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RE-THINKING CITIES: A STRATEGY FOR INTEGRATED INFRASTRUCTURE

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Executive Summary

By any measure, Australia's cities are facing significant infrastructure challenges, with considerable flow-on impacts for their productivity, liveability and sustainability.

The cost of these impacts extend well beyond city boundaries; after all, Australia's major cities employ 70 per cent of the national workforce and contribute close to 80 per cent of Gross Domestic Product (GDP) (see Figure 1).

As well as contributing to a relative decline in national productivity, capacity shortfalls in Australia's major cities are impacting our global competitiveness. In the past decade, Australia has fallen from the fifth most competitive economy in the world to the twentieth, with infrastructure constraints cited by the World Economic Forum as a key motivator for Australia's relative decline.¹

Real improvements in the functioning of Australia's major cities will require greater clarity of responsibilities and required actions, as well as greater transparency of performance over time. Tasking the Productivity Commission with the development of tangible performance benchmarks for cities at both a sector (i.e. transport, water, electricity, waste) and city-wide (i.e. liveability, sustainability) level is a critical first step to achieving these goals. Aside from ensuring a robust and transparent assessment of performance, this would place Australia's cities firmly at the centre of the drive for national productivity growth.

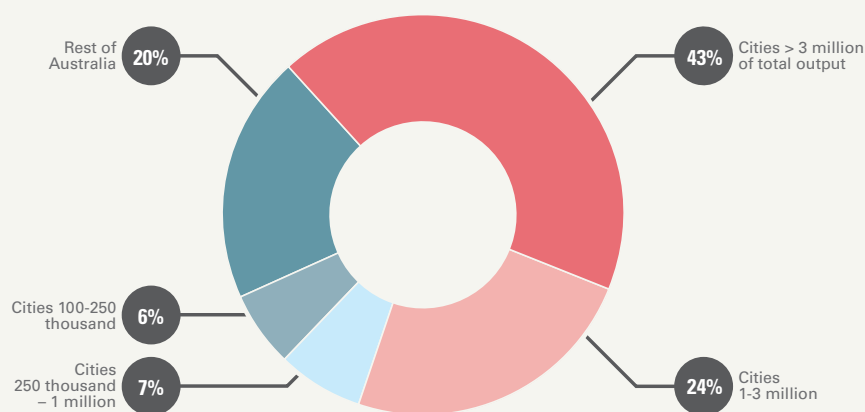
REAL IMPROVEMENTS IN THE FUNCTIONING OF AUSTRALIA'S MAJOR CITIES WILL REQUIRE GREATER CLARITY OF RESPONSIBILITIES AND REQUIRED ACTIONS, AS WELL AS GREATER TRANSPARENCY OF PERFORMANCE OVER TIME.

Solutions also lie with smarter, more integrated and more efficient approaches to the way infrastructure is conceived, funded and regulated.

The seamless integration of land-use and infrastructure planning will be fundamental in ensuring that Australia brings forward the right projects, in the right places – and delivers them at the right time. Greater integration will also provide for Treasuries and central agencies to better play facilitative roles, ensuring that project requirements are linked to budget processes. This will give procuring agencies, business and the community a higher degree of transparency about how, where and when particular projects will be delivered.

▼ FIGURE 1

MAJOR CITY CONTRIBUTION TO ECONOMIC OUTPUT (BY POPULATION)



Source: Estimates derived from ABS (2009) and ABS (2006).

Seamless integration goes well beyond the mere assimilation of strategic plans; it also requires the integration of policy and planning functions within and across government. This involves a whole-of-government approach to pursuing innovative city-wide and cross network infrastructure solutions, such as energy from waste plants and transport networks that support multi-destination and multi-modal travel.

Driving more integrated and efficient approaches to infrastructure delivery will also require ongoing reform to the way major projects are conceived and governed. The creation of *Infrastructure Australia* and equivalent state bodies in some jurisdictions is a positive step forward in this regard. Policymakers have given these bodies clear mandates to deliver multi decade strategic infrastructure plans that are free of geographic, modal or political bias. Moreover, the transparency of long-term planning and project prioritisation based on clarity of need provides a platform for cohesive decision making.

SOLUTIONS ALSO LIE WITH SMARTER, MORE INTEGRATED AND MORE EFFICIENT APPROACHES TO THE WAY INFRASTRUCTURE IS CONCEIVED, FUNDED AND REGULATED.

The scale of the infrastructure investment task facing Australia's cities is substantial, and comes at a time of declining revenues and a renewed commitment to fiscal constraint. Sustaining a desirable increase in public infrastructure investment therefore demands progressive market reforms, such as the sale of publicly held assets, greater use of outsourcing and increased contestability in energy, waste and water and transport services.

Where contestability has been introduced into infrastructure markets, such as in freight, some passenger transport services and the energy sector in some states, the legacy has been an overwhelmingly positive one. Further building on this legacy through greater competition and contestability in infrastructure markets will best position Australia's major cities to address existing capacity constraints and to anticipate future growth.

Of course, new infrastructure is only part of the solution; Australia's cities will increasingly need to consider the demand side of the equation too. This will mean difficult decisions about the role of pricing in maximising the value of existing investment in transport networks and other infrastructure services such as electricity, water and waste.

OF COURSE, NEW INFRASTRUCTURE IS ONLY PART OF THE SOLUTION; AUSTRALIA'S CITIES WILL INCREASINGLY NEED TO CONSIDER THE DEMAND SIDE OF THE EQUATION TOO.

There is ample evidence to suggest that other countries and cities are already embracing the concepts and recommendations identified in this report. If Australia's major cities are to remain competitive in a global market then governments here must also move beyond infrastructure delivery ideals and must begin implementing tangible actions.

Focusing on four key infrastructure areas integral to the functioning of cities – energy, transport, water and waste – this report provides governments with a clear action agenda for realising productivity and liveability gains, and meeting sustainability outcomes.

This report is principally focused on Australia's major capital cities; however it also provides important learnings for Australia's smaller but fast growing regional centres, which are increasingly competing against the established urban centres as places to live and do business.

IF AUSTRALIA'S MAJOR CITIES ARE TO REMAIN COMPETITIVE IN A GLOBAL MARKET THEN AUSTRALIA'S GOVERNMENTS MUST MOVE BEYOND INFRASTRUCTURE DELIVERY IDEALS AND MUST BEGIN IMPLEMENTING TANGIBLE ACTIONS.

RECOMMENDATIONS

A more robust assessment of the actual performance – and progress over time – of Australia’s major cities is needed to drive improved outcomes. To this end:

The Productivity Commission should be tasked with developing performance benchmarks for Australia’s major cities aimed at both a sector (i.e. transport, water, electricity, waste) and city-wide (i.e. liveability, sustainability) level. Benchmarks must be transparent and measurable.

- Cities should be assessed on their progress over time against these benchmarks; accounting for the unique challenges and existing capacity constraints in any particular city.
- Progress in meeting benchmarks should be independently audited and published on an annual basis.
- Benchmarks should be reviewed regularly to ensure continuous improvement.

Australia’s governments must move beyond broad policy ideals towards the seamless integration of land-use and infrastructure planning. To achieve this:

The Productivity Commission should be tasked with developing a best practice framework for the seamless integration of land-use and infrastructure planning at both a state and city level.

- The framework should aim to build on COAG’s existing high-level strategic planning commitments by articulating tangible actions for governments to achieve truly integrated planning.
- Jurisdictions should be assessed annually on their progress in implementing a seamlessly integrated approach to infrastructure planning; the COAG Reform Council is best placed to carry out this assessment.

All jurisdictions should consider whether existing governance frameworks and structures adequately support integrated planning approaches. In particular:

- All governments should assess, on a jurisdiction by jurisdiction basis, whether an independent advisory body would aid in identifying and prioritising long-term infrastructure requirements on a whole-of-government basis.
- Jurisdictions should move to vest transport policy and planning functions within a single agency, spanning all modes, ensuring a much higher degree of integration between and across modes.
- For significant infrastructure projects, all states should identify, preserve and protect relevant infrastructure corridors and initiate the securing of early development approvals for near-term project pipelines.

All jurisdictions should adopt a whole-of-government policy to pursue innovative city-wide and whole network infrastructure solutions where commercially viable and offering value for money. Practical examples include:

- Innovative technological solutions, such as energy from waste plants;
- City-wide – and state-wide – waste systems, integrating all components of service provision including collection, transfer and transport, recycling, treatment and final disposal; and
- Whole-of-city integrated public transport networks that support seamless multi-destination and multi-modal travel. This should include integrated network and line structures, timetables, ticketing and overall branding.

As well as responding to growing and changing demand, infrastructure delivery approaches in all jurisdictions must aim to influence demand in a way that delivers on sustainability objectives and maximises the value of existing investment. This requires:

- All jurisdictions to legislate a clear timeframe for transitioning away from water restrictions towards a system of rational water pricing, where consumers pay more explicitly for the amount of water they use.
- All jurisdictions to identify opportunities to introduce demand management options on key congested motorway links, including time of day tolling where appropriate – in advance of a broader rational road pricing system across Australia.
- All jurisdictions to assess cost-effective options for the roll-out of electricity smart meters; rollouts must be accompanied by well-funded consumer literacy programmes educating energy users on ways and benefits of controlling consumption.

All states must implement progressive infrastructure market reforms; in recognition of the fact that efficient markets provide the best means of addressing existing capacity constraints and anticipating future growth and behavioural change. As a priority:

- All states should introduce competitive reforms into the provision of public transport services, such as wider use of franchising and contestability.
- All jurisdictions should introduce third-party access regimes for the water and wastewater sector – including for third party access to monopoly network infrastructure.
- All jurisdictions should assess the case for structural reform of metropolitan water and wastewater services, with the aim of facilitating increased levels of competition and realising efficiency gains.

- All jurisdictions where electricity businesses remain state-owned should undertake an immediate, independent assessment of the direct fiscal and broader economic impacts of a full sale – including network businesses. This assessment must consider the increased capacity for investment in productivity boosting infrastructure under a full sale scenario.
- Working through COAG, all jurisdictions should aim to establish a standard national approach to waste levies, with levies closely linked to the attributed cost.

To fully utilise private sector capital, skills and experience in solving infrastructure challenges, all states must ensure a streamlined, transparent and innovative procurement framework. To this end:

- All jurisdictions must put in place a transparent and dependable procurement gateway process. An established procurement gateway will ensure procuring agencies are both well informed and confident in pursuing a procurement model that will deliver the best project outcome.
- With effective decision making being a critical factor in the successful delivery of infrastructure projects – particularly when partnering with the private sector – all states must take steps to ensure that government infrastructure delivery teams retain – and continue to grow – their skills base. Development of this skills base should closely mirror project pipelines.
- All jurisdictions must ensure a realistic approach to risk transfer in procurement, which means only transferring risk to the party most capable of managing it.



1.0 Infrastructure & Cities

Australian cities are a major driver of economic growth, prosperity and quality of life for all Australians. Cities rely on the quality and capacity of infrastructure to operate, with poor infrastructure significantly impacting productivity and competitiveness.

This section explores the key drivers for infrastructure demand in Australian cities, and highlights the linkages between the functioning capacity of cities and national productivity.

1.1 IMPORTANCE OF INFRASTRUCTURE IN CITIES

1.1.1 Productivity & Competitiveness

Australia's major cities are home to over 14.3 million people, or around three-quarters of the total population, and employ nearly 70 per cent of the national workforce.²

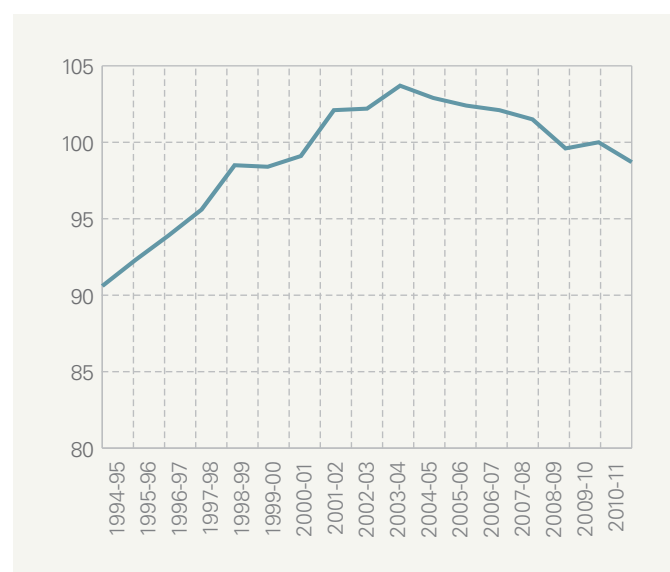
But the importance of Australian cities extends well beyond the direct interest of the populations that inhabit them. Cities also host many of the important international gateways and contain economic infrastructure critical to national productivity, making them essential to national economic growth and prosperity.

Australia's major cities contribute nearly 80 per cent of Gross Domestic Product (GDP), with the three largest cities – Sydney, Melbourne and Brisbane – contributing over 50 per cent of GDP.³ This means the welfare of all Australians, whether living in urban centres or regional areas, is linked to the welfare of cities.

It also means a marked lift in the functioning capacity of Australia's major cities will provide a considerable stimulus for reversing the current decline in national productivity and global competitiveness (see Figures 2 & 3).

▼ FIGURE 2

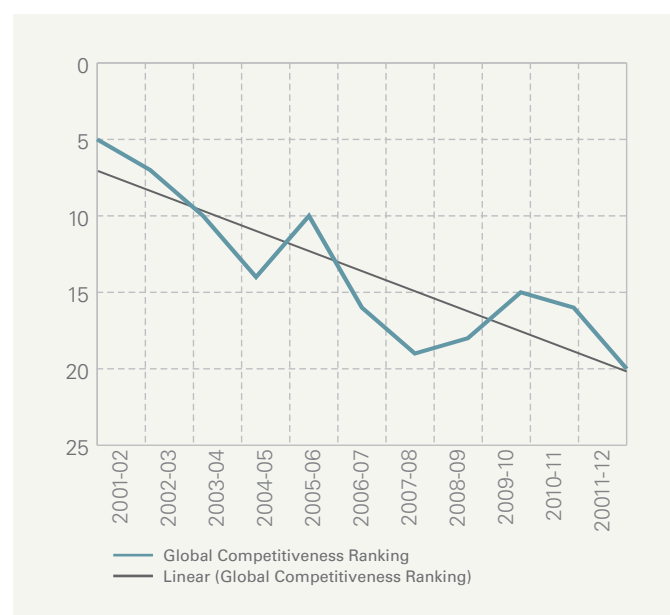
AUSTRALIA'S MULIFACTOR PRODUCTIVITY



Source: ABS, 2011

▼ FIGURE 3

AUSTRALIA'S GLOBAL COMPETITIVENESS RANKING



Source: World Economic Forum

2 ABS. 3218.0 – Regional Population Growth, Australia, 2009-10. 2011; Commonwealth Department of Infrastructure and Transport. *State of Australian Cities*. 2010.

3 Ibid.

1.1.2 The role of infrastructure in cities

This report focuses on four key infrastructure areas that are integral to the successful growth of Australian cities; energy, transport, water and waste.

Energy infrastructure is critical to supplying basic human needs, including heating, cooling, lighting and cooking, through to being a key enabler for other infrastructure, including transport, water, waste as well as communications, entertainment, health and education. Cities rely on consistent energy supply to ensure these services are delivered. The efficiency of electricity networks impacts the price of energy and ultimately the cost of living.

Transport infrastructure focuses on moving people and freight, providing access to employment, services, social and recreational opportunities. Transport infrastructure in cities is necessarily more diverse than in rural areas, and the right transport infrastructure in the right places is critical to efficient movement.

