Infrastructure Australia has previously called for additional funding for infrastructure – particularly for solutions that make better use of existing infrastructure, in Recommendations 1.5 and 1.7 of the 2016 *Australian Infrastructure Plan*.⁶⁶

More funding for the right projects, at the right time, would help to close the gap between what we have and what we need. The *Infrastructure Priority List* provides a list of projects which have been assessed as productivity-enhancing solutions to nationally significant problems.⁶⁷

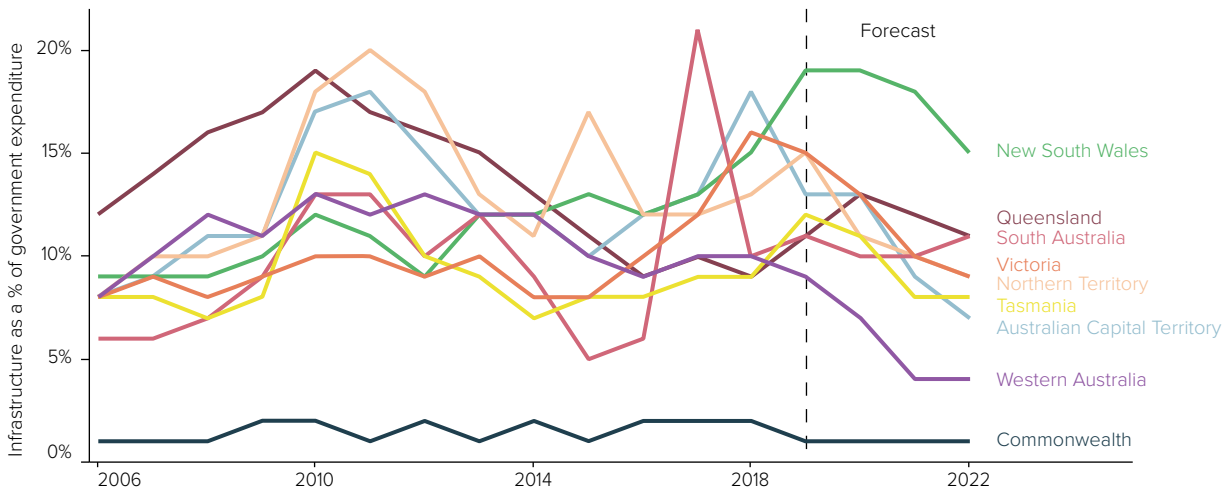
Funding for infrastructure varies greatly between jurisdictions

Around \$39 billion of engineering construction work was done for governments of all levels in the 12 months to December 2018.⁶⁸ This represents 2.1% of GDP.⁶⁹ Australia invests heavily in transport, particularly roads, compared to other OECD nations, however, we rank below the long-term OECD average for total infrastructure investment as a proportion of GDP.⁷⁰ Australia's investment levels are also below the 2.5% of annual GDP forecast by the OCED to be required to 2030.⁷¹ The current levels of infrastructure investment by some governments is perceived as elevated, however the levels of investment from our OECD trading partners will mean further investment in our infrastructure will be required to maintain our quality of life and productivity over the longer term.

A further \$58 billion was spent by private proponents on infrastructure each year,⁷² though much of this is concentrated in the mining and resources sector. In 2016-17, governments also spent \$125 billion on health, and \$94 billion on education.⁷³

Among Australia's states and territories, funding levels vary considerably (Figure 3). New South Wales and Victoria now account for half of all definitive project investment, up from 12% in 2012.⁷⁴ They additionally are forecast to account for around one-third of planned future project activity. Jurisdictions with vast areas and dispersed populations – Queensland, Western Australia, South Australia and the Northern Territory in particular – face considerable pressures to fund equitable services, being home to some of Australia's most isolated and most disadvantaged communities.

Figure 3: Australian governments vary in terms of proportion of expenditure spent on infrastructure



Source: Infrastructure Partnerships Australia (2019)⁷⁵

24. Challenge

Funding for public infrastructure has risen above historical trends, but remains below that of many other nations and may need to rise further to maintain or improve user outcomes. Without sufficient funding for public infrastructure, outcomes for users will deteriorate over time, undermining productivity and quality of life.

When this will impact:

- 0-5
- 5-10
- 10-15
- 15+

Where this will impact:



User pays remains underutilised as a funding source

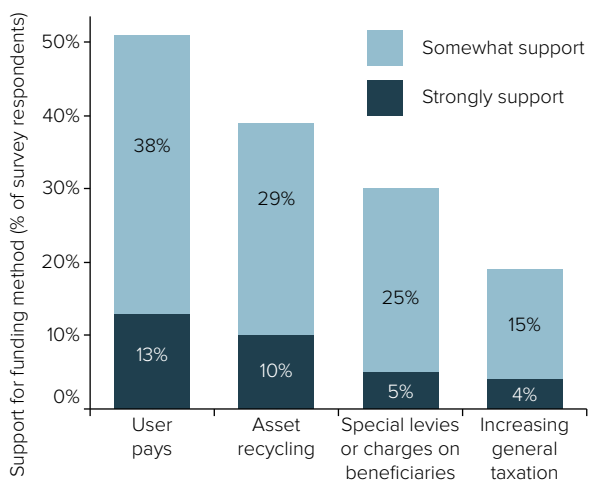
In general, recovering costs from those who use or directly benefit from services is an efficient, equitable and sustainable funding method. User pays fees and charges range across most sectors from public transport to water and electricity, and in social infrastructure sectors from gallery visitation, court fees and some health care.

User pays arrangements have a long history in Australia, dating back to the very first toll road built in Sydney in 1811, and to the Sydney Harbour Bridge in 1932.⁷⁶ Today, user pays arrangements are the only model that receive support from a majority (51%) of Australians as a means of increasing funding for infrastructure development (Figure 4).⁷⁷

Despite this, the degree to which user fees cover the full costs of infrastructure services vary greatly. For example, in 2013, the estimated cost recovery for public transport services in Australian cities ranged from 22% in Sydney to 30% in Perth. This is well below comparative cities, such as 44% for Auckland and 73% for Toronto.⁷⁸ However individual routes can deliver commercial returns, including the Manly fast ferry service in Sydney, which operates at full cost recovery.

In some sectors, the amount that would be acceptable to charge users does not cover the full cost of delivering, operating and/or maintaining the required level of infrastructure and services. As a result, the broader taxpayer base must contribute to these costs via government funding. This is evident in the provision of most roads, rail and smaller ports. Consequently, user pays arrangements are most commonly used as part of a mixed funding model.

Figure 4: User pays is the most popular way of increasing infrastructure funding



Source: JWS Research (2018)⁷⁹

Infrastructure services are often reliant on ongoing subsidies

Community service obligations (CSOs) exist to support services that are provided for a social purpose that are non-commercial or would need to be provided at a higher cost in order to be commercial.

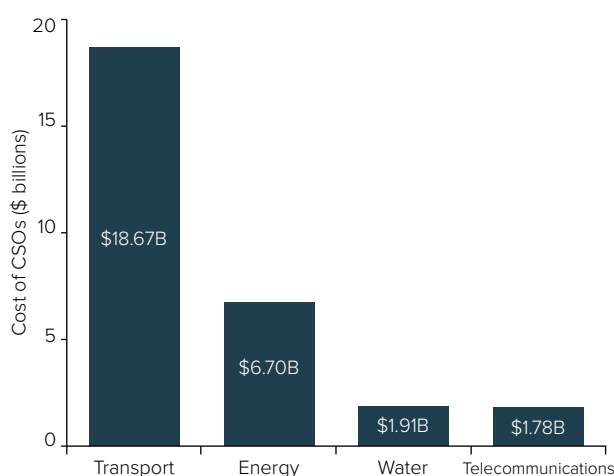
Within some areas of infrastructure service delivery across Australia, and in most infrastructure sectors in small towns, rural communities and remote areas, these subsidies are vital to the provision of infrastructure that supports quality of life and addresses social disadvantage.

Research conducted for Infrastructure Australia identified there are over 300 CSOs in transport, energy, telecommunications and water across Australia, with a total annual cost of approximately \$29 billion, or 1.7% of GDP (Figure 5).⁸⁰ This does not account for CSOs in social infrastructure.

Within those sectors that were examined, definitional ambiguity, similar in nature to the concerns identified by the Productivity Commission (formerly the Steering committee on National Performance Monitoring of Government Trading Enterprises) in 1994,⁸¹ presents challenges to accurately identify, and reflect the scale of CSOs and compare between sectors.⁸²

Of these CSOs, we have identified that 78% are indirect subsidies – their purpose is to provide services at a higher quality or a lower cost than would be commercially viable. Some 39% of CSOs in Australia are not transparent. This varies across jurisdictions – from the 20% that lack transparency in Queensland, to the 75% of unclear CSOs in the Northern Territory.

Figure 5: Community Service Obligations play a major role in funding infrastructure across the country



Source: Centre for International Economics (2018)⁸³

CSOs play a particularly dominant role in transport funding. Almost half of Australia's infrastructure CSOs are in the transport sector, and these account for 64% of the total annual CSOs cost – or \$18.7 billion each year. Roads are almost entirely funded by taxpayers – with the exception of toll roads, which represent only 248.4 km – or 0.0003% – of Australia's road network.⁸⁴ Some state and territory jurisdictions also hypothecate vehicle registration to road expenditure. Public transport is also heavily subsidised by taxpayers, on average 70% to 80% in our fast-growing cities and more than 90% in smaller cities and regional centres.⁸⁵

Across other sectors, the proportion of services funded by taxpayers rather than users is lower, but the scale of CSOs remains extensive:

- In telecommunications, for example, there are 18 CSOs, with a total value of \$1.8 billion (6% of all CSOs).
- In energy, there are 91 CSOs with a collective value of \$6.7 billion. These are primarily to provide discounts, concessions and rebates for households and businesses, to provide uniform prices, to address peak demand, or to allow for cross-subsidisation for regional and remote areas.
- In the water sector, there are 54 CSOs with a total value of \$1.9 billion. Of these, over 60% of the value is to subsidise revenue gaps for remote services or to deliver remote and Aboriginal and Torres Strait Islander policy objectives. The National Water Initiative has driven greater efficiency in funding arrangements and has led to greater transparency with 69% of CSOs categorised as transparent.⁸⁶

The nature of CSOs is likely to come under increasing scrutiny as improvements in data and technology allow more accurate understanding of their efficacy.

Transparency around the role and nature of these subsidies will be essential to allowing monitoring of their performance and potential tailoring to better meet the needs of users.

While some existing CSOs are longstanding, notably in the provision of transport services using long-established routes and networks or the provision of technology specific telecommunications services, the needs and preferences of consumers are shifting rapidly potentially leaving expensive CSOs outdated and undervalued.

