ACIL ALLEN CONSULTING

REPORT TO
INFRASTRUCTURE AUSTRALIA

DECEMBER 2014

NATIONALLY SIGNIFICANT INFRASTRUCTURE

NATIONAL ECONOMIC ANALYSIS FOR INFRASTRUCTURE AUSTRALIA

ACIL ALLEN CONSULTING PTY LTD
ABN 68 102 652 148

61 WAKEFIELD STREET
ADELAIDE SA 5000
AUSTRALIA
T +61 0412 089 043

LEVEL FIFTEEN
127 CREEK STREET
BRISBANE QLD 4000
AUSTRALIA
T+61 7 3009 8700
F+61 7 3009 8799

LEVEL TWO
33 AINSLIE PLACE
CANBERRA ACT 2600
AUSTRALIA
T+61 2 6103 8200
F+61 2 6103 8233

LEVEL NINE
60 COLLINS STREET
MELBOURNE VIC 3000
AUSTRALIA
T+61 3 8650 6000
F+61 3 9654 6363

LEVEL ONE
50 PITT STREET
SYDNEY NSW 2000
AUSTRALIA
T+61 2 8272 5100
F+61 2 9247 2455

LEVEL TWELVE, BGC CENTRE
28 THE ESPLANADE
PERTH WA 6000
AUSTRALIA
T+61 8 9449 9600
F+61 8 9322 3955

ACILALLEN.COM.AU

SUGGESTED CITATION FOR THIS REPORT

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Contents

Abbreviations

ABARE	Australian Bureau of Agricultural and Resource Economics
ABC	Australian Broadcasting Corporation
ABS	Australian Bureau of Statistics
ACCC	Australian Competition and Consumer Commission
ACT	Australian Capital Territory
ADSL	Asymmetric Digital Subscriber Line
AEEI	Autonomous energy efficiency improvement
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
AGO	Australian Greenhouse Office
AIA	Australian Infrastructure Audit: National Economic Analysis
AIP	Australian Infrastructure Plan
ANZSCO	Australian and New Zealand Standard Classification of Occupations
ARTC	Australian Rail Track Corporation
ASGS	Australian Statistical Geography Standard
AU	Access undertaking
AUSRAP	Australian Road Assessment Program
AUD	Australian dollar
BCA	Benefit cost analysis
BITRE	Bureau of Infrastructure, Transport and Regional Economics
BREE	Bureau of Resources and Energy Economics
BOM	Bureau of Meteorology
CAGR	Compound annual growth rate
CAN	Customer access networks
CEA	Clean Energy Act
CGE	Computable General Equilibrium
COAG	Council of Australian Governments
CPI	Consumer Price Index
CPRS	Carbon Pollution Reduction Scheme
CQCN	Central Queensland Coal Network
CSP	Carriage service provider
DA	Telstra Distribution Area
DCCEE	Department of Climate Change and Energy Efficiency
DEC	Direct Economic Contribution
DSL	Digital subscriber line
ESA	Exchange Service Area
ESCOSA	Essential Service Commission of South Australia
EUA	European Union Allowance

FAC	Federal Airports Corporation
FIFO	Fly-In Fly-Out
FMG	Fortescue Metals Group
FPSO	Floating Production – Storage and Offloading
FTTH	fibre to the home
FTTN	fibre to the node
FTTP	fibre to the premise
FY	financial year
G20	Group of Twenty
GA	General aviation
GCCSA	Greater Capital City Statistical Area
GDP	Gross Domestic Product
GFC	Global Financial Crisis
GL	Gigalitre
GPON	Gigabit capable passive optical
GRP	Gross Regional Product
GSP	Gross State Product
GTAP	Global Trade Analysis Project
GVA	Gross Value Added
GW	Gigawatt
GWh	Gigawatt hour
HFC	Hybrid Fibre Coaxical Cable
HML	Higher Mass Limits
HPVs	High productivity vehicles
HVRN	Hunter Valley Rail Network
IGR	Intergenerational Report
IMF	International Monetary Fund
I-O	Input-Output
IP	Internet Protocol
IPS	Internet service provider
IRN	Interstate Rail Network
JUHI	Joint User Hydrant Installation
Kbps	Kilobits per second
km	kilometre
LGA	Local Government Area
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
LRET	Large-scale Renewable Energy Target
LRMC	Long run marginal cost
LTE	Long Term Evolution
Mbps	Megabites per second
MDQ	Maximum Daily Quantity
ML	Megalitre
MRO	Maintenance, Repair and Operations

MT	Megatonne
Mtpa	Million tonnes per annum
MW	Megawatt
MWh	Megawatt hour
NBN	National Broadband Network
NCC	National Competition Council
NCP	National Competition Policy
NEM	National Electricity Market
NFEE	National Framework for Energy Efficiency
NLTN	National Land Transport Network
NOM	Net overseas migration
NSW	New South Wales
NT	Northern Territory
NWC	National Water Commission
NWI	National Water Initiative
NWIS	North-West Interconnected System
OC	Operating Cost
OLV	Office of Living Victoria
OPEC	Organization of the Petroleum Exporting Countries
PC	Productivity Commission
PCE	Passenger Car Equivalent
PJ	Peta Joule
Ppm	Parts per million
PPP	Population/Participation/Productivity
PV	Solar photovoltaic
PwC	PricewaterhouseCoopers
PWC	Power and Water Commission
QCA	Queensland Competition Authority
QLD	Queensland
RAB	Regulatory asset base
RBA	Reserve Bank of Australia
RET	Renewable Energy Target
RPT	Regular Public Transport
RSP	Retail service provider
SA	South Australia
SEQ	South East Queensland
SMI	Smart Metering Infrastructure
SRES	Small-scale Renewable Energy Scheme
SWC	Sydney Water Corporation
SWIS	South-West Interconnected System
TEU	Twenty Foot Equivalent Units
TGA	Terminal gate price
TPA	Trade Practices Act, 1974
TSSS	Transport Supply Services & Storage Account

TWh	Terawatt hour
US	United States of America
USD	United States dollar
VDSL	Very high speed DSL
VIC	Victoria
VOC	Vehicle operating costs
VoIP	Voice over Internet protocol
WA	Western Australia
WA ERA	WA Economic Regulation Authority
WEM	Western Energy Market
WDV	Written down value
3Ps	Population, Participation and Productivity
4G	Fourth generation telecommunication services
%	per cent
$b	$ billion
$m	$ million

HIGHLIGHTS

- Nationally significant infrastructure services — airports, ports, rail, nationally significant roads, the urban transport networks, electricity, gas, petroleum terminals, water and sewerage infrastructure and telecommunications — play a pivotal role in Australia's economic and social development. The availability, location, quality, pricing and use of efficient infrastructure shapes the prosperity and quality of life of the whole community.
- The findings from the Audit Data Set underlying the Australian Infrastructure Audit: National Economic Analysis provide a top down review of nationally significant infrastructure which will assist Infrastructure Australia (IA) in identifying where further effort should be applied to identify specific infrastructure priorities and supportive policy change. This will result in a 15-year Infrastructure Plan which will identify infrastructure initiatives supportive of continued economic growth and the needs of growing communities in Australia.
- This report finds that access and availability to nationally significant infrastructure services across Australia is uneven. Capital cities generally have good access to a wide range of infrastructure services. There are also some non-urban regions that are specialist infrastructure service providers by either supporting the supply of electricity to networks or facilitating the exports of bulk commodities through large-scale port facilities.
- Rural and remote regions experience lower access or reduced quality infrastructure services. The digital disparity across Australia in terms of poor access to telecommunications services and access to poor quality broadband is evidence of this.
- Urban transport network infrastructure in Australia's largest urban areas is congested and travel is subject to significant delays at key times of the day in often around other key infrastructure facilities including ports, airports, and major employment areas.
- Existing infrastructure investments make a substantial contribution to the economy. The direct economic contribution (DEC) of nationally significant infrastructure services was $187.1 billion in 2010-11 (in real 2010-11 prices). This is equivalent to 13.3 per cent of GDP.
- Future infrastructure needs are expected to reflect the needs of a growing population, growth in the economy, structural change in the economy, changes in technology and the particular needs of different regions of Australia. The long-term projections provided in this review take into account mainstream projections about population growth and productivity growth that drive an average rate of GDP growth of 3.1 per cent per annum over the period from 2010-11 to 2030-31.
- Given these projections, nationally significant infrastructure services are expected to double — that is, they are expected to be 2.01 times larger than they were in 2010-11. Their economic contribution will increase to $376.6 billion by 2030-31. This involves growth that is more rapid than population and economic growth. The most rapid of this growth is projected to occur in Australia's urban transport networks within the capital cities.
- This report provides an overview of infrastructure sector needs across 73 regions in Australia by infrastructure service sector via the production of heat tables. The heat tables show future expected infrastructure service hot spots across Australia. Project increases in the demand for infrastructure services does differ by sector and region.
- The projections are sensitive to different population and economic productivity assumptions. Higher population growth produces larger infrastructure service demands. Increased infrastructure productivity has a more muted impact on future infrastructure needs, but improves the competitiveness of the Australia's economy by more and, in doing so, raises the income and wellbeing of Australians.

Overview

Efficient infrastructure is the backbone of a well-functioning economy. Efficient infrastructure stimulates and enhances the productivity of the economy in the short and long term. The provision of efficient infrastructure:

- provides essential services that underpin life, community and commerce such as water and waste services
- facilitates the production of goods and services, connecting the links in complex supply chains that connect the modern economy
- overcomes the tyranny of distance that could otherwise stifle Australia's dispersed population and weaken its economy and
- enables engagement with global and national cultural, commercial and sporting endeavours that are critically dependent upon access to fast, reliable and affordable communications.

The assessment of infrastructure needs and future projections reflect the need to facilitate the provision of efficient infrastructure. More infrastructure does not automatically meet the needs of the community or lead to economic growth. As recognised by the Productivity Commission (PC):

> Efficient infrastructure provides services that improve both productivity and quality of life. However poorly chosen infrastructure projects can reduce productivity financially burden the community for decades with infrastructure that is unnecessary and expensive to maintain.
>
> *Productivity Commission 2014a, Public Infrastructure, Inquiry Report No.71, Canberra.*

This sentiment was reflected slightly differently in the recent Independent cost-benefit analysis of broadband and review of regulation which noted:

> …while there are net benefits to increased access [to broadband infrastructure], they will only be realised by efficient investment, operation and pricing."
>
> *Vertigan Review 2014, Independent Cost-Benefit Analysis of Broadband, Volume II – The costs and benefits of high-speed broadband,*

When highlighting the expected growth in economic output from investment in public infrastructure by governments, the International Monetary Fund (IMF) has similarly recognised that these gains are most apparent when investment efficiency is high. Conversely, the IMF highlight the inferior economic outcome from poor investment infrastructure decisions:

> Inefficiencies in the investment process, such as poor project selection, implementation, and monitoring, can result in only a fraction of public investment translating into productive infrastructure, limiting the long-term output gains.
>
> *International Monetary Fund 2014, World Economic Outlook: Legacies, Clouds, Uncertainties, Washington.*

The focus on the efficient provision of infrastructure and the value it provides; options for efficient investment and funding, and how it can contribute to the community's economic needs is also being recognised internationally, with the Group of Twenty (G-20) recently committing to facilitating efficient investment in infrastructure.

The Australian Infrastructure Audit

Infrastructure Australia commissioned this review as part of the Australian Infrastructure Audit (AIA).

The AIA (Audit) examines and assesses *nationally significant infrastructure* – a subset of *all* economic infrastructure. According to the *Infrastructure Australia Act 2008*:

> "Nationally significant infrastructure includes
>
> (a) Transport infrastructure
>
> (b) Energy infrastructure
>
> (c) Communications infrastructure
>
> (d) Water infrastructure
>
> in which investment or further investment will materially improve national productivity."

A materiality threshold limiting the focus of data about infrastructure supporting infrastructure services that account for at least 0.01 per cent of Gross Domestic Product (GDP) by 0.01 per cent (approximately $150 million in 2010-11), was adopted as an initial starting point to guide the development of the data set of nationally significant infrastructure.

However, there are some cases where infrastructure assets that do not meet the threshold have been included in the Audit Data Set. ACIL Allen has also included analysis of:

- infrastructure that Australian Governments have recognised as forming a national network. An example is nationally significant roads. This sector comprises: the National Highway (National Land and Transport Network (NLTN) roads) and key freight routes (identified with the assistance of the State and Territory governments)
- urban transport networks in the largest capital cities (6 major conurbations) of Australia (given the significance of urban transport networks in supporting the major economic contribution of cities)[1].

The key questions this review answers are:

- What infrastructure services are currently available in Australia? Part of this question also involves answering: where are infrastructure services located?
- What is the economic contribution of infrastructure services to the Australian economy?
- What additional infrastructure services will be needed in the future?
- What are the most valuable infrastructure service needs that must be filled if we are to continue to grow the economy and meet the needs of growing communities?

What nationally significant infrastructure services are available in Australia?

Capacity, utilisation and direct economic contribution (DEC) indicators for Australia's nationally significant infrastructure are shown in Figure A.

[1] This modelling and analysis was undertaken using a transport model from Veith-Lister Consulting. To enable an analysis of the economic contribution of the urban transport networks in Darwin and Hobart, ACIL Allen Consulting also completed a top-down analysis of these two urban transport networks.

Figure A **Key statistics from the Australian Infrastructure Audit (2011)**

	Subsector	Capacity	Utilisation	DEC ($ million)
NATIONAL INFRASTRUCTURE				
Transport	Nationally significant roads	34,656 km of nationally significant roads	1,871,211 vehicles per day	$9,499m
	Ports	1,417 Mt/a 12 million TEUs	1,051 Mt/a 7 million TEUs	$20,655m
	Airports	276 airports	132 million RPT passenger movements	$20,677m
	Rail	41.7 per cent of available time with scheduled services*	51.1 per cent (maximum available minutes utilised*)	$5,426m
Energy	Electricity	Generation installed: 54 GW Transmission peak demand: 41 GW Distribution peak demand: 37 GW	Generation: 228,195 GWh Transmission : 216,050 GWh Distribution: 183,992 GWh	$16,064m
	Gas	Gas transmission: 1,334 PJ/a Gas distribution: 344,121 TJ/a	Gas transmission: 1,334 PJ/a Gas distribution: 344,121 TJ/a	$2,345m
	Petroleum product terminals	79,199 ML	79,199 ML	$1,077m
Water	Water & sewerage	Dam capacity: 84,111 GL Dam water in storage: 58,488 GL Desalination capacity: 539 GL Length of water mains: 213,518 KM Length of sewer mains: 133,508 KM	Water supplied: 7,641 GL Number of properties served (water): 8.5 million Sewerage collected:1,931 GL No. of properties served (sewerage): 7.8 million	$10,610m
Communications	Telecommunications	Broadband availability: 4.53 out of 5 Broadband quality: 1.88 out of 5 Household with 3G coverage: 81% Households with 4G coverage: 59%	Business use of internet: 51.1% Volume of data downloaded: 274,202 TB p.a. No. of households using internet: 6,177,000	$21,050m
TOTAL — NATIONALLY SIGNIFICANT INFRASTRUCTURE				**$107,403m**
URBAN TRANSPORT NETWORK				
	Road	Vehicle kilometres travelled per day: 2,277.1 million	Vehicle kilometres travelled per day: 420.1 million CAR DELAY COSTS = $15.8 MILLION	$70,268m
	Rail	Passenger vehicle kilometres per day: 178.7 million	Passenger vehicle kilometres per day: 46.4 million	$4,216m
	Bus	Passenger vehicle kilometres per day: 59.5 million	Passenger vehicle kilometres per day: 16.8 million	$3,411m
	Ferry	Passenger vehicle kilometres per day: 2.8 million	Passenger vehicle kilometres per day: 299,535	$18m
	Light rail / tram	Passenger vehicle kilometres per day: 21.9 million	Passenger vehicle kilometres per day: 4.2 million	$335m
Urban transport networks (6 capital city conurbations)				$78,250m
ACIL Allen Consulting estimates of Darwin and Hobart urban transport networks				$1,435m
TOTAL — URBAN TRANSPORT NETWORKS				**$79,685m**
TOTAL NATIONAL INFRASTRUCTURE AUDIT				**$187,088m**

Note: Sub-totals may not exactly add totals due to rounding. Nationally significant roads=the National Highway (which is essentially the NLTN outside the capital cities) and key freight routes (identified with the assistance of the State and Territory jurisdictions). Note that availability and quality indices relate to premises-weighted data for broadband access with 5=highest rating and 0=lowest rating drawing on Department of Communication data. (*) national average for rail. Natural gas pipelines are constrained by peak flow capacity rather than annual throughput capacity. The annual throughput figures are not an indication of potential total throughput capacity of the pipeline system. See relevant gas chapter in Part B for more detail.

Urban transport modelling – detailed transport modelling was completed for 6 capital city conurbations (excluding Darwin and Hobart). The 6 major conurbations includes Sydney-Newcastle-Wollongong, Melbourne-Geelong, Brisbane-South-East-Queensland, Perth-Wheatbelt, Adelaide-Yorketown and Canberra-Goulburn-Yass. To include estimates of the DEC for Australia's total urban transport network, ACIL Allen Consulting undertook a top down economic analysis of Darwin's and Hobart's urban transport network. These high-level DEC estimates were added to the more detailed analysis of the 6 major conurbations to provide the TOTAL – URBAN TRANPORT NETWORKS DEC.

Source: AIA Audit Data Set

The DEC measures highlight the size of the economic contribution of the services of different types of existing infrastructure by region across Australia in 2010-11. This is supplemented by physical measures of the capacity and utilisation of infrastructure, such as kilometres of roads and regular public transport (RPT) passenger movements of airports.

Urban transport networks

Australia's urban transport networks comprise those transport infrastructure services in urban areas made available to the public. These services include the road network, buses, rail, light rail/trams and ferries within Australia's capital cities.

The public transport component of these networks moved significant passengers per day in 2010-11: rail travel utilised 46.4 million passenger vehicle kilometres per day, bus travel utilised 16.7 million passenger vehicle kilometres per day, ferry travel utilised 300,000 passenger vehicle kilometres per day while light rail/trams utilised 4.2 million passenger vehicle kilometres per day. The road network is also heavily utilised with 420.1 million vehicle kilometres travelled per day.

The significant task of Australia's urban transport networks is not surprising given that these networks cover an area of Australia with a population of 17 million in 2010-11.

Nationally significant roads

Nationally significant roads comprise the National Highway (spanning the non-capital city NLTN roads) and key freight routes across Australia, identified with assistance from the State and Territory governments. Nationally significant roads do not encompass those roads analysed in the urban transport component of the AIA.

The Audit Data Set for nationally significant roads contain information about every link in these roads that have been assessed reflecting the volume of traffic that uses the roads and the condition of the roads.

Nationally significant roads involves a network of about 34,653 kilometres of roads comprising of those roads that connect all of Australia's capital cities and identified key freight routes. These nationally significant roads carried 1.87 million vehicles per day in 2010-11.

Each link of the National Highway has been rated with a rating of between 1 to 5 stars, with 1 star being the least safe and 5 stars being the safest. About 40 per cent of the National Highway has been rated as 1 or 2 stars. Some 40 per cent of the National Highway has been rated as having 2 stars or less in 2011.

Ports

The ports with rated capacity in the Audit Data Set have an aggregate capacity of 1,417 million tonnes per annum. These ports manage a throughput of 1,051 million tonnes per annum (although spare capacity does differ significantly by port).

Major ports are operated as businesses and are managed to obtain commercial rates of return on investment. Many have been privatised. Different ports face different challenges.

The Audit Data Set provides information specific to each port and include elements such as channel depths.

The aggregate picture suggests there is capacity to handle current trade volumes.

Airports

Of the 276 airports identified and assessed in the Audit Data Set, a small number of airports carry most RPT passenger and aircraft arrivals and departures. The major airports in Australia are operated to obtain commercial returns on the capital invested, and are subject to a “light handed” price regulation regime.

Australia’s airports managed 132 million RPT passenger movements in 2010-11. The balance of capacity relative to demand (or utilisation) is reflected in various performance indicators, especially those reflecting excessive congestion or delays.

The data available for major airports suggests that there was sufficient capacity to meet demand in most airports in 2010-11. In some cases airport managers assess that the aeronautical capacity of their airport is many times larger than current demand (in the case of Canberra airport).

There are some airports where projected growth points to capacity shortfalls in the medium term. Brisbane airport has commenced building a new parallel runway that will be completed in 2020. Development of a second Sydney airport has been announced to meet demand projections. The findings reported in this Audit support the need for increasing the capacity of airports in the Greater Sydney region to meet the expected substantial increase in demand for airports.

Electricity

Electricity supply is determined on commercial terms across most of Australia (it is subsidised in some areas including Western Australia). Electricity infrastructure is generally provided where the cost of supply can be brought into balance with the prices users and consumers are able to pay. Australia’s 54 gigawatts of installed generation capacity is not fully utilised over a year, because different facilities play different roles in the electricity market. Some 183,992 gigawatt-hours of electricity was delivered to customers in 2010-11 through distribution networks.

The Audit Data Set notes regions of Australia, mainly remote, are not supplied by electricity infrastructure. A key issue with electricity supply in recent years has been a sharp increase in prices which have exceeded the average increase in the Consumer Price Index (CPI).

Gas pipelines

Gas supply is another area where supply and demand are brought into balance at prices on a commercial basis.

The Audit identifies regions that do and do not have the opportunity to source gas from gas transmission networks. There is some speculation that there may be gas shortfalls in some regions and states and/or rapid price adjustments in the near-to-medium term.