Water infrastructure provides safe water to drink and safe disposal of wastewater. In addition, water is critical to industry, maintaining cleanliness and enabling places of leisure such as gardens and sporting facilities.

Waste infrastructure ensures that cities are sanitary, providing a crucial role in minimising the spread of disease and removing unwanted items from habitable places and public spaces. Waste infrastructure can also play a critical role in enabling cities to recover valuable resources and generate renewable energy.

1.2 CURRENT INFRASTRUCTURE IN AUSTRALIAN CITIES

Australian cities are regarded as being amongst the most 'liveable' cities in the world. For example, Melbourne leads *The Economist's* 2011 liveability index while Sydney is listed sixth and Perth and Adelaide are jointly listed eighth.⁴ However, as Australia's cities have grown, infrastructure networks have typically failed to keep up with increased demand. This is highlighted by a number of symptoms evident in Australian cities such as:

- Brown-outs caused by demand for electricity exceeding capacity to deliver;
- Road and rail congestion;
- Restrictions on water usage and concerns about security of supply; and
- Concerns about how to deal with waste from cities.

1.2.1 Energy

The Commonwealth is moving to increase the sustainability of energy infrastructure in Australia. This includes increasing the focus on wind and solar and signalling an intention to begin shutting down the most emission intensive coal-fired power stations, including Victoria's largest brown coal plant (Hazelwood). This transition towards greater renewables-based generation compounds existing concerns around security of supply for Australia's cities, and presents challenges in getting the best value for money from different forms of energy infrastructure (especially wind and solar).

1.2.2 Transport

Transport congestion, while evident to varying degrees across Australia's cities, is by far the single biggest handbrake on productivity nationwide.

Rail and road systems in Australia's major cities are reaching capacity limits during peak periods, impacting on the movement of both people and goods. This congestion has a direct impact on the productivity of cities, and affects the standard of living by limiting accessibility, increasing the cost of living and impacting on human health.

The link between productivity and congestion has been quantified by the Bureau of Transport and Regional Economics. In 2004, it was estimated that the avoidable cost of road congestion for Australian capitals was approximately \$9.2 billion. This is projected to rise to \$20.4 billion by 2020 according to base case projections.⁵

TRANSPORT CONGESTION, WHILE EVIDENT TO VARYING DEGREES ACROSS AUSTRALIA'S CITIES, IS BY FAR THE SINGLE BIGGEST HANDBRAKE ON PRODUCTIVITY.

1.2.3 Water

Variation in rainfall patterns has presented water security challenges for Australian cities. A prolonged period of low rainfall in catchment areas prompted water restrictions and water saving measures in most Australian cities over the past decade. These were introduced in an effort to maintain a level of security over the medium to long-term water supply.

Governments around the country also commenced a programme to secure water supply through commissioning a number of desalination plants. However, the delivery of these desalination plants was not in time to avoid long periods of water restrictions across Australian cities and have since raised concerns about the adequacy of long-term planning of water infrastructure. This underlines the critical importance of long-term strategic planning around water supply.

1.2.4 Waste

Governments across Australia have identified resource recovery and reducing waste to landfill as key priorities, with pressure to identify and deliver new landfill capacity for Australia's cities.

Australia generates around 2.08 tonnes of waste per capita per annum, of which approximately 50 per cent is recycled.⁶ Identifying future sites to increase the capacity of waste infrastructure will continue to be a challenge as the population grows.

1.3 FUTURE DRIVERS FOR INFRASTRUCTURE

There are a number of drivers impacting on infrastructure demand and delivery. This report focuses on the drivers that are likely to have the largest impact:

- Population & economic growth;
- Technological change; and
- The drive towards sustainable development.

The population of Australian cities is expected to grow considerably between now and 2030.⁷

Failure to deliver an increase in capacity will exacerbate current symptoms of the infrastructure backlog (transport congestion, unreliable electricity supply, insecure water supply, uncertainty around future waste locations and associated resource recovery capacity) becoming worse. This will impact on quality of life and Australia's reputation as having some of the most liveable cities in the world. The way in which increased infrastructure capacity is delivered will also be influenced by changes in technology and the transition towards a more sustainable society.

A further influence on infrastructure delivery is the need, real or perceived, for fiscal constraint. Governments at a state level are constrained by a need for prudence in management of spending, mindful of the need to maintain credit ratings. As a consequence, state governments do not have the financial capacity to increase spending on infrastructure without collateral impacts on other areas of spending. This is not a problem unique to Australia; fiscal realities have led governments elsewhere to set targets and explore procurement approaches in order to attract significant private sector investment.

This section does not attempt to forecast quantitative increases in capacity, but explores the key drivers behind infrastructure requirements in Australia's cities between now and 2030.

1.3.1 Population & economic growth

Population growth is a core driver for infrastructure, with the population of Australian cities expected to grow by 37 per cent between 2008 and 2030.⁸ While other factors will determine the exact increase in required capacity, the increase in population alone will drive a requirement to increase existing infrastructure capacity through a combination of new infrastructure and investment in existing infrastructure.

Growth in Australian cities is not evenly spread, with some cities and regions experiencing significantly higher growth rates. The highest percentage increase is forecast in the areas of Sunshine Coast, Toowoomba, Mackay, Geelong and Townsville where growth is expected to exceed 70 per cent to 2030. These cities will face significant and unique challenges in handling such a rapid increase in population.

The cities of Melbourne and Sydney are also expected to experience significant increases in population with both cities growing by well over one million people by 2030. The South East Queensland region is also forecast to experience significant growth, with an expected increase in population of 1.85 million people by 2030.

Both the type and utilisation of existing infrastructure has a significant influence on how new capacity can be added. In addition, how these cities plan to locate growing populations will be critical to the type and cost of infrastructure that is rolled-out. For instance, new development in the outer ring will have different infrastructure implications particularly in respect to cost, compared with infill development in the inner ring of these cities.

4 Economist Liveability Index 2011 Intelligence Unit's Global Liveability Survey 2011
 5 Commonwealth Department of Infrastructure & Transport, *State of Australian Cities*, 2010.
 6 *Inside Waste Industry Report 2011-12*. Prepared by WME, Hyder and Waste Management Association of Australia, 2011.

7 Australian Bureau of Statistics, 2008, 3222.0 - Population Projections, Australia, 2006 to 2101
 8 Ibid.

▼ FIGURE 4

POPULATION PROJECTIONS TO 2030

CITY	PROJECTED POPULATION IN 2030	POPULATION INCREASE FROM 2008 TO 2030	POPULATION GROWTH FROM 2008 TO 2030
Sydney	5,654,428	1,254,706	29%
Melbourne	5,292,696	1,400,277	36%
Brisbane	2,844,536	898,897	46%
Perth	2,415,387	812,828	51%
Adelaide	1,431,699	259,594	22%
Gold Coast/Tweed	885,033	326,145	58%
Newcastle	541,346	10,155	2%
Sunshine Coast	510,484	272,922	115%
Canberra	421,250	26,124	7%
Wollongong	351,185	67,016	24%
Geelong	307,508	135,208	78%
Townsville	276,710	113,980	70%
Hobart	253,303	44,016	21%
Toowoomba	232,213	106,874	85%
Cairns	223,211	80,735	57%
Darwin	175,822	58,422	50%
Mackay	150,743	69,323	85%
Bendigo	145,842	57,238	65%
Launceston	126,658	22,009	21%
Ballarat	124,694	32,679	36%
Albury-Wodonga	119,910	16,659	16%
Mandurah	114,871	36,049	46%

Source: ABS, 2008, 3222.0 – Population Projections, Australia, 2006 to 2101

1.3.2 Technological change

Technological change will significantly impact existing and new infrastructure assets and their associated services. As well as enabling different and more efficient infrastructure, technological change facilitates new forms of real-time communication, which has the capacity to better respond to and shape the expectations and behaviour of consumers.

The emergence of new technology also enables infrastructure to become more efficient and effective. For instance, in transport new technology is able to facilitate greater capacity on public transport networks by enabling trains to run closer together. Electricity grids are also able to be more effectively managed through access to better information on system loads, while energy usage patterns

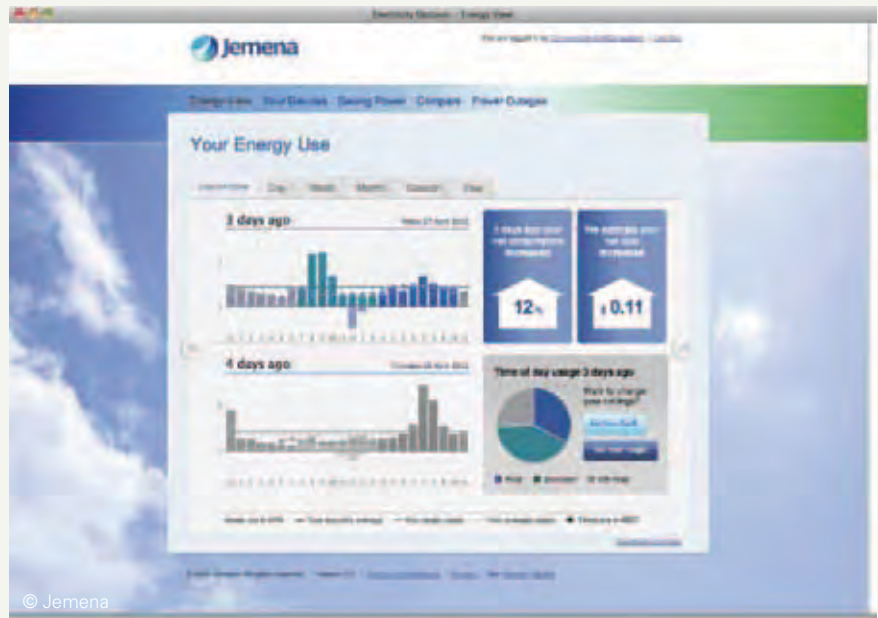
can now be monitored remotely. In the waste industry, radio frequency identification (RFID) and the associated ability to track and record dynamic information, as well as new technology such as new energy recovery, greenhouse gas capture, sorting and composting technology is also revolutionising approaches.

The ability to capture, access and utilise real-time information relating to infrastructure will ultimately change the way that infrastructure is planned, delivered and operated. With more accurate and timely information, infrastructure can be better planned to better match supply and demand, and the operation can be more dynamic to reflect usage. The ability for consumers to access real-time information and data will also provide a valuable tool in managing demand. Electricity usage can be displayed in real-time, with pricing information based on time of use transparent to the consumer.

▼ FIGURE 5

EXAMPLES OF REAL-TIME INFORMATION

Jemena's web-based interactive application, Electricity Outlook, provides customers with accurate and real-time information on their current energy use and associated costs.



Developed by Veolia Transdev, Yarra Trams' tramTRACKER® provides Melbourne commuters with accurate and real-time arrival information straight to their mobile phone, in-addition to timetable and route data.



1.3.3 Sustainability

The transition towards a more sustainable society – one that strikes a better balance between economic, environmental and social outcomes – is a further key driver of both infrastructure demand and effective delivery.

“WORLD-CLASS INFRASTRUCTURE NETWORKS ARE ESSENTIAL TO DRIVING SUSTAINABLE ECONOMIC DEVELOPMENT AND GROWTH, LIFTING LEVELS OF PRODUCTIVITY AND BOOSTING EMPLOYMENT.”

Infrastructure Australia, 2009

Infrastructure life-cycles are considerable, with many assets useful life between 50 and 100 years. As a result, the decision to invest in an infrastructure asset can have considerable long-term implications on the local community and the broader economy. For instance, a preference for road-based transport infrastructure during the 1950s has resulted in the dominance of road transport in all Australian cities to this day.

It follows that changes to the way we plan for and provide infrastructure can have a transformational affect that flows throughout the community. A more long-term, balanced and sustainable approach to infrastructure is a vital component of moving society to a more sustainable way of life.

From the early 1990s Australia has taken some very positive steps in embedding the concept of sustainability into the mindset of government, business and the wider community. The critical role that Australia's infrastructure networks play in the transition towards a more sustainable society is also increasingly well understood and recognised by governments as well as industry.

Over the next 20 years, sustainability will further influence infrastructure demand and delivery approaches. Specifically, infrastructure will increasingly be expected to:

- balance social, economic and environmental trade-offs over its entire life (i.e. greater whole-of-life emphasis);
- be resilient and adaptable to changing external circumstances (not just environmental but social and economic changes);
- be an integral and consistent part of the wider infrastructure 'jigsaw'; and
- Fulfil community expectations by helping to solve sustainability challenges (i.e. assist in positively influencing consumer behaviour).⁹

But while progress has clearly been made, the evolution towards a shared understanding and consistent application of sustainability as it relates to infrastructure, remains far from complete. At the infrastructure project level, notions such as 'sustainability costs more', 'clients don't want it' and 'we're already doing it' continue to present barriers to further progress. A sole focus on environmental sustainability, rather than a holistic assessment of environmental, economic and social factors, also persists in some areas.

These challenges are clearly for the sector as a whole to overcome. However, as the largest procurer of infrastructure and associated services, government also has a unique role to play by ensuring a clearer and more consistent approach to sustainability within public tenders. The recently launched Australian Green Infrastructure Council (AGIC) Rating Tool should provide procuring agencies and their delivery partners with much needed guidance in respect to the challenges outlined above. As such, the AGIC Tool should continue to receive strong public and private sector support, and should continue to be refined in advance of its potential adoption for all applicable public infrastructure projects.

But the sector cannot rely on assessment tools alone to deliver the fundamental shift in outlook and application that will be required. Rather, government and the private sector must work in partnership towards the goal of early and continuous application of sustainability principles from the earliest stages of a project's development, including the strategic policy and planning stages, through to the end of its useful life.

“THE DEVELOPMENT OF INCLUSIVE, MORE EQUAL, HEALTHY COMMUNITIES, THEIR EDUCATION, ECONOMIC DEVELOPMENT AND SUSTAINABILITY REQUIRES FOUNDATIONS PROVIDED BY INFRASTRUCTURE AND SERVICES.”

Federal Government's Sustainable Population Strategy 2011

9 IPA. *Directions in sustainable infrastructure*. 2012.

Energy & sustainability

All Australian cities face challenges in transitioning to sustainable sources of energy, however the scale of this challenge differs across jurisdictions; Victoria, New South Wales and Queensland all share a heavy reliance on coal, while South Australia relies heavily on gas fired generation.

Around 90 per cent of Australian electricity in 2011 was sourced from non-renewable sources, including coal (78 per cent) and natural gas (12 per cent)¹⁰. Over the same period renewables accounted for only 10 per cent of output, including hydro (7 per cent), wind (3 per cent), and a small amount of biomass and biogas (see Figure 6). The Commonwealth's Clean Energy Future reforms will be a significant driver for transformation in the energy sector, with new infrastructure needing to consider the impact of a carbon price into the future.

Transport & sustainability

Transport is a heavy consumer of energy, and the use of oil in road transportation in particular poses a significant challenge in moving to a more sustainable future.