Pressure on government budgets is likely to be compounded by rising CSO costs. Over the four-year budget cycle, CSOs are projected to rise by \$3.6 billion, or around 12%.⁸⁷ This is largely driven by the transport sector, where outdated services, continued network expansion, under-recovery of operating costs, ongoing population growth and an increasing proportion of users who are eligible for concessions is expected to lead to further growth in the cost of taxpayer-funded obligations.

The potential for a growing gap can be compounded by a set and forget approach to services. For example, root-and-branch reviews of public transport networks are infrequent, and have not taken place in most Australian cities and regional centres for decades. The slow pace of review is resulting in highly subsidised bus services, which are relatively simple to review and reassign, continuing to follow the routes of long-removed tram services, first laid out more than 100 years ago and removed during the 1950s and 1960s.

The energy sector could also be a source of increasing CSO costs, especially if energy prices continue to rise, causing a rising cost of concessions and rebates funded by taxpayers.⁸⁸

25. Challenge

Many community service obligations lack transparency, are not frequently reviewed, and may be inefficient. Opaque funding arrangements erode community support for CSOs and the benefits they deliver, while the lack of consistent review processes means taxpayers cannot be sure that this funding is efficient and delivers value for money.

When this will impact:

0-5

5-10

10-15

15+

Where this will impact:





Ageing assets represent a long-term funding and performance risk

There is little doubt that a maintenance backlog exists across many parts of our infrastructure networks, although the extent varies by sector and region. Some of the maintenance backlog is evident to users of many roads and bridges that suffer from poor upkeep, particularly in regional areas, causing safety risks, reliability issues and adding to vehicle costs.

The causes of the maintenance backlog are diverse. In some cases, the absence of cost recovery arrangements means that there is no mechanism linking usage (which drives the physical depreciation of assets and the need for maintenance) with a direct funding source to undertake repairs. In other cases, the backlog has been caused by governments prioritising the construction of new assets, or failing to undertake preventative maintenance – leading to higher costs for reactive maintenance.

Australian Government or state and territory government funding is often provided as a one-off grant for construction, without provision of additional funding for ongoing maintenance and operational costs. As such, capital grant programs can increase the value of asset bases without committing forward funding certainty, and can exacerbate existing maintenance backlogs and decrease the value of the original investment.

Funding for infrastructure is also typically provided within forward budgetary cycles of four years, making it difficult to plan for the future of assets that have much longer economically useful lives. A lack of certainty of funding beyond the budgetary period can introduce incentives to ‘patch-up’ problems, rather than apply more efficient long-term solutions. This is compounded by a lack of transparency in reporting of asset and network condition, maintenance and performance.



26. Challenge

A historical underspend on preventative maintenance, short budgetary and funding cycles, a lack of data and incentives, and inadequate reporting have contributed to a maintenance funding backlog across infrastructure sectors. An ongoing maintenance backlog will erode quality and reliability of many assets, and bring higher costs for future asset maintenance and renewal.

When this will impact:



Where this will impact:



Optimising existing networks can help meet future needs

While the Australian economy and our population are growing relatively rapidly, it is often not affordable or practical to fund new projects, especially in urban areas where space is already limited. Physical constraints, particularly within urban areas, inhibit the provision of additional capacity to many assets. For example, the space provided to cars, public transport, active transport and street furniture must be balanced kerb to kerb on any street.

Governments will need to make better use of existing assets rather than simply funding additional supply. Some options include using technology to increase the efficiency and operational capacity of networks or to more efficiently manage demand, or using price signals to match existing supply with demand in the most efficient way.

Since the last Audit, the consideration of smarter applications of technology has been applied to major transport infrastructure enhancements across our fast-growing cities. Within Sydney, for example, the planned introduction of metro rail has increased the capacity of the existing railway lines, such as Epping to Chatswood Railway, while smart motorway technology has increased the capacity of the M4 corridor as a component of the WestConnex project

A similar approach has been applied to motorway upgrades in Perth, Adelaide, Canberra, Brisbane and Melbourne as part of a wider move to increased use of non-build enhancements within major capital investments. Despite the increased focus on major projects, there remains substantial scope for additional improvements through better use of existing assets in our smaller cities and regional centres.

There is no evidence of a shortfall in finance for infrastructure

Much of the strength of Australia's infrastructure today is its attractiveness to private investors, who complement the role played by government. Australian infrastructure has proven itself to be among the most stable and attractive asset classes for private capital over a long period. Australia's infrastructure finance markets are among the world's most sophisticated and attractive.⁸⁹

The stock of Australia's inward foreign direct investment has nearly doubled over the last decade, from \$444 billion in 2007 to \$849 billion in 2017.⁹⁰ Australia has a well-developed, strongly regulated system of debt and equity markets and a robust set of policy frameworks, supported by private property rights and the rule of law. In 2017, Australia attracted the 13th largest amount of inward Foreign Direct Investment (FDI) in the world.⁹¹ Transport, communication, electricity, gas and water attracted around \$50 billion of FDI in 2017, while a further \$500 million of FDI was in industries that rely on infrastructure.⁹²

Approximately 96% of participants in Infrastructure Partnerships Australia's 2018 investor survey view Australia as one of the better markets for infrastructure business, including half who consider Australia a clear leader. Participants in this survey collectively own or manage around \$380 billion of infrastructure assets around the world.⁹³

There is little evidence that financing constraints are acting as an obstacle to the provision of productive infrastructure across the country. Conversely, 90% of potential investors are 'highly likely' to invest in Australia, up from 70% in 2017.⁹⁴ Competition to operate infrastructure services is also high, with significant growth in interest from overseas operators over recent decades across all sectors.

27. Opportunity

Low- or non-capital better-use solutions to infrastructure problems could help to avoid or delay investment in expensive new or upgraded assets. These solutions could stretch public funding for infrastructure further, bringing productivity benefits for more users sooner.

When this will impact:

0-5

5-10

10-15

15+

Where this will impact:



4.4 Market depth and skills

At a glance

The project pipeline is large, deep and visible, but this has not led to better coordination of projects entering the market. Subsequently, an overheated market is leading to competition challenges and risk aversion in project delivery. Governments are increasingly turning to international contractors, but their unfamiliarity with the local market can cause problems, with opportunities remaining for better engagement of tier 2 and 3 contractors.

This section finds challenges in:

- encouraging competition to support user outcomes
- managing Australia’s skills pipeline, including for the public sector
- addressing the construction industry’s entrenched culture and gender inequity.

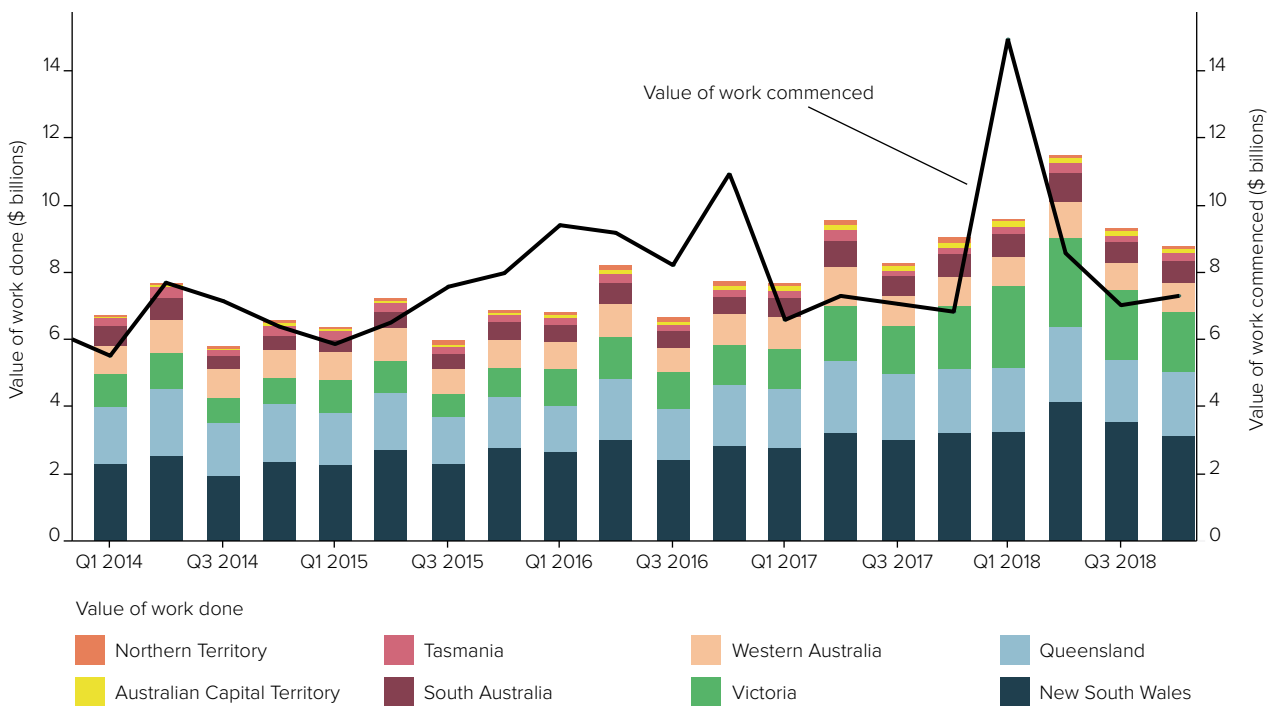
The project pipeline is large, deep and visible but it remains ‘lumpy’

Since the last Audit, Australia has moved into a period of unprecedented infrastructure construction activity. Engineering work for the public sector grew to its highest level ever recorded, while declining marginally in recent quarters, as shown in Figure 6. The lift in total work done has not been uniform, with the change almost solely the result of

increased expenditure by the Australian, New South Wales and Victorian Governments. Figure 6 also shows the ‘lumpiness’ of the overall pipeline, with commencements showing high levels of volatility.

This increase in overall work done is a good problem to have, but it is posing challenges to the market and government sector alike. There is a shortage of capacity, skills and resources to delivery these projects.

Figure 6: The total value of infrastructure work done for the public sector has reached record levels because of New South Wales and Victoria



Note: Bars represent value of work done per state, and the line represents value of work commenced nationally.

Source: Australian Bureau of Statistics (2019)⁹⁵

The concentration of general activity in New South Wales and Victoria is mirrored in the major project future pipeline, shown in Figure 7. This figure shows over \$130 billion in credible and committed, near term major projects in New South Wales and Victoria – while all other jurisdictions combined are fielding less than half the volume and value.

A number of factors have led to this unprecedented level of activity, including population growth, ageing existing infrastructure, political appetite and market conditions. Strong transport investment is the most significant contributor and is expected to stay elevated.