Petroleum product terminals

The Audit Data Set includes the six operating refineries and terminals at 28 locations around the coast of Australia. Petroleum product distribution infrastructure includes refineries, pipelines and fuel terminals.

The utilisation of petroleum product terminals in 2010-11 in Australia was 79,199 mega litres. Of this, 34,104 mega litres of throughput was attributable to terminals at refineries, some of which is conveyed by pipeline to other terminals. The throughput through non-refinery terminals is the difference between these figures (i.e. 45,095 mega litres). Total net consumption of petroleum in 2010-11 was 52,095 mega litres.

Water and sewerage infrastructure

The Audit Data Set indicates the balance between factors such as dam capacity and water demand in 2010-11 in every region.

As an indicator of capacity to deliver water services, there are 213,518 kilometres of water mains. These supplied 7,641 gigalitres of water in 2010-11.

In some regions of Australia - especially remote regions - water is not provided through infrastructure services and individuals, communities and homesteads source their own water in these circumstances.

Some progress has been made towards greater economic efficiency in water. Water pricing reforms have been patchy across regions and subsidisation of urban and rural water infrastructure investments has confused and blurred industry incentives to invest optimally.

Telecommunications

The Audit Data Set presents detailed information about the quality of telecommunications services infrastructure and the access that premises have to high speed and reliable telecommunications throughout different regions. The capacity metrics highlight the existing digital divide in terms of broadband quality and availability in remote/regional areas relative to more urban areas within Australia.

The rollout of the National Broadband Network (NBN) had only just begun in 2010-11 providing around 4,000 active service connections by the end of 2011.

What is the economic contribution of infrastructure services to the Australian economy?

Infrastructure adds value to the Australian community and economy when it is used. This value added can be measured in much the same way that the contribution of other goods and services is counted. The direct economic contribution (DEC) of Australia's nationally significant infrastructure (including urban transport) is estimated to amount to $187.1 billion in 2010-11, equivalent to a 13.3 per cent share of Australia's GDP.

Figure B indicates the infrastructure DEC overlaid as a share of GDP and the contribution made by Australia's other major industries.

It is notable that nationally significant infrastructure does not capture all infrastructure services and the DEC estimate includes value for some unpriced services not counted in GDP measured with the production approach. The DEC estimate and GDP are shown together to illustrate the relative order of magnitude of each.

The DEC for infrastructure services measures the value added of the specific infrastructure service. In the case of transport it does not seek to measure the value of goods being carried. Doing so would risk double counting of goods that are carried by many links in a supply chain. For similar reasons the DEC does not include the value of impacts felt by third parties, or externalities. While it is subject to limitations the DEC provides an indication of the magnitude and availability of infrastructure and its contribution to economy that is comparable between infrastructure categories and different locations of infrastructure throughout Australia.

Urban transport network infrastructure services account for about 42.6 per cent of the nationwide DEC from infrastructure[2] with other transport infrastructure services (non-urban roads, airports, rail and ports) accounting for just over 30 per cent.

The fact more than 72 per cent of the economic contribution from Australia's nationally significant infrastructure is provided by transport infrastructure should not be surprising considering the role transport plays in Australia connecting producers with buyers (especially through international trade), employees with employers and overcoming the tyranny of distance by connecting Australia's dispersed communities. The relatively large share of Australia's urban transport network is also unsurprising given that they cover an area of Australia with a population of 17 million in 2010-11.

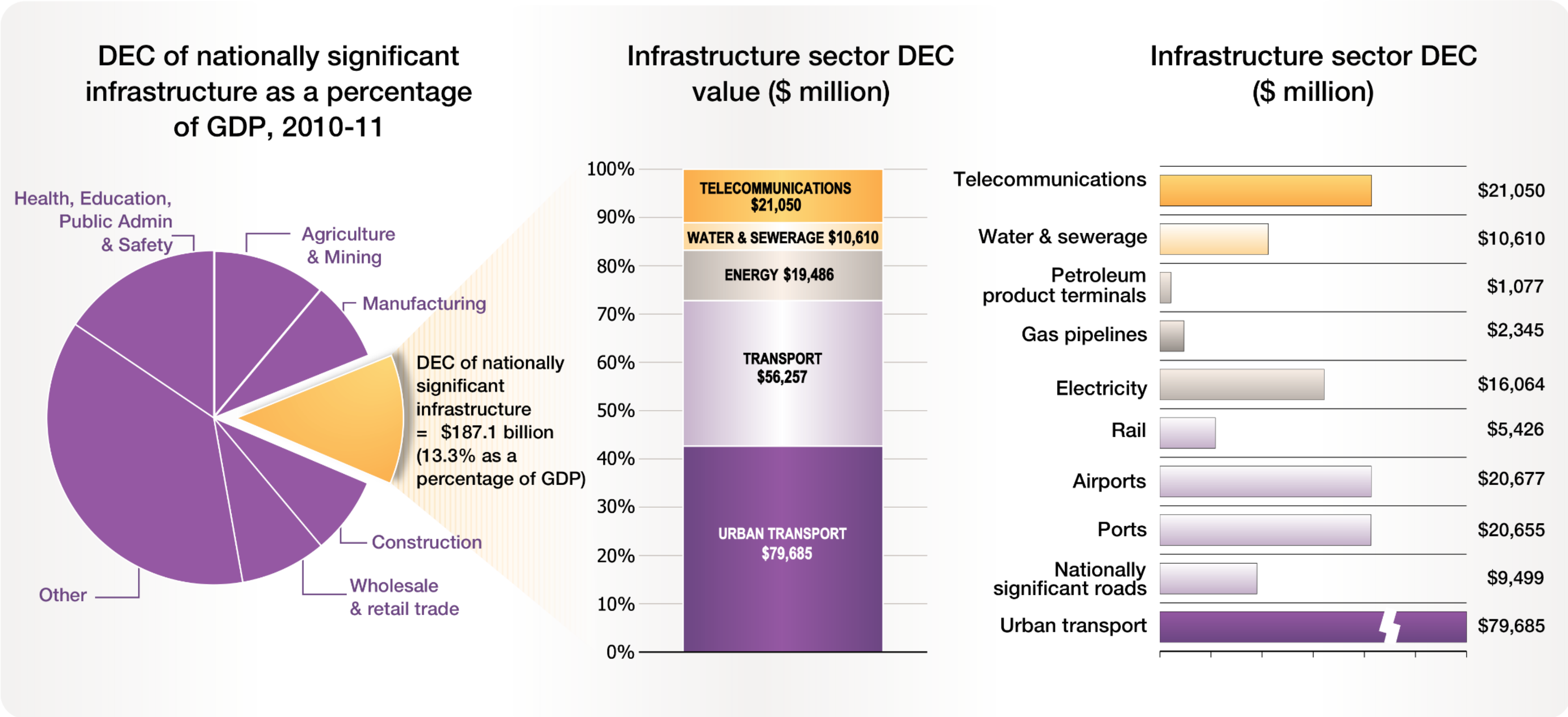
Energy infrastructure accounts for about 10.4 per cent of the DEC provided by nationally significant infrastructure. Most of this is provided through electricity supply infrastructure.

Telecommunications infrastructure services made a DEC of $21.05 billion in 2010-11, and provided just over 11 per cent of the DEC from nationally significant infrastructure. Telecommunications is a key input to most industrial activity, especially services industries that now dominate the economy.

Water and sewerage infrastructure services accounted for just under 6 per cent of the DEC provided by nationally significant infrastructure.

[2] This includes the DEC for all 8 capital city urban transport networks, not just for the major 6 conurbations.

Figure B **Economic contribution of nationally significant infrastructure in Australia, 2010-11**



Note: The DEC and GDP estimates are illustrative to show the relative order of the magnitude of the economic contribution of infrastructure services to the economy. The estimated DEC for urban transport includes all 8 capital city urban transport networks.

Source: ACIL Allen Consulting analysis, 2014

Infrastructure economic contribution by region

The economic contribution of infrastructure (not including the urban transport networks) in Australia's 20 largest urban regions in 2010-11 is portrayed in Figure C. Figure D and Figure E provides the DEC for other regions while Figure F provides the DEC for the urban transport networks by mode in 2010-11.

The large DEC estimates portrayed in Figure 3 highlight the economic importance of the major cities which account for a very large proportion of national product. The major cities are the dominant producers of services which dominate the economy, they are gateways for the trade of goods and visitors and depend on a wide range of infrastructure services.

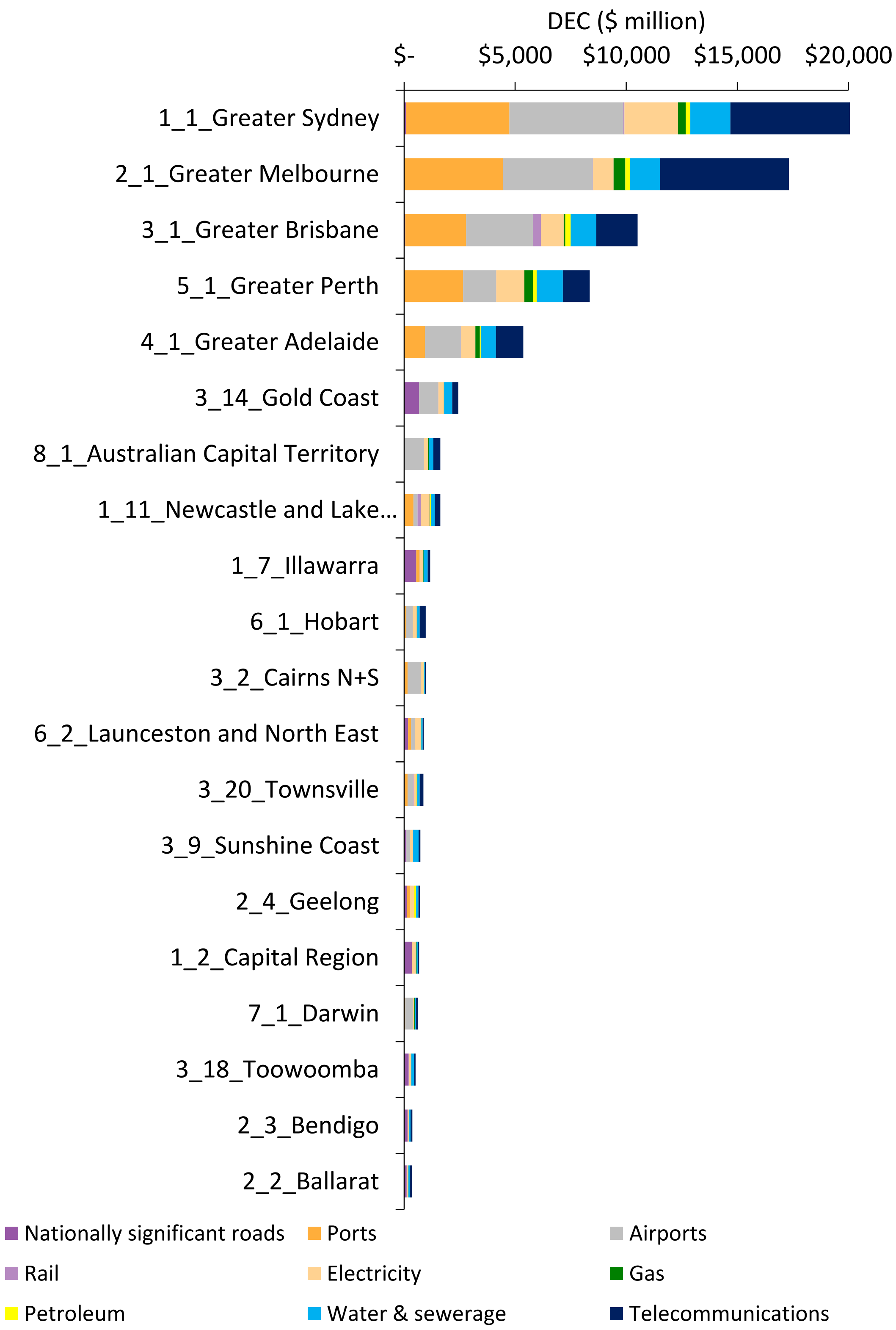
It is notable that transport infrastructure, especially the nationally significant roads, account for a relatively large share of Infrastructure DEC in regions outside the major cities. This highlights the importance of infrastructure to connect regional and remote regions to economic opportunities and markets.

Some regions are specialist providers of infrastructure services. The dominance of electricity generation DEC in Latrobe – Gippsland and in the Rest of Tasmania, or water supply infrastructure in Shepparton, are good examples.

The DEC of car travel for Australia's urban transport networks clearly dominates all other modes of travel on these networks, irrespective of where the networks are located. Public transport travel however accounts for a larger proportion of the overall urban transport network DEC in the larger capital cities.

The DEC estimates in 2010-11 by region and by infrastructure service category indicate where the community's unlimited demands for service needs have been brought into balance with the limited and scarce resources required to provide infrastructure services, through prices in markets or by the expenditure decisions of governments.

Figure C **DEC of infrastructure services subsectors by audit region in 2010-11 (excluding urban transport) – top 20 urban centres**

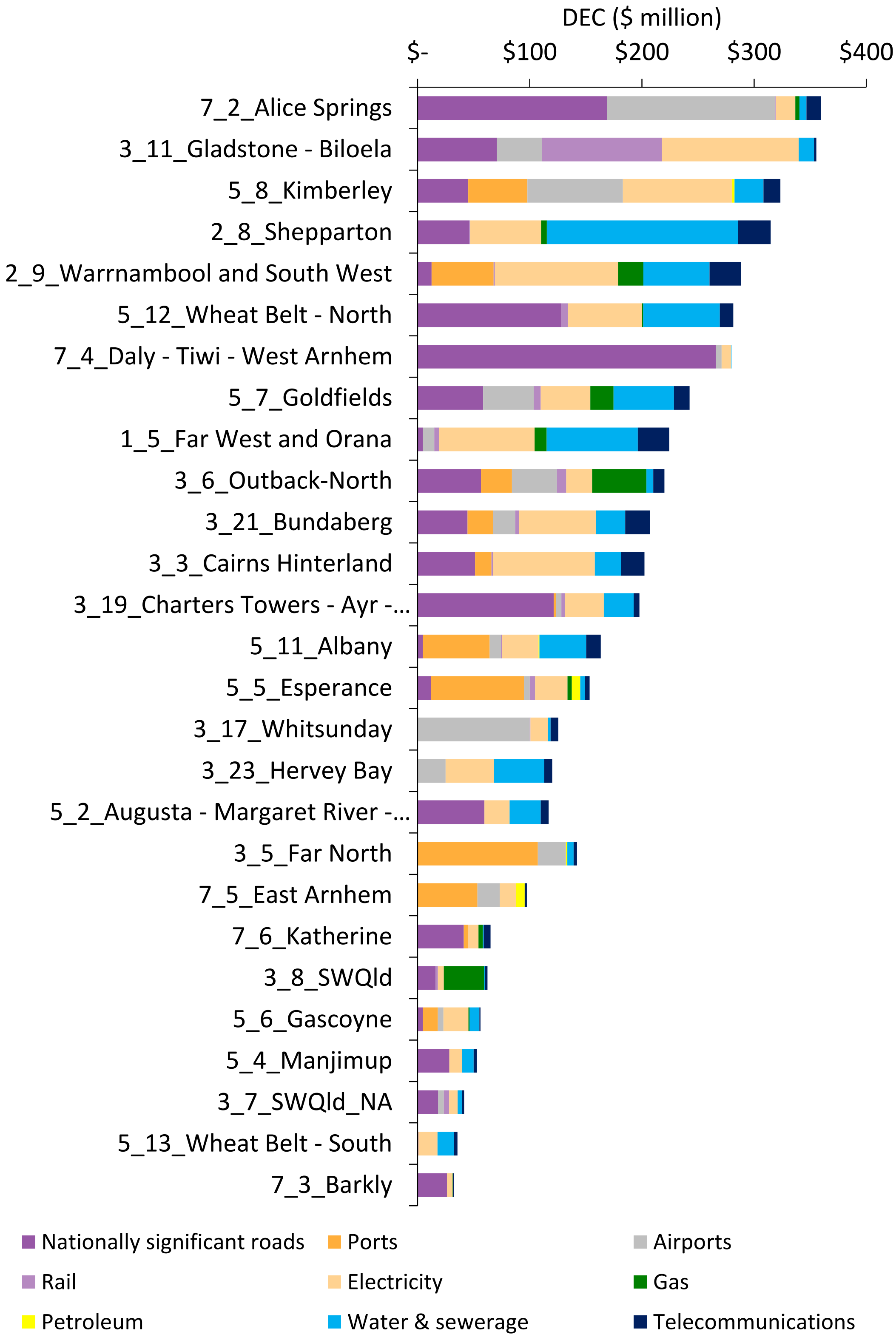


Source: ACIL Allen Consulting, 2014

Figure D **DEC of infrastructure services subsectors by audit region in 2010-11 (excluding urban transport) – other regions A**

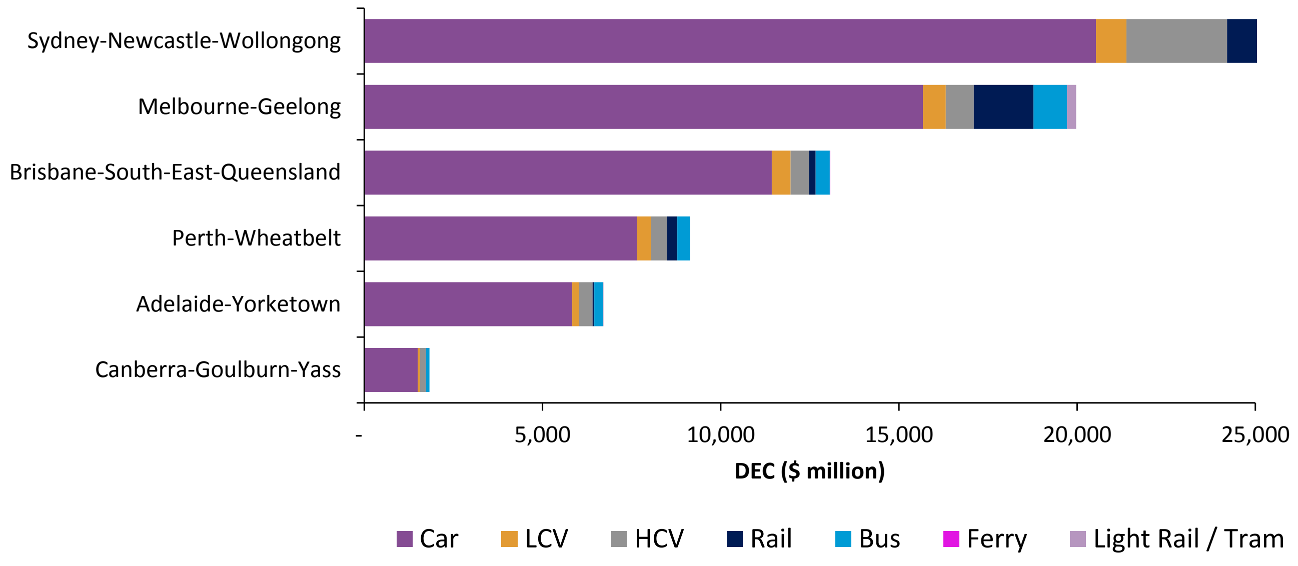
Source: ACIL Allen Consulting, 2014

Figure E **DEC of infrastructure services subsectors by audit region in 2010-11 (excluding urban transport) – other regions B**



Source: ACIL Allen Consulting, 2014

Figure F **DEC of urban transport infrastructure services by region in 2010-11**



Note: The DEC by transport model is only presented for the 6 major conurbation urban transport networks (not for Darwin and Hobart as the DEC breakdown by transport type is not available from the top-down economic analysis undertaken by ACIL Allen Consulting)

Source: ACIL Allen Consulting, 2014

What additional infrastructure services will be needed in the future?

To form a view of what additional infrastructure services will be needed in the future (national infrastructure projections) in order to sustain and support economic and population growth, a series of economic and population projections were prepared from the top down to 2030-31.

Economic and demographic projections

The economic and population projections prepared reflect the following:

- Changes in Australia's demography including immigration, interregional migration (following employment opportunities). Population growth is expected to average 1.6 per cent per annum over the next two decades.
- Changes in workforce participation to reflect Australia's aging population. This is driving a trend reduction in participation rates.
- Continued export growth in agriculture, mining, and manufacturing and especially in energy and iron ore. This reflects sustained underlying demand from our major trading partners, including China.
- Structural changes in Australia's economy including the decline of some domestic manufactured products and the shift towards generating services including demand in the digital economy.
- Regional transitions and transformations, especially rapid economic growth in key Northern Australian regions.
- Future productivity growth to average 1.5 per cent per annum over the next two decades.

- Changes in land use, with greater population density in Australia's major cities.
- Expected GDP growth of about 3.1 per cent per annum out to 2030-31.

National infrastructure projections

Given the population and economic projections, the DEC of nationally significant infrastructure services (including the urban transport networks) is expected to be 1.98 times larger by 2030-31 than they were in 2010-11. The economic contribution of nationally significant infrastructure will increase to $371.2 billion in 2030-31.

The increase in DEC provides a monetised measure of infrastructure services demand in 2030-31. In terms of a toll road or tunnel, for example, the DEC estimates reflect projections of the quantity of traffic likely to be carried by tolled vehicles at a price users are willing and able to pay for use of the road infrastructure.

Table A indicates the projected change in nationally significant infrastructure provision between 2010-11 and 2030-31. The change is reflected in two key indicators:

- DEC $m (2010-11 prices): the level of DEC in 2030-31 in each infrastructure category that can be compared to the DEC estimates for the 2010-11 audit results
- DEC index: the change in the level of DEC in each infrastructure category in 2030-31 compared to 2010-11.