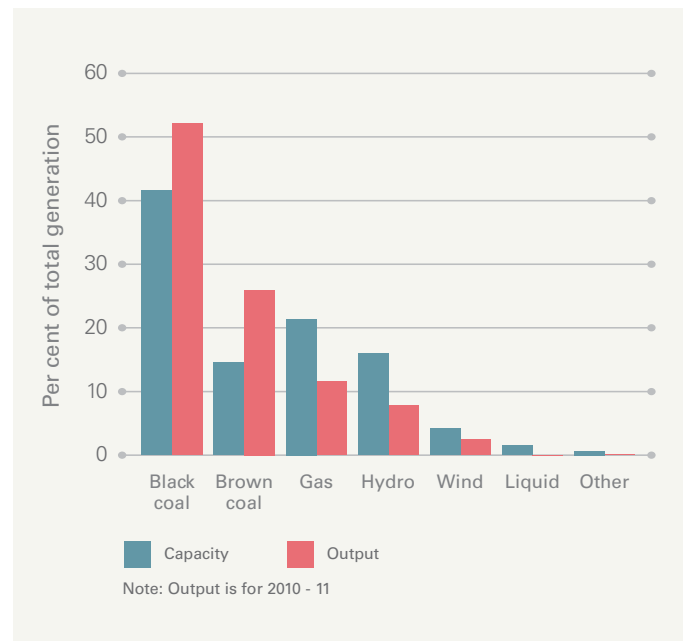
One of the biggest challenges is the use of private vehicles on cities' roads. Car travel is the most common mode for commuting to work, with more than 60 per cent of commuters travelling to work by car. Conversely, commuting by public transport represents less than 15 per cent of journeys. For those cities with a population of less than two million, commuting by public transport represents an average of approximately five per cent of journeys.¹¹

Increasing the use of public transport has the potential to reduce carbon emissions through reduced energy intensity. This has the added benefit of reducing congestion on roads, in turn removing a major constraint on national and state productivity. An analysis of public transport usage in Australian cities shows that as the population of cities increase, the proportion of public transport usage also increases (see Figure 7). The focus on the timely delivery of public transport infrastructure to accommodate the projected increase in population is therefore critical to the successful and sustainable growth of cities.

Other sustainable technologies for private vehicles will also become more affordable and widely available, including electric cars and the use of biofuels as a substitute for petrol, impacting on infrastructure demand. New modes of transport and a change in user preference towards more active lifestyles will also require different infrastructure to that which is already present in Australian cities.

▼ FIGURE 6

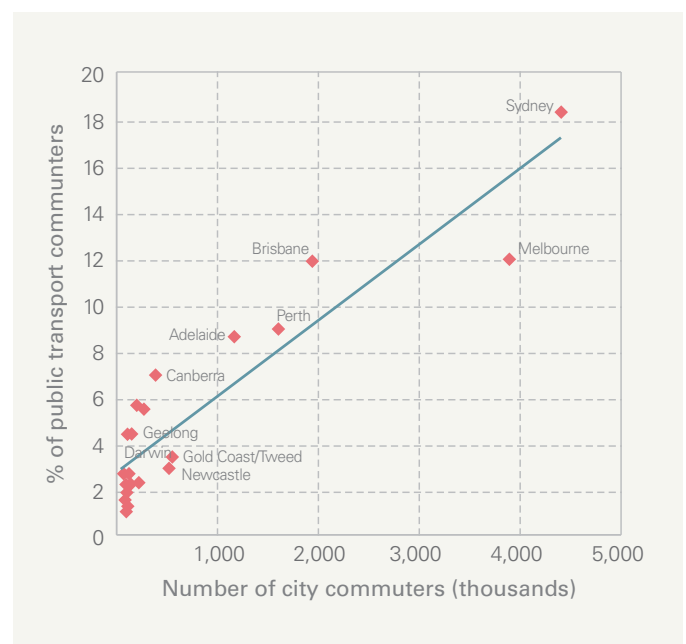
REGISTERED CAPACITY IN REGIONS, BY FUEL SOURCE, 2011



Source: AER, 2011

▼ FIGURE 7

PUBLIC TRANSPORT IN AUSTRALIAN CITIES – UTILISATION VS POPULATION SIZE



Source: Arup analysis based on ABS data (2008)

¹⁰ AER. *State of the Energy Market*. 2012.

¹¹ 2006 Census, Australian Bureau of Statistics

Water & sustainability

Climate change is expected to increase the frequency of extreme weather events, including periods of drought. This will directly impact the security of water supply in Australia's cities, which have a heavy reliance on established rainfall patterns to source potable water.

Water efficiency measures, water restrictions and behaviour change arising from community awareness of water scarcity have all helped reduce the per capita demand for potable water. While restrictions were temporary, the effect on per capita consumption may be more permanent, with per capita consumption not yet returning to pre-restriction levels.¹²

Alternative sources of water, including desalination, bring other challenges. These technologies are generally energy intensive and have the potential to contribute to additional carbon emissions in generating energy for these plants.

WITH AN INCREASED EMPHASIS ON RECOVERY AND REUSE, TECHNOLOGIES SUCH AS HEAT RECOVERY IN COGENERATION PLANTS AND WATER RECOVERY IN WATER TREATMENT PLANTS CAN HELP TO REALISE EFFICIENCIES ACROSS BOTH WATER AND ENERGY.

Waste & sustainability

Population growth will increase municipal solid waste (MSW) generation directly, as well as indirectly through associated increases in commercial and industrial (C&I) and construction and demolition (C&D) waste streams.

While the depletion of natural resources has been a major driver for resource recovery in the waste sector over the past two decades, Australia lags other developed nations in recovery rates and waste minimisation, or in utilising the ability for innovative infrastructure solutions to deliver greater environmental outcomes.¹³

The degradation of biodegradable waste disposed in landfills is responsible for almost three per cent of Australia's emissions and the waste sector is within scope of the Commonwealth's proposed carbon price.¹⁴ The introduction of the carbon price has the potential to make new low carbon technologies more cost effective.

Across the globe there is an increasing recognition of the contribution waste materials can make to energy provision. SBI Energy estimates there is potential to supply 10 per cent of the world's total electricity needs by recovering energy from waste.¹⁵ It reports waste already provides 14 per cent of Finland's total electricity requirements and six per cent of Denmark's, while the power generated from waste feedstocks in the US currently would be enough to power Western Australia, Tasmania and South Australia combined.¹⁶

In contrast, bioenergy is a significantly under-exploited resource in Australia representing less than 0.5 per cent of Australia's energy consumption.¹⁷ Australia's energy-from-waste industry is currently dominated by landfill gas extraction and anaerobic digestion technologies. There are considerable opportunities to develop new resource recovery technologies, including advanced thermal treatments that can convert waste to a range of energy sources including gas and fuel; however a concerted public education campaign is required to address the unpopularity of these technologies.

In addition to generating energy from waste, there are also opportunities for using waste as a raw material in compatible industrial processes and as an industrial fuel.

12 WSAA, 2005, *Testing the Water: Urban Water in Our Growing Cities: The Risks, Challenges, Innovation and Planning*, Position Paper No. 1

13 Department of Environment Heritage Water and the Arts, 2010, *National Waste Report 2010*

14 Australian Greenhouse Office, 2010, *National Greenhouse Gas Inventory: Accounting for the Kyoto Target*

15 SBI Energy, Thermal and Digestion: Waste to Energy Technologies Worldwide report 2011.

16 *Inside Waste Industry Report 2011-12*. Prepared by WME, Hyder and Waste Management Association of Australia, 2011.

17 Geoscience Australia and ABARE, 'Australian Energy Resource Assessment', Geoscience Australia, March 2010.



2.0 Greater transparency & accountability

As critical centres of economic activity Australia's cities are too important not to have strong levels of transparency and clear lines of accountability in respect to their functional performance. But despite several important developments at the Commonwealth and state level in recent years, processes for measuring performance remain largely intangible while accountability for performance remains blurred.

The importance of setting more tangible performance targets both at the sector (i.e. road congestion) and city-wide level (i.e. liveability/sustainability) is already starting to be recognised by cities overseas. If Australia's cities are to remain competitive by markedly lifting their functioning capacity then policymakers here must also embrace the need for greater transparency through benchmarking, as well as clearer lines of accountability across and within government.

This section of the paper assesses the strength of current performance monitoring in respect to Australia's cities, and explores opportunities to further strengthen transparency and accountability based on best-practice in Australia and overseas.

AS CRITICAL CENTRES OF ECONOMIC ACTIVITY AUSTRALIA'S CITIES ARE TOO IMPORTANT NOT TO HAVE STRONG LEVELS OF TRANSPARENCY AND CLEAR LINES OF ACCOUNTABILITY IN RESPECT TO THEIR FUNCTIONAL PERFORMANCE.

2.1 ESTABLISHING TANGIBLE BENCHMARKS

The Commonwealth Government's *State of Australian Cities* report, first published in 2010, represents a significant step forward in improving the transparency of cities' performance. Drawing together existing data across a range of economic, social and environmental parameters the report provides an important national snapshot of Australia's eighteen largest urban centers, guiding policymakers in managing growth and behavioral change. The commitment to continually update the report will also prove essential in highlighting emerging trends and issues and in driving continuous improvement.

The 2011 release of the Commonwealth Government's National Urban Policy *Our Cities, Our Future* represented a further welcome development. Underpinned by the State of Australian Cities report's strong evidence base, *Our Cities, Our Future* provides a useful blueprint for guiding policymakers and importantly, establishes shared principles and objectives across all levels of government.

But while these developments have undoubtedly strengthened transparency and accountability in respect to the functioning of Australia's major cities, there is clear room for improvement. In particular, a more robust assessment of the actual performance – and progress over time – of Australia's major cities is needed to drive improved outcomes. To this end, the Productivity Commission should be immediately tasked with developing tangible performance benchmarks for Australia's major cities aimed at both a sector (i.e. transport, water, electricity, waste) and city-wide (i.e. liveability, sustainability) level. Rather than a direct comparison of performance particular jurisdictions should be assessed on their progress against these benchmarks over time; accounting for the unique challenges and existing capacity constraints of Benchmarks should also be reviewed regularly to ensure continuous improvement. Progress in meeting benchmarks should be independently audited and published on an annual basis.

The considerable gains that stand to be achieved through tangible and publicly reported benchmarking have been well demonstrated at a state level through strategic planning frameworks. For example, South Australia's *State Strategic Plan*, which is publicly available and supported by an interactive website, outlines a series of key indicators and targets that can be used for measurement and reporting purposes. The South Australian Government reports on current performance against the targets and also on the likelihood of achieving the targets over the life of the Plan.¹⁸ The State Plan is also accompanied by a *Plan for Greater Adelaide*.

Cities overseas have also begun to increase transparency of their functional performance, in-turn strengthening lines of accountability. For example, New York City launched a *Citywide Performance Reporting system (CPR)* in 2002 enabling members of the community and service delivery providers to monitor how well the city is performing in more than 500 service categories. CPR also assists with strategic planning by enabling authorities to map service requests and locate hotspots of activity.

▼ CASE STUDY

NEW YORK CITY – CITYWIDE PERFORMANCE RATING SYSTEM

In 2002 NYC launched a Citywide Performance Reporting system (CPR) designed to instil greater transparency and accountability in respect to the city's performance.

As well as enabling individuals – through a website – to see how the city is performing in more than 500 categories of services, CPR enables authorities to map service requests and locate hotspots of activity.

In the context of the Federal Government's US\$800 billion stimulus package, the CPR platform was upgraded to help the city manage its US\$7 billion allocation of stimulus funds. This involved the development of a Stimulus Tracker, enabling the public to follow stimulus funding by project, job type, or location, and to track key success measures, such as job creation.

Source: www.nyc.gov

2.2 STRONG COMMONWEALTH LEADERSHIP

Commonwealth leadership is also needed to deliver meaningful change to the functional performance of Australia's cities.

Recognition of the Commonwealth's role in developing Australia's cities, beyond its stewardship of the national economy, has increased markedly in recent years. Particularly through the *State of Australian Cities* report and National Urban Policy the Commonwealth has displayed clear thought leadership in establishing broad objectives as well as optimal policy and planning settings. The linking of strategic planning criteria with Commonwealth infrastructure funding decisions is a further welcome step and demonstrates the capacity for the Commonwealth to be a strategic stakeholder in the cities debate.

The Commonwealth should continue to build on this leadership role, particularly in exploring and promoting the policy and planning settings that are required to improve the productivity, livability and sustainability of Australia's cities. However, closer engagement in urban issues must also be accompanied by a drive for greater clarity of Commonwealth structures and policies. While its structures and policies do not need to be fully integrated with state and territory functions, the Commonwealth's approach to urban issues must, at the very least, consider critical points of interaction and coordination with policies and programmes of other levels of government.¹⁹

Ultimately, no one government or sphere of government has all the policy responsibility or expertise for the functioning of Australia's major cities. As such, it is essential that future drivers for the development of cities, whether clearly defined performance benchmarks or broad policy objectives, are developed collaboratively across all levels of government.



3.0 Long-term, integrated planning

The demand for infrastructure is driven by both land-use within cities and the behaviours of the population. Government has the ability to influence both these factors through land-use plans and targeted behavioural change initiatives.

New infrastructure also has the potential to impact on many city systems. Understanding these impacts on a city-wide scale are important when developing plans and delivering new infrastructure. This section focuses on the following key themes relating to integrating land-use and city-wide planning:

- *Integrating land-use and infrastructure planning* – Adopting integrated approaches to land-use and infrastructure planning will result in better quality plans which respond more effectively to population growth, technological change and sustainable development.
- *Systems approaches to achieve city-wide benefits* – Significant structural differences to the sustainability and productivity of cities can be achieved by more effectively integrating their functional systems, and building on their competitive advantages through agglomeration and improved accessibility.

THERE IS GROWING RECOGNITION OF THE IMPORTANCE OF INTEGRATED CITY PLANNING, WITH THE COUNCIL OF AUSTRALIAN GOVERNMENTS (COAG) AGREEING THAT ALL STATES MUST DEVELOP PLANS THAT MEET NEW NATIONAL CRITERIA FOR CAPITAL CITIES BY 1 JANUARY 2012.

3.1 INTEGRATING LAND-USE AND INFRASTRUCTURE PLANNING

Land-use (spatial) plans provide a mechanism for managing the growth and change of cities, with an objective of improving quality of life, maintaining prosperity for communities and protecting the natural environment. Spatial planning includes the infrastructure required to meet the needs of the community.

The role of different levels of Government

Lack of integration and poor strategic alignment of metropolitan planning and infrastructure delivery detracts from productivity, sustainability and liveability of cities.²⁰

There is growing recognition of the importance of integrated city planning, with the Council of Australian Governments (COAG) agreeing that all states must develop plans that meet new national criteria for capital cities by 1 January 2012.²¹ The Commonwealth's National Urban Policy places further focus on integration and strategic alignment of metropolitan planning and infrastructure delivery.²² Since *Infrastructure Australia* (IA) was established in 2008 there has also been a transformation in the approach to Australia's national infrastructure policy through the development of an annual priority list of projects and the first ever national audit of infrastructure.

These initiatives are a positive step forward in improving the clarity of planning priorities for major infrastructure projects within Australian cities. There is however an opportunity to develop a more inclusive approach to preparing land-use and infrastructure plans.²³

While jurisdictions around Australia are making progress individually, state government planning and infrastructure departments generally have sole responsibility for capital city strategic planning with limited input and buy-in from other government stakeholders. A more inclusive approach to land-use and infrastructure planning would bring key stakeholders into the process in a more strategic way, including:

- Treasury departments – in relation to long-term, fiscal planning for major infrastructure requirements
- Environment departments – in relation to the application of biodiversity, water and climate change policies; and
- Other agencies whose local decisions have impacts upon settlement and travel patterns.

²⁰ *Our Cities, Our Future* – A national urban policy for a productive, sustainable and liveable future. Department of Infrastructure and Transport, 2011, p.72.

²¹ Council of Australian Governments, *Communiqué*, 7 December 2009, Brisbane, pg.8.