Despite reflections that Australia is currently undergoing a short-term infrastructure investment boom, project commitments within the short- and medium-term pipeline, and major unfunded long-term promises means new work is likely to stay elevated for more than a decade. Many of these long-term commitments, particularly urban rail enhancements such as the Outer Suburban Rail Link in Melbourne, MetroNet in Perth and Metro expansions in Sydney, will be delivered over many years.⁹⁶ Queensland's long-term outlook is also strong continued investment, while short to medium term enhancements to the Bruce Highway and M1 Pacific Motorway will continue.

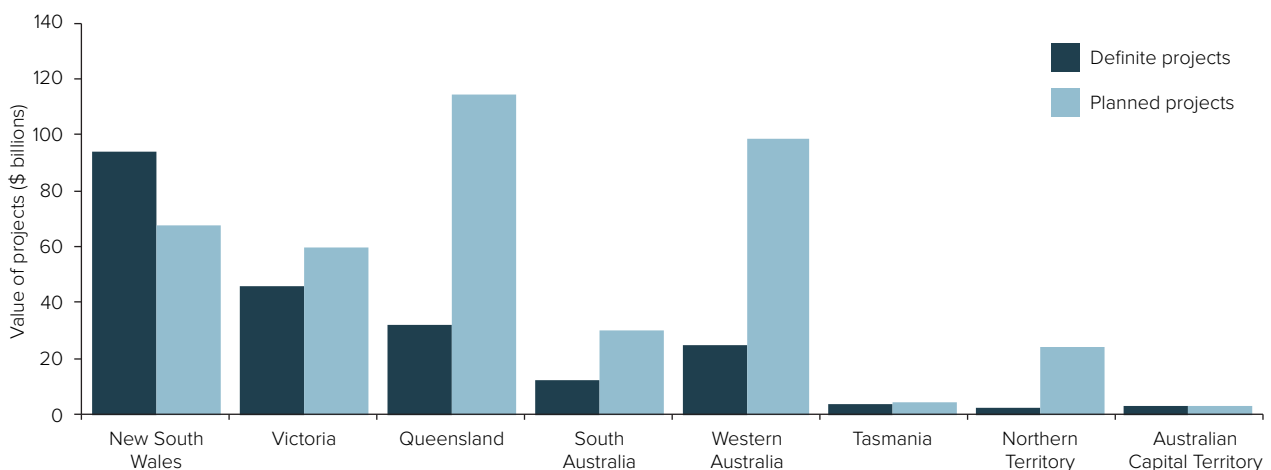
A strong project pipeline is therefore likely to dominate for a substantial period and governments and the market will need to adjust.

The visibility of the major project pipeline has markedly improved since the last Audit. This is a result of:

- Federal initiatives such as the Infrastructure Australia *Infrastructure Priority List* and the Department of Infrastructure, Transport, Cities and Regional Development long-term capital planning
- Individual efforts of jurisdictions including respective government infrastructure bodies
- Industry initiatives such as the Australian & New Zealand Infrastructure Pipeline, published by Infrastructure Partnerships Australia.

However, this increased visibility has not yet contributed to clearer coordination between jurisdictions. Similar projects on similar timelines continue to be released, in different parts of the country. This is most likely due to states and territories owning the responsibility for the majority of infrastructure delivery, the state of each jurisdictions' infrastructure asset base and the concurrent political priorities. The coordination of projects into the market has always been assumed as a natural benefit of greater transparency, however this has yet to materialise.

Figure 7: The committed major project pipeline is dominated by New South Wales and Victoria



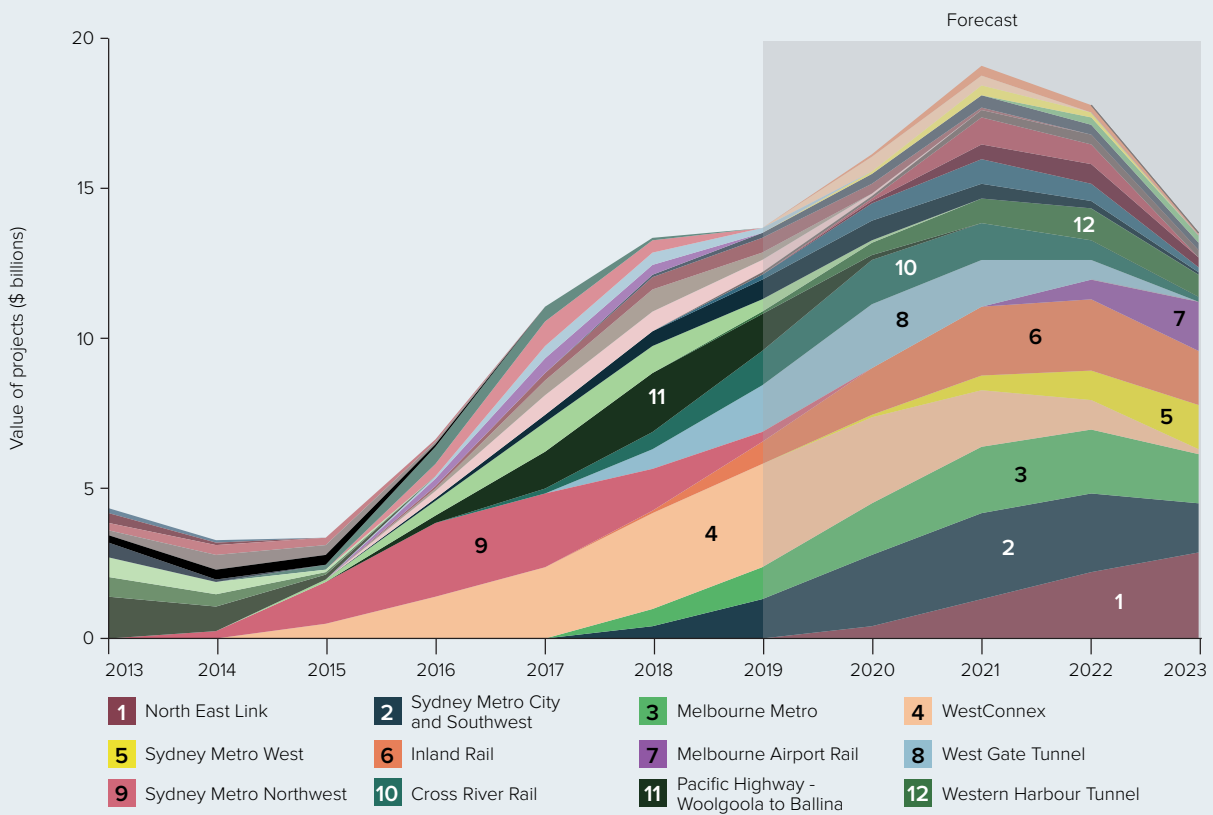
Source: Deloitte Access Economics (2019)⁹⁷

The transport infrastructure mega-projects pipeline is growing

Figure 8 shows a representation of transport mega-projects (those larger than \$1 billion in value). This chart highlights the significant growth in the major project pipeline and the significant demand for similar skills and resources, such as within the railway sector, that coincide over particular time scales peaking in 2021. In a heated, concentrated market a pipeline that lacks coordination increases the risk of low competition, or poor outcomes because the best teams were not available.

In reading Figure 8 it is also important to acknowledge government expenditure is inherently more certain within the four year forward estimates budget cycle. The certainty of the project pipeline tends to decrease from years 2 or 3 (2020 and 2021) before reducing more significantly in year 4 (2022). This is illustrated by the declining peak on these years. While this is a feature of current government budget practices, long-term planning and asset management can improve certainty to industry over longer periods allowing skills and capacity ramp-up.

Figure 8: The Australian road and rail infrastructure major projects pipeline has been growing



Source: Deloitte Access Economics (2019)⁹⁸

28. Challenge

Increased transparency of the infrastructure pipeline has not improved coordination on the timing and release of projects into the market, leading to some stretching of resources. A lack of coordinated procurement and delivery activity is resulting in constraints in key resources and skills.

When this will impact:



Where this will impact:



A 'hot' market has increased push back on risk by contractors

The delivery of infrastructure is dependent on the differing skills, resources and knowledge of the public and private sectors. To support the efficient delivery and operation of infrastructure, the public sector contracts the private sector for services they are better able to deliver. In many cases, this involves the construction of infrastructure assets, operations, financing and other services.

The use of private sector resources and expertise supports the delivery of value for money infrastructure delivery and operation for users and taxpayers, while also protecting the taxpayer from various risks. Best practice contracting and procurement ensures risks reside with the party best placed to manage them. This concept is core to the delivery of high quality, value for money services.

Since the last Audit in 2015, the make-up and risk-appetite of the infrastructure sector have changed. Large financial losses on some construction projects and a strong pipeline of work have caused the market to push back on a range of risks. These losses are at least in part the product of aggressive pricing by contractors seeking to maintain market share. Despite these challenges, in some cases poor allocation of some risks has also created distinct issues. For example, the transfer of regulatory risks and responsibility for negotiating with other government agencies, such as utilities, are key risks transferred to the private sector, which potentially could have been more efficiently managed by government.

The impacts of reduced risk appetites on securing competition for the delivery of projects is most prominent on mega-projects, where the capacity of the market is already limited because of the scale of these projects.

Australia's larger contractors have large volumes of work in hand. They also have a wide range of choice in the forward pipeline. However, several are facing substantial losses due to troubled major projects. Together, these conditions have resulted in larger contractors 'pushing back' on risk transfer, particularly for very large projects.

Construction tiers

Tier one: A small number of large contractors capable of delivering mega-projects over \$1 billion without partnering. These major contractors are currently constrained by high volumes of existing work. Lead contractors on mega-projects often use international contractors and tier two contractors to reduce risk on very large projects.

Tier two: A small number of medium-sized construction firms that undertake projects up to around \$500 million, before requiring support of a joint venture partner. These contractors will lead smaller projects, particularly with well understood risks. They currently have a larger appetite for new projects, however they have less capacity to support large contracts and manage certain risks, such as those requiring specialised skills.

Tier three: A large number of smaller firms, generally with an appetite for projects under \$100 million. They are usually less willing to take aggressive price or risk positions.

In current market conditions, a challenge to public sector procurers of infrastructure is to consider adjustments to the risk allocation and scale of contracts issued to the market to ensure competition. For example, the New South Wales Government's Rozelle Interchange project exceeded the market's appetite and saw only a single bidder. This forced a fundamental revisit of the project's commercial and procurement and delivery strategy to meet contemporary market appetite and capacity.

The aim of each procurement process will be to bring individual contracts within the capacities of the market to drive vibrant, value-creating competition. In some cases this may involve considering the structure of works packages, reducing their size or risk profile to suit market depth, capacities and capabilities.



Tier one contractors and larger tier two contractors seek to limit the degree of project risk they are exposed to. The challenge in procurement policy and strategy is to align the scale of the project, contracting model and risk allocation approach. In some instances the scale of works packages inhibit participation by tier 2 and 3 contractors, thereby limiting competition on a project that would otherwise be within the skills range and capability of these businesses.