Table A **Nationally significant infrastructure projections**

Infrastructure	DEC 2010-11 ($m)	DEC 2030-31 Baseline scenario ($m)	Index 2030-31 (2010-11 DEC=1.00)
Nationally significant infrastructure			
Nationally significant roads	9,499	15,571	1.64
Ports	20,655	41,889	2.03
Airports	20,677	40,928	1.98
Rail	5,426	9,466	1.74
Electricity	16,064	26,149	1.63
Gas pipelines	2,345	4,686	2.00
Petroleum product terminals	1,077	1,722	1.60
Water infrastructure	10,610	15,939	1.50
Telecommunications	21,050	42,261	2.01
Sub-total	**107,403**	**198,611**	**1.85**
Urban transport			
Urban transport networks - (6 capital city conurbations)	78,250	175,104	
Urban transport networks – (ACIL Allen Consulting estimates for Darwin & Hobart)	1,435	2,916	
TOTAL urban transport networks	**79,685**	**178,020**	**2.23**
AUSTRALIA-WIDE TOTAL	**187,088**	**376,631**	**2.01**
Top down indicators			
Australian population			1.37
Australian economy			1.84

Source: ACIL Allen Consulting, 2014

The DEC index indicates the projected change in the demand for infrastructure services from infrastructure to meet the expected needs and expectations of the community. Different infrastructure sectors are characterised by different growth projections.

The most rapid growth is projected for the urban transport networks in Australia's capital cities. These networks have an increase in their DEC index value of 2.23. This suggests that the utilisation of urban transport networks (and the resources used in urban transport) is expected to expand by 123 per cent over the next two decades to meet the expectations and needs of the community and economy. This is much higher than projected growth in Australia's population (index of 1.37) and higher again than projected growth in Australia's economy (1.84). Without additional augmentation of urban transport capacity or other policies to alter demand growth it is expected that the quality of service will deteriorate significantly and the cost of congestion and delays in Australia major urban transport networks is projected to rise to $53.3 billion per annum which will grow more significantly than growth in overall travel demand.

The projected growth in gas pipelines results in a DEC index value of 2.00, suggesting a 100 per cent increase in value added from this sector. That is, current gas services need to expand their contribution by 100 per cent over the next two decades. It is expected that this will be reflected in similar increases in the current asset base for gas transmission and distribution, or in a significant increase in productivity in the sector (or a combination of both). This reflects a view that supply is expected to continue to grow as Australia expands capacity to fill the current gap between domestic and international prices. More gas will need to move through an expanding network of transmission pipelines.

Ports are expected to slightly more than double in economic terms by 2030-31. This reflects sustained increases in export demand for bulk commodities.

Significant growth is also foreshadowed in rail infrastructure. Much of this growth is required to support the transportation of key bulk commodities from mines to ports.

Sustained increases in demand for airports is reflected in the DEC index of 1.98. This points to growth of 98 per cent over the 20 year projection period. This is broadly in line with industry projections published in long term plans for the major airports.

Telecommunications infrastructure services are expected to grow above the economy wide average with a DEC index of 2.01. This suggests that the value added in this sector will double in real terms between 2010-11 and 2030-31. This reflects the increasingly ubiquitous nature of telecommunications and reinforces expectations that that more economic activity will occur online over the next two decades.

Water infrastructure, petroleum product terminals, electricity and nationally significant roads are projected to grow at a little above the rate of population growth.

What are the most invaluable infrastructure needs that must be addressed?

Different increases in DEC for infrastructure services are projected by region and sectors of infrastructure services in 2030-31. This reflects different needs of the economy and community in each region and infrastructure sector.

There are a set of projections for nationally significant infrastructure that apply over most if not all regions and for Urban Transport infrastructure in selected major urban areas.

When looking at the nationally significant infrastructure across Australia, the Baseline scenario projections of infrastructure service needs and infrastructure DEC reflect circumstances where the estimated direct economic benefits of infrastructure equals the estimated direct economic costs of providing that infrastructure over the long run. The projections seek to avoid infrastructure gold plating where providers focus on the size of additional facilities and confuse construction costs as being the driver of benefits to the community.

The projected increases in DEC provide general guidance about what, where and how much infrastructure services are required in 2030-31. However additional analysis is required to identify more specific means of meeting the needs of the community and economy and to identify the potential ways of making more efficient use of the community's scarce resources, including:

1) utilising the spare capacity of existing infrastructure
2) making more efficient use of existing infrastructure
3) undertaking demand management/reforms
4) expanding infrastructure facilities
5) changing pricing and input costs.

The heat tables provided in Table B show the increases required by nationally significant infrastructure sector and region by 2030-31. The largest increases can be viewed as infrastructure service provision hotspots.

Table B **Increase in DEC by audit region, 2010-11 to 2030-31, Baseline scenario ($m)**

Audit Region	Nationally significant roads	Ports	Airports	Rail	Electricity	Gas	Petroleum	Water & Sewerage	Telecommunications	Total
1_1_Greater Sydney	48	2,924	4,311	18	1,346	140	84	211	6,956	16,039
1_2_Capital Region	170		7		93	11		13	34	328
1_3_Central West	216		27	120	197	6		13	49	628
1_4_Coffs Harbour - Grafton	65	2	29		61			8	34	199
1_5_Far West and Orana	4		6		47	4		20	19	102
1_6_Hunter Valley exc Newcastle	172			217	407			40	31	866
1_7_Illawarra	302	59		1	92	6		10	71	542
1_8_Mid North Coast	168		18		93			14	23	316
1_9_Murray	118		23		41	2		10	23	217
1_10_New England and North West	74		26	18	59			7	42	226
1_11_Newcastle and Lake Macquarie		157	103	35	235	9	15	40	149	743
1_12_Richmond - Tweed	88		25		97			9	53	273
1_13_Riverina	115		28	2	113	9		25	30	321
1_14_Southern Highlands and Shoalhaven	159	13			39	4		12	18	245
2_1_Greater Melbourne		3,339	3,985	9	475	53	97	826	6,149	14,933
2_2_Ballarat	61				42			18	69	190
2_3_Bendigo	84				39			20	50	193
2_4_Geelong	66	59			91		42	77	44	379
2_5_Hume	162				200			23	17	402
2_6_Latrobe - Gippsland	116	24			671	5		51	32	898
2_7_North West	235		18		33			23	23	334
2_8_Shepparton	24				31			51	20	127
2_9_Warrnambool and South West	8	22			54	2		15	17	119
3_1_Greater Brisbane	44	2,228	3,146	194	492	19	155	624	2,271	9,173
3_2_Cairns N+S	29	94	619	3	62		6	38	58	909
3_3_Cairns Hinterland	34	9			37			13	20	114
3_4_Darling Downs - Maranoa	210		9	1	127	12		13	28	400
3_5_Far North		99	30		-21			6	4	118
3_6_Outback-North	73	24	46	12	20	12		4	15	207
3_7_SWQld_NA	21		5	3	3			2	3	36
3_8_SWQld	13			1	2	9			2	27
3_9_Sunshine Coast	75		115		75			134	77	476
3_10_Central Highlands (Qld)	110		25	158	9			5	11	319
3_11_Gladstone - Biloela	59		34	45	42			5	2	187
3_12_Gladstone - Biloela_NA	6	500		39	450	1,618	9	154	8	2,783
3_13_Rockhampton	84	20	107	22	85			40	41	399
3_14_Gold Coast	591		804	3	121	2		286	293	2,101

Audit Region	Nationally significant roads	Ports	Airports	Rail	Electricity	Gas	Petroleum	Water & Sewerage	Telecommunications	Total
3_15_Bowen Basin - North	148	55	5	319	10			8	9	554
3_16_Mackay	174	298	160	19	46		9	34	40	780
3_17_Whitsunday			88		7			1	6	102
3_18_Toowoomba	164			8	58	1		86	88	405
3_19_Charters Towers - Ayr - Ingham	86	1	4	1	12			10	6	121
3_20_Townsville	26	105	275	15	68	2	10	109	207	815
3_21_Bundaberg	30	14	17	1	32			12	23	128
3_22_Wide Bay	104	10		2	118			15	57	305
3_23_Hervey Bay			21		23			23	8	75
4_1_Greater Adelaide		477	1,126	1	380	45	12	358	954	3,354
4_2_Barossa - Yorke - Mid North	74	19			57	6		41	10	207
4_3_South Australia - Outback	70	27	31	1	97			6	13	245
4_4_South Australia - South East	68		10		47	2		12	17	155
5_1_Greater Perth		3,711	2,622	5	1,733	260	159	1,278	2,130	11,898
5_2_Augusta - Margaret River - Busselton	48				28			13	8	97
5_3_Bunbury	153	38		3	591	44		56	33	918
5_4_Manjimup	25				13			3	3	44
5_5_Esperance	15	71	5	2	27	3	7	1	4	136
5_6_Gascoyne	6	13	6		25			4	2	56
5_7_Goldfields	76		57	3	57	14		12	17	236
5_8_Kimberley	49	68	121		115		2	19	25	399
5_9_Mid West	140	82	1	1	84	27	3	16	20	375
5_10_Pilbara	82	6,433	369	2,750	34	-39	16	102	47	9,793
5_11_Albany	8	46	10		35			13	14	127
5_12_Wheat Belt - North	90			2	70			17	12	191
5_13_Wheat Belt - South					15			3	2	20
6_1_Hobart		35	157		26	8	1	25	172	424
6_2_Launceston and North East	82	38	83		23	7		7	29	269
6_3_Rest of Tas.	45	27	16		65	2	2	12	9	177
7_1_Darwin		38	323		29	37	8	63	95	593
7_2_Alice Springs	179		130		9	6		2	14	340
7_3_Barkly	25				3					30
7_4_Daly - Tiwi - West Arnhem	265		5		4					275
7_5_East Arnhem		51	20		4		5		3	83
7_6_Katherine	37	4			4	6			7	59
8_1_Australian Capital Territory			1,043		78	-17		107	340	1,551

Note: Red shading indicates a relatively large projected increase in DEC value while yellow shading indicates a relatively low projected increase in DEC value. Blank cells indicate that DEC values for infrastructure at corresponding audit region was zero or less than $1 million. Shading has been applied by infrastructure sector (i.e. along the columns).

Source: ACIL Allen Consulting, 2014

When looking at urban transport infrastructure in Australia's major urban areas, the baseline projections of infrastructure service needs and infrastructure DEC reflect the growing demand for mobility from growing populations and the increased distance between where people live and where they work and access other services. The projections measure transport capacity, utilisation, congestion and DEC in the future in a scenario where the transport networks in each area are constrained to those that are present now. The projections of DEC therefore reflects an estimate of the need for mobility in the future and flag where there is an opportunity to augment the transport infrastructure or take policy action to alter demand or address costly increases in delays and congestion.

The urban transport projections provide projections for all major urban transport networks by mode of transport and for each major urban areas, by sub-region within each urban area, by transport corridor, route and link. This produces a vast pool of data. Very little is able to be reflected in this overview and summary of the analysis.

The change in the urban transport DEC by audit region is reported in Table C. This shows the increase in DEC by audit region for urban transport in a way that enables comparison with the nationally significant infrastructure for the whole of Australia. Hotspots are reported by urban transport mode. This analysis serves to highlight the large magnitude of the urban transport challenge that projected urban growth is posing and that all of the capital cities face challenges in accommodating increased demand for mobility.

Table C **Urban Transport – increase in DEC by region, 2010-11 to 2030-31, Baseline Scenario ($m)**

Conurbation	Car	LCV	HCV	Rail	Bus	Ferry	Light Rail / Tram	Total
Sydney-Newcastle-Wollongong	18,958	887	2,664	2,122	1,320	41	140	26,131
Melbourne-Geelong	15,068	151	639	3,147	979		804	20,789
Brisbane-South-East-Queensland	16,257	130	563	605	407	53	13	18,028
Perth-Wheatbelt	21,052	1,089	1,151	717	476			24,484
Adelaide-Yorketown	4,933	151	338	76	164		6	5,668
Canberra-Goulburn-Yass	1,454	50	133		117			1,753

Note: Red shading indicates a relatively large projected increase in DEC value while yellow shading indicates a relatively low projected increase in DEC value. Blank cells indicate that DEC values for infrastructure at corresponding audit region was zero or less than $1 million. Shading has been applied by infrastructure sector (i.e. along the columns).
Source: ACIL Allen Consulting, 2014

The outlook for the top 20 corridors across the major urban areas studied is reported in Table D. This is the first time that the major transport corridors in urban areas have been compared across Australia's capital cities and compared with the expected performance of other infrastructure services. The table shows the DEC for projected travel demand in each corridor which reveals the expected value added by the relevant transport facility. Clearly these corridors are projected to add significant value and they all should be seen as meeting the criteria for national significance in their own right. In addition, the table also reports the projected cost of delays which are expected to prevail by 2030-31 given growth in demand. These values flag the potential to avoid costs. Additional analysis is required to identify more specific means of meeting the needs of the community and economy and to identify the potential ways of making more efficient use of the community's scarce resources, including:

1) utilising the spare capacity of existing infrastructure
2) making more efficient use of existing infrastructure
3) undertaking demand management/reforms
4) expanding infrastructure facilities
5) changing pricing and input costs.

Table D **Top-20 corridors by DEC in 2010-11**

Conurbation	Description	Total capacity	Utilisation	Congestion (Volume-to-capacity during typical work day)	Delay cost	DEC
		VKT per hour	VKT per day	%	$m	$m
Melbourne-Geelong	Monash/Princes Fwy Corridor	962,280	8,974,207	39%	180	994
Melbourne-Geelong	North-South Arterials - Eastern Suburbs	560,679	4,601,362	34%	174	862
Sydney-Newcastle-Wollongong	Sydney to Central Coast	831,633	7,724,994	39%	158	852
Perth	Perth Mandurah Corridor	1,193,302	6,728,635	23%	218	769
Melbourne-Geelong	Eastlink/Frankston Fwy Corridor	683,742	5,335,131	33%	87	612
Melbourne-Geelong	East-West Arterials - Lilydale Corridor	439,378	3,350,758	32%	97	546
Melbourne-Geelong	West Gate/Princes Freeway Corridor	638,072	5,193,777	34%	105	498
Sydney-Newcastle-Wollongong	East West corridor	313,134	3,419,907	46%	128	470
Sydney-Newcastle-Wollongong	Mittagong to SW Sydney via Hume Mwy	636,827	4,591,610	30%	72	433
Sydney-Newcastle-Wollongong	South Coast to Sydney	420,307	3,246,397	32%	107	431
Melbourne-Geelong	Western/Metropolitan Ring Road	334,294	4,076,503	51%	87	426
Melbourne-Geelong	East-West Arterials - Wantirna Corridor	303,901	2,310,501	32%	65	391
Brisbane-Gold Coast-Sunshine Coast	Logan River - Gateway Mwy	438,272	3,815,916	36%	75	369
Melbourne-Geelong	Inner Beach Suburbs Corridor	304,426	2,245,022	31%	61	362
Brisbane-Gold Coast-Sunshine Coast	Pacific Mwy | City - Beenleigh	353,893	3,859,594	45%	75	349
Sydney-Newcastle-Wollongong	Homebush Bay to Mona Vale Corridor (A3)	156,685	1,685,038	45%	135	328
Perth	Mitchell Fwy Corridor	288,527	2,783,612	40%	114	319
Brisbane-Gold Coast-Sunshine Coast	North Brisbane - Sunshine Coast	570,335	4,168,199	30%	17	297
Brisbane-Gold Coast-Sunshine Coast	City - Brisbane North	154,024	1,577,282	48%	87	290
Sydney-Newcastle-Wollongong	Sutherland - Ryde/Parramatta Corridor	130,052	1,492,970	49%	113	290

Source: ACIL Allen Consulting, 2014

The Audit Data Set underlying this review reports in more detail urban transport DEC and delays costs by region, by corridor, by route and by different transport modes.

Part A

NATIONALLY SIGNIFICANT INFRASTRUCTURE AND FUTURE NEEDS

1 This report

ACIL Allen Consulting (ACIL Allen) has been engaged by Infrastructure Australia (IA) to review infrastructure and develop an Audit Data Set reporting on Australia's nationally significant infrastructure. The Audit Data Set will support IA's evidence-based Australian Infrastructure Audit of Australia's infrastructure.

In its recent report on Public Infrastructure, the Productivity Commission observed:

> Efficient public infrastructure provides services that can improve productivity and quality of life. But poorly chosen infrastructure projects can reduce productivity, financially burden the community and crowd out more highly valued projects.
>
> *Productivity Commission, 2014a.*

The Productivity Commission's view is supported by other economic advisers and regulators.

The focus on infrastructure and the value it provides: options for efficient investment and funding and how it can contribute to meeting the economic needs of the community is also recognised internationally. The G-20 recently committed to facilitating higher investment in infrastructure.

IA also recognises that efficient investment and provision of infrastructure is a necessary requirement of any well-functioning economy, and is critical to meeting the needs of the Australian community.

Development of the Audit Data Set is a component of the IA's work to audit Australia's infrastructure in order to ensure future efficient infrastructure investment and provision.

1.1 Objectives of Australian Infrastructure Audit and underlying Audit Data Set

The Deputy Prime Minister and Minister for Infrastructure and Regional Development, the Hon. Warren Truss MP, has asked IA to undertake an evidence-based audit of Australia's current infrastructure base. The Minister requested the Audit be conducted in collaboration with Commonwealth, State and Territory governments to assist in the preparation of a 15-year infrastructure 'pipeline' of projects.

ACIL Allen Consulting's contribution has been to develop an underlying Audit Data Set reporting on Australia's nationally significant infrastructure.

The objective of this work is to develop baseline data on nationally significant infrastructure, together with projections of future demand for infrastructure services.

The Audit Data Set underlying IA's Australian Infrastructure Audit (AIA) informs answers to the following key questions:

- What infrastructure services are currently available in Australia? Part of this question also involves answering: where are they located?
- What is the economic contribution of infrastructure services to the Australian economy?
- What additional infrastructure services will be needed in the future?

- What are the most valuable infrastructure service needs that must be filled if the nation is to realise its expectations of continued economic growth, and to meet the needs of growing communities?

The Audit Data Set identifies the existing and projected:

- utilisation (demand) and capacity (supply) of nationally significant infrastructure
- direct economic contribution (DEC) of infrastructure services (i.e., the economic value-add arising from the use of infrastructure at the facility or regional, sub-State or sub-Territory level).

The Audit Data Set highlights the difference between current and projected value-add of services provided to the community and economy from infrastructure.

Identifying the baseline data for nationally significant infrastructure in terms of capacity, utilisation and economic value, now and 20 years into the future, will assist IA with developing a 15-year Australian Infrastructure Plan (AIP). This plan will identify a portfolio of initiatives (in areas of investment as well as governance and policy reforms) that are most likely to support achieving national and jurisdictional aspirations.

1.2 Audit scope

The AIA (Audit) examines and assesses *nationally significant infrastructure* – a subset of *all* economic infrastructure. According to the *Infrastructure Australia Act 2008*:

> "Nationally significant infrastructure includes
>
> (e) Transport infrastructure
>
> (f) Energy infrastructure
>
> (g) Communications infrastructure
>
> (h) Water infrastructure
>
> in which investment or further investment will materially improve national productivity."

A materiality threshold limiting the focus of data about infrastructure supporting infrastructure services that account for at least 0.01 per cent of GDP (approximately $150 million in 2010-11) has been adopted as an initial starting point to guide the development of the data set of nationally significant infrastructure.

However, there are some cases where infrastructure assets that do not meet the threshold have been included in the Audit Data Set. ACIL Allen has also included analysis of:

- infrastructure that Australian Governments have recognised as forming a national network. An example is nationally significant roads. This sector comprises: the National Highway (National Land Transport Network (NLTN) roads) and key freight routes (identified with the assistance of the State and Territory governments)
- the urban transport infrastructure networks in the largest capital cities of Australia (given the significance of urban transport networks in supporting the major economic contribution of cities).

The urban transport component of the AIA encompasses transport infrastructure services in the urban areas of Australia's major capital cities that are available to the public. Due to the level of detail in the urban transport component of the AIA, a stand-alone urban transport report has also been produced. It complements this report. The higher-level findings of the urban transport component of the audit are however presented in this Audit.

1.3 The Australian Infrastructure Audit

Development of the underlying data set is the first time that a study has been completed for IA bringing together data to produce a baseline of Australia's national significant infrastructure that embraces major recognised economic infrastructure sectors: energy (electricity, gas transmission and distribution and petroleum product terminals), telecommunications, transport (airports, ports, rail, nationally significant roads and urban transport) and water and sewerage.

Doing this has been a complex exercise because the AIA:

- brings together data from various sources (from different types of infrastructure and State/Territory governments) to measure existing capacity and utilisation
- measures the economic value of the different types of infrastructure using economic analysis and projections from the computable general equilibrium (CGE) Tasman Global model of the Australian economy
- allocates the economic value of the different types of infrastructure across 73 audit regions.

When considering the AIA and Audit Data Set, it is important to emphasise its limitations. The AIA does not:

- represent a substitute for undertaking a transparent benefit cost analysis (BCA) of proposed infrastructure projects
- focus on social infrastructure (e.g., social housing, public health infrastructure and public education infrastructure), which provides many critical services and contributes substantially to the well-being of the community
- measure the cost of building or replacing existing infrastructure
- select individual infrastructure projects to be invested in by government
- rank individual infrastructure projects to be invested in by government.

Instead, the AIA focuses on providing economic data for infrastructure services that significantly contribute to Australia's economic performance.

The baseline data in the AIA are provided at a level to allow IA to undertake a strategic assessment of different types of nationally significant infrastructure across Australia so it can provide effective advice to government about Australia's current and future needs.