²² *Our Cities, Our Future*, op. cit.

²³ *Built Environment Meets Parliament Discussion Paper – Spotlight on Australia's Capital Cities – An independent assessment of city planning systems*. Prepared by KPMG for Built Environment Meets Parliament.

Similar issues exist outside of the capital cities. More inclusive planning approaches have the potential to secure wider support for infrastructure proposals and increase the likelihood of effective delivery. More effective integration of land-use and infrastructure planning will also enable infrastructure options to be considered at an earlier stage when genuine options are still available. The New South Wales Department of Planning and Infrastructure and *Transport for NSW* are positive examples of a new approach in attempting to pull together all government interests upfront in strategic land-use and infrastructure plans.

Evidence based planning

Gathering the right evidence to support infrastructure decisions provides a number of benefits. Decisions supported by a strong evidence base have a higher likelihood of delivering the right infrastructure, and provide the wider community with confidence that the right infrastructure decisions are being made.

The establishment of *Infrastructure Australia* was a positive step in ensuring that the right infrastructure projects are selected for funding. In particular, the rigour associated with its approach has the potential to provide greater certainty and continuity through political cycles. At the state level, *Infrastructure NSW* represents a further positive step in supporting this approach. This process also has the potential to build trust in the community that infrastructure planning is not being driven by short-term political agendas that may not be in the best interest of the wider city. This process also has the potential to provide business and industry with greater certainty and confidence relating to future infrastructure.

However, the current situation still provides limited information on the supply pipeline, from land identification to development approval stage, for infill and greenfield development. This makes it difficult to effectively plan for the timely delivery of appropriate infrastructure.²⁴

Understanding the costs of land-use strategies

Over the past decade a number of studies have shown that the low density development of Australian cities makes infrastructure and associated services more expensive, less efficient and more damaging to the environment.²⁵ For the most part these studies have focused on transport-related infrastructure; however the same issues from low density development are present for energy, water and waste related infrastructure. The composition of housing stock in Australia is dominated by low density detached housing which makes up approximately 79 per cent of housing, with 9.4 per cent being semi-detached houses and 10.4 per cent being flats, units or apartments.²⁶ While the CBDs of cities have higher concentrations of multistorey residential apartment buildings, densities generally decrease rapidly towards the outer areas. Exceptions to these patterns can be found on the Gold Coast, where high-rise residential buildings extend along the coastline, and in Sydney, where higher density residential development can be found around each of the major centres encompassed by the metropolitan area.²⁷

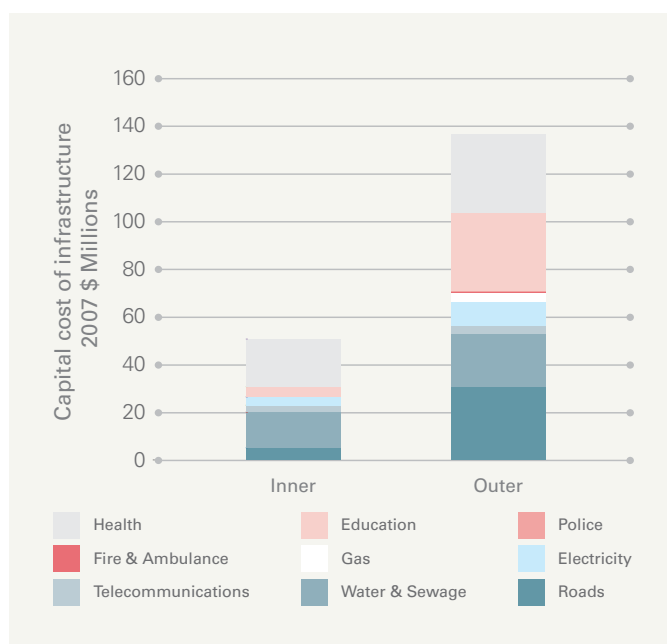
Figure 7 below shows the comparative capital costs for infrastructure associated with developing 1,000 new dwellings.²⁸ The comparison is between developments occurring in the inner and outer city. It shows that outer suburban development is estimated to cost around 2.5 times that of inner city development.

In developing land-use strategies, it is important that the cost and efficiency of associated infrastructure is considered. The broader costs and benefits of outer and inner ring development are important to recognise as part of integrated plans and the viability of infrastructure projects.

The following sections focus on each of the infrastructure areas defined in this report, and the importance of integrating infrastructure planning with land-use.

▼ FIGURE 8

CAPITAL COSTS OF INFRASTRUCTURE REQUIRED TO SERVICE 1,000 RESIDENTIAL DWELLINGS²⁹



Source R. Trubka, P. Newman and D. Bilsborough, 2008

3.1.1 Water infrastructure & land-use planning

Water infrastructure is generally sized and installed for the maximum predicted flow of future development. This allows new development to be incrementally added to the wider grid as it develops. However, developments isolated from wastewater grids face challenges in the supply of services. Establishing wastewater infrastructure for isolated developments is often not economical until the size of the development is sufficient to provide a suitable demand volume.

²⁴ Built Environment Meets Parliament Discussion Paper – Spotlight on Australia's Capital Cities – An independent assessment of city planning systems. Prepared by KPMG for Built Environment Meets Parliament.

²⁵ R. Trubka, P. Newman and D. Bilsborough, *Assessing the costs of Alternative Development Paths in Australia Cities*, Curtin University Sustainability Policy Institute Fremantle, prepared for Parsons Brinckerhoff; Centre for International Economics, 2010, *The Benefits and Costs of Alternative Growth Paths for Sydney: Economic, Social and Environmental Impacts*, Prepared for the Department of Planning; *Infrastructure Australia Major Cities Unit. State of Australian Cities* 2010. Australian Government 2010.

²⁶ Dodson, J & Sipe, N 2008, *Unsettling suburbia: The new landscape of oil and mortgage vulnerability in Australia's cities*, Research Paper 18, Urban Research Program, Griffith University, Brisbane

²⁷ Ibid.

²⁸ R. Trubka, P. Newman and D. Bilsborough, *op. cit.*

²⁹ Ibid.

Some land and property developers have elected to build and own wastewater treatment infrastructure in the early phases of development, using a more scalable and modular approach that more closely aligns with the demand profile of the development. However, longer-term planning for wastewater infrastructure by government is generally not undertaken for new isolated developments. This provides uncertainty around how long modular wastewater solutions will be required, and specifically when a connection to the larger scale city wastewater treatment may be expected.

Planning of city fringe developments should consider the implications for wastewater infrastructure, and identify plans that incorporate short and long-term solutions. This includes identifying sites for wastewater infrastructure, and consideration for how these may be integrated to the city system.

▼ CASE STUDY

LIVING MELBOURNE, LIVING VICTORIA – OFFICE OF LIVING VICTORIA

In recent years Victoria has taken some important steps towards better integrating water infrastructure with land-use planning.

In 2011 the Victorian Government established a Ministerial Advisory Council (MAC) tasked with providing independent advice on the changes needed to improve liveability in Melbourne through better planning and management of urban water systems. The Victorian Government's response to the MAC's report has been a positive one, with a commitment to establish an Office of Living Victoria (the OLV) tasked with driving reform and ensuring a more coordinated approach to water planning.

In particular, the creation of the OLV and associated reforms promises to deliver a water planning framework that is closely aligned with community needs and is fully integrated with urban planning. It also promises to drive a more integrated approach to projects and developments across rainwater, recycled water and stormwater sources.

3.1.2 Waste infrastructure & land-use planning

The major constraint on developing new landfill infrastructure in Australian cities is often community objections during the planning process.³⁰ Similarly, a key factor in the limited roll-out of treatment technologies in Australia is community fear of air quality impacts from the incineration of waste.³¹

There is a need for waste infrastructure sites to be identified early in order to build acceptance within the wider community. This site identification process is most effectively undertaken as part of the land-use planning process when genuine site

alternatives can be examined. Without early identification, land considered suitable for these sites (and land immediately adjacent) is often developed for residential or other purposes that make it very difficult to get retrospective acceptance from the community for waste infrastructure.

Community concerns – and associated politicised decision making – create significant commercial barriers for the private sector, in terms of timing and finance. The risk and cost associated with securing approvals for waste infrastructure sites means that it is harder for the private sector to get finance on attractive financial terms. Where possible, governments can significantly reduce this risk through early identification and reservation of waste infrastructure sites. Longer term infrastructure plans (five and 20-year time horizons) that identify all infrastructure needs, including waste, would also assist in elevating the planning debate and resolution.

This approach is employed in the United Kingdom, where local planning authorities are tasked with preparing waste development frameworks which identify sites for new waste infrastructure. These plans also set out priorities for waste infrastructure focused on resource recovery and establish appropriate policy controls for waste infrastructure. They are prepared in consultation with the private sector and the public to maximise the likelihood that new infrastructure will be delivered in accordance with the plan.

3.1.3 Energy infrastructure & land-use planning

A number of councils in Australian cities have been investigating thermal networks as a potential solution to help reduce or minimise CO₂ emissions, notably the City of Sydney and City of Melbourne councils.³² If fuelled by gas-fired combined heat and power plants, these networks can provide a substantial reduction in greenhouse gas emissions associated with space heating and cooling, domestic hot water and low temperature process heat. These pieces of infrastructure also provide future opportunity to be fuelled from renewable sources making them greenhouse gas neutral.

However the commercial viability of these networks is dependent on the consistency and density of thermal energy demand. The nature of land-use is a key factor in determining whether thermal energy networks are viable, with development diversity and density being critical drivers of demand consistency. The traditional Australian approach to the development of cities which makes extensive use of low rise, low density development represents a considerable barrier to distributed energy growth.

It is important that sites for distributed energy are identified as part of the spatial planning process, specifically recognising where there is a viable case for thermal energy networks (the right density and diversity of development). The importance of these schemes has been recognised by both Melbourne and Sydney city councils and this should be reflected in the land-use planning process.

³⁰ Hyder, 2009, *Australian Landfill Capacities into the Future*, prepared for the Department of Environment, Water, Heritage and the Arts

³¹ GHD, 2009, *Waste Technology and Innovation Study*, prepared for the Department of Environment, Water, Heritage and the Arts

³² Kinesis, 2011, *Decentralised Energy Master Plan: Trigen Master Plan*, prepared for the City of Sydney; Arup, 2008, *Zero Net Emissions by 2020: Update 2008*, prepared for the City of Melbourne,

3.1.4 Transport infrastructure & land-use planning

Investment in transport infrastructure has a greater return when patronage approaches the operating capacity of the infrastructure. Research also shows that energy consumption (on a per capita basis) relating to transport decreases where urban density increases.³³ This implies more sustainable transport is associated with higher urban densities.

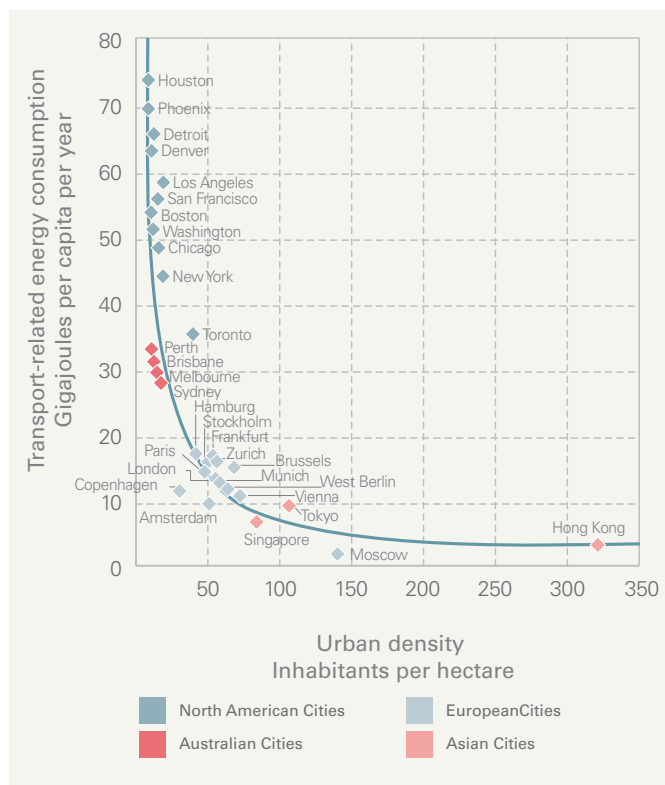
Patronage and utilisation of transport infrastructure is heavily influenced by the land-use of adjacent and surrounding areas. Transport (or Transit) Orientated Development (TOD) is generally a mixed use (e.g. residential and commercial) development designed to maximise access to and use of public transport. A public transport hub forms a key element of the development, enabling people to walk from most parts of the development.

The success of TODs relies on densities surrounding transport infrastructure being appropriate to the capacity of the infrastructure. TODs are often designed with high frequency transport services that have the capacity to service a significant proportion of the transport needs of the development. In order to increase the utilisation of transport infrastructure, development is often designed to be diverse, with mixed use development a key element of TODs. This provides employment opportunities and creates a destination for commuters, generating transit trips and providing activity during working hours.

In order for TODs to be successful, it is critical that land-use plans are integrated with transport plans. Developments surrounding appropriate transport infrastructure should be optimised to ensure that public transport infrastructure utilisation (and investment) is maximised.

▼ FIGURE 9

URBAN DENSITY AND TRANSPORT RELATED ENERGY CONSUMPTION



Source: Newman P. & J.R. Kenworthy. Sustainability and Cities: Overcoming Automobile Dependence. 1999

▼ CASE STUDY

SUBI CENTRAL TRANSPORT ORIENTED DEVELOPMENT

Subi Central, located at Subiaco in Perth, Western Australia, is an example of a highly successful TOD. Previously an industrial site, the area has been transformed into a major mixed-use urban centre. The development includes over 1,350 new dwellings and 7,000m² of retail. Retail, residential and commercial uses are concentrated around the Subiaco train station and a new supermarket node and high quality public realm contribute to a vibrant precinct attracting almost triple the patronage to Subiaco train station when compared to 1999 patronage levels.



33 Newman P. & J.R. Kenworthy (1999). Sustainability and Cities: Overcoming Automobile Dependence. Washington DC: Island Press.

3.2 CAPTURING CITY-WIDE BENEFITS

Cities consist of a number of interrelated networks, including transport networks, social networks, business networks, water supply networks, energy networks, waste management networks and many others. The health of communities, what it costs people to live in cities, where and how food is accessed, whether people walk or drive to work, how much people see their friends, and how safe they feel are all influenced by the city's structure, its buildings, systems and services.

The benefits of infrastructure projects are often wide ranging and extend beyond the original intent and functional demand. Individual projects in one network will often impact many other city networks. Evaluating and capturing the holistic impacts on city-wide networks is important in selecting and scoping projects that deliver the best value across the whole city system.

Systems thinking provides an approach to understanding the nature and inter-relationships between city networks. It provides a method for taking advantage of the synergies that exist within a city's systems by looking at each issue as part of an overall system, rather than isolating individual components in a static analysis. Systems thinking also uses cyclical rather than linear cause and effect relationships.

This section discusses how each of the four infrastructure types considered by this report have the potential to deliver benefits across multiple networks.

3.2.1 Energy, waste and water – Integrated solutions

Integrated infrastructure solutions that combine energy, waste and water have the potential to provide benefits across multiple city systems that would not be evident if the infrastructure was approached in isolation. Traditionally, major infrastructure is centralised in large scale plants to maximise the efficiency of the operation. This measure of operational efficiency may be simplistic as it does not necessarily consider the impact across other city systems, including transportation and logistics, system resilience and security of supply.