To date, the response to the changing risk appetite has been inconsistent and uncoordinated. Subsequently the risk pendulum has swung unnecessarily far towards the public sector and ultimately the taxpayer, on some projects with the public sector holding risks comfortably managed by the private sector. This reduces value for money for taxpayers, whereby increasing infrastructure costs.

However in other instances, the transfer of excessive or inappropriate risks to the private sector has inhibited the ability for governments to reach financial close on some procurements, and lead to delivery risks and ultimately litigation in other projects. This also reduces value for money for taxpayers and increases the costs of infrastructure.

The misalignment and low coordination of projects between jurisdictions also reduces the ability for the private sector to manage a portfolio of projects, or varying sizes and risk profiles. As a result of the strong project pipeline, the private sector is able to reduce its exposure to risk through rebalancing its project portfolio. The private sector push back on risk is therefore likely to persist for at least the next five years. However, if the current levels of investment

continue as expected for longer and the depth of the market remains static, the current levels of risk tolerance may continue.

However, the future risk appetite of the industry is neither static nor certain. Changes to the scale, type and contractual sophistication of projects has implications for contractor risk profiles. With these changing market conditions and rebalancing in risk, it will be important to consider whether existing procurement policies and processes are appropriate. Procurement and contracting changes could have significant long term effects, such as resetting the norm for acceptable risk transfer.

Ultimately, the costs of poor procurement practices are borne by the taxpayer and infrastructure users through increased costs or reduced quality of infrastructure. Therefore jurisdictions have a strong imperative to improve procurement practices and increase coordination.

International contractors are unlikely to fill the void

Discussions about constraints for mega-projects often turn to the role of international contractors supplementing domestic industry capability.

International contractors, advisors and operators strengthen competition in the market by extending the financial and technical capability, and supporting the innovation and risk appetites of incumbent market participants. International design firms also provide additional innovations and capabilities in the design phase. Many infrastructure subsectors are dominated by international operators, including transport and water.

Austrade and various state agencies have made concerted efforts to support the increased presence of international contractors. A range of international contractors have entered the Australian market in recent years, including Bouygues, Samsung, Salini Impregilio, Dragados, Acciona and Bechtel.

However, new international entrants to the market can take a substantial amount of time and resources to upskill and acclimatise to Australian legislative and policy requirements. International contractors may also be unfamiliar with Australian regulatory requirements, community expectations or operational requirements. If not well-managed, these gaps in

knowledge and capacity can result in sub-standard project delivery, network integration or user outcomes. This poses additional risks to procuring agencies, who may need to support and guide foreign participants.

Sustaining competition in Australia's construction market, including its attractiveness to foreign industry participants, is integral to high quality outcomes for the community. Recent steps by some jurisdictions to encourage foreign suppliers to the market has supported affordable, high quality infrastructure for users in those jurisdictions.

29. Challenge

The overall volume and project scale of infrastructure construction has created a heated, stretched construction market and reduced competition for projects. High risk projects are not achieving a desired level of competition during procurement. This may result in delivery being delayed or delivered by a higher risk, lower skilled contractor.

When this will impact:

0-5

5-10

10-15

15+

Where this will impact:



Construction sector productivity is lagging

Concerns about efficiency and productivity are commonplace within many countries.⁹⁹ Internationally the average annual growth in construction sector labour productivity averaged 1% over the past two decades, compared with broader economic growth of 2.8% for the total world economy.¹⁰⁰ In contrast, productivity of the Australian construction sector declined by around 2.5% between 2017 and 2018, on an hours worked basis.¹⁰¹ Multifactor productivity within the construction sector has declined for each of the past four years. However, productivity is not consistent across states and territories, with New South Wales historically performing well.¹⁰²

It has been estimated that a 1% increase in construction sector efficiency would result in an approximately \$500 million saving to the taxpayer, however this is dependent on industry activity at that time.¹⁰³

Low levels of productivity improvement have previously been linked to low levels of capital investment, such as in plant and machinery, which would increase an individual's productivity.¹⁰⁴ However, high rates of workforce turnover, low workforce morale, low levels of investment in training and education and other sector culture factors are likely to compound the productivity plateau.¹⁰⁵

The transformation of the workforce to a higher level of digitisation will present new opportunities to improve productivity. Construction is currently one of the least digitised sectors.¹⁰⁶ The application of emerging technologies such as drones, building information modelling (BIM) and 3D printing offer the potential opportunity to support productivity improvement. The improved use of data and enhanced communication with clients and customers has been identified in the United Kingdom as offering the potential to enhance productivity within the construction workforce.¹⁰⁷

The reluctance of employers to invest significantly in workforce development, and the subsequent lag in productivity, may be linked to low levels of confidence regarding the future project pipeline and a perception of an elevated level of market activity. While the transparency of the project pipeline has improved significantly since the last *Australian Infrastructure Audit* in 2015, little further analysis to support the implications of the pipeline for workforce needs has been developed. Noting the expectation that work levels will likely remain elevated for several decades, improvements to workforce skills forecasting provides a significant opportunity.



The skills of the public sector are as critical as the private sector

High-quality outcomes across project procurement and delivery require the achievement and sustainment of commercial symmetry between the public and private sectors.

High quality procurement and project management skills within the public service support value for money outcomes for users and taxpayers, while minimising unforeseen risk to sector participants.

The potential contribution of a skilled public sector procurement or project manager is therefore substantial. There is a strong case for the public sector to employ and develop highly skilled candidates with these skillsets as they hold a disproportionate ability to drive value for money outcomes for the government and taxpayer, while also supporting a well-functioning and stable industry.

Since the 2015 Audit, progress has been made in the formation and enhancement of specialist procurement, financing and commissioning units within various jurisdictions. These centralised skills supplement industry and project specific capability within line agencies. However, despite these changes, the increased volume of procurement and project delivery is stretching the public service, as well as the private market.¹⁰⁸

Expertise in the evaluation of projects, including the development of business cases and the application of CBA, has additionally been identified as an area of concentrated industry capacity in both the public and private sectors. While the overheated market is leading to over-stretched public service resources in fast-growing cities, the capacity of the local public services is less well-developed in some smaller cities and regional towns, including some smaller capitals.

The most common cause of poor business case development, and subsequently poor procurements is inadequate scoping.¹⁰⁹ Improved problem definition is critical to allow appropriate, value for money solution design and to manage project risks. While more contemporary insights would be valuable, the *Scope for Improvement* prepared by Blake Dawson with Infrastructure Partnerships Australia and the Australian Constructors Association regularly identifies scoping inadequacies as attributing to cost overruns (61%), delayed completion (58%) and disputes (30%).¹¹⁰ The 2008 Report identified insufficient competence as the major cause of inadequacies by 45% of respondents, while the 2014 Report found skills had declined.

There is an opportunity for governments to greater prioritise the development of commercial, financial and project skills amongst the public services in order to reduce total project costs, avoid cost overruns and disputes.



30. Challenge

Despite meaningful progress in key jurisdictions and large agencies, the public sector is inadequately resourced and skilled to undertake a high volume of sophisticated procurement activity, including the oversight of projects during the delivery phase. Inadequate public sector procurement expertise can result in the taxpayer being exposed to inappropriate risks or costs, and compromising the capability of projects to achieve user outcomes.

When this will impact:



Where this will impact:



Australia faces infrastructure sector skills constraints

At all levels and for all types of infrastructure, access to appropriate skills is a problem. For major projects in fast-growing cities, the largest skill constraints are among professional project managers, bid teams and skilled labour. Key professional skills, especially in the rail sector, electricity transmission construction and maintenance as well as emerging technology sectors, are impacted by skill shortages.

For example, the demand for rail industry skills are expected to rise by 5.5% from 2018 to 2023.¹¹¹ Skills constraints are expected to impact frontline operational staff including drivers as well as technical skills such as signalling technicians. The sector will experience challenges meeting this requirement compounded by a decline in the proportion of national rail workforce of under 40, when compared to those over 40, of 4.4%.¹¹² The sector also lacks diversity. The workforce is currently over 80% male, with the gender imbalance potentially reducing attractiveness of the industry to some female recruits. Future technological changes, including the introduction of automation, are expected to fundamentally alter the structure of the rail workforce

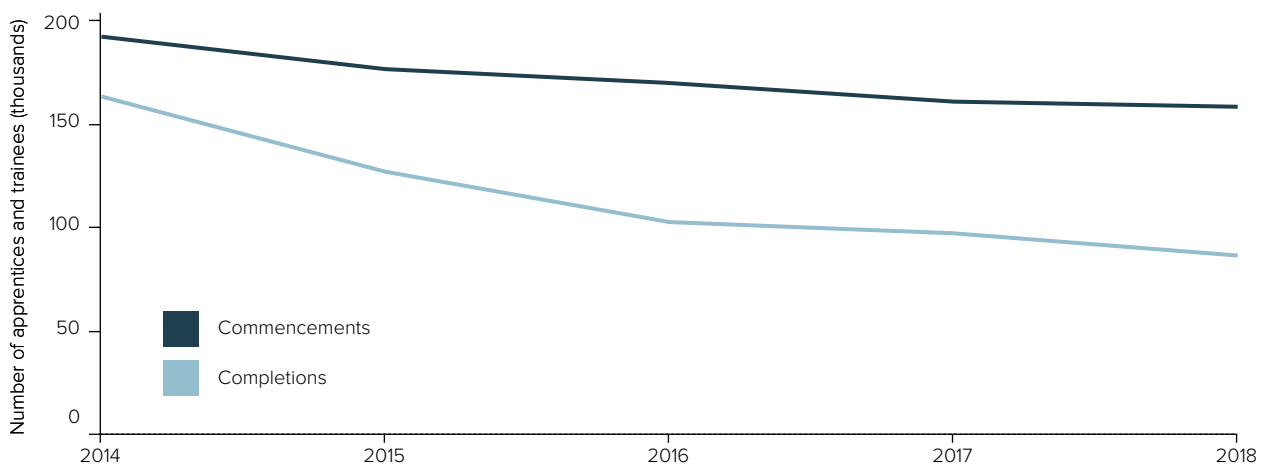
over coming decades with a decline in some frontline skills and a greater reliance on technical infrastructure roles, such as signalling.

In regional centres and remote areas, on top of the national skills constraints, labour shortages affect most levels of the workforce including attracting and retaining semi-skilled construction workers. These labour constraints present opportunities for developing local workforces, if project pipelines are certain and well understood sufficiently in advance of the skills being required.

Despite the growth in infrastructure volumes, commencements and completion of apprenticeships across the economy have continued to trend downwards, see Figure 9. The decline in apprenticeship commencements alongside the ageing of the technical skills workforce, is likely to further compound shortages of key skills.