1.3.1 Australian Infrastructure Audit dataset metrics

The baseline data underlying the AIA includes information on the following:

- **Facilities**: a description of identified items of physical infrastructure and the services they provide
- **Location**: the GIS data of specific facilities where these are able to be identified separately, or a description of the area serviced by network facilities. The Audit region in which the infrastructure facility is located is identified also
- **Capacity**: the rated service potential of infrastructure facilities
- **Utilisation**: the amount of service provided in the Audit year
- **Direct Economic Contribution (DEC)**: the economic contribution of infrastructure services to GDP or GRP measured using national accounts and industry data.

This baseline information refers to fiscal year 2010-11: the most recent year for which substantial information is available across all infrastructure categories in Australia (including Census information).

These metrics provide the economic baseline for Australia's nationally significant infrastructure for 2010-11: nationally, by state and territory, and by audit region, for the:

- supply of infrastructure measured by capacity metrics
- demand for infrastructure measured by utilisation metrics
- economic contribution of infrastructure services measured by gross-product metrics.

1.3.2 Projections of infrastructure needs to 2030-31

To enable IA to undertake a strategic assessment of Australia's current and future infrastructure needs, the contribution of infrastructure services to GDP and to GRP at the state, territory and audit region levels were projected for the financial year 2030-31. The national infrastructure projections for 2030-31 are based upon economic and demographic projections for Australia to 2030-31 using the *Tasman-Global* computable general equilibrium (CGE) model of the Australian economy.

In the national infrastructure projections, increases in demand for infrastructure services are only provided where the estimated direct economic benefits equals the estimated direct economic costs over the long run. The projections seek to avoid infrastructure gold plating where providers focus on the size of additional facilities and confuse construction costs as being the driver of benefits to the community.

The projected increases in DEC by types of infrastructure sector and by audit region provide general guidance about what, where and how much infrastructure services are required in 2030-31. However additional analysis is required to identify more specific means of meeting the needs of the community and economy and to identify the potential ways of making more efficient use of the community's scarce resources, including:

1) utilising the spare capacity of existing infrastructure
2) making more efficient use of existing infrastructure
3) undertaking demand management/reforms
4) expanding infrastructure facilities
5) changing pricing and input costs.

1.3.3 Next steps

This report offers readers with a high-level strategic assessment of Australia's infrastructure and identifies future infrastructure service needs by sector and audit region across Australia. However, further analysis is required to assess how much additional capacity is required to meet the projected increases in demand. This will be undertaken by IA following this report.

The next stage of the AIA will involve IA developing a 15-year AIP for Australia drawing upon analysis from this report and also from analysis and reports from other parts of IA's AIA.

The 15-year AIP will identify a portfolio of initiatives (areas for investment as well as governance and policy reforms) most likely to support national and jurisdictional aspirations.

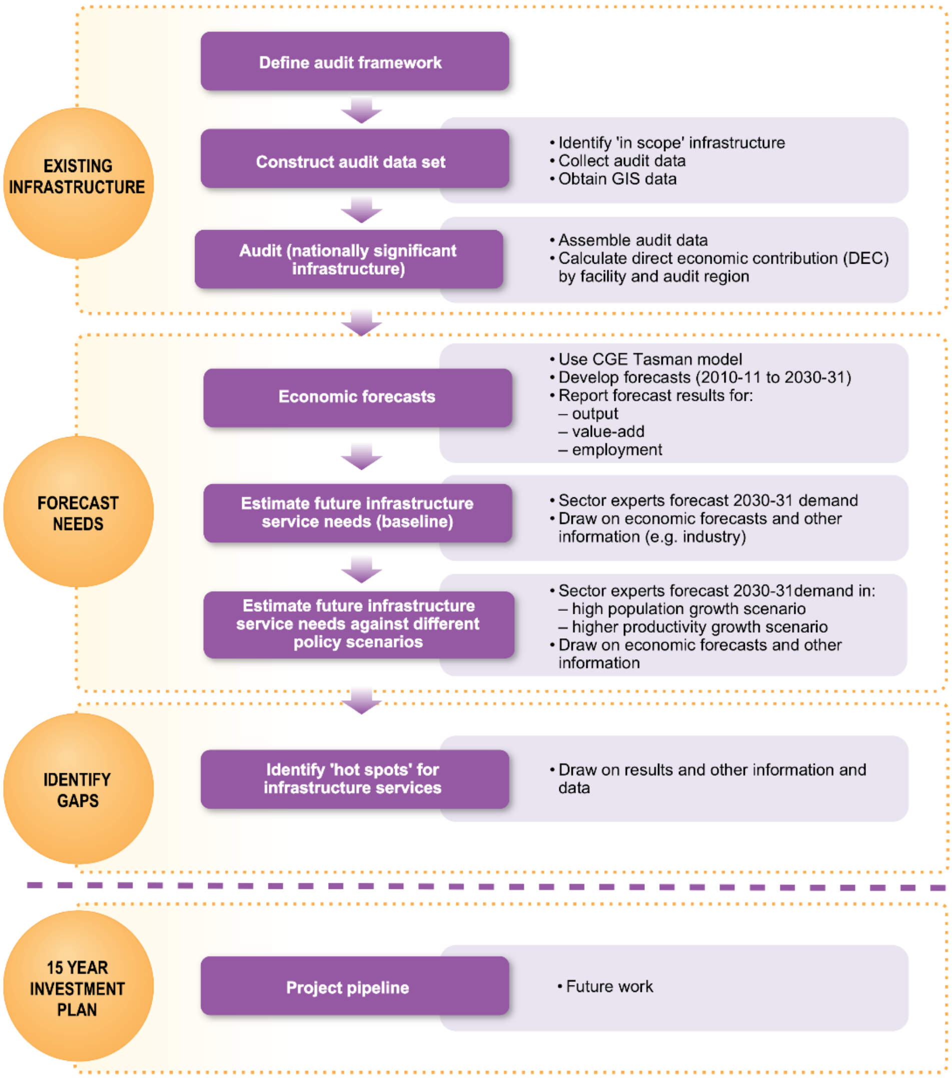
1.4 Approach

This section summarises the steps and consultation process used to develop the Audit Data Set.

1.4.1 Phases of this work

The steps used to develop the underlying data set for the AIA are summarised in Figure 1.

Figure 1 **Approach used to develop the data set underpinning the AIA**



Source: ACIL Allen Consulting, 2014

These steps involved the following tasks:

1. Defining Audit data set framework. This involved:
   a) developing and applying a definition of what constitutes nationally significant infrastructure
   b) defining infrastructure sectors
   c) identifying the audit regions across Australia
   d) projecting baseline demographics for the economic model of the Australian economy.
2. Constructing Audit data set. This involved:
   a) identifying infrastructure 'in scope' for the purposes of the AIA
   b) collecting audit data
   c) identifying infrastructure GIS locations.
3. Auditing existing nationally significant infrastructure in 2010-11. This involved a series of activities, including:
   a) assembling information and data on existing nationally significant infrastructure (listing, description, location of infrastructure, capacity, utilisation and quality, where available) by facility and Audit region
   b) calculating the direct economic contribution (DEC) of infrastructure by infrastructure facility and Audit region
4. Identifying future needs for nationally significant infrastructure. Using the baseline population forecasts for Australia, the Tasman Global model of the Australian economy was used to develop economic forecasts for Australia (2010-11 to 2030-31). This is referred to as the 'baseline scenario'. Baseline scenario results were reported at the national, state/territory and audit region level for:
   a) output
   b) value-add
   c) employment
5. Using the forecast results and other industry information and data, 'hot spots' for infrastructure were identified by sector and audit region.
6. Identifying future infrastructure needs in nationally significant infrastructure against policy scenarios (sensitivity testing of future needs). Using the audit data for 2010-11 and forecast results, this step involved identifying future infrastructure needs as a result of different scenarios (sensitivity analysis). The alternative policy scenarios involve a 'higher population growth scenario' (relative to the baseline forecast) and 'higher productivity growth scenario'.

   Using the forecast results, alternative 'hot spots' for infrastructure were identified by sector and audit region.

1.4.2 Consultations

Developing the Audit Data Set of nationally significant infrastructure across different sectors and across all regions in Australia has required ongoing and extensive consultation process with key stakeholders.

The consultations greatly assisted development of the data set, particularly in relation to:

- sourcing detailed and timely data for the Audit, in addition, to identify existing data gaps
- determining relevant infrastructure (networks and aspects) to be included in the Audit
- outlining the context of different issues and challenges being confronted in different areas across Australia in relation to infrastructure, and

- developing the economic projections for future demand for infrastructure in 2030-31.

ACIL Allen's consultation engagements included the following:

- two rounds of discussions with the four Expert Review Panels established by IA for this Audit
- three rounds of consultations with the Commonwealth, State and Territory jurisdictions on preliminary and draft Audit results
- consultations with more than 45 different organisations. This included public and private sector organisations and jurisdictional economic regulators; public water agencies; Commonwealth and State telecommunications agencies and private telecommunications firms; airport corporations; the Australian Railway Track Corporation; Queensland Rail; Qld Transport and Main Roads; private rail firms; ports corporations and industry bodies; road user associations; the Bureau of Meteorology; Geoscience Australia. The Appendix provided in Part C of this report lists the stakeholders consulted with throughout this Audit.

1.5 Status of this report

This report documents the metrics and findings from the development of the Audit Data Set.

This report incorporates all feedback received to date from the extensive consultations completed by ACIL Allen and IA during development of the Audit Data Set underlying the AIA.

1.6 Structure of this report

This report is presented in Part A, Part B and Part C.

The remainder of Part A comprises the following chapters:

- Chapter 2 examines the role of infrastructure in the economy
- Chapter 3 outlines the strategic approach to developing the data set underlying the Australian Infrastructure Audit
- Chapter 4 reports the high-level metrics and findings from the baseline data of nationally significant infrastructure across Australia in 2010-11
- Chapter 5 outlines future projections for Australia's infrastructure needs
- Chapter 6 outlines sensitivities of the future projections to changes in key economic and demographic parameters.

Part B details the findings of the Audit data set by infrastructure services sector.

Part C contains the Appendices.

2 The role of infrastructure in the economy

This chapter describes the role infrastructure plays in supporting the economy and the community more broadly. It also discusses Australia's economic conditions over the last few decades, how Australia's demography, labour force, and economy have changed and recent trends in infrastructure investment.

These contextual factors influence the nature and extent of infrastructure investment.

2.1 Role of infrastructure

Efficient infrastructure is the backbone of a well-functioning economy. Efficient infrastructure stimulates and enhances the productivity of the economy in the short and long term. The provision of efficient infrastructure:

- provides essential services that underpin life, community and commerce such as water and waste services
- facilitates the production of goods and services, connecting the links in complex supply chains that connect the modern economy
- overcomes the tyranny of distance that could otherwise stifle Australia's dispersed population and weaken its economy and
- enables engagement with global and national cultural, commercial and sporting endeavours that are critically dependent upon access to fast, reliable and affordable communications.

Stakeholders have emphasised during the conduct of this audit that infrastructure has a crucial role of supporting other sectors in the economy. Some stakeholders considered that the value of infrastructure could be measured by examining the value-add of economic activities that relied on that infrastructure. Stakeholders also emphasised that infrastructure investment assisted economic development by reducing private parties' production costs.

While infrastructure is critical to supporting the Australian community, not all infrastructure investment is necessarily beneficial. Over recent decades, policy-makers have sought to strengthen the incentives for efficient investment in and use of infrastructure services across Australia.

The assessment of infrastructure needs and future projections reflect the need to facilitate the provision of efficient infrastructure. More infrastructure does not automatically meet the needs of the community or lead to economic growth. As recognised by the Productivity Commission (PC):

> Efficient infrastructure provides services that improve both productivity and quality of life. However poorly chosen infrastructure projects can reduce productivity financially burden the community for decades with infrastructure that is unnecessary and expensive to maintain.
>
> *Productivity Commission 2014a, Public Infrastructure, Inquiry Report No.71, Canberra.*

When highlighting the expected growth in economic output from investment in public infrastructure by governments, the International Monetary Fund (IMF) has similarly recognised that these gains are most apparent when investment efficiency is high. Conversely, the IMF highlight the inferior economic outcome from poor investment infrastructure decisions:

> Inefficiencies in the investment process, such as poor project selection, implementation, and monitoring, can result in only a fraction of public investment translating into productive infrastructure, limiting the long-term output gains.
>
> *International Monetary Fund 2014, World Economic Outlook: Legacies, Clouds, Uncertainties, Washington.*

The focus on the efficient provision of infrastructure and the value it provides; options for efficient investment and funding, and how it can contribute to the community's economic needs is also being recognised internationally, with the Group of Twenty (G-20) recently committing to facilitating efficient investment in infrastructure.

2.1.1 Infrastructure supporting growth

Investment in public infrastructure can significantly improve the productivity of the economy, which can lead to higher economic growth. This link has been established both at an international level and within the Australian economy. Private infrastructure investment may also support growth in output for the investing firms, and also more widely if the resulting infrastructure is subject to third party access regimes.

2.1.2 Infrastructure supporting competitiveness

Efficient investment in infrastructure may enhance the opportunities for firms to advertise their goods and services and reduce the transaction costs for firms to move their product to market. This may strengthen competition in relevant markets, potentially benefitting consumers. One example of this has been the increased competition in Australian retail markets engendered by technological improvements in telecommunications and investment in telecommunications infrastructure. 'Bricks and mortar' retail now competes on-line with other domestic and international retail firms.

Investment in export facilities may also strengthen competition in international markets by Australian firms by allowing goods to be physically exported – e.g. by building LNG liquefaction facilities in Gladstone – or by decreasing the time and costs associated with exporting product – e.g. by building a third coal export terminal in the Port of Newcastle.

2.1.3 Infrastructure supporting communities

Infrastructure not only supports communities through stronger economic outcomes but also by supporting social and environmental capital that binds our communities and makes them liveable. Examples of such social infrastructure include hospitals, schools and parkland. Failure to provide sufficient or appropriate infrastructure undermines the competitiveness of a place and its social and environmental sustainability. However, social infrastructure of this type is outside the scope of the existing Audit.

2.2 Economic conditions

International and domestic macroeconomic conditions both play crucial roles in shaping infrastructure investment trends. This section provides context to the infrastructure audit by briefly discussing the state of the global and Australian economies over the past few decades.

The data presented herein have been sourced from publications of organisations such as the International Monetary Fund (IMF), the World Bank, Reserve Bank of Australia (RBA) and Australian Bureau of Statistics (ABS).

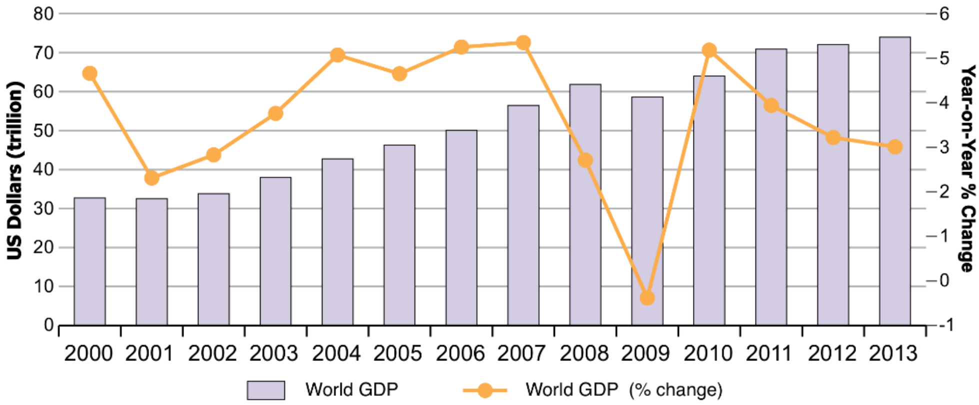
Unless otherwise indicated, all dollars are Australian.

2.2.1 Global economy

Global economic output

The global economy has grown substantially over the past decade, with gross domestic output more than doubling between 2000 and 2013 from just over US$30 trillion to US$74 trillion (Figure 2).[3]

Figure 2 **World gross domestic product, 2000 to 2013**



Note: Constant prices, calendar years. See footnote below for further information on how IMF compiles composite data.
Source: IMF 2014[4]

Following the deceleration in economic growth experienced in the aftermath of the dot com bubble, the global economy enjoyed strong growth during most of the 2000s until disrupted by the global financial crisis (GFC) in 2007.

The average annual growth in world output between 2000 and 2013 has been recorded at 3.7 per cent.

The IMF projects the global economic growth rate to bounce in 2014 to 3.6 per cent compared to the relatively weaker growth observed in the previous two years (3.2 per cent and 3.0 per cent, respectively).

Output by major economies

Looking at some of the major economies, it is evident that output growth has varied significantly by country during this period.

As shown in Figure 3, China recorded seven consecutive years of increasing output growth starting in 2001, peaking at 14.2 per cent in 2007 before gradually falling to around 7.5 per cent annual growth by 2012. In contrast, output growth in the United States increased between 2001 and 2004 but declined thereafter through to 2009. China averaged 9.9 per

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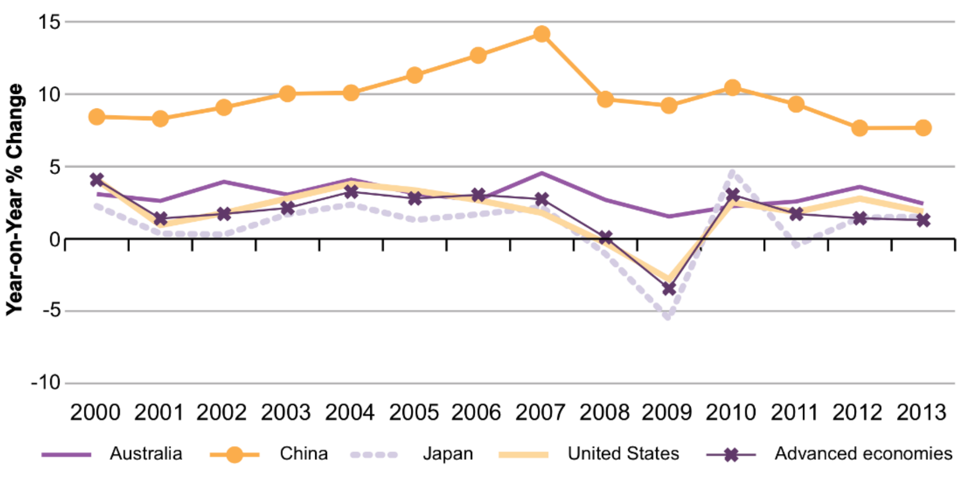
3 See 'note' under each Figure for whether dollar values referenced in the text is are constant prices (real values) or current prices (nominal values). Distinction between fiscal and calendar years is also provided.

4 Composite data for country groups in the World Economic Outlook are either sums or weighted averages of data for individual countries. Composites for fiscal data are calculated as the sum of the U.S dollar values for the relevant individual countries. Data refer to calendar years, except for a few countries that use fiscal years. Further information is available at https://www.imf.org/external/pubs/ft/weo/data/assump.htm.

cent annual output growth between 2000 and 2013 while the United States averaged 1.9 per cent.

The Australian experience is unique compared to Advanced Economies, which include the United States and Canada in North America, most nations in Europe, Japan and the Asian tigers, as well as Australia and New Zealand. Although it was not an exception when it came to adverse impacts of the global economic downturn of the GFC, the trough observed in 2009 was at 1.5 per cent annual growth compared to the average -3.4 per cent observed by Advanced Economies in the same year. Australia's average annual growth rate between 2000 and 2013 has been 3.0 per cent – much higher than the average 1.8 per cent annual growth of Advanced Economies and the 0.9 per cent experienced by Japan.

Figure 3 **GDP growth major economies, 2000 to 2013**

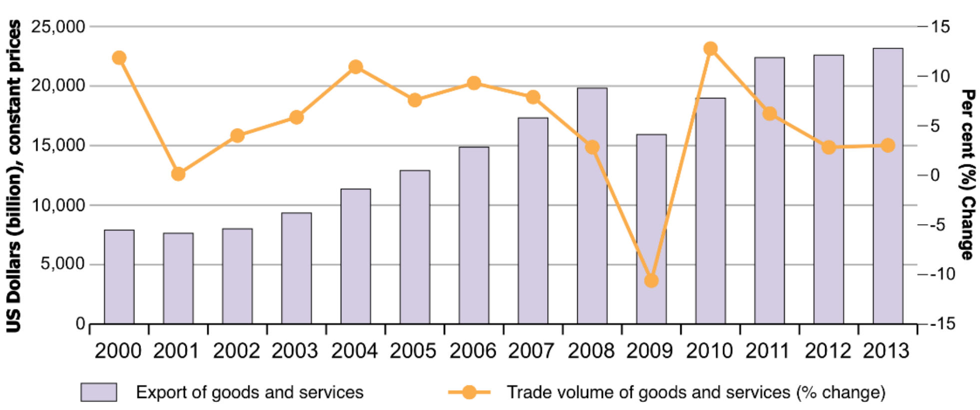


Note: Year-on-year percentage change, constant prices
Source: IMF 2014

Trade of goods and services

As the global economy has grown, the total volume of goods and services traded internationally has also grown. As shown in Figure 4, the volume of worldwide exports increased from just under US$8 trillion in 2000 to US$23 trillion in 2013 – this is equivalent to an almost tripling of international trade volumes in just over a decade.