Infrastructure that spans multiple areas, such as energy from waste plants and integrated energy and water plants, impact the broader city system in a number of ways. For example, a distributed energy from waste plan provides a solution that reduces the demand on landfill, while providing local energy in the form of electricity and direct heat. It also reduces the requirement for transport of waste and the demands on the electricity distribution network by providing energy locally.

When planning and evaluating these infrastructure projects, the impact across city networks should be evaluated in a holistic way. The benefits of these projects across transport, waste, water and energy networks provide a wider value to a city that is often not captured in a linear business case approach.

▼ CASE STUDY

VICTORIA: CREATING SERVICE EFFICIENCIES



Through undertaking the *Transforming Australian Cities report*, the Victorian Government, in association with the City of Melbourne, recognised the need for spatial and infrastructure needs to be planned in coordination.

The report highlights the need for compact settlement patterns to support better use of infrastructure, in particular transport infrastructure. The plan focuses on maximising development around trunk public transport routes to create urban corridors. In proposing this, the report understands that this approach must be politically palatable, and that conveying the realities of higher densities to the public is a key component of enabling acceptance and traction on the development of this approach.

The urban corridor approach is analysed to present significant cost benefits, with the report suggesting that urban infill development will save Melbourne approximately \$110 billion over the next 50 years. A major benefit of the urban corridor approach is that Australian cities could immediately start to move to improve their long-term liveability, economic productivity and environmental sustainability, through the positive forces of the private market system, and achieve this by only changing about three per cent of the existing footprint of the city.

▼ CASE STUDY

HONG KONG SLUDGE TREATMENT TO ENERGY PLANT

The Hong Kong Government has commissioned the construction & operation of a sludge treatment plant – to treat the sewage generated by Hong Kong’s 11 sewage treatment plants. The plant will have a treatment capacity of 2,000 metric tonnes a day and will eventually produce over 20 MW of electricity.

It will be entirely self-sufficient; at full capacity, the energy generated from the plant will exceed its needs and any surplus electricity can be exported to the regional electricity grid. A seawater desalination plant will be used to produce up to 600KL/day of potable water to supply its needs. In addition, rainwater will be collected for non-potable use, and the wastewater produced will be treated and re-used on site. The facility also has an education centre and a spa for the community to use.



In Hong Kong, the Government has commissioned the construction of a sludge treatment plant that will treat sewage, generate over 20MW of electricity, utilise a desalination plant and rainwater collection, while also providing a leisure facility for the community.

3.2.2 Transport – Focusing on the whole network

There is a strong interrelationship between different transport modes in cities, with the infrastructure of each mode impacting on the utilisation of other modes. However, the planning and delivery of transport has traditionally been separated, with government having separate departments for roads, rail, buses and other forms of transport.

The importance of integrated transport planning has been recognised by the New South Wales Government, moving to set up a consolidated transport planning department. This has the potential to improve the coordination and evaluation of all transport infrastructure, ensuring that the right infrastructure and best value for money is achieved across a unified transport network.

Applying a systems thinking approach for the transport network involves considering infrastructure as a unified transport network, implementing the right transport-wide governance and optimising legacy transport infrastructure across all transport modes.

Planning a unified network

There is an increasing recognition that public transport operates most successfully when it is planned as a unified network, supporting seamless multi-destination travel rather than as individual lines catering to single trips.³⁴

Public transport systems designed around widely distributed networks, which intersect to support multiple transfers, offer a wider choice of trip making. This allows a trip to be based on individual destination and journey preferences rather than attempting to cater for every potential origin destination combination by supplying routes to satisfy these travel opportunities.³⁵ This is particularly relevant in Australian cities that have dispersed urban environments.³⁶ The challenge in effectively implementing a network based system is ensuring a fast seamless interconnected trip, optimised to provide a competitive travel experience in comparison to car travel.³⁷ This planning task includes network and line structures as well as timetables, tickets and overall ‘branding’.

Integrated ticketing is an important part of planning a unified network and increasing patronage. Evidence suggests that high patronage is difficult to achieve where transport modes are treated as separate commodities and consumers must select custom options to match their intended travel.³⁸ The use of public transport has shown to be maximised when travellers pay for access to the total aggregate network.³⁹

34 Jago Dodson, Paul Mees, John Stone and Matthew Burke. *The Principles of Public Transport Network Planning: A review of the emerging literature with select examples*. Griffith University Urban Research Program, Issues Paper 15, March 2011.

35 Ibid.

36 Ibid.

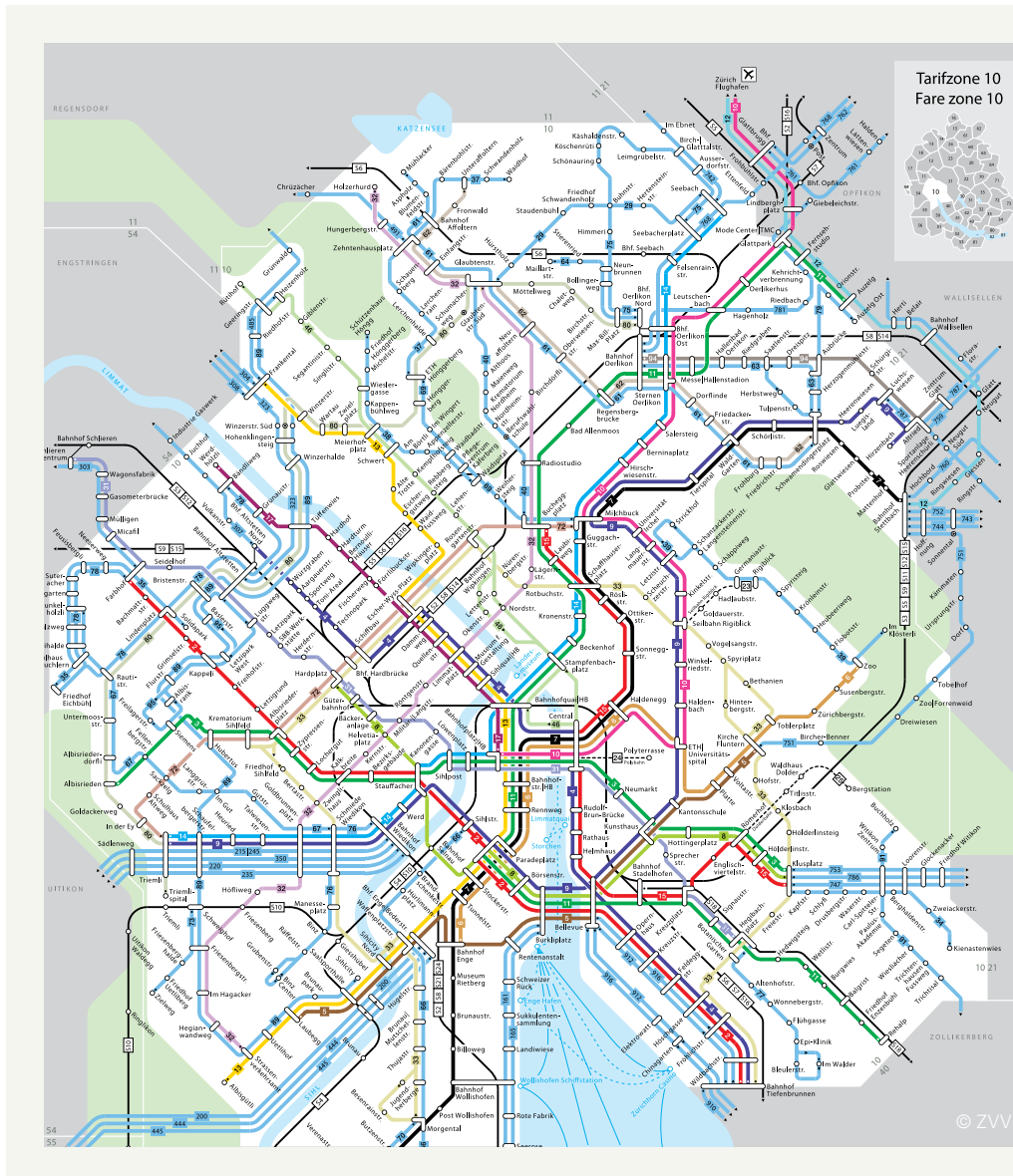
37 Ibid.

38 Mees, P. (2000). *A Very Public Solution: Transport in the Dispersed City*. Melbourne, Melbourne University Press.

39 Nielsen, G., Nelson, J., Mulley, C., Tegner, G., Lind, G. and Lange, T. (2005). *Public Transport – Planning the Networks – HiTrans Best Practice Guide 2*. Stavanger, Norway, European Union Interreg III and HiTrans; Mees, P. (2010). *Transport for Suburbia: Beyond the Automobile Age*. London, Earthscan; Stone, J and Mees, P. *Planning public transport networks in the post-petroleum era*. Australian Planner. Volume 47 Number 4 – Cities and Oil Vulnerability, p263-271.

▼ CASE STUDY

ZURICH PUBLIC TRANSPORT NETWORK



Zurich is a highly successful dispersed public transport network with one of the highest per capita rates of public transport use in the developed world. The structure of the network is focused around a set of radial rail and tram lines intersected by multiple, generally circumferential, bus routes. Each rail, tram or bus line intersects with multiple other lines creating a web of multi-directional transfers.

Services on most of the bus and tram lines operate at frequencies of 7.5 minutes resulting in short waiting times for transfers between most services on the network and regular and easily remembered service times that largely eliminate the need for timetables on most lines (although these are provided).

Public transport governance

In order to plan a unified planning network, it is important that the right governance structure is established to plan, deliver and operate parts of the network. Australian cities, states and territories have a number of different models for transport infrastructure with different levels of integration across transport modes.

To ensure that the network is unified and evaluated across all infrastructure types, it is important that the organisation responsible for planning the transport network spans all transport modes. This includes responsibility for planning a safe, reliable and

efficient network or service expansion, specifying and integrating service characteristics for operators, managing operator subsidies, designing attractive fare structures to support the network, undertaking better marketing of the overall system, and managing network financing. It is not essential that this organisation operate the public transport services that it plans.⁴⁰

Operators of public transport services should be engaged as a service provider⁴¹ with agreed service levels. This includes management and maintenance of all fleet factors, including vehicles, staffing, work schedules and maintenance. This applies to both private and public sector operators.

40 Jago Dodson, Paul Mees, John Stone and Matthew Burke. *The Principles of Public Transport Network Planning: A review of the emerging literature with select examples*. Griffith University Urban Research Program, Issues Paper 15, March 2011.

41 Ibid.

Optimising legacy public transport infrastructure

Concerns about capacity on rail networks have emerged in Sydney, Melbourne and Brisbane. Transport planning agencies in these cities have argued that systems face ‘capacity issues’ requiring multi-billion dollar infrastructure investments in order to keep up with growth for demand.⁴²

Future investment in transport networks should be optimised to ensure that the best value for money is achieved. This includes carefully evaluating the available options, including a sensible base case, and appropriate options for upgrading existing infrastructure.

Comparisons with other public transport networks suggest that Australia’s transport infrastructure has the potential to provide more capacity. Australian public transport networks have lower patronage loads than those of high performing systems in Europe.⁴³ The options for increasing patronage on existing infrastructure, including by technology upgrades and addressing network bottlenecks, should be explored and evaluated against any proposals for new infrastructure.

When evaluating these options, it is important to consider the city-wide impact on the entire transport network. The capacity of existing infrastructure can often be increased through technology upgrades, timetabling efficiencies, or other augmentations that build on existing transport infrastructure. However, changes to timetables on one transport mode also have the potential to degrade patronage if connecting transport modes are not aligned. Similarly, augmentation of existing networks can be of limited benefit if the key bottlenecks in adjoining parts of the network are not addressed.

COMPARISONS WITH OTHER PUBLIC TRANSPORT NETWORKS SUGGEST THAT AUSTRALIA’S TRANSPORT INFRASTRUCTURE HAS THE POTENTIAL TO PROVIDE MORE CAPACITY.

▼ CASE STUDY

CH2 MELBOURNE



The Council House 2 (CH2) building in Melbourne is an example of a building retrofit which considered the water-energy nexus. The council implemented integrated water management without increasing greenhouse gas emissions.

The building has its own water reduction scheme and utilises wastewater from the building and sewer and harvested stormwater for non-potable supply. The building also has a renewable energy system strategy, which uses co-generation and solar photovoltaic cells to supply 32 per cent of the site’s electricity. The remaining electricity is funded by green power. If the energy was sourced conventionally this would generate 764 tonnes of greenhouse gases.

⁴² Stone, J and Mees, P. *op. cit.*

⁴³ *Ibid.*

3.2.3 Energy and Water – Getting the balance right

Traditionally, water has been sourced from surface waters and groundwater. However, recent trends have moved toward the use of alternative water sources such as wastewater, seawater and stormwater. Although these methods reduce the pressure on surface water supplies they also require more advanced treatment technologies and are often more energy intensive.⁴⁴ Figure 10 below shows the energy intensity of supply from a range of water sources. Sourcing clean water from seawater and wastewater are the most energy intensive methods. These methods have also been the recent focus for governments around Australia, with several new desalination plants being commissioned in the last 10 years.

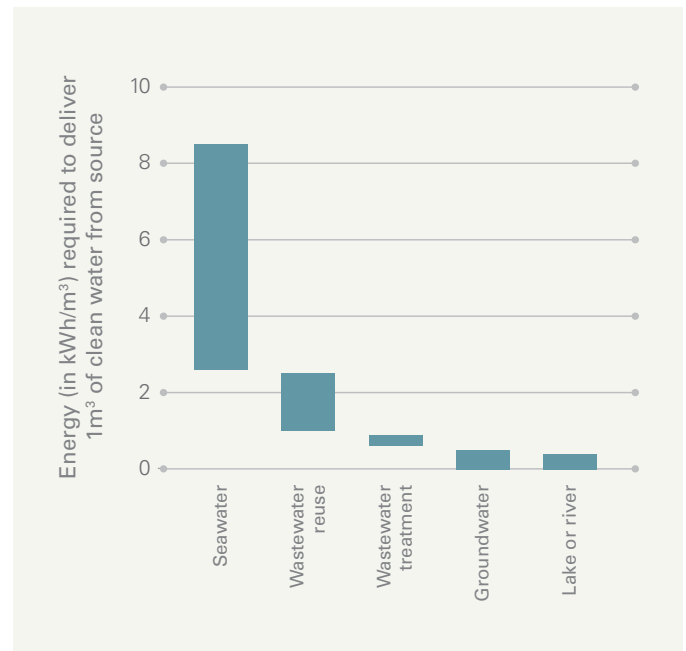
The trend towards alternative water sources has provided benefits by reducing the reliance on surface water, but has increased the demand for energy. The carbon impact of these projects has not always been calculated, and it has been suggested that the projects have come at an increased economic and environmental cost.⁴⁶

An understanding of the interactive relationship between water and energy is important in reducing the operational energy costs and carbon impacts of the water industry.⁴⁷ Developers and owners of new buildings are often focussed on designs that achieve high efficiency ratings for both energy and water. However, a high rating for water often requires sourcing water from an energy intensive method, potentially reducing the energy rating of the building. The Council House 2 building in Melbourne addressed the entire carbon impact by sourcing the energy required from renewable sources.

It is important that water infrastructure considers the total impact on the various systems that it touches, including carbon emissions and the requirements around energy infrastructure.

▼ FIGURE 10

ENERGY INTENSITY COST BY SOURCE



Source: Colonial First State Group, 2011. Carbon regulation and infrastructure: risk or opportunity? Infrastructure Research Paper⁴⁵

44 Colonial First State Group, 2011. *Carbon regulation and infrastructure: risk or opportunity?* Infrastructure Research Paper.