The Sydney Metro project is a good example of planning ahead. The Sydney Metro project team entered a very early partnership with TAFE NSW, to train a work-ready near-entry level workforce.¹¹³ This program also focused on Aboriginal and Torres Strait Islander participation, with reportedly strong retention results.¹¹⁴

Figure 9: Commencements and completions of apprenticeships and trainees have declined over time



Source: National Centre for Vocational Education Research (2018)¹¹⁵

Industry culture can hinder talent attraction and retention

The Australia infrastructure sector is a collection of relationships between clients and project teams, partners and competitors, with a relatively small number of organisations, each of which may fulfil various roles from operator to advisor, contractor to investor. The concentration in the market is particularly notable for large projects and within specific sectors. The culture of the sector therefore varies from sector to sector, however also from firm to firm and profession to profession.

Some common characteristics of the domestic infrastructure market include:

- Short-term project based relationships – leading to a culture prioritising short-term ‘wins’ rather than long-term community outcomes
- Project based workforces – reducing the focus on long-term workforce development
- Fragmented supply chains – accentuated by Australia’s isolation in global markets, and amplified in remote areas
- Industrial relations constraints – outdated industrial practices remain a consideration within the sector, particularly for public sector workforces or those traditionally part of the public sector
- Disjointed corporate knowledge – large and complex projects do not occur with sufficient frequency to instil specialised knowledge or supplier relationships.

An absence of trust between client and contractor, and community and construction project teams presents a cultural challenge for the sector as it seeks to continue the current level of activity. Communities experiencing so-called ‘construction fatigue’ will be less willing to endure disruption to facility construction if the lead contractor has not been able to establish trust with the local community.

Similarly, over recent years, at a jurisdiction to jurisdiction level, the sector culture has evolved to have a strong focus on securing projects within

a highly competitive market. Subsequently, some contractors have shifted their operational model to low costs bids with a greater emphasis placed on the use of contractual variations and other mechanisms to ensure profitability. This approach is not consistent with a long-term sustainable sector and is likely to reduce partnership and cooperation.

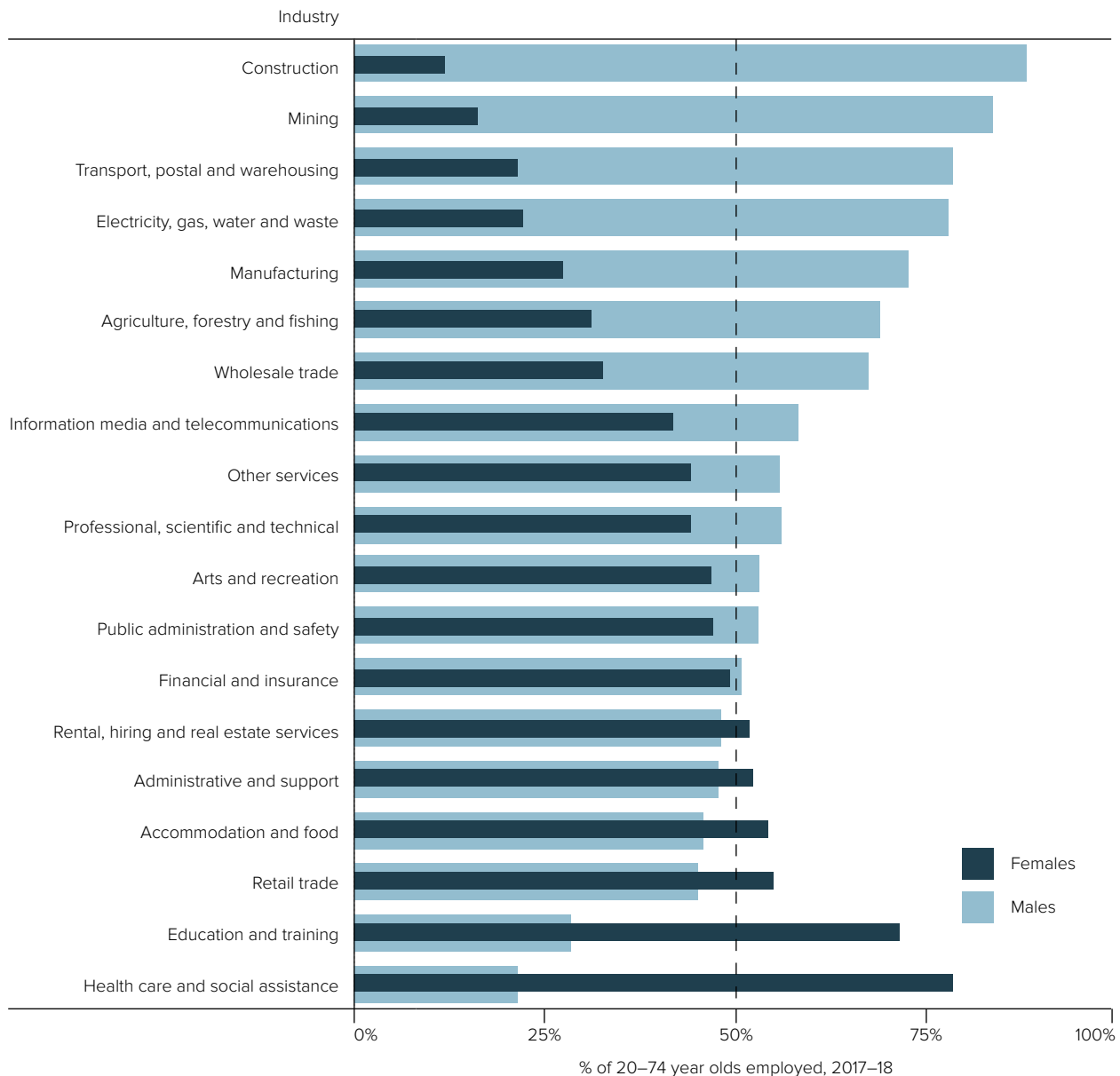
Greater recognition within the sector that the current level of activity is a norm, rather than a boom, could provide a catalyst for a shift in behaviours and a renewal of industry culture as a normal manner of relationship is re-established.

Within some professions, a strong and distinct culture has developed. In particular construction and engineering are well-known as strongly male-dominated professions. The construction sector is Australia’s third largest employer, yet it has the lowest levels of female workplace participation of any industry, see Figure 10. Female participation within the sector has declined in recent years. Representation of women is low and declining, with gender bias identified as a potential barrier along with gender pay gaps, and industry practices, such as long work hours.¹¹⁶ For example, John Holland Group has identified that that 15% of the women in the workforce were being paid less than their male counterparts.¹¹⁷

The lack of engagement of women within the construction sector restricts access within the industry, which is currently experiencing skills and labour constraints, to women who make up the majority of the population. The closure of the industry from this significant pool of workers has been the focus of significant government focus over previous years, including the promotion of Science Technology, Engineering and Mathematics (STEM) education.¹¹⁸ However, the lack of significant progress in the participation of women within the sector despite this investment warrants closer examination.

Workforce wellbeing is also impacted by long-hours and limited opportunities for advancement or the development of skills. Threats to workforce physical and mental health also persist. In particular, high rates of male suicide present a key risk to the sector.¹¹⁹

Figure 10: The construction and mining industries have the lowest levels of female workplace participation



Source: Australian Bureau of Statistics (2018)²⁰

31. Challenge

Skill constraints are affecting key roles within the sector. The entrenched construction sector culture is limiting the sector’s attractiveness to potential future employees.

When this will impact:

0-5
5-10
10-15
15+

Where this will impact:

4.5 Procurement and contracting

At a glance

Infrastructure outcomes for users are strongest where considerations of whole-of-life project outcomes are acknowledged and deliberated upfront.

This sections examines:

- Whole-of-life and user project outcomes
- Innovations in contracting to support user outcomes, including unsolicited proposals
- Bid timelines and tendering costs
- Risks posed by accelerated procurement and delivery.

Contracting innovations can support user outcomes

The involvement of the private sector in the delivery of infrastructure services is well established in most infrastructure sectors, from hospitals to water and bus services. The involvement of the private sector through service contestability has in many cases prioritised value for money outcomes for the taxpayer.

However more recently, procuring agencies have matured their contracting models in order to better prioritise improved services for users. Recent public transport franchising and other service contracts in major jurisdictions have given at least equal priority to customer outcomes in procurement decisions. A significant, but important, step since the last Audit in 2015 is the move from many governments from the prioritisation of 'lowest cost' to 'value for money' procurement outcomes, allowing improved services for the community to be considered within procurement processes.

For example, the introduction of contestability to Sydney's Region 6 Inner West bus contract supported the introduction of electric buses, on-demand services as well as an increase in services by 20%.¹²¹

However, existing infrastructure contracts such as public private partnerships (PPPs) regularly range up to 40 years, making revision to support customer outcomes difficult. To emphasise the challenges, casting back 40 years from today personal computing, smart phones and the sharing economy were largely unknown. For example, privately operated motorways are required to provide emergency broadcasting capacity using the dominant entertainment broadcast mediums FM and AM radio from the time of their contract, however do not have the same obligations to provide digital radio broadcasting.

In order to ensure infrastructure services are able to cater for contemporary user requirements in a rapidly changing environment, changes to the way long-term contracts are designed and renewed will be critical. Similarly contract managers entering long-term service contracts today will face a similar challenge heightened by the accelerating rate of technology change. Governments, procurement managers and their advisors will need to consider how to predict or anticipate changes in user needs and preferences over this period and avoid contractual arrangements that lock-in outdated service standards or outdated practices.

In many jurisdictions a focus on value for money, whole-of-life and user outcomes in contracting is not consistently applied in infrastructure contracts. In these jurisdictions, an opportunity exists to embed user-orientated performance metrics, renegotiation clauses and specific needs as contracts are periodically re-tendered. This incremental progress will support user outcomes ahead of more significant future contract innovations.

Elsewhere, contract innovation has focused on the enhancement of user outcomes and the provision of value for money service enhancements. Most notably, the introduction of the Newcastle Integrated Service Offering, also known as Newcastle Transport, is the first multi-model public transport contract in Australia contracted on a geographic region. The contract combined bus, ferry and planned light rail service provision into a single contract. The contract additionally provided the private operator significant scope to redesign the bus network and increased risk-based incentives to grow patronage. The contract also facilitated the introduction of on-demand transport services to New South Wales.¹²²

Capital investment is unbalanced despite whole-of-life priorities

Infrastructure is not an ends to itself, rather it is the means for delivering a range of services to the community. Despite the importance of the services that infrastructure provides, too often the priority is given to capital works and new infrastructure builds over policy reform or maintenance.

The preference for capital expenditure is influenced by the increased availability of funding, including intergovernmental grants, community support and the potential to use new infrastructure builds to reduce existing maintenance obligations.