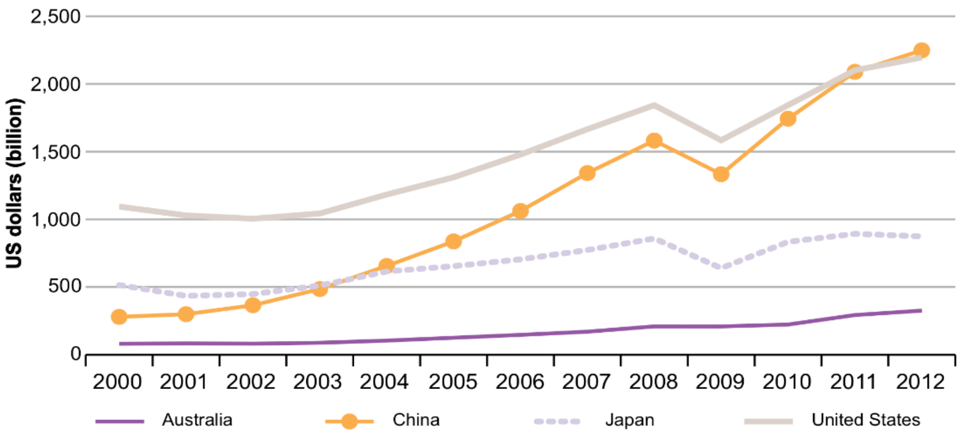
Figure 4 **World trade, volume of goods and services, 2000 to 2013**



Note: Constant prices, calendar years
Source: IMF 2014

Looking at major economies once again, it is clear that China has played a significant role in the global surge in export volumes. In 2000, the value of exports from China was recorded at approximately US$280 billion, accounting for around 3.5 per cent of total international exports. By 2012, however, this value had increased nearly ten-fold to US$2.2 trillion (surpassing that of the United States) and amounted to approximately 10 per cent of total global exports.

Figure 5 **Export of goods and services by major economies, 2000 to 2012**

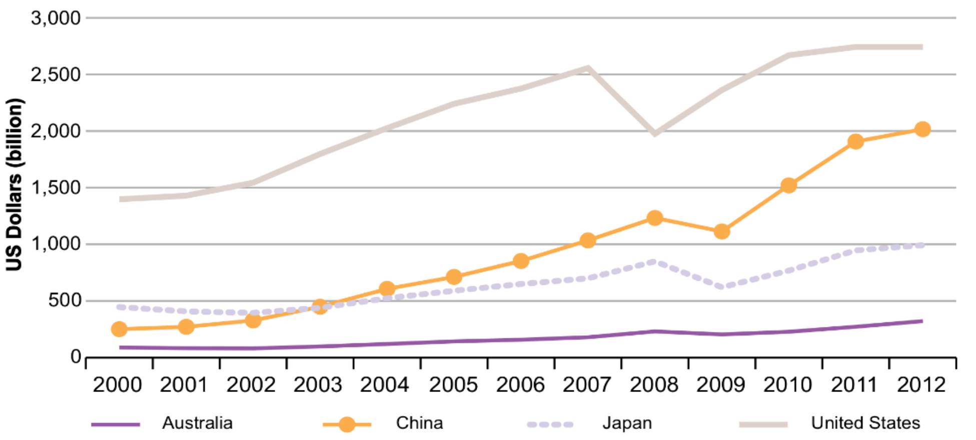


Note: Current U.S. dollars, calendar years[5]
Source: World Bank 2014

Growth in import of goods and services has varied across economies as shown in Figure 6. Although the United States consistently recorded the highest volume of goods and services imports during the years 2000 to 2012 in absolute terms, annual growth in imports has been modest at a CAGR of 5.3 per cent compared against countries such as Australia (11.3 per cent) and China (19.0 per cent). The increase in the volume of imports by China is particularly noteworthy. This demonstrates the dramatic improvement in Chinese living standards reflected by the ever increasing demand (and ability) of its people to purchase goods and services produced outside of its national borders.

[5] See https://datahelpdesk.worldbank.org/knowledgebase/articles/201203-is-all-the-wdi-data-based-on-calendar-year-or-fisc and https://datahelpdesk.worldbank.org/knowledgebase/articles/114942-what-is-the-difference-between-current-and-constan for further information on distinction between current and constant prices, and fiscal and calendar year dates.

Figure 6 **Import of goods and services by major economies, 2000 to 2012**



Note: Current U.S. dollars, calendar years[6]
Source: World Bank 2014

Energy demand

As economies grow, so too does the amount of energy consumed to support their economic activities. Worldwide electricity consumption has been on a stable upward trend, growing by approximately 45 per cent from 14.1 trillion kWh to 20.3 trillion kWh during this period. China's annual growth in electricity consumption has been staggering compared to the other major economies shown, much like its overall economic performance.

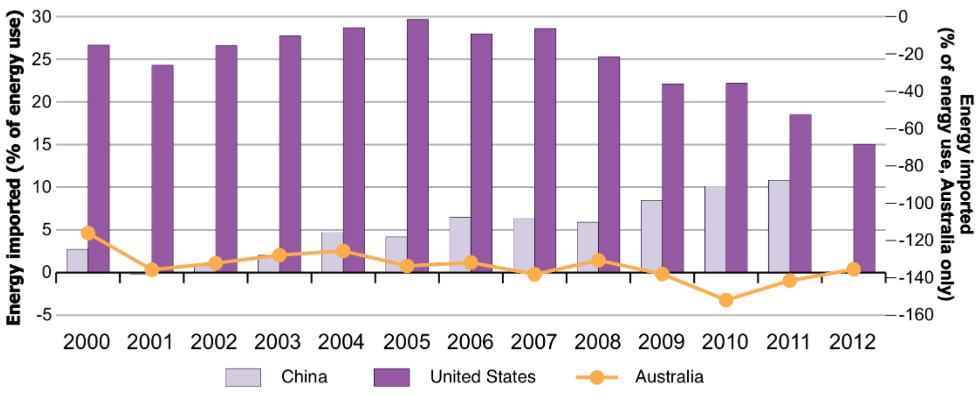
For China, this rapid growth has meant an increasing need to rely on energy imported from abroad. Figure 7 shows the historical change in net energy imports as a percentage of domestic energy use, for China, Australia and the United States.

China's dependency on imported energy has grown from 3 per cent of domestic energy use in 2000 to 11 per cent in 2011. During this period, the United States' net energy imports fell from 27 per cent to 19 per cent of domestic consumption, largely as a result of increased domestic production of petroleum and natural gas.

Australia has long been a net exporter of energy due to the abundance of non-renewable resources. In 2000, Australia's energy exports amounted to approximately 116 per cent of what was consumed domestically. Energy exports peaked in 2010 at 152 per cent of domestic use, and more recently, were around 135 per cent in 2012.

[6] Ibid.

Figure 7 **Imported and exported energy for selected countries**



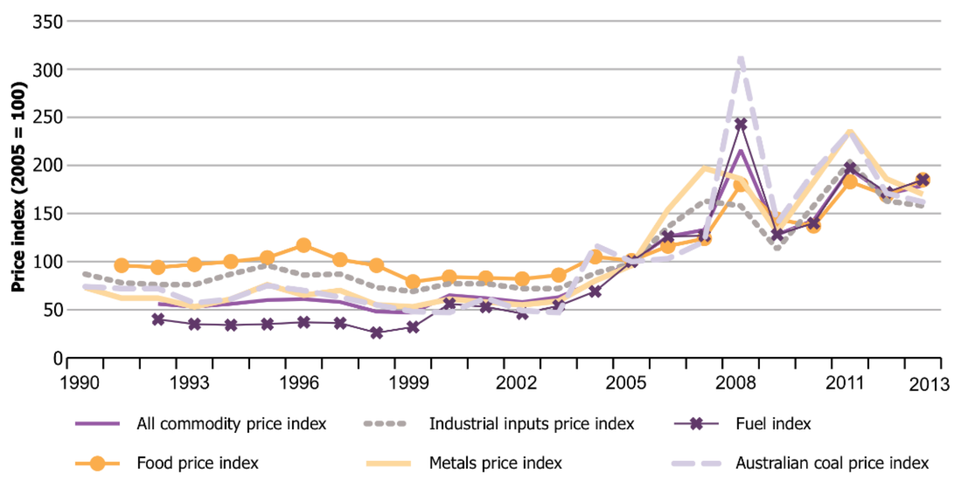
Note: Energy imported and exported as a percentage of domestic use, calendar years
Source: World Bank 2014

Commodity prices

Figure 8 shows historical changes in various international commodity prices between 2000 and 2013.

Commodity prices have generally been on a noticeable upwards trend since the early 2000s compared with the relatively stable levels observed over the preceding decade. The price increase in fuel is particularly noticeable, with prices roughly tripling in twenty years. Changes in commodity prices reflect patterns of global demand – the increasing size of the world market and associated demand for energy is one of the key driving forces behind higher commodity prices in recent years.

Figure 8 **International commodity price indices**



Note: Calendar years, 2005=100
Source: IMF 2014

2.2.2 National economic fundamentals

National output

The Australian economy has grown at a relatively consistent pace over the past two decades. National aggregate output has increased from approximately \$750 billion in 1990 to just over \$1.5 trillion in 2013, in real terms (2011-12 prices).

Annual GDP growth rate has consistently been above two per cent since 1993, except for the years in which there were global economic downturns (i.e. the dot com bubble burst at the turn of the century, and the GFC). Australia averaged an annual GDP growth rate of 3.2 per cent between 1990 and 2013.

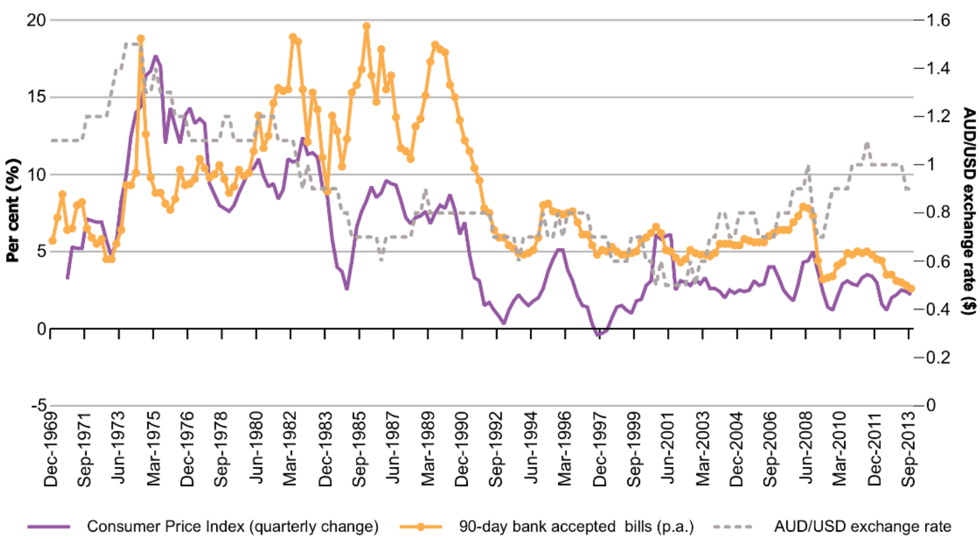
Interest rates, prices and exchange rates

Figure 9 shows historical series for the RBA 90-day bank accepted bills, the consumer price index (CPI) and the AUD/USD exchange rate.

Prior to the inflation targeting monetary policy implemented by the RBA in 1994, both the interest rate and CPI trended at relatively high levels compared to what has been observed over the past two decades. CPI growth has averaged around 2.7 per cent each quarter since September 1994 which is considerably lower than the average 8.1 per cent per quarter two decades preceding.

The value of the Australian dollar has fluctuated during this period. Over the 15 years between 1971 and 1986, the Australian currency was worth, on average, approximately 1.14 U.S. dollars per Australian dollar. Over the following 15 years from 1987 to 2002, the currency had depreciated to around an average of 0.63 U.S. dollars per Australian dollar. An appreciation of the Australian dollar has been observed in the past ten years, averaging around 0.84 U.S. dollars per Australian dollar.

Figure 9 **Interest rates, consumer price index and currency exchange rate**



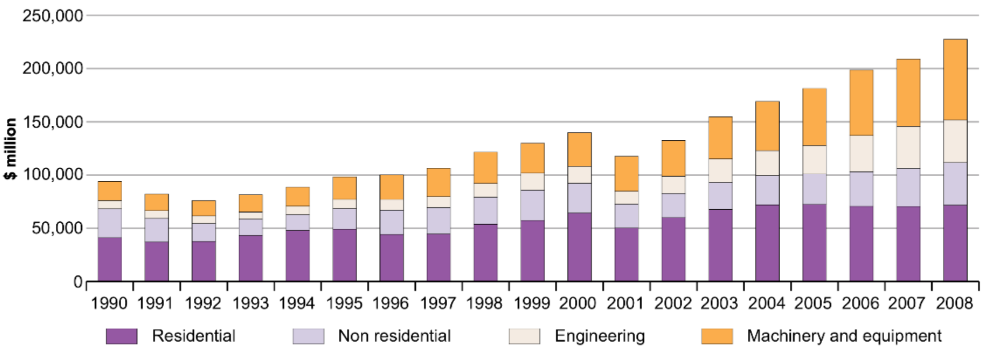
Source: Reserve Bank of Australia 2014

Investment in physical capital

One of the key changes to the Australian economy observed from the national accounts time series is the change in the absolute amount and composition of gross fixed capital formation. Gross fixed capital formation shows the total amount of investment in fixed assets that has taken place in the economy.

As shown in Figure 10, fixed asset investment in Australia has grown significantly over the past 10 years from approximately $155 billion in 2003 to $295 billion in 2013. It is also clear that almost all of the increase in capital formation during this period is attributed to investment that has taken place in the engineering and machinery-and-equipment categories, driven largely by major projects in the non-renewable resources sector.

Figure 10 **Gross fixed capital formation, Australia, 1990 to 2013**

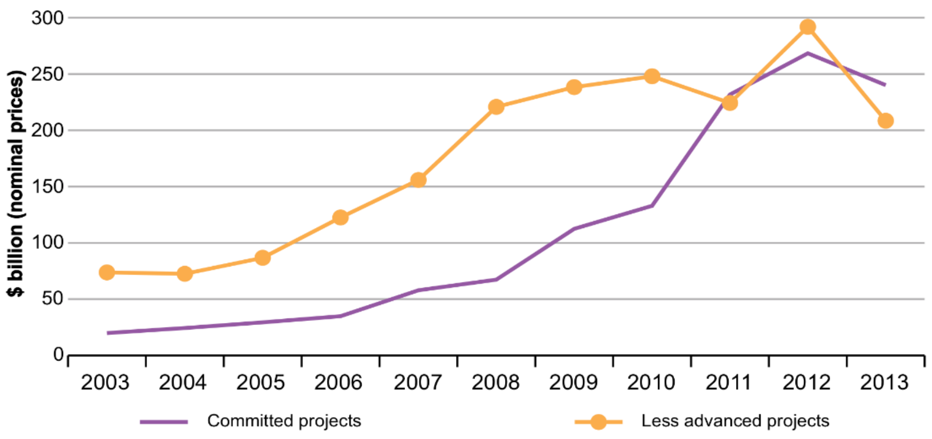


Note: Chain volume measures in 2011-12 prices, financial years
Source: ABS catalogue 5206.0, Australian National Accounts

The upward trend in gross fixed capital formation observed over the past decade is unlikely to continue indefinitely. Figure 11 shows the value of committed projects and of less advanced major projects in the resources and energy sector as reported by the Bureau of Resource and Energy Economics (BREE). Each of the series represents the total value of relevant future projects identified by BREE at the time of data release.

As can be seen, the value of less advanced projects (i.e. projects that are either in stages of feasibility studies or have been publicly announced) outweighed the value of committed projects between 2003 and 2010 but this gap disappeared by 2011, as a result of the decline in the value of less advanced projects in 2011 and 2013. Together, these two series signal that an overall downturn in resources and energy sector investments may be imminent, which will result in a reduction in fixed asset investment in the short-to-medium term.

Figure 11 **Resources and energy major projects**



Note: Nominal prices, financial years
Source: BREE 2014

2.3 Australia in transition

2.3.1 Demography

Between 1971 and 2013, Australia's population grew on average by 1.4 per cent per year from 13.1 million to 23.1 million people – an increase of around 77 per cent.

The composition of the population by age group has also changed during this period. As shown in Table 1, the proportion of youth aged 0 to 14 years declined from 28.7 per cent of the population in 1971 to 19.0 per cent of the population in 2011. On the other hand, the working population (15 to 64 year olds) as a proportion of the total population increased by 4.2 per cent and the retired age cohort (65 years and above) as a proportion of the total population increased by 5 per cent.

The old age dependency ratio (number of people aged 65 and as percentage of working age population) has subsequently increased from 13.2 per cent to 20.6 per cent during this period – a trend that is projected to continue into the coming decades.

Combined with rising healthcare costs, the provision of appropriate aged care infrastructures to address the ageing population is one of the major policy challenges faced by the Australia government (it is noted that this type of infrastructure is not included in the IA's AIA).

Table 1 **Population composition by age group, Australia**

Age group	1971	1991	2011
0 to 14	28.7%	21.9%	19.0%
15 to 64	63.0%	66.8%	67.2%
65 and above	8.3%	11.3%	13.8%
Dependency ratio[a]	13.2%	16.9%	20.6%

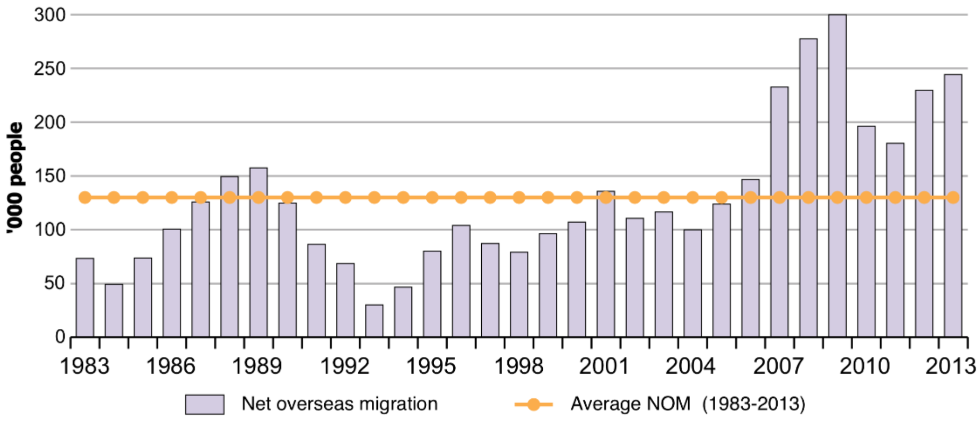
[a] People aged 65 and above as percentage of working age (15 to 64) population
Source: ABS catalogue 3101.0 Australian Demographic Statistics

Net overseas migration

The number of people immigrating to and emigrating from Australia has varied over the years. As shown in Figure 12, although net overseas migration (NOM) has fluctuated over the past three decades, there has been an overall increase in immigration in recent years.

In the five years to 2013, Australia's population grew by an average of 240,000 people per year through NOM. This is in stark contrast to the yearly average growth of 85,000 people through NOM in the five years starting in 1983. The average annual increase to the national population through NOM in the years 1983 to 2013 was about 130,000 people.

Figure 12 **Net overseas migration, Australia, 1983 to 2013**



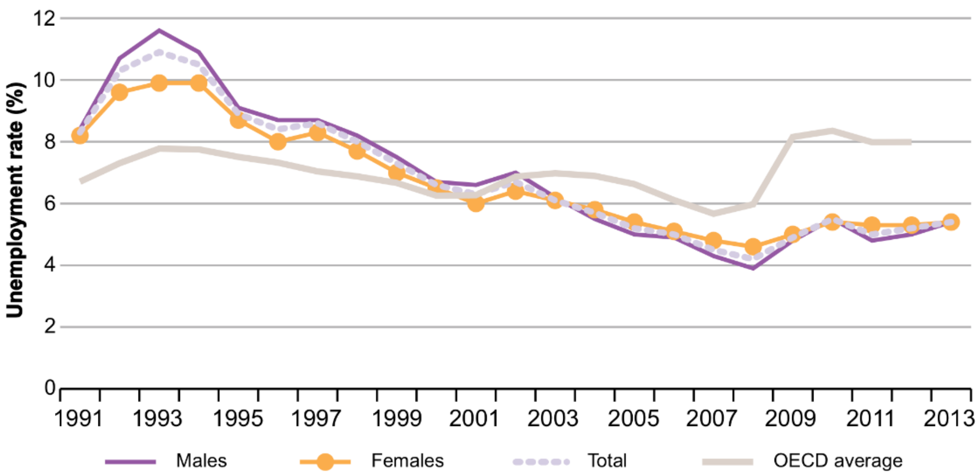
Note: Calendar years
Source: ABS catalogue 3101.0 Australian Demographic Statistics

2.3.2 Labour force

Unemployment rate

Over the past two decades, the Australian unemployment rate fell from above 10 per cent to between five and six per cent. On this front, Australia has performed well compared against other OECD nations, particularly since the 2000s. The average annual unemployment rate between 2008 and 2013 for Australia was around 5.5 per cent – a significantly better result than the OECD average of 7.7 per cent.