45 Available at: http://www.cfsgam.com.au/uploadedFiles/CFSGAM/PdfResearch/110722_Carbon_Regulation_and_Infra.PDF

46 Rocheta E and Peirson W, 2011. *Urban water supply in a carbon constrained Australia*. UNSW.

47 WSAA, 2009. Position Paper Vision for a sustainable urban water future

4.0 Effective demand management

Forecasting infrastructure requirements depends on understanding demand. Conventional practices of infrastructure delivery have a tendency towards 'predict and provide' service provision, with forecasts of increasing demand met in advance through supply oriented options such as new power stations, landfill, road or reservoir construction. However, actively managing and influencing demand patterns have the potential to increase the value from infrastructure investment.

Demand management includes initiatives such as encouraging off-peak usage of transport and energy networks, reducing the total demand for potable water, and changing the amount of waste produced and recovered for recycling. These initiatives can help to optimise the utilisation of existing infrastructure, and delay or negate the need for new infrastructure. It also provides an opportunity to achieve more sustainable outcomes through encouraging demand for more sustainable infrastructure types.

DEMAND MANAGEMENT CAN HELP TO OPTIMISE THE UTILISATION OF EXISTING INFRASTRUCTURE, AND DELAY OR NEGATE THE NEED FOR NEW INFRASTRUCTURE.

4.1 WATER – REDUCING TOTAL DEMAND

Until the recent introduction of desalination plants in Australia, water supply was largely dependent on rainfall in catchment areas. The size of the catchment area and associated dams was designed to service a projected population based on a per capita usage. However, a prolonged period of low rainfall in catchment areas reduced the supply in dams.

A number short, medium and long-term initiatives commenced in order to secure a continuous water supply for Australian cities. This included imposing water restrictions (short-term), the construction of desalination plants and recycling schemes (medium-term) and the investigation of increasing capacity of catchment infrastructure (long-term).

Water restrictions had a significant impact on reducing the demand on potable water, spanning residential, commercial and industrial users. The Institute for Sustainable Futures and ACIL Tasman assessed the impact of water restrictions across Australia and concluded that the restrictions resulted in a demand reduction of between 8 per cent and 33 per cent (depending on location and the stage of restrictions). The Australian Bureau of Statistics also reported that during the period of water restrictions, (between 2004-05 and 2008-09) total water consumption in those cities declined by 25 per cent.⁴⁸

In addition to increasing the efficiency of end use through upgrades (water efficient shower heads, aerators, more efficient industrial sprays and the introduction of recycled water for suitable applications) a number of behavioural changes were also introduced. These behavioural changes included banning the hosing of hard surfaces.

Although the restrictions were temporary, the impact that restrictions had on reducing per capita usage have been mostly permanent. Per capita water usage has not returned to pre-restriction levels following the easing or lifting of water restrictions in major cities. The Water Services Association of Australia (WSAA) has projected a decrease in per capita demand in Sydney and Perth from 2009 to 2026. Looking further ahead, per capita demand is projected to decrease in all capital cities from 2026 to 2056 due to advances in water efficiency and the expected trend towards higher density living.⁴⁹ However, urban water restrictions – which remain in place in cities and towns across Australia – have placed significant economic costs on households and businesses. Depending on their severity and frequency, water restrictions are estimated to have cost the economy between \$800 million and \$3 billion per annum Australia-wide.⁵⁰

48 Water Account Australia 2008-2009. Australian Bureau of Statistics, cat no 4610.0.
49 Water Services Association Occasional Paper No 25. July 2010

50 Allen Consulting Group. *Saying goodbye to permanent water restrictions in Australia's cities.* 2009. Report prepared for Infrastructure Partnerships Australia (IPA).

Accordingly, while demand management should continue to form a critical component of the broader planning process for water infrastructure delivery, governments must move beyond water restrictions longer-term and economically prudent solutions. Transitioning away from rigid pricing regimes towards rational water pricing should be a key priority in this regard. The National Water Commission (NWC) has recently stated that “incorporating the value of a supply-constrained resource into price signals has the potential to benefit government, water businesses and consumers.”⁵¹

4.2 WASTE – INFLUENCING WASTE GENERATION

Demand for waste infrastructure is driven by the amount of waste generated at source, the amount of waste diverted from landfill and targets for greenhouse gas abatement. Prevention and reduction of waste at source is a complex issue, and presents a number of challenges including influencing both the decisions of consumers and the practices of manufacturers of packaging products.⁵²

Consumer purchasing decisions are influenced through community and business education programmes as well as education across the full spectrum from formal education (e.g. in schools) to on-the-ground sessions (e.g. within businesses). Price mechanisms have also been introduced to encourage certain behaviours. Supermarket chain ALDI recently commenced charging for plastic bags and estimates that in a single year this initiative has prevented disposal of 150 million plastic bags. Other large supermarket chains have relied on education programmes, with success of these programmes having mixed reports.

Waste minimisation within industry has targeted packaging, which makes up approximately 10 per cent of total urban solid waste.⁵³ Industry has achieved reductions in packaging over the past two decades, driven largely by the incentive of achieving production cost reductions.⁵⁴ However, research shows that consumers still consider items to be over packaged, or packaged in materials that are difficult to recycle or re-use.⁵⁵

The Australian Packaging Covenant, which came into effect in 2010, documents a new agreement between companies in the supply chain and all levels of government to reduce the environmental impacts of consumer packaging through sustainable design, use and recovery of packaging.⁵⁶ The Covenant has the potential to encourage more sustainable behaviours, through increased recovery. The success of the Covenant should be closely monitored, with consideration of stronger regulation if timely results are not achieved.

The Australian Government has also recently agreed to develop and enact national legislation to support voluntary, co-regulatory and mandatory product stewardship, and extended producer responsibility schemes, starting with televisions and computers under the National Television and Computer Product Stewardship Scheme. This commitment is set out in the Government’s National Waste Policy: *Less waste, more resources*.

These developments represent positive steps forward, however there continues to be a strong reliance on industry cooperation in volunteering to be bound by regulation. The success of this approach should be closely monitored, with government ready to enact stronger regulation in the future if timely progress has not been made.

4.3 TRANSPORT – INFLUENCING TRAVEL BEHAVIOUR

The requirements for transport infrastructure are driven by demands during peak periods. Outside of peak periods, transport infrastructure typically operates below maximum capacity. This means that distributing demand away from peak periods has significant potential to better utilise existing infrastructure as well as mitigating the need for new infrastructure.

There are a number of initiatives that have potential to distribute peak demand including time-based transport infrastructure pricing and flexible employee start and finish times.

Time-based pricing on transport infrastructure has been introduced in a number of Australian cities. This includes road-based tolls (Sydney Harbour Bridge) and train ticketing (Melbourne). Both of these initiatives were successful in changing the behaviour of commuters, reducing the demand for infrastructure during peak periods. Other international cities, such as London and Singapore, have also introduced a congestion charge, imposing a cost for private and business vehicles in certain areas of the city at certain times. These initiatives are low cost, and have the potential to significantly improve the efficiency and value received from

51 National Water Commission. *Urban water in Australia: Future Directions*. 2011.

52 *Report from the Commission to the Council and the European Parliament on the implementation of Directive 94/62/Ec on packaging and packaging waste and its impact on the environment, as well as on the functioning of the internal market*. Commission of the European Communities, 2006.

53 Robin Tuckerman. *Packaging the Statistics*. Packaging Council of Australia 2005.

54 Ibid.

55 *National Waste Report 2010*. Department of the Environment, Water Heritage and the Arts and the Environment Protection and Heritage Council, 2010.

56 *Australian Packaging Covenant* (Available at: <http://www.packagingcovenant.org.au/page.php?name=home>)

transport infrastructure. Governments should continue to embrace these initiatives where potential benefits are clearly defined.

However, it is critical that these initiatives are only implemented where there are viable alternatives for commuters and there is a clear picture of what alternative is being encouraged. For example, before increasing the price of toll roads, it is important to understand what alternative routes and modes are available. If there are limited public transport options or these public transport options are at capacity, then increasing the price of toll roads is not likely to deliver benefits.

Similarly, encouraging off-peak travel must be accompanied by policy changes that allow flexible working hours. Government has an important role as an employer, as they currently employ a significant proportion of the workforce, and have the ability to influence this through policy change alone.

▼ CASE STUDY

DISCOUNT FARES FOR OFF PEAK COMMUTERS, VICTORIAN DEPARTMENT OF TRANSPORT



In an attempt to spread the load of passengers on Melbourne's public transport system during the peak periods, the Victorian Department of Transport has introduced the 'Early Bird travel' ticket.

The Early Bird ticket provides free travel on metropolitan Melbourne train services before 7.00 am on weekdays. Commentary on the initiative suggests that the Early Bird travel ticket had shifted up to 3000 people off the peak service to earlier services.

The Early Bird ticket scheme provides an example of price-based demand management, enabling better use of existing infrastructure. This initiative was enabled by the smartcard ticketing system, which accommodates variable pricing through an automated time-based system.

▼ CASE STUDY

BRISBANE CENTRAL



As part of the former Queensland Government's response to managing urban congestion, the Department of Transport and Main Roads launched the Flexible Work Program – Brisbane Central Pilot in 2009. The Program demonstrated that flexible work arrangements can reduce peak hour travel and result in an overall reduction in travel:

- Peak hour travel was reduced by 34 per cent in the morning and 32 per cent in the afternoon peak period amongst Pilot participants
- Car trips decreased by 43 per cent in morning and 45 per cent in afternoon amongst participants during the Pilot.

4.4 ENERGY – DISTRIBUTING PEAK DEMAND

The residential electricity demand profile in Australian cities currently has peak demand periods. These peak periods create a maximum instantaneous demand that drives the capacity requirements of infrastructure. However, the infrastructure only operates at this capacity during these relatively short peak periods, which results in poor allocative efficiency.

The variability of the demand on the electricity network has led to different categories of generation infrastructure based on the ability to supply base-load steady supply at a relatively low cost, versus peak load generation which is expensive but which can be turned on and off dynamically as demand peaks and declines. The peak electricity is typically delivered at a price premium, and spot prices for electricity can escalate rapidly in peak periods where supply is short.

At times of low demand, base-load generation continues whether or not there is demand, as large base-load power stations can generally not increase and decrease generation over a short period. Making use of the underutilised off peak generation capacity to displace peak demand assists with managing peak capacity issues. For example, hydroelectric power plants are able to utilise off-peak capacity by pumping water from the base of dams to the top of dams in order to generate and sell electricity at peak times.⁵⁷ Other innovative applications include the Singapore Marina Bay district cooling scheme which uses ice storage to replace peak electricity demand with off-peak demand.

The ability to better distribute demand on the electricity network directly impacts on the way that new infrastructure is planned and delivered. Investment in more expensive peaking plants may be reduced.

Demand for electricity may be influenced through introducing time-based pricing for retail consumers. This provides an incentive for consumers to shift consumption of non-time critical electricity such as hot water heating, dishwashers and washing machines. However, older style meters generally do not record the time of electricity consumption, only the total usage. Smart meters are required in order to address this issue.

In 2007 and 2008, the Ministerial Council on Energy decided the minimum functionality for smart meters to be rolled out across Australia's electricity networks, where the benefits outweighed the costs. Minimum functional requirements for smart meters being introduced are focused primarily on improving the efficiency of meter reading and allowing for future technology upgrades. The minimum functions do not include any measure for a consumer to access the data collected other than visually reading the meter.

▼ CASE STUDY

OPOWER (CALIFORNIA)



Opower, based in California, is a neighbourhood comparison tool for gas and electricity bills. Based on a foundation of consumer psychology, Opower used the notion that "Simple information about what constitutes a good choice is rapidly, almost primitively, processed." Residents receive reports showing how much energy they use in comparison to efficient neighbours and similar households in their neighbourhood. Customers in the programme have reduced annual energy usage by an average of 2.8 per cent, or the equivalent of 280 kilowatt-hours per year.

Implementation of more advanced functionality, including the ability for consumers to access real-time usage and pricing information, has the potential to distribute the demand more evenly across the network. Recent research from the United Kingdom focussed on the long-term impact from the installation of smart meters suggests substantial energy savings can be achieved from the wide spread adoption of this technology (when implemented with complementary communication systems).⁵⁸

The findings from the Energy Demand Research Project suggest that smart meters are a critical component in residential behaviour change and that with complementary services such as real-time displays and energy efficiency audits, an average long-term reduction in energy consumption of up to five per cent can be achieved. Using Time-of-Use tariffs in conjunction with smart meters and in-home displays resulted in a 10 per cent shift in power consumption away from the peak periods.⁵⁹

Future government and industry electricity infrastructure planning should include initiatives to manage and distribute peak demand. This includes introducing advanced functionality of smart meters in order to improve the use of existing infrastructure and mitigate, reduce or delay the need for new peak generation infrastructure.

⁵⁷ <http://www.theage.com.au/news/national/snowy-scheme-in-uphill-water-battle/2007/03/28/1174761567946.html>

⁵⁸ AECOM, 2011, Energy Demand Research Project: Final Analysis, prepared for Ofgem
⁵⁹ Ibid.



5.0 Efficient infrastructure markets

In recent decades, approaches to infrastructure delivery have shifted from governments directly providing virtually all infrastructure, to the creation of more competitive markets where public and private suppliers can compete to provide infrastructure more efficiently.⁶⁰

Resulting increased levels of private sector infrastructure investment has seen the ratio of total Australian infrastructure investment to GDP rise from an average of around three per cent from 1987 to 2000 to almost 4.5 per cent by 2006.⁶¹ The Productivity Commission has also estimated that competition and structural reforms have added 2.5 per cent to GDP, or about \$7,000 to household income each year (in 2005 dollars).

“SIGNIFICANT OPPORTUNITIES REMAIN TO FURTHER ENHANCE INFRASTRUCTURE MARKET EFFICIENCY, AND TO RAISE NATIONAL PRODUCTIVITY AND WELLBEING.”

Yet significant opportunities remain to further enhance infrastructure market efficiency, and to raise national productivity and wellbeing. In particular, governments must address outstanding reforms that will drive further competition and contestability in the water, energy and transport sectors. At the same time, pressure to provide infrastructure more efficiently is increasing, with governments entering a period of fiscal constraint, and population and economic growth compounding existing capacity limitations.

Both public and private operators in the infrastructure market have significant expertise, and considerable experience from Australian and international operations. The challenge for Australian cities is to efficiently capture and utilise this capability for the delivery of infrastructure and associated services.

Government has a key role in managing the efficiency of infrastructure markets across energy, transport, water and waste. While regulation is required in these markets to ensure that outcomes are in the broader public interest, it is important that regulation is structured in such a way that maximises private sector efficiency and innovation.

This section presents recommendations relating to government ownership, regulatory adjustments and the consistency of standards across Australia that will deliver better infrastructure outcomes in Australian cities.

5.1 REGULATING FOR INNOVATION AND EFFICIENCY

Government regulation is critical in encouraging innovation and efficiency. It is important that regulation has sufficient detail to achieve the desired public policy objectives, while allowing enough flexibility for the market to innovate and develop efficient responses.

While jurisdictions have made progress individually, the lack of a coordinated and consistent approach to infrastructure regulation across Australia is currently restricting the ability for the market to respond efficiently. The variation across energy, water and waste infrastructure regulation currently mean that efficiencies in one jurisdiction are not being realised in others. For instance, the fragmentation of electricity network distribution organisations adds further complexities, with the multiple interfaces for electricity generators negotiating connection to the electricity distribution network.