However, large and capital intensive projects can in practice create new long-term maintenance obligations for governments and communities. For example, market rules allowed network operators to overinvest in electricity networks, resulting in increasing payments to network owners and increased bills for consumers.¹²³ The current high levels of new capital works is likely to transfer into increases in asset maintenance obligations, compounding maintenance requirements that are not currently being fulfilled.

Within the development of project business cases seeking support from the Commonwealth Government, we have observed reduced priority being given to low-cost alternatives. Often business cases only pay lip service to cheaper non-capital solutions, which can reduce costs to users and taxpayers. In their place, high cost project opportunities are put forward potentially influenced by a desire to secure higher levels of funding support. This preference for new-build risks exacerbating the existing maintenance deficit.

In circumstances where step changes in service standard are required, large capital investments have the potential to unlock major changes in economic, social and environmental outcomes. However, non-capital alternatives, like policy and regulatory reform, or maintenance and minor capital works, can also deliver significant benefits and address user needs.

Bidding timelines and tendering costs present a barrier to competition

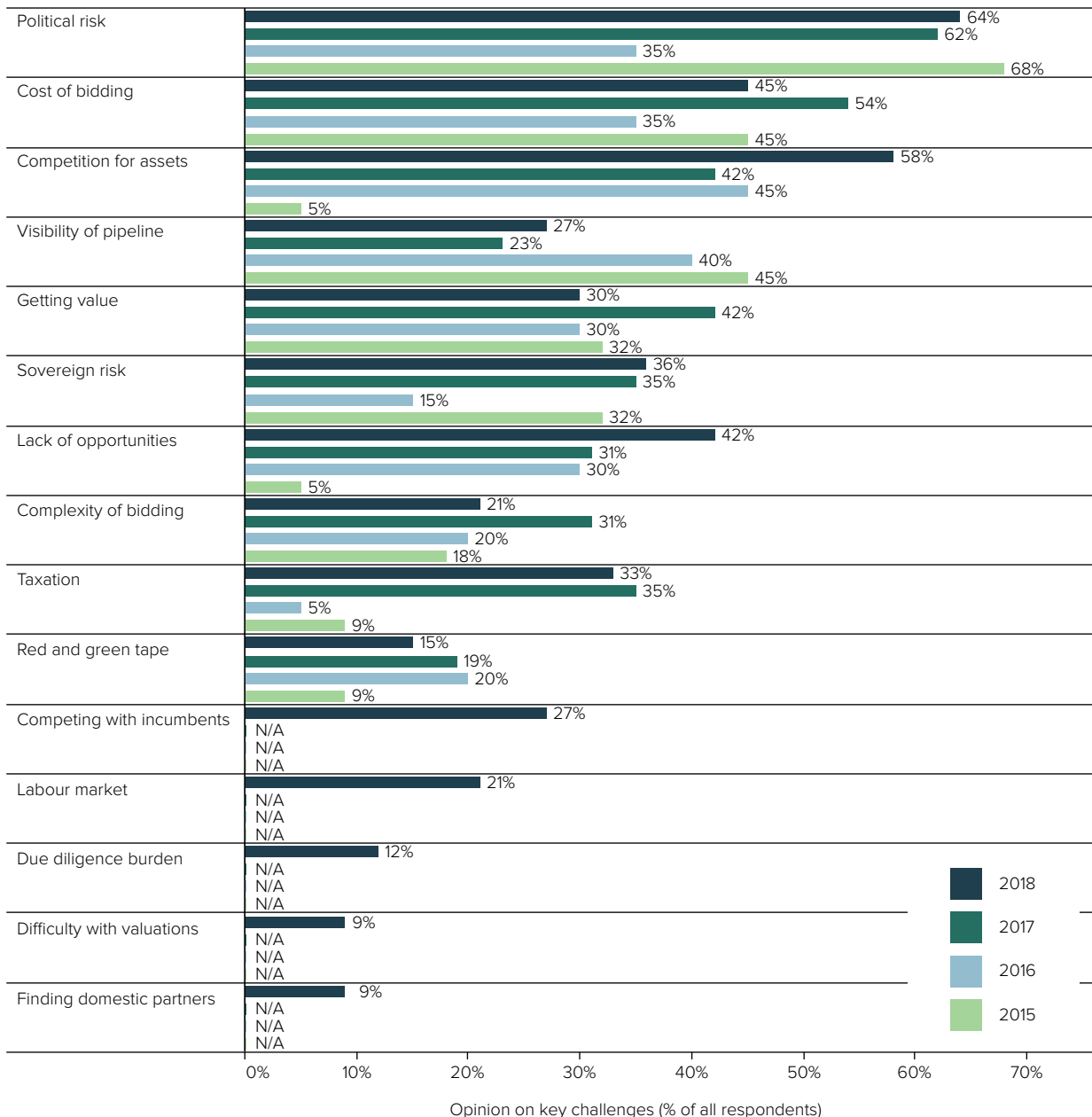
High levels of activity within the market have resulted in constraints on public sector procurement resources. Within many jurisdictions, these resource constraints have in-turn led to truncated procurement timelines. This inhibits the ability for new market entrants to compile compelling offers and increases risks for both successful proponents and client agencies.

For major projects, the cost of tendering remains a large expense for contractors, making it harder to attract suitable competition. There are a range of opportunities that have been identified by a range of works, including by Infrastructure Australia, could be adopted to lower inefficient costs during the contract bid phase:

- Early announcement of projects
- More consistent and rigorous application of guidelines for procurement model selection
- Rationalising information requested that are not material to the evaluation of bids
- Recruitment, development and retention of high quality government project team members¹²⁴
- Jurisdictions making partial reimbursement of bid costs to unsuccessful parties. Some of these payments are up to 50% of eligible pre-estimated bid costs.¹²⁵ Direct reimbursements are likely to continue to be a key response to attract competition for major projects over the next 0-5 years.

These initiatives will serve to mitigate the challenge of high bidding costs, shown as the third most significant challenge to investing in Australian infrastructure in Figure 11.

Figure 11: Political risk, bidding costs and competition for assets have been identified as the top market inhibitors in 2018



Source: Infrastructure Partnerships Australia (2018)¹²⁶

Due to the reduced capacity for certain contractors within the sector to tender, larger tenders will require clear processes and bidders will require clarity about the size of the shortlist that will be used for the bidding phase.

Generally, the public sector has shown a preference for shortlists with more than two bidders. This is to ensure competition in the event that a party withdraws from the bid. While this has occurred for some significant and high-risk projects, notably Sydney Light Rail, there is a risk that the market will not be able to sustain this for multiple larger contracts.

In the current environment with a substantial project pipeline, many companies would rather ‘lose early’ than ‘lose late’ due to the financial impost and the

opportunity cost of bidding. The private sector is more likely to commit to procurements that limit shortlists to an appropriately small field. This will in-turn reduce infrastructure costs, as successful bid costs are ultimately recovered on future projects.

The New South Wales Government’s Construction Leadership Group, in partnership with industry, has also recently committed to develop and publish simple guidelines which document contemporary and best practice procurement method selection for projects and, when appropriate, work packages within projects.¹²⁷ The work of this group presents an opportunity to support a foundation for national best practice.

32. Challenge

Truncated bidding timelines, unnecessary documentation requirements, and under-resourced government project teams are leading to poor procurement and delivery outcomes. This results in higher levels of risk and uncertainty being priced into tenders. These costs are ultimately carried by the users through poor quality services or additional costs, or met through government reimbursements.

When this will impact:

0-5

5-10

10-15

15+

Where this will impact:



Fast tracking procurement and delivery can be costly

There is an inherent tension between the time required to identify, scope, compete and commission major projects, versus the political and community desire to see progress on (or under) the ground. This has been enhanced by the sheer scale and volume of major projects under consideration or in delivery.

For mega-projects, the planning and bidding phases alone may take several years. The scale and complexity of Australia's current major transport projects include projects with delivery timelines nearing a decade.

This tension puts pressure on governments to reduce planning and procurement timelines. In some cases, this has resulted in inadequate understanding and scoping of projects risks, or a misallocation of risk between parties.¹²⁸

Where timelines are shortened by political priority or poor procurement and commercial advice, it is taxpayers and users who ultimately absorb the costs and delays, or endure a service that is poorly integrated into existing networks. Recent examples include the Tibby Cotter Bridge in Sydney, Adelaide Rail Network Electrification, Sydney Light Rail or the Moreton Bay Rail Link in Brisbane. These projects either saw major cost rises or major programme delays linked in-part to inadequate project planning.

In recent decades, procuring agencies have adopted more sophisticated contracting models that protect the taxpayer, through the use of PPPs, Design and Construct (D&Cs) and Design, Build, Operate and Maintain (DBOM). These approaches take longer and cost more to bid than lower risk models, like alliances or construct only. This is due to the competitive processes and detailed due diligence performed by procuring agencies and the market. However, these processes are important in securing long-term value for money outcomes.

Project costs can be grossly underestimated. The 2014 *Scope for Improvement* report, published by the Australian Construction Association, attributes 'political imperatives' as a major factor causing insufficient time for project scoping and planning.¹²⁹

In many cases this is due to political promises made in the context of elections. Significantly, community pressure often leads to political commitments during election processes. However, due to caretaker provisions limiting the role of the bureaucracy at this time, it is highly unlikely political representatives have access to appropriate skills or information to appropriately cost a project during this time.

Large, complex projects require careful consideration of risks and a considered process to allocate and manage these risks. With good commercial advice, prudent gateways and careful delivery oversight, the community can expect better value, better designed and better quality infrastructure.



33. Challenge

Community pressure can encourage premature project commitments or the acceleration of project delivery. Decision makers are often poorly resourced to respond to this pressure and arrive at an informed decision. Poorly planned, budgeted or scoped projects can result in project cost blow-outs or delays, as well as a failure to meet project objectives resulting in long-term costs to users.

When this will impact:



Where this will impact:



Unsolicited proposals have become the de facto path for asset enhancements

Since the late 2000s, many states and territories have adopted guidelines to support the receipt and assessment of unsolicited or market-led proposals. The development of these guidelines is an evolution of processes that previously existed, such as the New South Wales Government *Working with Government Guidelines*.

While unsolicited proposals have broader application than the infrastructure sector, the long-term contracts and asset lifecycles that define the sector has led to their use principally on infrastructure assets.

These processes are an important mechanism for the private sector to support the reprioritisation of infrastructure delivery and to support innovative delivery models. They are designed to provide a pathway for consideration of innovative sole-source project proposals from the private sector, where the private sector has a unique ability to deliver the project.

The majority of proposals received by government do not progress. This is due to either a deemed absence of 'uniqueness', a lack of strategic alignment with broader government investment and planning, or a general lack of government support for the proposition. Despite the relatively small number of projects that do progress, the unsolicited proposals approach has delivered multi-billion dollar projects, including road enhancements, student accommodation, tourism developments and urban renewal.¹³⁰

These frameworks have been successful in securing the progress of projects aligned to government priorities. However, they have also exposed the shortcoming of pre-existing contractual arrangements that provide limited opportunity for incumbent infrastructure owners and operators to propose asset improvements or enhancements within existing contractual arrangements.