Figure 13 **Unemployment rate, Australia, 1991 to 2013**



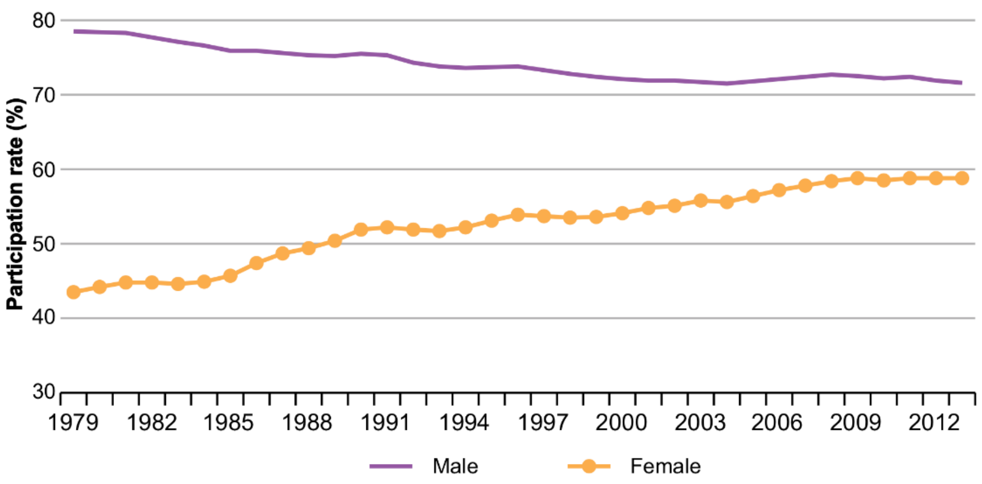
Note: Financial years for Australia, calendar years for OECD average
Source: ABS catalogue 6202.0 Labour Force, Australia, and World Bank 2014

Labour force participation

One of the notable changes to the Australian labour force over the past three decades has been the increasing proportion of female workers.

While only 44 per cent of the female working population (i.e. 15 to 64 year olds) was participating in the labour force in 1979, this increased to 58.8 per cent in 2013. Combined with the effects of an increase in overall population, the number of females in the labour force grew from approximately 2.3 million in 1979 to 5.5 million in 2013.

Figure 14 **Labour force participation rates, Australia, 1979 to 2013**



Note: Financial years

Source: ABS catalogue 6202.0 Labour Force, Australia

2.3.3 Economic structure

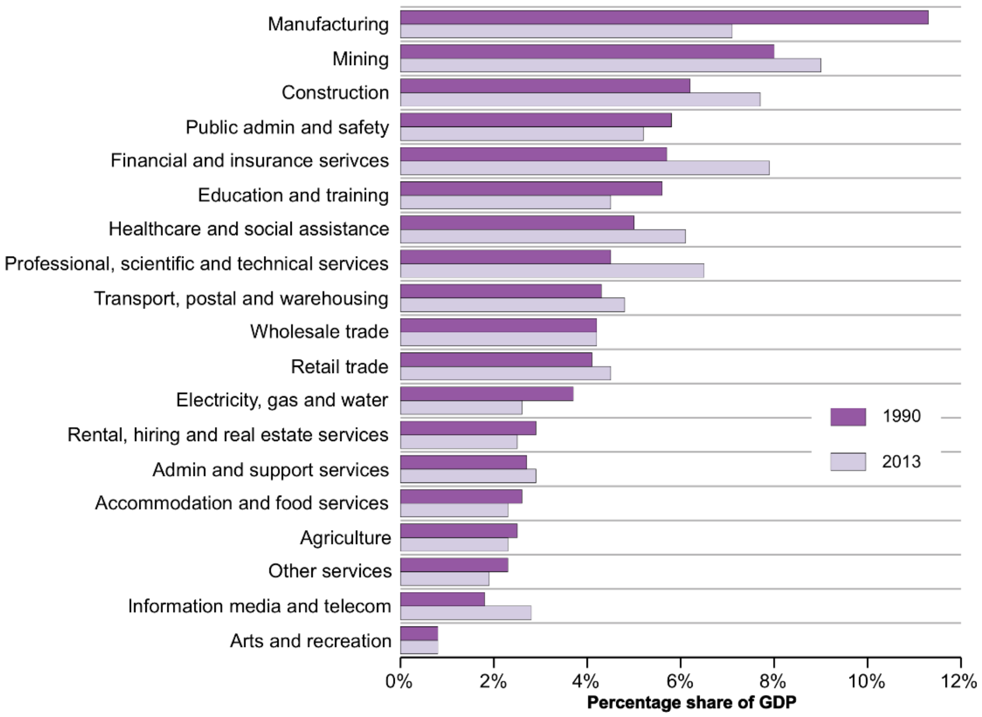
Significant changes have taken place in the structure of the Australian economy over recent years. Figure 15 indicates contributions to the nation's aggregate output by industry in 1990 and 2013. The main industries in which output as a percentage of GDP increased materially between 1990 and 2013 include:

- mining
- construction
- financial and insurance services
- healthcare and social assistance
- professional, scientific and technical services
- information, media and telecommunications

Industries that have fallen in terms of their relative contribution to national output during this period include:

- manufacturing
- electricity, gas and water
- education and training
- public administration and safety
- agriculture.

Figure 15 **Composition of national accounts, Australia (industry output as % of GDP)**



Note: Financial years

Source: ABS catalogue 5206.0, Australian National Accounts

Table 2 indicates the amount by which industry contributions to GDP changed between 1990 and 2013.

Table 2 **Change in industry contribution to GDP, Australia, 1990 to 2013**

Industry	Change in output as percentage of GDP (1990 to 2013) (%)
Increased share of GDP	
Financial and insurance services	2.22
Professional, scientific and technical services	2.02
Mining	1.78
Construction	1.36
Healthcare and social assistance	1.35
Information media and telecom	0.93
Decreased share of GDP	
Manufacturing	-4.50
Electricity, gas and water	-1.21
Education and training	-1.12
Public administration and safety	-0.66
Agriculture	-0.40

Source: ACIL Allen Consulting calculations based on ABS catalogue 5206.0 Australian National Accounts

The reduction in the output contribution of the manufacturing sector in just over two decades is striking.

This demonstrates the loss in Australia's comparative advantage in labour-intensive production (such as car manufacturing) against lower wage rates available abroad in an increasingly integrated international economy. By contrast, the proportion of value-add in the professional services sectors has increased.

The mining sector has always played a major role in the overall economic output for Australia, coming second to the manufacturing industry in 1990.

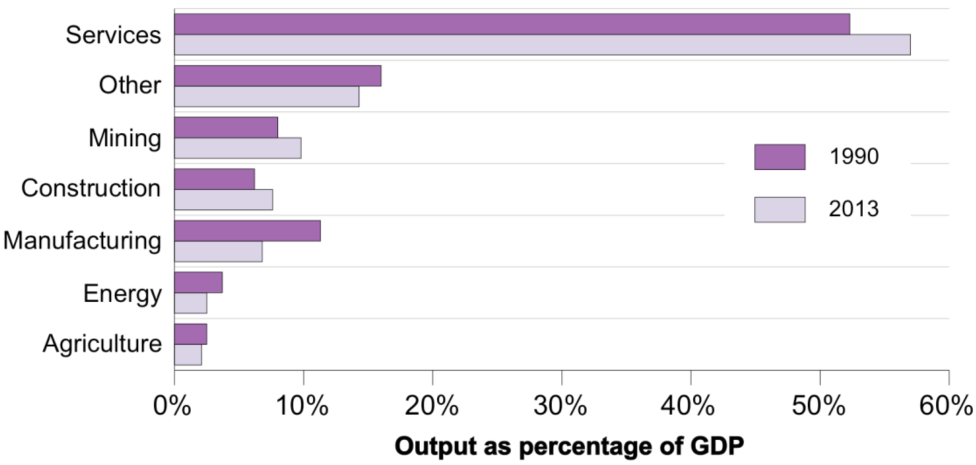
As Figure 15, in 2013, the mining industry accounted for just below 10 per cent of national output, well ahead of the other industries.

Broader structural change

A comparison of national output between 1990 and 2013 using a broader categorisation of industries reveals that the services industry has remained the dominant sector of the Australian economy.

Figure 16 presents the same national accounts data shown in Figure 15 with various service industries aggregated into one group. The services sector output in 1990 was $386.4 billion, growing to $868.9 billion by 2013. As a share of total GDP, the services sector has increased from 52.3 per cent to 57.0 per cent during this time. In this regard, the growth in the overall contribution of the services sector to total national output has been greater than that of mining, which grew from 8.0 per cent to 9.8 per cent during the same period.

Figure 16 **National output by sector – change in economic structure**



Note: Chain volume measures in 2011-12 prices, financial years
Source: ABS catalogue 5206.0, Australian National Accounts

2.3.4 Changes in states and territories

Population

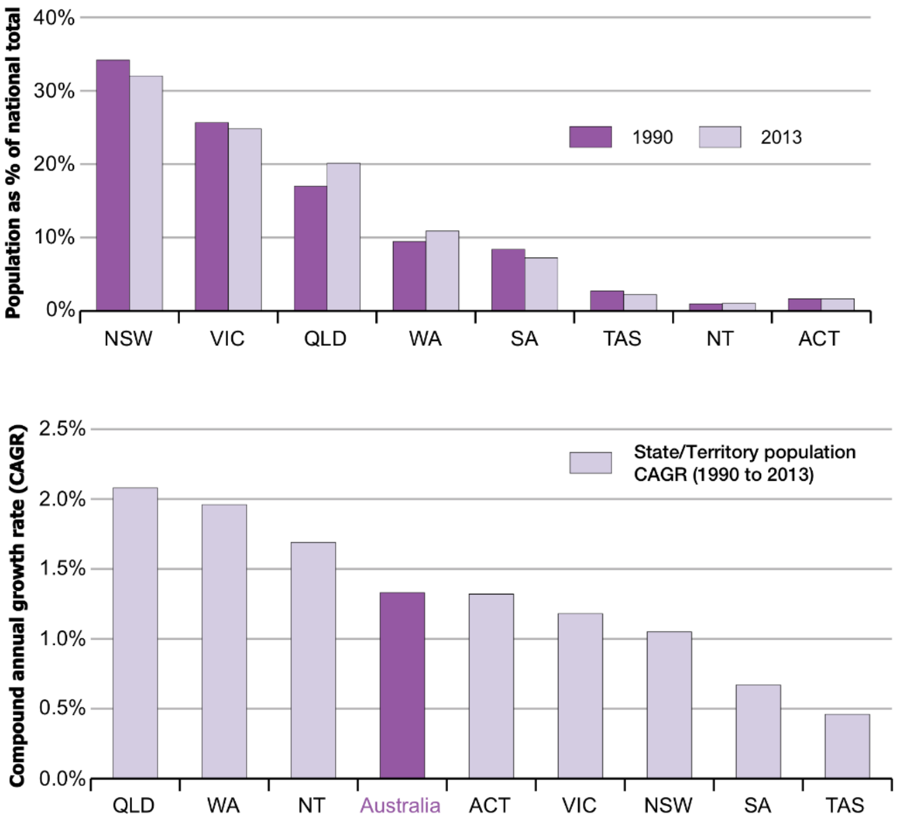
Demographic changes have varied across states and territories as well. For instance, population in some jurisdictions has grown faster than in others.

The first chart in Figure 17 shows each jurisdiction's population as a proportion of the national population in 1990 and 2013. Whilst the overall ranking of the states/territories in terms of population size has been unchanged since 1990, it is evident that the shares of Queensland, Western Australia and the Northern Territory in Australia's population has increased during this period.

The differential population growth rates across the jurisdictions between 1990 and 2013 are shown in the second chart in Figure 17. Queensland, Western Australia and the Northern Territory's population compound annual growth rate (CAGR) are all well above the Australian average, exceeding 1.5 per cent.

On the other hand, the other two major states of New South Wales and Victoria have lagged in comparison. One of the key explanations of this variation is the mining-led economic expansion that has taken place in the first group.

Figure 17 **Population change by state and territory – 1990 to 2013**



Note: Population at 30 June of corresponding financial year

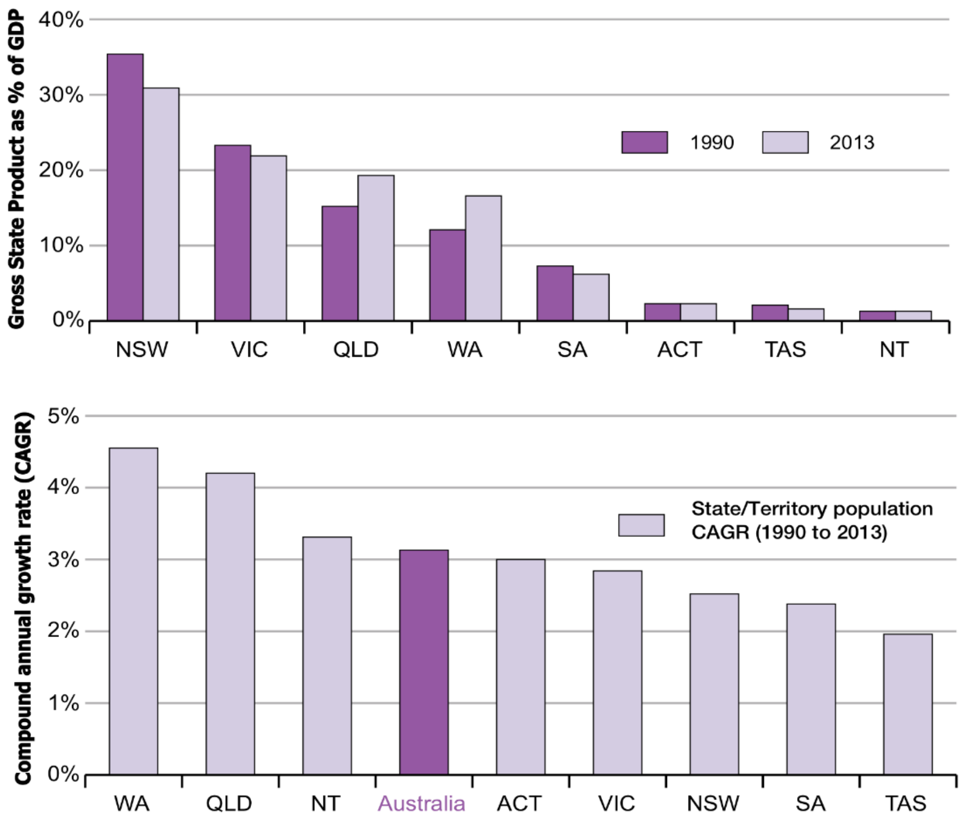
Source: ACIL Allen Consulting calculations based on ABS catalogue 3101.0 Australian Demographic Statistics

Gross state product

Changes in gross product by state and territory are shown in Figure 18. Similar to Figure 17, the first chart shows the percentage shares of state/territory gross product in GDP, while the second chart shows the compound average growth rate (CAGR) of output between 1990 and 2013 for each of the jurisdictions.

The pattern of change in economic output is very similar to the pattern observed in the population change. The CAGRs show that the same jurisdictions that had the fastest population growth also achieved the highest growth rates in economic output.

Figure 18 **Output change by state and territory – 1990 to 2013**



Note: Financial years

Source: ACIL Allen Consulting calculations based on ABS catalogue 5220.0 Australian National Accounts

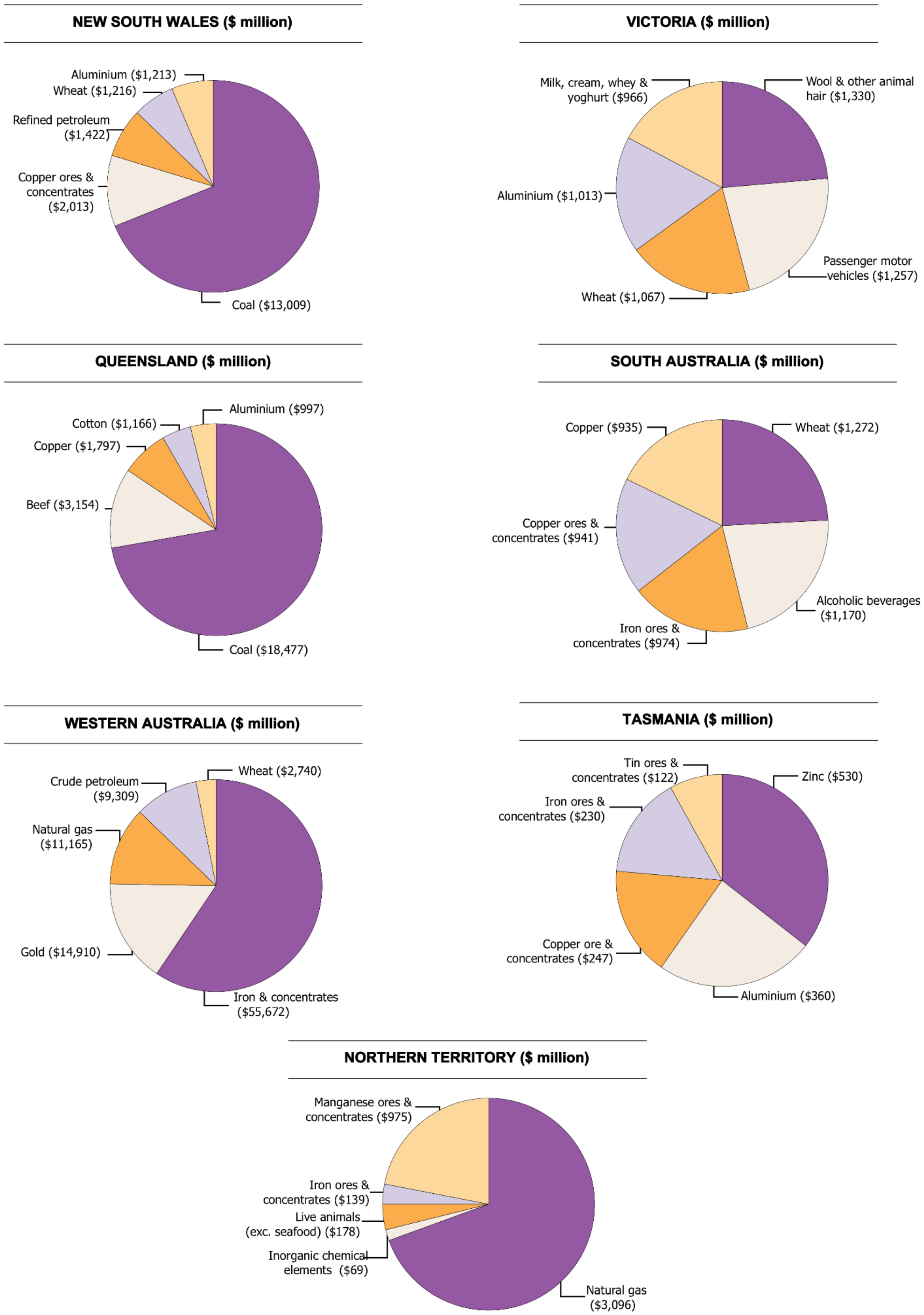
Exports of goods

The volume and composition of exports differs greatly across state and territory jurisdictions. Figure 19 and Figure 20 show the top five major export commodities for each state and territory (except the Australian Capital Territory) in 2012-13 on a balance of payments basis.

As can be seen, non-renewable natural resources and agriculture-related products form a significant component of exports for all jurisdictions. For example, coal is the dominant export commodity for New South Wales and Queensland at $13.0 billion and $18.5 billion, respectively. The value of Western Australia's exports of iron and other concentrates is over $55.6 billion. Tasmania and the Northern Territory are also characterised by a dominant natural resources export sector.

For Victoria, however, passenger motor vehicles are one of the largest export commodities at $1.2 billion, with agriculture-related commodities such as wool and dairy products together making up over $2.2 billion worth of exports in 2012-13.

Figure 19 **Top 5 major export goods by jurisdiction (2012-13)**



Note: Values in balance of payment basis; Australian Capital Territory excluded due to marginal size of export sector
Source: Department of Foreign Affairs and Trade 2014

Figure 20 **Top five exported-goods destinations by jurisdiction (2012-13)**

NSW		VIC		QLD		SA	
Destination	Value (A$m)	Destination	Value (A$m)	Destination	Value (A$m)	Destination	Value (A$m)
Japan	10,156	China	3,748	China	9,225	China	2,204
China	6,427	New Zealand	1,932	Japan	9,804	United States	1,016
Republic of Korea	3,042	Japan	1,741	Republic of Korea	5,023	India	682
Taiwan	2,011	United States	1,553	India	4,788	Japan	624
New Zealand	1,945	Republic of Korea	1,025	Taiwan	1,936	Malaysia	593

WA		TAS		NT	
Destination	Value (A$m)	Destination	Value (A$m)	Destination	Value (A$m)
China	54,082	China	644	Japan	3,290
Japan	21,512	United States	322	China	1,234
Republic of Korea	8,936	Taiwan	256		
India	4,081	India	250		
Singapore	3,744	Japan	246		

Note: Values in balance of payment basis; Australian Capital Territory excluded due to marginal size of export sector
Source: Department of Foreign Affairs and Trade 2014

Export destinations of goods vary by jurisdiction. That said, some countries such as Japan, China, New Zealand, Republic of Korea and the United States appear repeatedly as major export trading partners.

China, as discussed above, is a major net importer of energy, whilst Japan and Korea are resource-poor countries in terms of non-renewable natural resource deposits (for both energy and metals). It is therefore no surprise that commodities such as coal, iron, natural gas and other metals dominate exports to these trading partners.[7]

2.3.5 A snap shot of sub-state regions

Population and economic output by sub-state region provide valuable insights into the distribution of Australia's human capital resources and economic activity, by geographical location.