60 L.McInerney, C.Nadarajah, F.Perkins, Australia's infrastructure policy and the COAG National Reform Agenda

61 Ibid.

5.2 ENCOURAGING COMPETITION IN THE WATER MARKET

Competition in the water market is currently limited, with the majority of infrastructure and services under the management of state government or local council controlled entities.

Enabling the private sector to more fully participate in Australia's water market has the potential to drive efficiency and innovation to levels that are simply not attainable with uncontested government-owned monopolies. This has been well demonstrated in the United Kingdom, where greater private sector participation has resulted in increased efficiencies, as well as water quality and service improvements. Overseas experience has also demonstrated the importance of appropriate regulation in ensuring that outcomes are in the broader public interest.

Some jurisdictions are beginning to recognise the benefits of greater contestability and are taking steps to facilitate third party access to water and wastewater infrastructure. For instance, in New South Wales the Water Industry Competition Act (WICA) has put in place a licensing regime for private sector participants to operate in all facets of the water and wastewater industries, as well as for third party access to water and wastewater infrastructure. Several ground-breaking projects have already been established under WICA, including the \$100 million Rosehill-Camellia Recycled Water Scheme, which has been enabled by the licensing provisions of the Act.

As demonstrated by the Water Factory Company's Vermont Estate development, localised water solutions have also been enabled under WICA, reducing the upfront costs to government and private developers in rolling-out new water infrastructure, and the amount of water available for drinking through the provision of on-site recycling capabilities.

But while WICA is working well and should continue as the principal mechanism by which private sector participation is encouraged and overseen, there is clear scope to further improve it. In particular, WICA has yet to facilitate private sector involvement in the sector beyond water treatment and re-use. Given the capital constraints facing public utilities, there is clear value in exploring the feasibility of greater private sector innovation and investment above and beyond current levels.

As well as third party access regimes there is a case for all states to explore possible structural reforms to their metropolitan water markets in order to facilitate increased bulk supply and retail competition. In this regard, policymakers should closely monitor the learnings from the United Kingdom, where retail competition is currently being progressed.

▼ CASE STUDY

ROSEHILL-CAMELLIA RECYCLED WATER SCHEME, NSW



The Rosehill-Camellia Recycled Water Scheme will supply recycled water for irrigation and industry to seven Foundation Customers in Camellia and Smithfield, Western Sydney. The recycling plant and pipelines will be built, owned and operated by AquaNet Sydney with the treatment of the recycled water by Veolia Water. AquaNet Sydney and Veolia Water have obtained the required licences to operate the scheme and provide the recycled water to Sydney Water under the New South Wales Government's Water Industry Competition Act 2006. The Foundation Customers have recycled water supply agreements with Sydney Water.

▼ CASE STUDY

WATER FACTORY COMPANY
VERMONT ESTATE DEVELOPMENT, PITT TOWN, NSW

© Water Factory Company

The Water Factory Company, which operates as a micro water utility, will provide a privately-owned wastewater treatment plant for the Vermont estate at Pitt Town in North Western Sydney. Under the WICA legislation the company has been granted a full service licence, meaning it will not only treat and supply recycled water but have a direct relationship with customers.

The treatment plant aims to supply 500kL a day to homes and businesses for clothes washing, toilet flushing and outdoor uses, and 100kL a day to community facilities and sporting fields for irrigation, toilets and general wash down. This saves up to 120ML of drinking water per year. Additionally, the treatment plant will save the developer, Johnson Property Group, \$12 million in water infrastructure expenses by avoiding the \$24 million cost of connecting to Hawkesbury City Council's sewerage system, which would have required 14km of pipelines and two pumping stations.

The Water Factory Company plans to include social media and school partnership initiatives in order to inform and engage the Vermont Estate community.

5.3 ENCOURAGING COMPETITION
IN THE ENERGY MARKET

Australia has a strong track record of energy market reform, and has even been described by the OECD as “a pioneer”. These reforms have delivered considerable efficiencies, boosting both sector and national productivity. It is estimated that energy sector microeconomic reform has, to date, delivered a permanent increase in real GDP of \$1.5 billion per annum.

The decade from the early 1990s to the early 2000s saw a strong period of reform in the context of the National Competition Policy. The *Competition Principles Agreement* – signed in 1995 by Australia's states and the Commonwealth – saw governments commit to restructure their electricity sectors, apply competitive neutrality and grant third-party access. These reforms saw the structural separation of contestable generation and retail businesses – and the national regulation of natural monopoly network assets. They also paved the way for the creation of a National Electricity Market (NEM), with associated national institutions to oversee its rules and management.

Bringing together Queensland, New South Wales, Victoria and South Australia – as well as Tasmania following the completion of the Bass Link in 2006 – the NEM now facilitates over \$10 billion of trade each year, meeting the demand of nine million end-use consumers.

But while Australia has undoubtedly come a long way since the days of single, vertically integrated utilities under full government ownership, two very important realities remain. Firstly, reform momentum has stalled – this has meant the progression towards a fully functioning NEM has yet to reach its logical conclusion. Secondly, significant differences remain between states in respect of ownership, efficiency and overall sector performance.

In particular, many states still retain retail price regulation, significant public ownership in generation, and absolute monopolies on distribution and transmission. As well as distorting the function and efficient signals across the NEM, this is contributing to inefficiencies and higher usage costs for Australia's households and businesses.

Taxpayers are also being required to make massive capital investments into ageing electricity stock – with significant lost opportunity costs. In New South Wales, the electricity sector consumes 23.6 per cent of the State's capital budget – with 90 per cent of this capital allocated to networks, and 10 per cent allocated to generation. In Queensland, it consumes 22 per cent of that State's total capital outlays – with 88 per cent of this amount allocated to networks and 12 per cent allocated to generation.

At a time of historic infrastructure shortfalls, particularly in major cities, Australia cannot afford for scarce capital to be allocated to areas where private capital is readily available.

5.4 STANDARDISING ELECTRICITY NETWORK CONNECTIONS

Distributed energy schemes have the potential to provide energy more efficiently and more sustainably than large-scale electricity generation. The increased efficiency is realised through the more efficient delivery of heat and cooling locally by directly supplying district cooling and district heating infrastructure. This is supplemented by the generation of electricity for export to the grid.

A key factor in evaluating the viability of distributed energy schemes is the interface with the electricity distribution network (grid). While the price for electricity can be reasonably negotiated, the value that these plants provide to the electricity distribution network is not consistently recognised. The Ministerial Council on Energy has identified this as a key barrier, and has highlighted the value of these plants in avoided investment in transmission and distribution infrastructure.⁶²

In some distribution jurisdictions there is an explicit obligation for distribution authorities to compensate embedded generation for avoided Network Use of System (NUoS) charges, in others the obligation is less clear (i.e. with AusGrid where there is no consistent regulatory requirements for different scales of generation).⁶³

Even when this obligation is explicit (as with Citipower and Powercor in Victoria), there is no transparent and standardised methodology for estimating the value of avoided NUoS. This makes planning an embedded generation project more complex, and discourages the market from participating due to the uncertainty of costs and revenue from the project.

A standard national methodology should be developed and implemented to ensure that the avoided NUoS value is recognised consistently. This will result in an increase in the certainty and efficiency in the market for distributed energy generation.

5.5 CONSISTENTLY RECOGNISING THE IMPORTANCE OF LOCALISED ENERGY

As discussed in section 3.1.2, distributed energy schemes can provide more efficient and sustainable energy through the direct provision of heat and cooling. This is done through district heating and cooling infrastructure, but is restricted to a relatively local distribution area. This means that the success of these plants rely on a consistent and dense thermal energy demand locally.

Currently, the demand for thermal energy can only be forecast with a low degree of certainty. The ability to forecast local demand for district heat, cooling and electricity is restricted by the ability for the consumer to choose their retailer. Without certainty of demand locally, the viability of distributed energy plants remains uncertain.

There is an opportunity for government to increase the certainty of demand and to enable the benefits of these plants to be realised. For example, recent trigeneration projects in New South Wales have been enabled by the case-specific relationship between the generator, end user and retailer of electricity. These projects demonstrate the viability of distributed plants where the certainty of demand has been satisfied.

DISTRIBUTED ENERGY SCHEMES HAVE THE POTENTIAL TO PROVIDE ENERGY MORE EFFICIENTLY AND MORE SUSTAINABLY THAN LARGE-SCALE ELECTRICITY GENERATION.

62 Renewable and Distributed Generation Working Group, 2006, Impediments to the Uptake of Renewable and Distributed Energy: Discussion Paper, Ministerial Council on Energy

63 Victorian Essential Services Commission (ESC) Guidelines no 15. Electricity Industry – Connection of Embedded Generation Clause 4 and Clause 5; AusGrid, 2011, ES11 Requirements for Connection of Embedded Generation

5.6 STANDARD NATIONAL APPROACH TO WASTE LEVIES

Waste levies should be an important part of an integrated waste strategy, where levies are used to encourage and realise strategic objectives established in the strategy. Levies can be used effectively to change the behaviours and influence the viability of different waste infrastructure solutions.

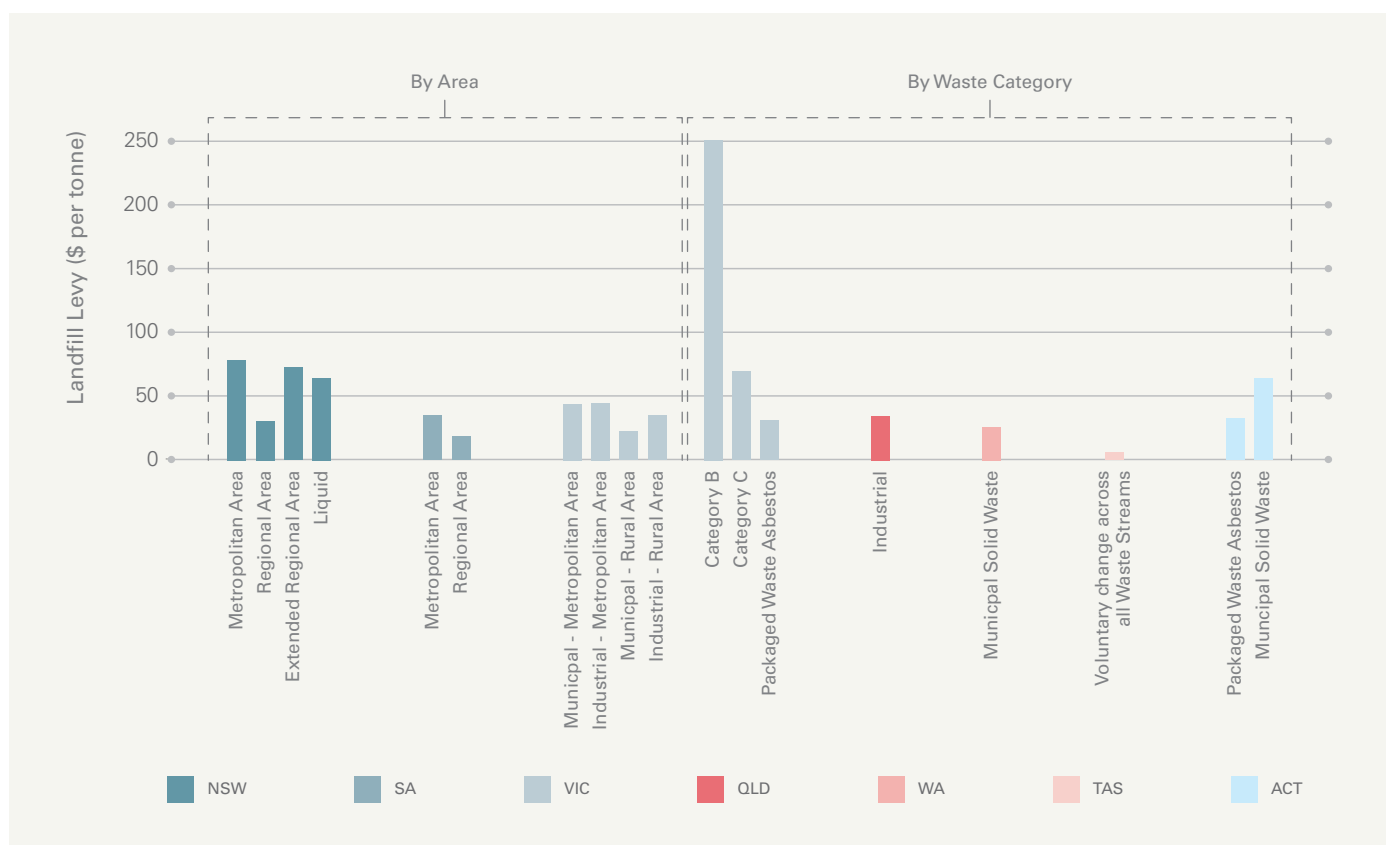
Currently, waste levies in Australian cities vary significantly by jurisdiction. Levies range from zero, right through to more than \$80 a tonne. However, the strategic objectives between jurisdictions are unlikely to differ significantly. Figure 11 shows the variation in selected waste levies and waste categorisation across Australia.

This variation has an impact on the ability for the waste infrastructure market to operate efficiently. As a result of the variation, the viability of waste infrastructure types varies significantly between jurisdictions.

Governments should work towards setting a transparent and consistent waste strategy that establishes clear objectives and targets. The setting of levies should be directly linked to these objectives and targets so that the success or otherwise of the levies can be evaluated. Periodic reviews should be completed to ensure that the levies are adjusted to assist in achieving these objectives and targets.

▼ FIGURE 11

LANDFILL LEVIES BY STATE



Source: Inside Waste, Industry Report, 2011 – 12



6.0 Innovative & Streamlined Procurement

The engagement of the private sector is critical to ensuring infrastructure requirements are met in Australian cities. This engagement brings to bear a combination of strong private sector skills and experience as well as a strong track record in on-time and on-budget delivery, and helps address the limited capacity of government to increase investment levels.

The main objective of governments when engaging the private sector is to extract the best value for money, with all governments exploring a number of different procurement options to achieve this. Each project has a different set of characteristics that will be best suited to a particular type of procurement. It is critical that governments understand what these characteristics are, and how to get the best value for money through selecting the right procurement approach for each project.

6.1 THE ISSUES AROUND INFRASTRUCTURE PROCUREMENT

A number of issues have to be addressed when planning the procurement of a particular piece of infrastructure, and these issues include:

- Size and dollar value;
- Land;
- Complexity;
- Patronage, usage and revenue risk;
- Urgency; and
- Control.

6.1.1 Size and dollar value

Infrastructure procurement is complex and strongly process driven. Delivery methods which seek to transfer significant levels of risk, including those risks associated with ownership, are complex and time consuming and incur significant costs for both public and private sector. As a consequence, projects which do not meet particular threshold criteria of size and dollar value are best procured through a simple process.

The establishment of Public Private Partnerships (PPP) and design build operate maintain (DBOM) contracts require significant effort, and it is critical that sufficient time is invested to ensure that the required outcomes are well defined. This investment of time is generally only justifiable for medium to large projects, where the potential benefits are proportional to the cost and effort of establishing PPP and DBOM contracting structures. Smaller projects, with fewer expected benefits, may not justify the effort and costs associated with establishing PPP and DBOM contracts.

6.1.2 Land

Most infrastructure projects require the identification and acquisition of a parcel of land upon which the infrastructure is to be built. In some cases, for example transport-related projects, the land may attract property development opportunities. Where the development opportunities are significant a cautious approach should be adopted to avoid the project becoming primarily a property development rather than an infrastructure project.