For example, the unsolicited proposals process in New South Wales and the market-led proposals process in Victoria have been used to assess proposals to widen and enhance heavily congested urban motorways in Sydney and Melbourne.¹³¹ The use of these frameworks acknowledges the limited mechanisms within the existing contracts to address congestion on these assets.

This necessity to use the unsolicited proposals approach exposes the shortcomings of the current approach to contracting. The requirement for asset enhancements to be progressed as unsolicited proposals reduces their ability to be considered as part of broader strategic planning by government and means private infrastructure owners and operators need to take on higher risks and costs to progress asset enhancements.

Ideally, unsolicited proposals or market led proposals should be an exception, rather than a routine way to procure infrastructure or infrastructure enhancements. Where agencies and the public sector have a better understanding of long-term public need and this is considered upfront in contracts, fewer unsolicited proposals or market led proposals would be required.

4.6 Security, resilience and sustainability

At a glance

Our infrastructure networks face unprecedented risks from technology, economy, evolving user preferences and climate change. Yet our resilience strategies do not provide enough guidance.

Typically, it is cheaper to build with risk in mind than to retrofit existing infrastructure. Furthermore, making our infrastructure more sustainable is critical to future success, including achieving our international emissions reduction targets.

Infrastructure networks are facing unprecedented risks

Australia's infrastructure networks face a series of complex and interconnected risks. As our digital connectivity and the impacts of climate increase, the likelihoods, specific nature and consequences of risks are changing. For example:

- **Technology:** New technologies and systems are becoming more sophisticated and complex, and are also more central to our lives and span a larger and more geographically dispersed range of service providers. As the complexity of networked systems grows, there is potential for failures and disruptions that are more difficult to predict and more pervasive in their impact.
- **Security:** Infrastructure is facing mounting risks from a range of security threats, including potential malicious attacks on critical assets. In particular, cyber security is an increasing risk, with the growing reliance on digital systems to support operations across all sectors introducing new and evolving vulnerabilities.
- **Economy:** Economic risks brought by greater exposure of Australia to global markets and competition from growing and developing Asian nations can cause uncertainty in demand for domestic supply chains and freight hubs. Changing world attitudes to free trade could impact on parts of our supply chain infrastructure networks.
- **Changing preferences:** Changes in user behaviour can also lead to rapid changes in user demand, placing some assets under increased strain or making others no longer fit-for-purpose, or even redundant.
- **Environment:** In a changing climate, infrastructure faces conditions different to those for which it was designed. This includes higher temperatures, higher and lower stream flows, changed seasonal rainfall and water availability, changed soil conditions, more intense bushfires, more extreme winds, and rising sea levels, causing coastal inundation and erosion. Climate change is bringing risks.

Resilience is not well-reflected in planning processes

Planning for resilience requires an understanding of the full scope of risks, their likelihood and the potential economic, social and environmental costs of outages, damage, disruption or failure. Timely access to evidence that aids the evaluation of likelihood and consequence can help the planning of construction, maintenance and resilience.

However, evidence about the scale of risks, their impacts and the costs of addressing them is often weak or not accessible. In some cases, risks are known but very technically complex and only a few people have the skills to assess them. In other cases, risks may require specialised and expensive modelling to assess. In a rapidly changing environment, risks shift in nature and severity, complicating assessment. This can lead to reactive, rather than proactive, responses to both short-and long-term risks to networks.

Australia's infrastructure sector lacks clear, publicly available guidance on how to manage risk and plan for greater resilience in the future. Those that exist are already outdated, for example, the Australian Government's *Critical Infrastructure Resilience Strategy* brought together the perspectives of government, industry and enforcement agencies through the Trusted Information Sharing Network in 2015 – meaning it does not reflect new dependencies and technologies such as the Internet of Things, blockchain and drones.¹³² Also, where they exist, many asset management plans do not reflect the whole-of-lifecycle benefits and costs of managing risks to balance appropriate levels of risk and cost. This can lead to inappropriate designs, specification and operating procedures.



34. Challenge

Anticipating and mitigating against ever-changing risks to infrastructure is becoming more difficult as assets and networks become more interdependent and complex. Australia lacks comprehensive resilience strategies for its assets and networks. A failure to appreciate and plan for risks to infrastructure may impose substantial financial, social and personal costs.

When this will impact:



Where this will impact:



Cyber disruption transforms old risks to a new scale

The threat of cyber disruption or attacks is not only increasing, but becoming more complex.

The 2017 *Independent Intelligence Review* found that ‘defensive and proactive technical security measures will increasingly be at the core of strategies to secure systems and data. Whether it is in relation to data analytics, encryption, decryption, data protection generally or the use of cyberspace, collaboration and co-operation between Australia’s intelligence agencies and the private sector will become increasingly necessary and relevant.’¹³³

The capability already exists for a cyber-attack to crash a car, pacemaker, and home security system or switch off a power grid.¹³⁴ The imminent arrival of vehicles that can operate themselves under certain conditions (level 3 automation), the prevalence of smart devices (almost 90% of Australians accessed the internet through their mobile phone in 2018, and over one-third of households own a smart TV)¹³⁵ as well as the growing dependence of a range of infrastructure services on telecommunications will increase the threat to life and the economy from cyber-attack.

As cyber threats become more complex and pernicious a great imperative will exist for governments and industry to ensure they are protecting critical infrastructure, particularly telecommunications networks.

Climate change impacts will vary across the country

Australia is a large and diverse continent, from the northern tropics to the tip of Tasmania. The impacts of climate change on different areas will be as diverse as their existing climates. For example:

- Coastal communities are already experiencing the effects of sea level rise
- Our cities are experiencing the impacts of the urban heat island effect

- Communities in inland areas are experiencing increasing incidence and intensity of drought
- Bushfires are increasing in intensity and the season is increasing in length
- Buildings and infrastructure assets across the country are needing to withstand more severe weather and changing temperatures. In northern Australia, increased intensity of cyclones threaten not only road infrastructure, but also water and wastewater, energy and telecommunications networks.¹³⁶

The cost of modifications to existing infrastructure, and the additional costs within new assets to cope are major climate adaptation challenges are not well understood.

The Reserve Bank has spoken of the impact of climate change on monetary policy and the economy, and noted existing data gaps and that major corporations are increasingly factoring in and disclosing climate risk.¹³⁷ A sampled majority of ASX 100 listed entities have considered climate risk to some extent.¹³⁸ The cost of insurance and costs of finance are rising to reflect these heightened risks, and some may find it difficult to source appropriate levels of insurance.¹³⁹

The Australian Government *National Disaster Relief and Recovery Arrangements* provide relief to states and territories in the wake of disasters, including for freight subsidies and reconstruction of essential public assets such as transport, water and social infrastructure.¹⁴⁰ The level of funding provided is linked to the pre-disaster function of the asset. Although only a funding guideline, this may constrain a case to build to a higher standard than pre-disaster function based on a long-term saving to taxpayers from a more resilient building design, or conversely to build to a lower standard reflecting a more frequent need to rebuild.

35. Challenge

Climate and cyber risks are likely to pose considerable and growing threats to Australia's infrastructure. Enhanced consideration of the risks to infrastructure can assist planning, design and operation of assets and networks, and can improve the resilience of services and reduce costs to future generations of users and taxpayers.

When this will impact:

0-5

5-10

10-15

15+

Where this will impact:



A whole-of-life view can lead to better upfront decisions

There is a well-accepted imperative to reduce the costs of construction of major projects, through avoiding high cost solutions and waste. However, when the whole-of-life costs of maintaining an asset are well considered and understood, in many instances there is a case to invest more up front to avoid or reduce future costs.

Ensuring better consideration of whole-of-life costs can be done through improved budgetary planning. This may include the use of whole-of-life contracting, and is often identified as a benefit of long-term outsourcing or the use of PPPs.¹⁴¹ Many of these benefits may also be achieved by placing responsibility for infrastructure construction and subsequent maintenance on a single client or provider.

More sustainable construction and operation of assets can minimise the upfront impact of infrastructure on the local and broader environment and reduce the total footprint of structures over their asset lives. Typically, retrofitting infrastructure to mitigate or avoid a known risk is more costly than initially building to address the risk.

The Australian Sustainable Built Environment Council (ASBEC), representing the built environment sector, has estimated that taking a building by building approach to emissions reduction could deliver almost \$20 billion in savings by 2020, and contribute to achieving a quarter of the emissions reduction required to meet Australia's Paris carbon emissions target.¹⁴² ASBEC points out that buildings may be at the cheaper end of abatement options, through implementing energy efficiency, fuel switching, rooftop solar and smart retrofitting of existing buildings.

Urban design can enhance natural features and incorporate them into places, broadening access to natural elements in urban areas, and protecting resources from degradation through over-development and pollution. Urban design can also support more sustainable user behaviour by minimising the need for travel by private vehicle and enabling public and active transport to meet most users' needs. Improved telecommunications can influence travel decisions, bringing local access to jobs and services or reducing the need to travel.

36. Opportunity

Australia could lead the world in developing and applying sustainability-enhancing approaches to its infrastructure. Taking the lead on sustainable infrastructure practices can benefit current and future generations of Australians, while providing opportunities for our businesses to share their expertise and innovation through exports and international development programs.