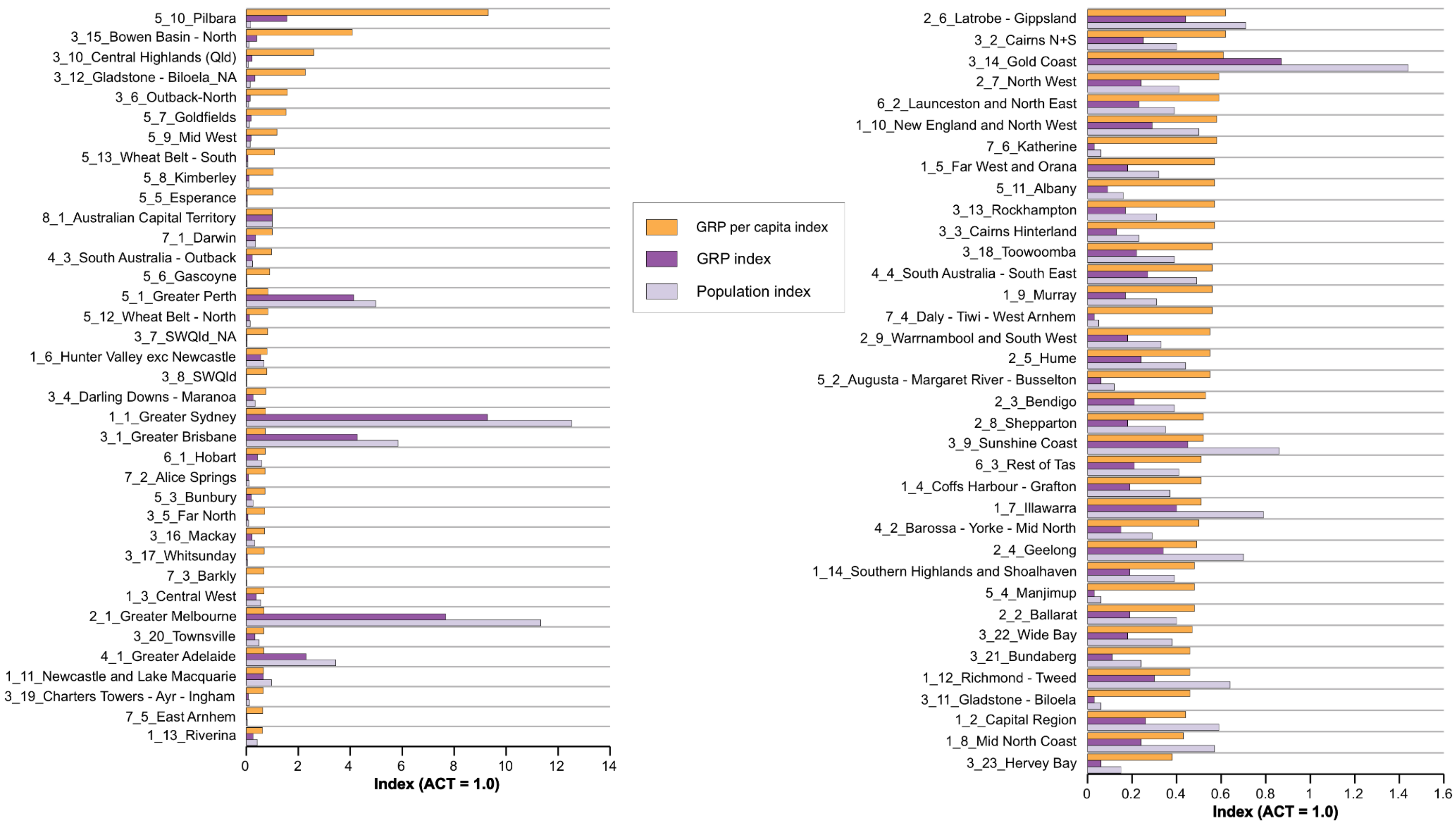
Figure 21 shows indices of population, gross regional product (GRP) and GRP per capita for each region considered in this project, where each series has been indexed to the values for the Australian Capital Territory (i.e. Australian Capital Territory equals 100 for each of the series). The regions have been ordered based on the size of their GRP per capita (highest to lowest).

As can be seen, the top five regions with the highest GRP per capita in 2011 are locations that have significant investments in non-renewable resources. These locations generate large amounts of value-add to the economy by utilising the fixed capital (machinery and equipment) invested in minerals production. Mining production is extremely capital intensive and is relatively labour un-intensive, which explains the high GRP per capita values.

[7] It should also be noted that Japanese demand for coal has increased since the 2011 earthquake, since generation from nuclear power plants have been reduced since then. Whether coal will indefinitely be used to supplement the energy gap arising from the reduction in nuclear power, is yet to be seen.

As can be seen in the first two tables of Figure 24, the ranking of regions by population and the ranking of regions by GRP roughly correspond except for the occasional mining townships that rank highly in terms of GRP but not in terms of population.

Figure 21 **Index of population, GRP and GRP per capita by region (ACT=1.00), 2011**



Note: Each indicator has been indexed to ACT values where ACT=1.00
Source: ACIL Allen Consulting calculations based on various ABS statistics

Figure 22 **Population, GRP and GRP per capital by region, 2011**

Population		GRP ($ million)		GRP per capita	
Region	Population	Region	GRP ($ million)	Region	GRP per capita
1_1_Greater Sydney	4,608,949	1_1_Greater Sydney	258,486	5_10_Pilbara	704,944
2_1_Greater Melbourne	4,169,366	2_1_Greater Melbourne	213,555	3_15_Bowen Basin - North	308,518
3_1_Greater Brisbane	2,147,436	3_1_Greater Brisbane	118,807	3_10_Central Highlands (Qld)	196,662
5_1_Greater Perth	1,833,567	5_1_Greater Perth	114,933	3_12_Gladstone - Biloela_NA	171,440
4_1_Greater Adelaide	1,264,091	4_1_Greater Adelaide	64,151	3_6_Outback-North	119,763
3_14_Gold Coast	528,766	5_10_Pilbara	43,549	5_7_Goldfields	115,665
8_1_Australian Capital Territory	367,985	8_1_Australian Capital Territory	27,850	5_9_Mid West	89,355
1_11_Newcastle and Lake Macquarie	357,562	3_14_Gold Coast	24,262	5_13_Wheat Belt - South	82,094
3_9_Sunshine Coast	318,279	1_11_Newcastle and Lake Macquarie	17,987	5_8_Kimberley	78,427
1_7_Illawarra	289,027	1_6_Hunter Valley exc Newcastle	15,269	5_5_Esperance	77,202
2_6_Latrobe - Gippsland	259,952	3_9_Sunshine Coast	12,407	8_1_Australian Capital Territory	75,682
2_4_Geelong	256,580	2_6_Latrobe - Gippsland	12,286	7_1_Darwin	75,383
1_6_Hunter Valley exc Newcastle	251,805	6_1_Hobart	11,939	4_3_South Australia - Outback	73,690
1_12_Richmond - Tweed	236,498	3_15_Bowen Basin - North	11,238	5_6_Gascoyne	68,415
6_1_Hobart	216,273	1_7_Illawarra	11,074	5_1_Greater Perth	62,683
1_2_Capital Region	215,828	1_3_Central West	10,499	5_12_Wheat Belt - North	62,516
1_8_Mid North Coast	208,090	7_1_Darwin	9,732	3_7_SWQld_NA	62,083
1_3_Central West	203,399	2_4_Geelong	9,465	1_6_Hunter Valley exc Newcastle	60,638
1_10_New England and North West	182,559	3_12_Gladstone - Biloela_NA	9,221	3_8_SWQld	60,020
4_4_South Australia - South East	180,532	3_20_Townsville	9,195	3_4_Darling Downs - Maranoa	57,067
3_20_Townsville	180,186	1_12_Richmond - Tweed	8,218	1_1_Greater Sydney	56,083
2_5_Hume	161,335	1_10_New England and North West	7,960	3_1_Greater Brisbane	55,325
1_13_Riverina	155,720	4_4_South Australia - South East	7,652	6_1_Hobart	55,203
6_3_Rest of Tasmania	151,579	1_13_Riverina	7,364	7_2_Alice Springs	54,581
2_7_North West	149,634	1_2_Capital Region	7,164	5_3_Bunbury	54,350
2_2_Ballarat	148,656	3_4_Darling Downs - Maranoa	7,148	3_5_Far North	53,887
3_2_Cairns N+S	147,505	3_2_Cairns N+S	6,920	3_16_Mackay	52,788
3_18_Toowoomba	144,258	1_8_Mid North Coast	6,798	3_17_Whitsunday	52,306
6_2_Launceston and North East	143,631	2_7_North West	6,734	7_3_Barkly	51,827
2_3_Bendigo	142,693	2_5_Hume	6,706	1_3_Central West	51,617

Population		GRP ($ million)		GRP per capita	
Region	Population	Region	GRP ($ million)	Region	GRP per capita
1_14_Southern Highlands and Shoalhaven	142,124	4_3_South Australia - Outback	6,402	2_1_Greater Melbourne	51,220
3_22_Wide Bay	139,001	6_2_Launceston and North East	6,365	3_20_Townsville	51,030
1_4_Coffs Harbour - Grafton	135,182	3_16_Mackay	6,121	4_1_Greater Adelaide	50,749
7_1_Darwin	129,106	3_18_Toowoomba	6,118	1_11_Newcastle and Lake Macquarie	50,304
2_8_Shepparton	127,002	3_10_Central Highlands (Qld)	6,002	3_19_Charters Towers - Ayr - Ingham	49,295
3_4_Darling Downs - Maranoa	125,260	6_3_Rest of Tasmania	5,895	7_5_East Arnhem	47,964
2_9_Warrnambool and South West	122,599	2_3_Bendigo	5,721	1_13_Riverina	47,288
1_5_Far West and Orana	117,991	2_2_Ballarat	5,351	2_6_Latrobe - Gippsland	47,264
3_16_Mackay	115,960	5_3_Bunbury	5,298	3_2_Cairns N+S	46,912
1_9_Murray	113,795	1_4_Coffs Harbour - Grafton	5,227	3_14_Gold Coast	45,884
3_13_Rockhampton	112,333	1_14_Southern Highlands and Shoalhaven	5,189	2_7_North West	45,000
4_2_Barossa - Yorke - Mid North	108,115	2_9_Warrnambool and South West	5,129	6_2_Launceston and North East	44,314
5_3_Bunbury	97,480	1_5_Far West and Orana	5,116	1_10_New England and North West	43,605
3_21_Bundaberg	86,895	5_7_Goldfields	5,015	7_6_Katherine	43,602
4_3_South Australia - Outback	86,876	3_22_Wide Bay	4,983	1_5_Far West and Orana	43,362
3_3_Cairns Hinterland	85,276	2_8_Shepparton	4,983	5_11_Albany	43,242
5_10_Pilbara	61,777	5_9_Mid West	4,942	3_13_Rockhampton	42,851
5_11_Albany	57,237	3_13_Rockhampton	4,814	3_3_Cairns Hinterland	42,772
5_9_Mid West	55,311	1_9_Murray	4,795	3_18_Toowoomba	42,408
5_12_Wheat Belt - North	54,846	3_6_Outback-North	4,137	4_4_South Australia - South East	42,383
3_23_Hervey Bay	54,106	4_2_Barossa - Yorke - Mid North	4,117	1_9_Murray	42,141
3_12_Gladstone - Biloela_NA	53,788	3_3_Cairns Hinterland	3,647	7_4_Daly - Tiwi - West Arnhem	42,087
3_19_Charters Towers - Ayr - Ingham	44,492	5_12_Wheat Belt - North	3,429	2_9_Warrnambool and South West	41,836
5_2_Augusta - Margaret River - Busselton	43,703	3_21_Bundaberg	3,052	2_5_Hume	41,567
5_7_Goldfields	43,356	5_8_Kimberley	2,885	5_2_Augusta - Margaret River - Busselton	41,409
7_2_Alice Springs	41,023	5_11_Albany	2,475	2_3_Bendigo	40,090
5_8_Kimberley	36,791	7_2_Alice Springs	2,239	2_8_Shepparton	39,232
3_15_Bowen Basin - North	36,427	3_19_Charters Towers - Ayr - Ingham	2,193	3_9_Sunshine Coast	38,980
3_6_Outback-North	34,541	5_2_Augusta - Margaret River - Busselton	1,810	6_3_Rest of Tas	38,893
3_5_Far North	31,624	5_13_Wheat Belt - South	1,751	1_4_Coffs Harbour - Grafton	38,666
3_10_Central Highlands (Qld)	30,517	3_5_Far North	1,704	1_7_Illawarra	38,316
5_4_Manjimup	22,267	3_23_Hervey Bay	1,568	4_2_Barossa - Yorke - Mid North	38,077

Population		GRP ($ million)		GRP per capita	
Region	Population	Region	GRP ($ million)	Region	GRP per capita
5_13_Wheat Belt - South	21,331	5_5_Esperance	1,241	2_4_Geelong	36,889
3_11_Gladstone - Biloela	20,485	3_17_Whitsunday	1,003	1_14_Southern Highlands and Shoalhaven	36,512
7_6_Katherine	20,400	7_6_Katherine	889	5_4_Manjimup	36,098
3_17_Whitsunday	19,177	5_4_Manjimup	804	2_2_Ballarat	35,999
7_4_Daly - Tiwi - West Arnhem	18,099	7_5_East Arnhem	772	3_22_Wide Bay	35,852
7_5_East Arnhem	16,101	3_7_SWQld_NA	768	3_21_Bundaberg	35,120
5_5_Esperance	16,069	7_4_Daly - Tiwi - West Arnhem	762	1_12_Richmond - Tweed	34,749
3_7_SWQld_NA	12,373	3_11_Gladstone - Biloela	709	3_11_Gladstone - Biloela	34,627
5_6_Gascoyne	9,674	5_6_Gascoyne	662	1_2_Capital Region	33,191
3_8_SWQld	8,093	3_8_SWQld	486	1_8_Mid North Coast	32,670
7_3_Barkly	6,563	7_3_Barkly	340	3_23_Hervey Bay	28,984

Note: Real values in 2010-11 prices

Source: ACIL Allen Consulting, 2014 calculations based on various ABS statistics

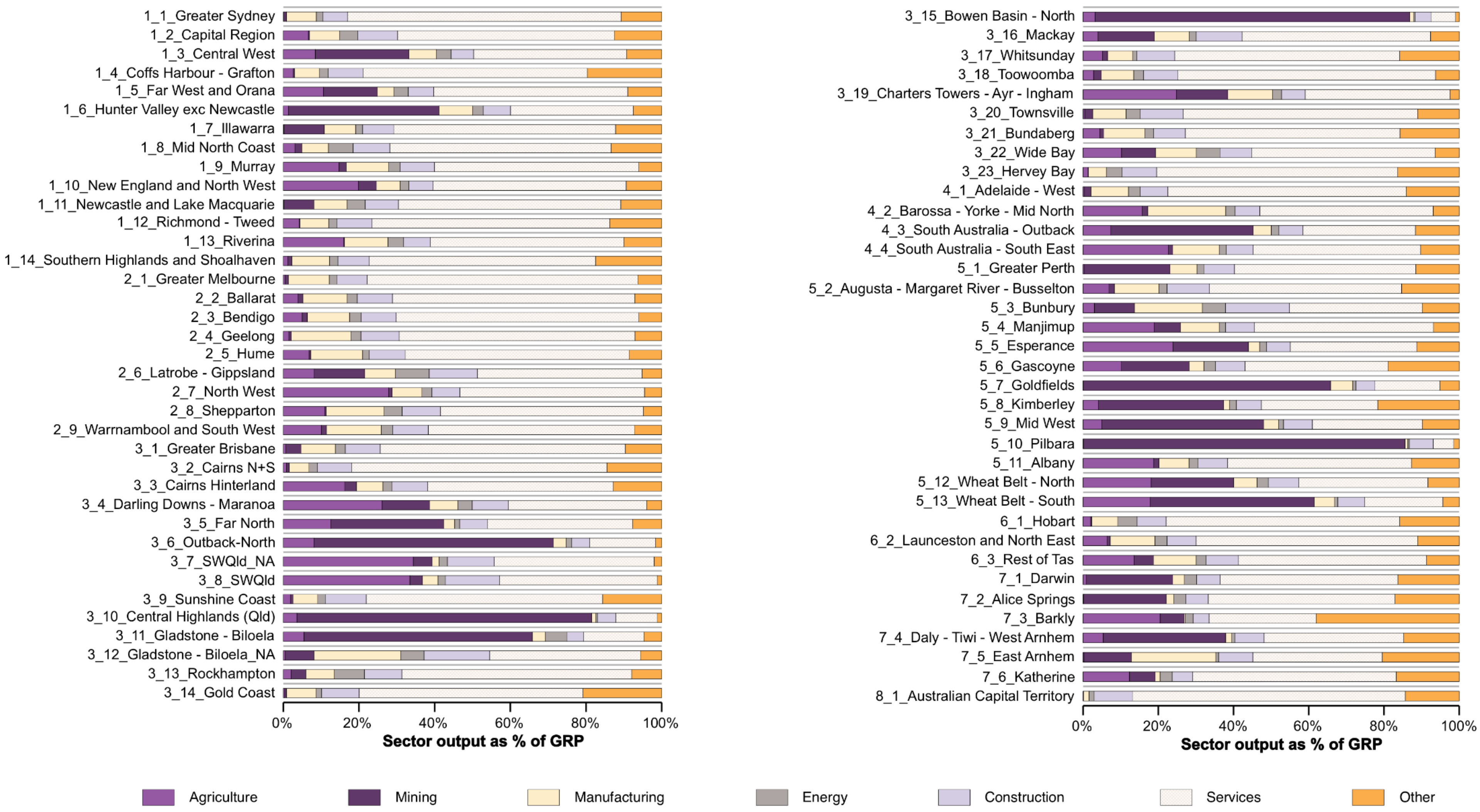
Regional sector output

Figure 23 shows sector gross product (defined using the broad categories as above) as a percentage of GRP for each region considered in this review. Whilst it is evident that each region has a unique economic profile, a number of observations can be made from the charts:

- Of the 73 regions, the majority are characterised by a dominant services sector economy. This is particularly the case for capital cities and for regions that have relatively large population.
- Regions prospering from non-renewable resources are concentrated in Queensland, Western Australia and the Northern Territory.
- Only a handful of regions have agriculture as their dominant sector.
- Broadly speaking, the contribution of the construction and manufacturing sectors to GRP tend to be similar in size within a region, and are relatively consistent across the different regions.
- The energy sector has typically one of the smallest shares in GRP.

The unique economic profiles of the regions are intrinsically linked to a multitude of factors such as demographic characteristics, government policy, regulation, infrastructure investments, and the availability of human capital and natural resources.

Figure 23 **Sector shares in gross regional product, 2011**



Note: Real values in 2010-11 prices

Source: ACIL Allen Consulting, 2014 calculations based on various ABS statistics

2.4 Infrastructure investment trends

2.4.1 Expenditure by sector

Sector totals

The charts in Figure 24 show historical construction spending in the residential, non-residential and engineering sectors in Australia from 2003 to 2013. In aggregate terms, expenditure has increased by close to 87 per cent during this period, from approximately $122.1 billion to $227.1 billion in chain volume measures (2011-12 prices).

The residential sector includes physical assets such as new houses, apartments and townhouses, and spending related to alterations made to existing residential buildings. Total expenditure in this sector has remained relatively constant over the past decade, hovering around the $70 billion (2011-12 prices) mark.

In comparison, some growth in the non-residential sector can be observed, with total spending increasing by approximately 53 per cent (or by around $13 billion) from $21.9 billion in 2003 to $33.6 billion in 2013. The non-residential sector includes non-dwelling physical assets such as offices, retail and wholesale trade buildings (i.e. shopping centres and warehouses), as well as health and aged care facilities.

Figure 24 **Construction spending – sector totals, Australia, 2003 to 2013**

Note: Chain volume measures in 2011-12 prices, financial years
Source: ABS catalogues 8762.0, 8755.0 and 8752.0

In contrast to the residential and non-residential categories, there was rapid growth in engineering construction between 2003 and 2013. Engineering construction includes physical assets that are broadly referred to as ‘infrastructure’.

These include roads, railways, ports, power stations, electricity network facilities, pipelines and water and sewerage plants, as well as heavy industry equipment that is typically used in the non-renewable resources industry. Engineering spending grew from $33.0 billion in 2003 to $121.9 billion in 2013.

Engineering construction – sub-sectors

Taking a closer look at the various components of engineering construction spending, we can see yet again that the uplift in infrastructure investment over the past decade has largely been driven by the non-renewable resources sector.

As shown in Figure 25, the largest contributing sub-sector to the overall spending growth in engineering is **heavy industry including mining**.

Expenditure in this sub-sector has increased from approximately $8.3 billion in 2003 to $58.7 billion in 2013. In terms of its contribution to the sector, heavy industry including mining has grown from 25.4 per cent to 48.1 per cent during this period (Figure 26).

Spending on **bridges, railways and ports** increased at a very similar rate to heavy industry including mining. This is not surprising given that the expansion in mineral production entails a need to augment the supply-chain infrastructure which includes railways for transporting minerals to ports, and larger ports that allows for efficient exportation. The spending on bridges, railways and ports share of total engineering construction expenditure increased from 8.2 per cent in 2003 to 11.8 per cent in 2013.