The second issue associated with land acquisition relates to the land upon which the project is to be built, and the party best able to identify and acquire the land. Government is frequently best placed to identify relevant land and to initiate the securing of early development approvals which has the effect of expediting later approvals and minimising the potential for disruptive land speculation.

6.1.3 Complexity

The extent to which an infrastructure project's service requirements are known, and the degree of complexity associated with the requirements, have significant implications for the choice of procurement model.

The complexity of infrastructure delivery and service outcomes is a critical factor in considering the best method of engaging the private sector. Generally, it is difficult to define a clear and detailed scope for complex infrastructure, which has the potential to introduce significant risk to government. Without a clearly defined scope for the private sector, there is significant uncertainty in the cost and effort required to deliver.

The difficulty in defining a clear infrastructure scope can be overcome by procurement approaches focused on outcomes rather than specific infrastructure definition. In order to procure a project based on an outcome, the scope of engagement with the private sector needs to be increased to ensure that the private sector has reasonable control of the factors that will influence the outcome. This includes models such as DBOM and PPPs. By packaging the phases of the project into a consolidated contract, government can manage based on milestones and outcomes and realise the benefits of:

- Private sector experience in other geographies;
- Private sector innovation that delivers a better design (minimising ongoing operational and maintenance costs); and
- Transfer of appropriate risks to a single private sector entity.

High levels of certainty lend themselves towards a procurement model that is readily able to transfer risk to a private sector partner, and hence towards procurement options that include transfer of the risks and rewards of ownership. This risk transferability is a function of the ability of private sector proponents being able to analyse and price risk. Higher uncertainty leads to a higher risk premium being included in the price of a project.

Projects which are highly complex or where the service requirements are uncertain, lend themselves towards solutions where risks are shared such as alliances and joint venture structures. Alliances and joint ventures seek to collaboratively work through the analysis and quantification of risk on a joint basis, progressively agreeing on how the risks are best allocated and managed and at what price.

6.1.4 Patronage, usage and revenue risk

The trend in procurement is to adopt an approach under which risk is transferred to the party best able to manage it. This model consistently secures the best value for money.

To be successful this approach must be realistic, with risks only considered for transfer if they are genuinely capable of being managed by the party to whom they are transferred.

6.1.5 Urgency

The procurement of infrastructure projects is usually a complex and time consuming process, taking several years in many cases. For those projects where there is a requirement for urgent delivery of pieces of infrastructure, it is possible to expedite the process through the adoption of alliance and joint venture based approaches, where the ultimate project specifications are developed jointly between government and proponent. Adoption of this approach should be carefully managed and the process carefully monitored lest the urgency encourages an undisciplined approach, and fails to deliver the intended public value.

6.1.6 Control

Where there is a high need for control of a piece of infrastructure by government, the most appropriate delivery mechanism is one which leans towards reduced transfer of risk to a private proponent. The most appropriate mechanism would often be a design and construct approach by either separate or combined contracts.

6.2 THE OPTIONS FOR INFRASTRUCTURE PROCUREMENT

Government has a range of procurement options available in the delivery and operation phases of infrastructure projects. The main variables in engaging with the private sector are the scope of single contracts, and the level of risk that is assigned to the private sector versus the public sector.

6.2.1 Scope

The scope packaged into a single project is an important consideration through the life cycle of a given infrastructure project. This includes the delivery, maintenance and operation, through to the financing. There are a number of options by which infrastructure is commonly scoped for procurement. These are outlined in Figure 12 below.

By offering more scope in a single package, there is potential to get improved value for money through:

- Proponents taking a whole-of-life view and approach to the design and development of the infrastructure being planned;
- Better pricing by providing more certainty of work; and
- Designs that are more efficient to maintain and operate, by shifting the responsibility for costs of maintenance and operation to those responsible for the design and construction.

The wider the scope, the greater the opportunity for the private sector to identify and realise efficiencies across the phases of the project. This approach also allows the private sector to use knowledge of the operations and maintenance phases to ensure that the design is optimised, with incentive as the responsible party for these phases. The benefit of this approach is the ability to closely link the design and construction of a piece of infrastructure with the long-term operation and maintenance regimes that will be required.

▼ FIGURE 12

OWNERSHIP AND FINANCE MATRIX

DESIGN	CONSTRUCT	MAINTAIN	OPERATE	FINANCE AND OWN
Separate Contracts	Separate Contracts	Separate Contracts	Separate Contracts	
Design and Construct (D&C)		Operate and Maintain		
Design, Construct and Maintain (DCM)				
Design, Construct, Maintain and Operate (DBOM)				
Design, Construct, Maintain, Operate, Finance and Own (DBFOM)				

Source: Arup, 2012

6.2.2 Risk

Transferring risk to the private sector also provides significant incentive for the private sector to be innovative and to ensure that infrastructure delivery and operation is highly efficient. A link to performance and outcome based results, strongly aligned with incentives that are driven by the achievement of agreed key performance indicators (KPIs) and financially driven service level agreements ensures that the management of infrastructure delivers optimal value for money.

A fixed financial component of the payment also provides government with certainty around the cost of delivering the project. Variable components of the payment should be designed to be subject to achievement of key milestones that may be linked to key delivery milestones, operational KPIs or shared budget outcomes as part of an alliancing. Variable components of a payment stream linked to patronage, demand and volume risk under an integrated delivery model have the added advantage of linking the cost of service delivery with the usage of the services being delivered.

All of these options have been extensively utilised by Australian governments.

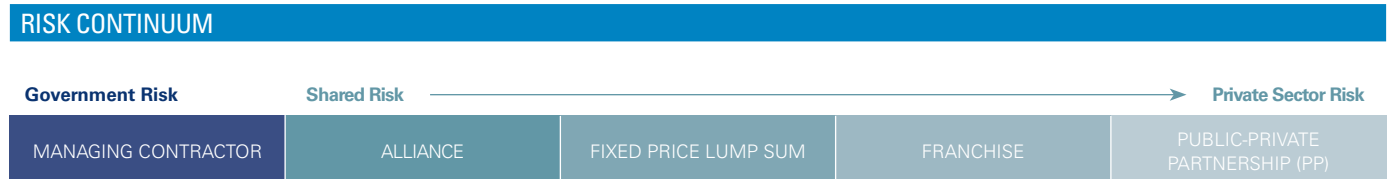
6.3 SELECTING THE RIGHT APPROACH FOR THE RIGHT PROJECT

The factors which should be taken into account when determining the procurement of new projects can be represented graphically in Figure 14 below.

The right procurement option will depend on the unique factors of each project, including its scale and complexity. Each project will also have a unique set of benefits and cost drivers that will need to be evaluated on a project by project basis.

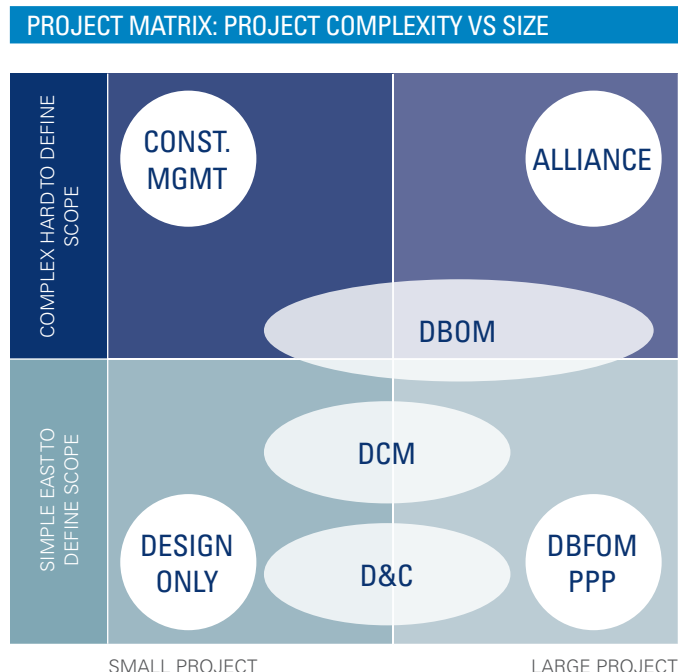
The decision tree overleaf provides governments with guidance on evaluating procurement options for an individual project (see Figure 15).

▼ FIGURE 13



Source: Arup, 2012

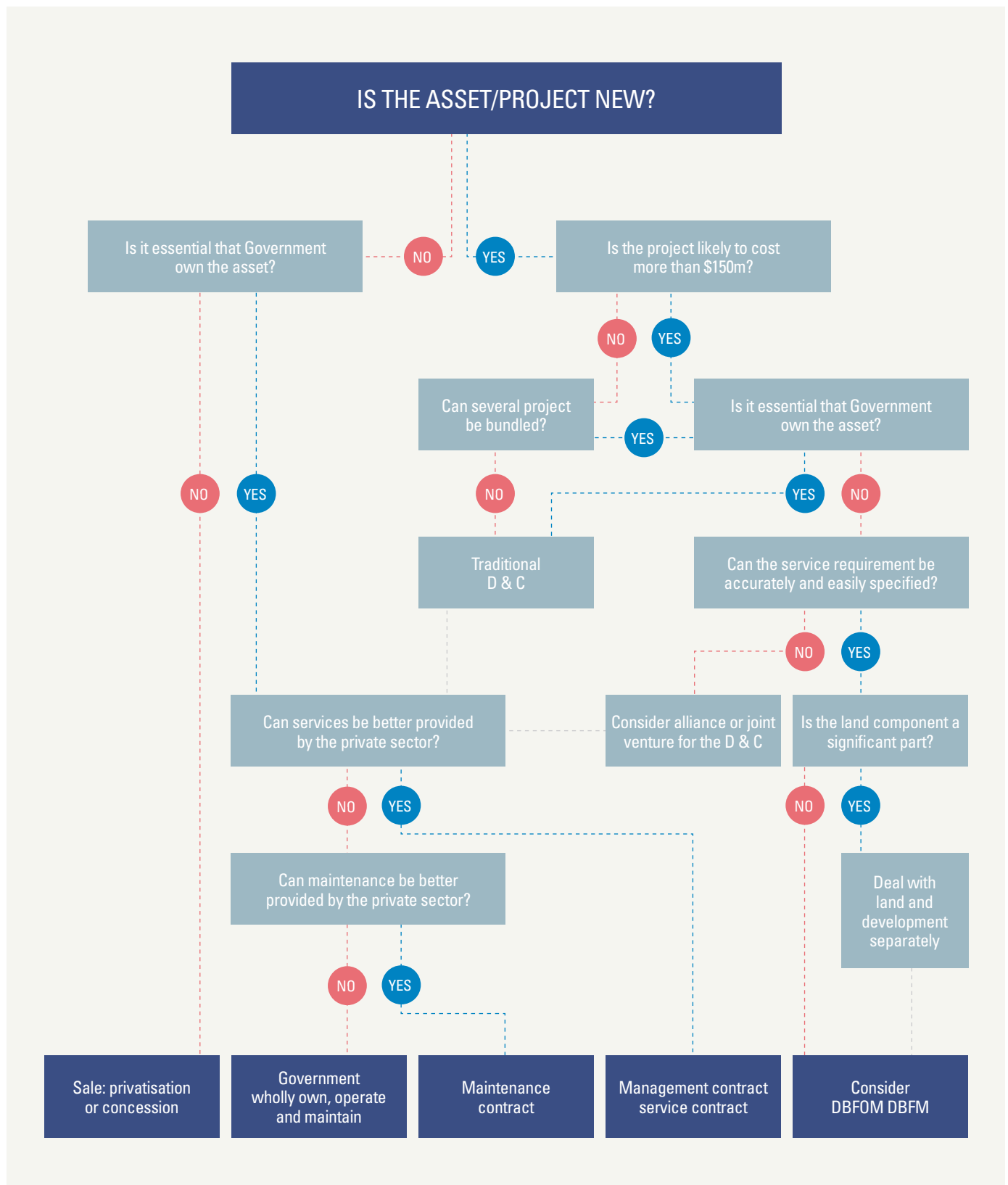
▼ FIGURE 14



Source: Arup, 2012

▼ FIGURE 15

INDICATIVE PROCUREMENT DECISION TREE



6.4 PPP AND PFI PROCUREMENT

The PPP procurement method includes both Design, Build, Finance and Maintain (DBFM) and Design, Build, Finance, Operate and Maintain (DBFOM) with, in each case, the financing element being the distinguishing characteristic. In the United Kingdom, PPPs are known as Privately Financed Initiatives (PFI's).

6.4.1 United Kingdom experience

The use of PPP and PFI as a procurement method was strongly adopted by the United Kingdom Government after its launch in 1992. It is a procurement method which is based on the concept that the public sector purchases a service for a specific price rather than providing the same service through the acquisition and procurement of an asset. The private sector provider funds the development of the asset either internally, through external debt or through a combination of the two.

The United Kingdom currently has approximately 700 operational PFI projects across a number of sectors. Approximately 40 PFI transactions reach financial close each year. The real benefits of this process and approach include:

- The extent and depth of the pipeline of projects encourages private sector proponents to confidently build skills and capacity;
- Officials involved in transactions are generally experienced and knowledgeable;
- A well tested set of precedents exist, including legal documentation, tender documentation, standards and output specifications; and
- Private proponents are experienced and well versed in the approach and requirements.

6.4.2 Australian experience

Australia has adopted the PPP approach in delivering economic infrastructure with a number of toll road projects having been procured as PPPs. The investment returns on several of these projects have been disappointing with the financial failure of several projects in recent years. Important to note, however, is that projects which have failed financially have succeeded in achieving the public value they were designed for.

While there are some very positive signs of change, historically Australia has been less enthusiastic about adopting the PPP approach for social infrastructure. In particular, individual states have adopted differing approaches, which has led to a largely fragmented approach.

To date, social infrastructure PPPs have included several transactions involving schools (Queensland, New South Wales, Victoria and South Australia), prisons (Western Australia) a TAFE institute (Queensland) and hospitals (New South Wales, Victoria, South Australia and Western Australia, with one planned in Queensland).

Several desalination plants have also been procured in Australia with states adopting different procurement approaches. The Victorian desalination plant at Wonthaggi was procured as a PPP, while the New South Wales plant at Kurnell was procured under a Design, Build, Operate and Maintain (DBOM) contract, and the plant at Tugun in Queensland was procured under an alliance. The Kurnell plant has been subsequently privatised by the New South Wales Government via a long-term lease, delivering \$2.3 billion for State taxpayers.

WHILE THERE ARE SOME VERY POSITIVE SIGNS OF CHANGE, HISTORICALLY AUSTRALIA HAS BEEN LESS ENTHUSIASTIC ABOUT ADOPTING THE PPP APPROACH FOR SOCIAL INFRASTRUCTURE.

6.5 FUNDING CAPACITY

One of the most significant challenges to the delivery of infrastructure in Australia is the limited funding capacity of the state governments. This is driven, in part, by the constrained nature of state balance sheets.

Because of the need to reflect privately financed projects – where the risks and rewards of ownership are not fully transferred to the private sector – onto the state balance sheet, the funding challenge cannot be overcome solely through the use of private sector finance. The effect of this accounting treatment is to substantially limit the capacity of state governments to develop and deliver infrastructure either by using government finance or private finance.

Exceeding the funding capacity constraints risks a downgrade in the state's debt rating by the financial ratings agencies. Such a downgrade carries with it increased borrowing costs on new debt and on existing debt as it is rolled over. A credit rating downgrade also risks blunting the investment appetite of potential investors.

A potential solution to this constraint could be increased support from the Commonwealth which has significantly greater financing capacity than state governments; however additional any funding allocations should be closely tied to existing project prioritisation frameworks and processes to ensure the right projects are brought forward.