When this will impact:

0-5

5-10

10-15

15+

Where this will impact:





Australia is at risk of failing our international emissions commitments

Australia’s emissions are among the highest in the world in per-capita terms – higher than the United States of America, and more than double the G20 and European Union average.¹⁴³

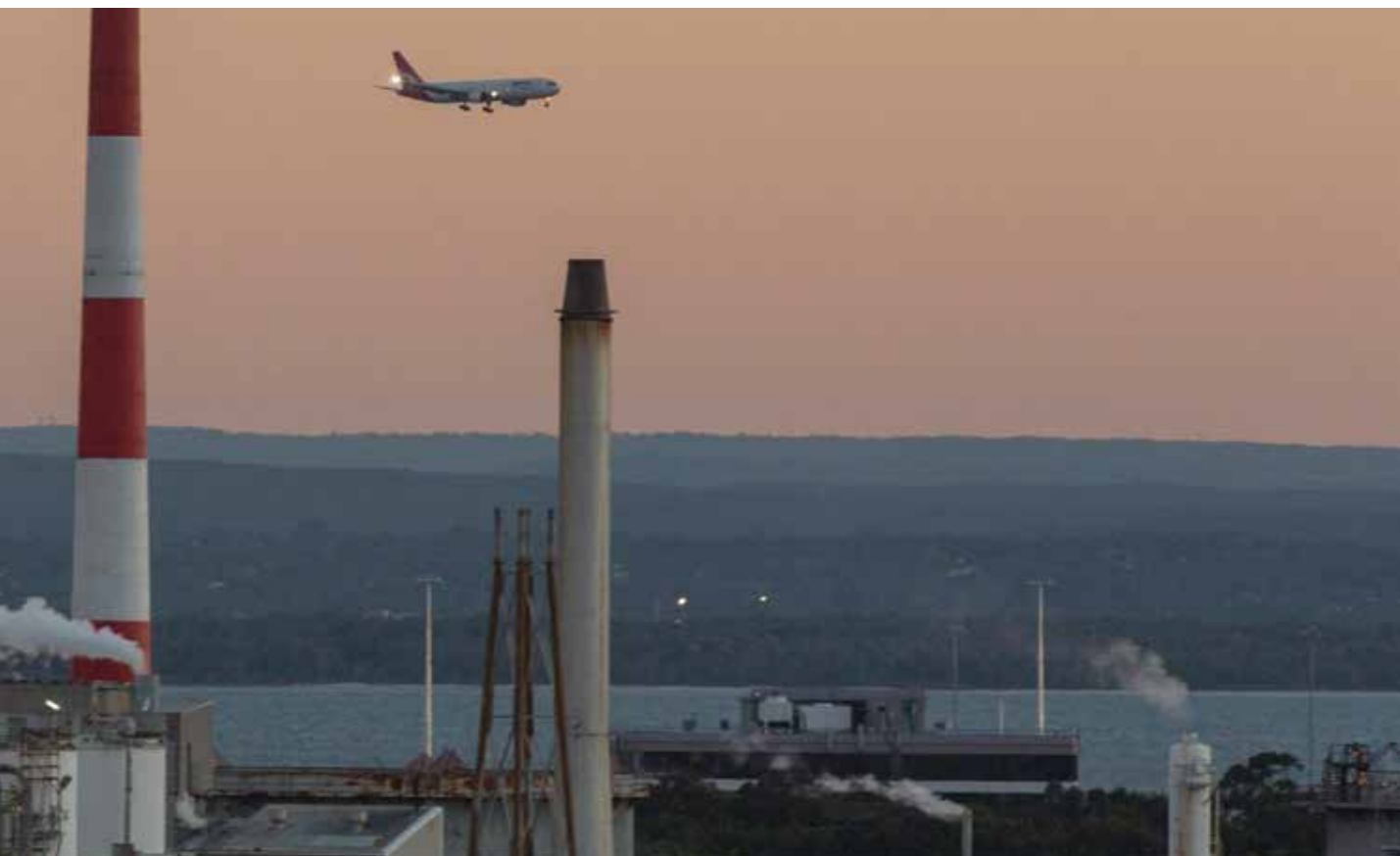
Our infrastructure accounts for more than half the national total, with transport, electricity generation and waste contributing 297 million tonnes of greenhouse gases.¹⁴⁴ The largest contribution to emissions is from the electricity sector, with 34% of emissions, mainly from combustion in coal- and gas-fired power stations. Transport is the next largest, with mainly tailpipe emissions from the combustion of petrol and diesel, totalling 19%. Emissions from waste, mainly via fugitive methane in landfills, adds a further 2%.¹⁴⁵

Infrastructure also contributes indirectly to a further 29% of our emissions inventory. Of this, 19% of total emissions are from the direct combustion of gas for energy in the form of heat, steam or pressure (and separate from electricity generation and most transport). This includes industrial production processes, as well as gas heating in households and commercial buildings. Also, a by-product of the extraction of fossil fuels are uncaptured (fugitive) emissions to atmosphere. This accounts for 10% of Australia’s emissions.

In terms of trends, it is notable that:

- Emissions from electricity generation have fallen about 10% over the last ten years and this is expected to accelerate as 10 gigawatts of renewable energy are planned to come online during 2018 and 2019.¹⁴⁶
- While vehicles are becoming more fuel efficient and there is an increasing share of more efficient diesel, transport emissions grew by 4% from 2012 to 2016, while vehicle kilometres travelled increased by 7%.¹⁴⁷
- Direct combustion emissions are expected to rise by 7% out to 2020, driven by gas combustion at a growing number of liquefied natural gas facilities and mining sector growth.¹⁴⁸
- Fugitive emissions have grown considerably with emissions from coal mines and new gas plants coming online over recent years.¹⁴⁹
- Solid waste and wastewater treatment emissions fell steadily until 2015 with improved processes and the capture of methane from landfill sites. Emissions have since flattened.¹⁵⁰

These trends are placing Australia at risk of not meeting our 2030 emissions reduction commitments as part of the Paris Agreement.¹⁵¹ Our infrastructure sectors therefore have a key role to play if Australia is to achieve these commitments.



37. Challenge



Australia is at risk of not meeting its 2030 Paris Agreement commitments to reduce emissions by 26-28% below 2005 levels, in part driven by increases in transport, direct combustion and fugitive emissions. Without action in these sectors to reduce emissions, Australia risks becoming one of the highest carbon emitters per capita in the world.

When this will impact:



Where this will impact:



4.7 Challenges and opportunities

Planning and decision making

20. Challenge

Decision-making processes across many jurisdictions and sectors are not meeting best practice standards, including application of the *Infrastructure Decision-making Principles*. Failure to improve project decision making is likely to reduce the potential productivity and quality of life improvements of infrastructure investments.

When this will impact:



Where this will impact:



21. Challenge

Many decisions are being made without meaningful engagement, and without the means for comment and stakeholder feedback to inform project planning and delivery. By not adequately engaging, governments and proponents miss the opportunity to address stakeholders' concerns, ensure projects and reforms meet their needs, establish social licence and build trust in decisions.

When this will impact:



Where this will impact:



22. Challenge

Across many infrastructure markets, regulatory principles are complex, inconsistent, do not sufficiently protect the long-term interests of users, and reporting does not always align with user outcomes. A lack of clarity on user-focused objectives is likely to lead to worse outcomes for many users, and frustration with the perceived complexity of markets and decision making.

When this will impact:



Where this will impact:



23. Challenge

How infrastructure is provided and used will transform over coming decades, meaning laws and regulations will need to be reviewed, removed or updated. Failing to anticipate and adapt to change will undermine Australia's global competitiveness, stifle innovation and reduce the benefits of productivity-enhancing technologies.

When this will impact:



Where this will impact:



Funding and financing

24. Challenge

Funding for public infrastructure has risen above historic trends, but remains below that of many OECD nations and may need to rise further to maintain or improve user outcomes. Without sufficient funding for public infrastructure, outcomes for users will deteriorate over time, undermining productivity and quality of life.

When this will impact:



Where this will impact:



25. Challenge

Many community service obligations lack transparency, are not frequently reviewed, and may be inefficient. Opaque funding arrangements erode community support for CSOs and the benefits they deliver, while the lack of consistent review processes means taxpayers cannot be sure that this funding is efficient and delivers value for money.

When this will impact:



Where this will impact:



26. Challenge

A historical underspend on preventative maintenance, short budgetary and funding cycles, a lack of data and incentives, and inadequate reporting have contributed to a maintenance funding backlog across infrastructure sectors. An ongoing maintenance backlog will erode quality and reliability of many assets, and bring higher costs for future asset maintenance and renewal.

When this will impact:



Where this will impact:



27. Opportunity

Low or non-capital better-use solutions to infrastructure problems could help to avoid or delay investment in expensive new or upgraded assets. These solutions could stretch public funding for infrastructure further, bringing productivity benefits for more users sooner.

When this will impact:



Where this will impact:



Market depth and skills

28. Challenge

Increased transparency of the infrastructure pipeline has not improved coordination on the timing and release of projects into the market, leading to some stretching of resources. A lack of coordinated procurement and delivery activity is resulting in constraints in key resources and skills.

When this will impact:



Where this will impact:



29. Challenge

The overall volume and project scale of infrastructure construction has created a heated, stretched construction market and reduced competition for projects. High risk projects are not achieving a desired level of competition during procurement. This may result in delivery being delayed or delivered by a higher risk, lower skilled contractor.

When this will impact:



Where this will impact:



30. Challenge

Despite meaningful progress in key jurisdictions and large agencies, the public sector is inadequately skilled and resourced to undertake a high volume of sophisticated procurement activity, including the oversight of projects during the delivery phase. Inadequate public sector procurement expertise can result in the taxpayer being exposed to inappropriate risks or costs, and compromising the capability of projects to achieve user outcomes.

When this will impact:



Where this will impact:



31. Challenge

There are skill constraints for key roles within the sector. The entrenched construction sector culture is limiting the sector's attractiveness to potential future employees.

When this will impact:



Where this will impact:



Procurement and contracting

32. Challenge

Truncated bidding timelines, unnecessary documentation requirements and under-resourced government project teams are leading to poor procurement and delivery outcomes. This results in higher levels of risk and uncertainty being priced into tenders. These costs are ultimately carried by the users through poor quality services or additional costs, or met through government reimbursements.

When this will impact:



Where this will impact:



33. Challenge

Community pressure can encourage premature project commitments or the acceleration of project delivery. Decision makers are often poorly resourced to respond to this pressure to arrive at an informed decision. Poorly planned, budgeted or scoped projects can result in project cost blow-outs or delays, as well as a failure to meet project objectives, resulting in long-term costs to users.

When this will impact:



Where this will impact:



Security, resilience and sustainability

34. Challenge

Anticipating and mitigating against ever-changing risks to infrastructure is becoming more difficult as assets and networks become more interdependent and complex. Australia lacks comprehensive resilience strategies for its assets and networks. A failure to appreciate and plan for risks to infrastructure may impose substantial financial, social and personal costs.

When this will impact:








Where this will impact:



35. Challenge

Climate and cyber risks are likely to pose considerable and growing threats to Australia’s infrastructure. Enhanced consideration of the risks to infrastructure can assist planning, design and operation of assets and networks, and can improve the resilience of services and reduce costs to future generations of users and taxpayers.






When this will impact: 0-5 5-10 10-15 15+

Where this will impact:     

36. Opportunity

Australia could lead the world in developing and applying sustainability-enhancing approaches to its infrastructure. Taking the lead on sustainable infrastructure practices can benefit current and future generations of Australians, while providing opportunities for our businesses to share their expertise and innovation through exports and international development programs.






When this will impact: 0-5 5-10 10-15 15+

Where this will impact:     

37. Challenge

Australia is at risk of not meeting its 2030 Paris Agreement commitments to reduce emissions by 26-28% below 2005 levels, in part driven by increases in transport, direct combustion and fugitive emissions. Without action in these sectors to reduce emissions, Australia risks becoming one of the highest carbon emitters per capita in the world.

When this will impact: 0-5 5-10 10-15 15+

Where this will impact:     

- Executive summary
- Introduction
- Future trends
- Users
- Industry
- Transport
- Social infrastructure
- Energy
- Telecommunications
- Water
- Next steps

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