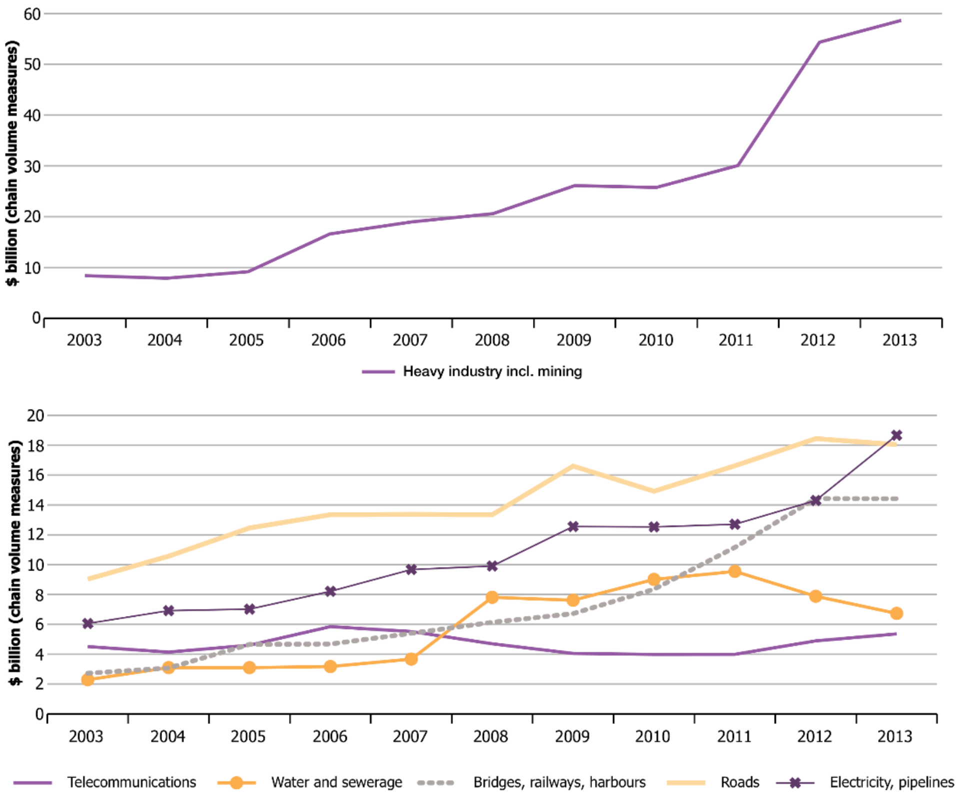
The amount of investment in **roads** across Australia roughly doubled between 2003 and 2013. Governments at both national and state/territory levels are responsible for this uptrend in spending on roads. In 2003, $9 billion was spent on roads and it accounted for roughly a quarter of all infrastructure investment expenditure in that year. In 2013, total road spending had increased to $18 billion but was only worth 14.8 per cent of total infrastructure spend (compared with the 27.4 per cent in 2003), due to the faster spending growth in heavy industry including mining.

Investment levels in the **telecommunications** sub-sector has ebbed and flowed over the years, with spending levels at somewhere between $4.5 billion and $6 billion each year. The spending pattern in telecommunications is largely dependent on technological changes.

A surge in **water and sewerage** infrastructure can be observed from the chart in the years following 2007. Average annual spending between 2008 and 2013 was approximately $8.1 billion, which is significantly higher than the average annual spending of $3.9 billion recorded between 2003 and 2007. The surge in water and sewerage infrastructure investments is largely explained by several of the major desalination plants constructed during this period.

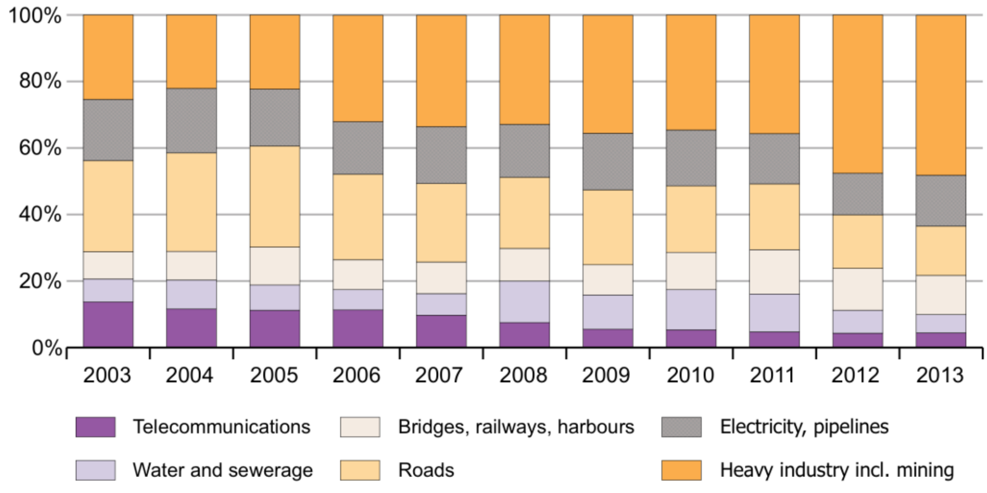
Infrastructure investment in the **electricity and pipelines** sub-sector has also increased in recent years, with network augmentation undertaken at both the transmission and distribution network levels. Increased investment in pipelines is attributed to the various natural gas and coal seam gas projects across Australia.

Figure 25 **Engineering construction spending by sub-sector, Australia, 2003 to 2013**



Note: Chain volume measures in 2011-12 prices, financial years
Source: ABS catalogues 8762.0, 8755.0 and 8752.0

Figure 26 **Engineering construction spending by sub-sector as percentage of total**



Note: Financial years
Source: ACIL Allen Consulting calculations based on ABS catalogues 8762.0, 8755.0 and 8752.0

2.4.2 Public and private investment trends

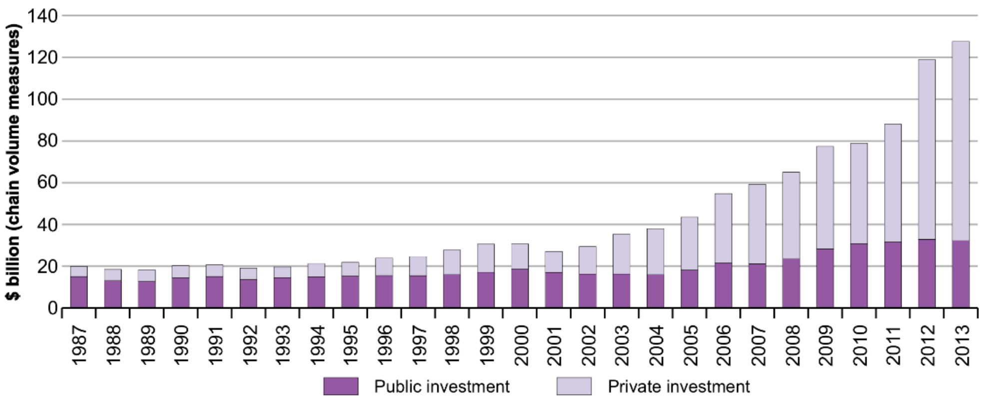
Aggregate spending

Figure 27 shows the split in infrastructure investment expenditures between the public and private sectors since 1987.

Private sector investment in 1987 was worth approximately $4.8 billion and accounted for only about a quarter of total infrastructure spending in the same year. By 2013, however, private sector investment had grown by nearly twenty-fold over to $95 billion, accounting for nearly three-quarters of all infrastructure investment that took place.

Although by not as much, public infrastructure investment has also grown during this period; doubling from $15 billion in 1987 to $32.3 billion in 2013.

Figure 27 **Infrastructure investment – public vs. private spending, Australia, 1987 to 2013**



Note: Chain volume measures in 2011-12 prices, financial years
Source: ABS catalogues 8762.0, 8755.0 and 8752.0

Looking at the components of infrastructure spending by public and private sectors separately, we are able to observe the different areas in which investment has been made.

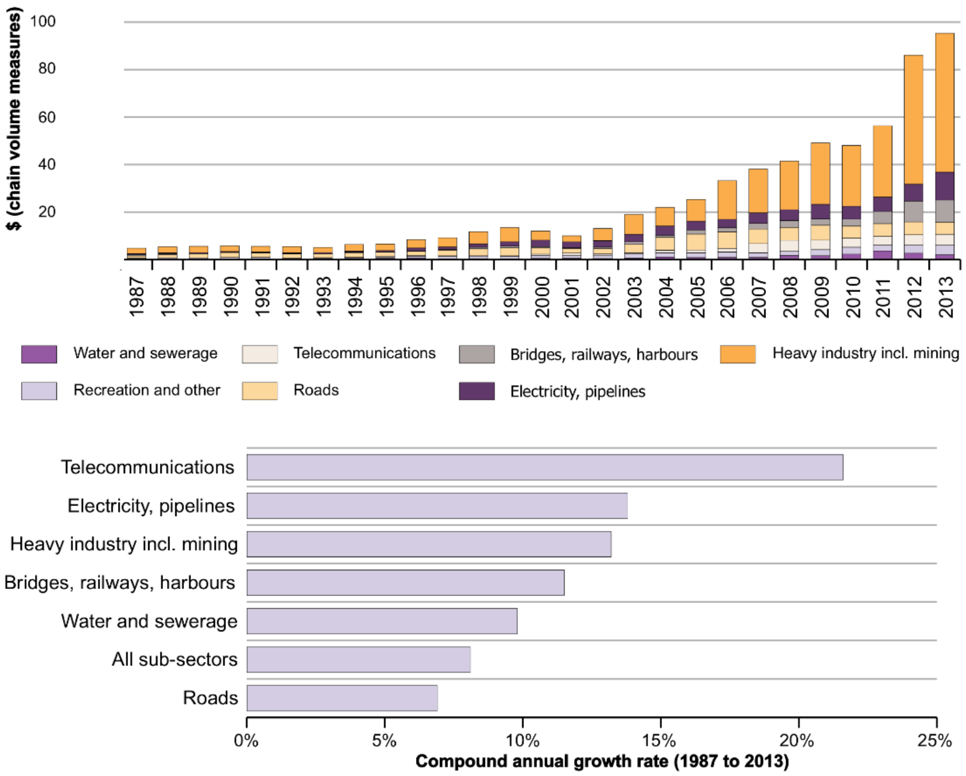
Private sector spending

As shown in Figure 28, the uptrend in private sector investments only began at the turn of the twenty-first century. The dominant sub-sector into which **private sector** capital has flowed into is heavy industry including mining. Major mining companies have spent billions of dollars over the past decade expanding existing open-cut mines as well as investing in new production capabilities. In CAGR terms, the heavy industry including mining sub-sector has achieved 13.2 per cent annual growth between 1987 and 2013.

Interestingly, spending in the telecommunications sector has grown faster than heavy industry including mining. This is primarily as a result of the privatisation of Telstra. Prior to privatisation, there was minimal private sector spending in telecommunications, averaging less than $100 million per year between 1987 and 1999. Since the second stage of Telstra's privatisation, however, annual investment has averaged at approximately $2.5 billion between 2000 and 2013.

Significant spending has also taken place in private electricity and pipelines infrastructure, particularly over the past decade. This has been driven by major investments undertaken by the private sector to augment the electricity network (both transmission and distribution) for privately-owned/leased networks to keep up with energy demand.

Figure 28 **Private sector infrastructure investment by sub-sector, Australia, 1987 to 2013 ($ billion)**



Note: Chain volume measures in 2011-12 prices, financial years
Source: ACIL Allen Consulting calculations based on ABS catalogues 8762.0, 8755.0 and 8752.0

Public sector spending

Similarly to the private sector, surge in public sector investment took place towards the middle of the 2000s, with most of the capital injection going into roads, railways, bridges and ports, and utilities such as water and power.

Spending on roads has nearly tripled between 1987 and 2013 from approximately $4.3 billion to $12.9 billion. During this time, many of the state and territory governments invested heavily on major highways and tunnels to improve both passenger and freight road transport networks.

The increase in water and sewerage spending between 2008 and 2013 is largely explained by the construction of numerous desalination plants as mentioned above.

The significant fall in public sector expenditure in the telecommunications sub-sector is explained by the privatisation of Telstra, as discussed above.

2.4.3 Australian infrastructure investment relative to OECD

Compared against major economies of the world, growth in Australia's investment in physical capital over the past decade has been substantial.

According to the World Bank, Australia's gross fixed capital investment grew approximately seven-fold from US$52 billion to US$424 billion between 1987 and 2012 (nominal terms). This is significantly higher than the 85 per cent average growth of investment for OECD countries over the same period. Australia has enjoyed substantial growth in capital investments over the past thirty-odd years, achieving a CAGR in investment of 8.7 per cent – more than double that of the OECD average of 4.3 per cent for the same period.

The high level of Australian capital investment during much of the 2000s compared against the OECD average is once again explained by the numerous large-scale non-renewable resource projects that have been commissioned during this period.

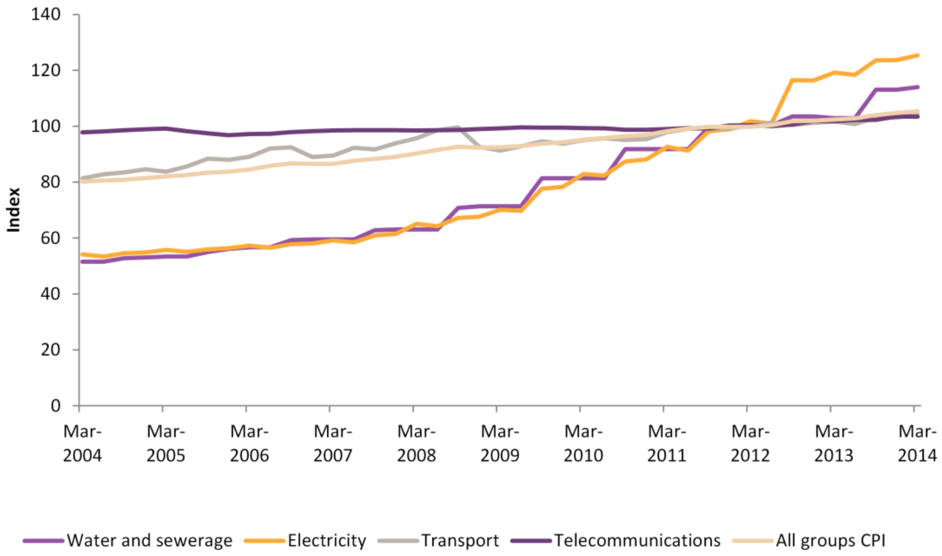
In this regard, Australia has an exceptional economic structure given the relatively large share of primary commodity (i.e. energy) exports that make up its national output, compared to most other OECD countries. As mentioned above, Australia's fixed capital investment has been driven in large part by the increasing demand for energy from countries such as China. Other OECD countries have not benefited from China's rapid growth in the same way.

2.5 Infrastructure performance

2.5.1 Prices for infrastructure services

As shown in the figure below, prices of electricity and water and sewerage services have increased by more than the All Groups CPI since 2009. By contrast, prices for transportation services have grown approximately in line with CPI while prices for telecommunications have grown at a rate less than CPI.

Figure 29 **CPI Australia, selected sub group and total CPI (2004-2014)**



Note: March 2012=100

Source: ABS Consumer Price Index, March 2014

2.5.2 Household expenditure on infrastructure services

Since 2012, increases in infrastructure service prices have contributed a much greater percentage of overall CPI growth than their relative weighting within the total CPI basket of goods. High price rises in electricity and water in particular have resulted in a higher overall CPI rate.

Infrastructure services accounted for 18.8 per cent of the CPI basket of goods in March 2014, up slightly from 18.6 per cent in 2012. Transport services make up the largest contribution, representing 11.4 per cent of the basket, while gas and other household fuels made the smallest at 2.6 per cent.

Despite accounting for only 2.6 per cent of the total CPI basket in March 2014, electricity services made up 9.3 per cent of total CPI growth in the past two years. Infrastructure services as a whole accounted for 25.3 per cent of total CPI growth.

The table below details the contributions of infrastructure services to the total CPI and to its changes over the last two years.

Table 3 **Infrastructure services contribution to total CPI, 2012 to 2014**

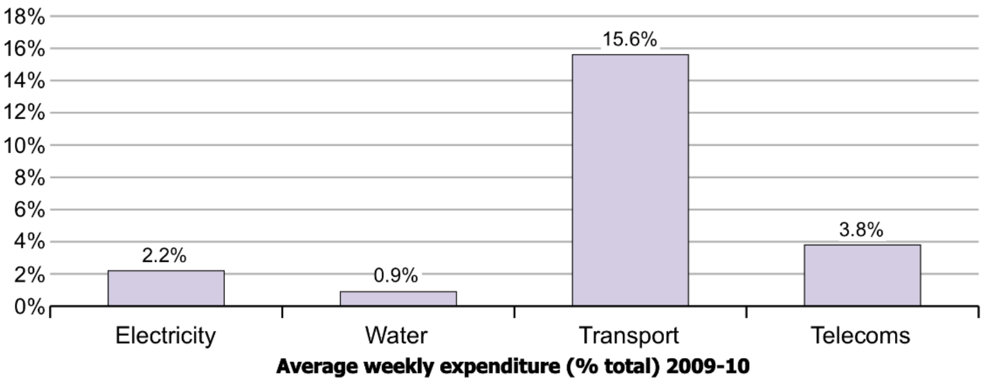
	Contribution to Total CPI			% Total CPI change	
	Mar-12	Mar-2013	Mar-2014	1 year	2 year
Water and sewerage	1.0%	1.0%	1.1%	3.7%	2.5%
Electricity	2.2%	2.5%	2.6%	4.7%	9.3%
Gas and other household fuels	0.8%	0.9%	0.9%	2.0%	3.5%
Transport	11.6%	11.5%	11.4%	10.0%	8.4%
Telecommunications	2.9%	2.9%	2.9%	1.3%	1.6%
Total	**18.5%**	**18.8%**	**18.8%**	**21.7%**	**25.3%**

Source: ABS Consumer Price Index, Australia, March 2014

2.5.3 Change in household expenditure on infrastructure services

In 2009-10, 22.4 per cent of household expenditure was spent on infrastructure services. As shown in Figure 39, the bulk of this was dedicated to transport (15.6 per cent), with telecommunications (3.8 per cent), electricity (2.2 per cent) and water (0.9 per cent) making up smaller shares.

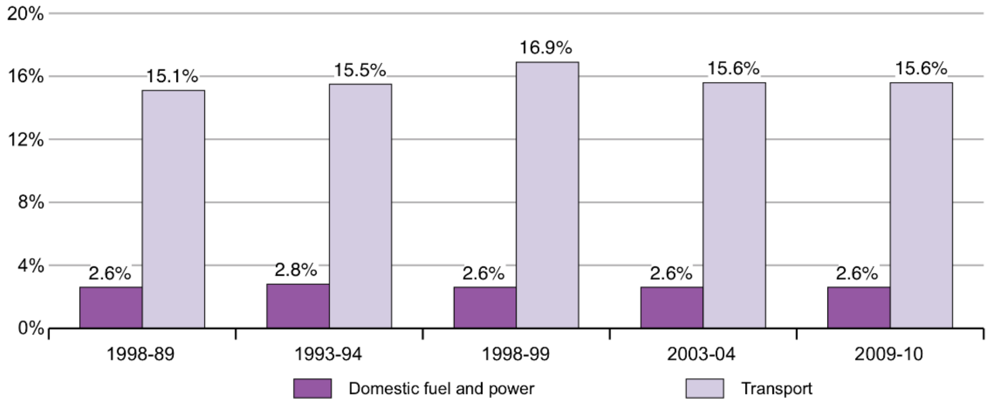
Figure 30 **Shares of selected infrastructure services in average weekly household expenditure, Australia, 2009-10**



Source: ABS Household Expenditure Survey, 2009-10

Figure 31 shows that expenditure on domestic fuel and power has been a fairly constant proportion of household expenditure since 1989-90. Spending on transport has varied between 15.1 per cent and 16.9 per cent of household expenditure over the same period.

Figure 31 **Share of selected infrastructure subsectors in Australian household expenditure, 1988-90 to 2009-10**



Source: ABS Household Expenditure Survey, 2009-10

3 Strategic approach to the Audit

This chapter discusses the strategic approach used to undertake this component of the Australian Infrastructure Audit (AIA). This is the first time that study has been completed for IA which brings together data to produce a baseline of Australia's nationally significant infrastructure covering the major economic infrastructure sectors: energy, telecommunications, transport and water.

3.1 Infrastructure

Infrastructure can be broadly classified into two distinct categories (Productivity Commission, March, 2014):

- *Economic infrastructure* incorporates the physical structures from which goods and associated services are used by individuals, households and industries, including rail, roads and public transport, water and energy networks, ports and airports; and
- *Social infrastructure* includes the facilities and equipment used to satisfy the community's education, health and community service needs, such as hospitals and schools.

These definitions can be extended in a number of different ways – for example social infrastructure can be extended to include entirely non-physical factors such as legal systems, and economic infrastructure can be extended to include things such as networks of businesses/retailers or supply chains where different services are interdependent (Australian Government, 2010).

For practical purposes, the audit has focussed on **physical, economic infrastructure that can be readily understood, easily defined and measured.**

The Audit has also attempted to break down supply chain networks according to the relative contribution of different kinds of infrastructure. This is discussed in section 3.2.2.

The Audit focusses on nationally significant transport, energy, telecommunications and water infrastructure. This Audit also refers to some of the urban transport findings however the detailed findings are outlined in a stand-alone report which complements this review.

3.2 Nationally significant infrastructure

The audit has focussed on *nationally significant infrastructure* – a subset of all economic infrastructure. Broadly speaking, nationally significant infrastructure is defined as economic infrastructure, the services of which provide economic value to Australia above a specified threshold (explained later). The focus of this audit is to measure:

- supply of infrastructure (which is measured using capacity metrics)
- demand for infrastructure (which is measured using utilisation metrics)
- economic contribution of infrastructure (which is measured in terms of the contributions of infrastructure services to GDP and GRP).

3.2.1 Definition of nationally significant infrastructure

For the modelling undertaken as part of the AIA, *nationally significant infrastructure* has been defined as meaning transport, energy, telecommunications, or water infrastructure facilities, the services of which generate a direct economic contribution to the national economy above a specified threshold (notionally 0.01 per cent of GDP per annum or approximately $150 million per annum as at 2010-11). There are some cases where specific pieces of infrastructure that do not meet the threshold have been included in the audit: facilities that the Australian Governments have recognised as forming a national network.

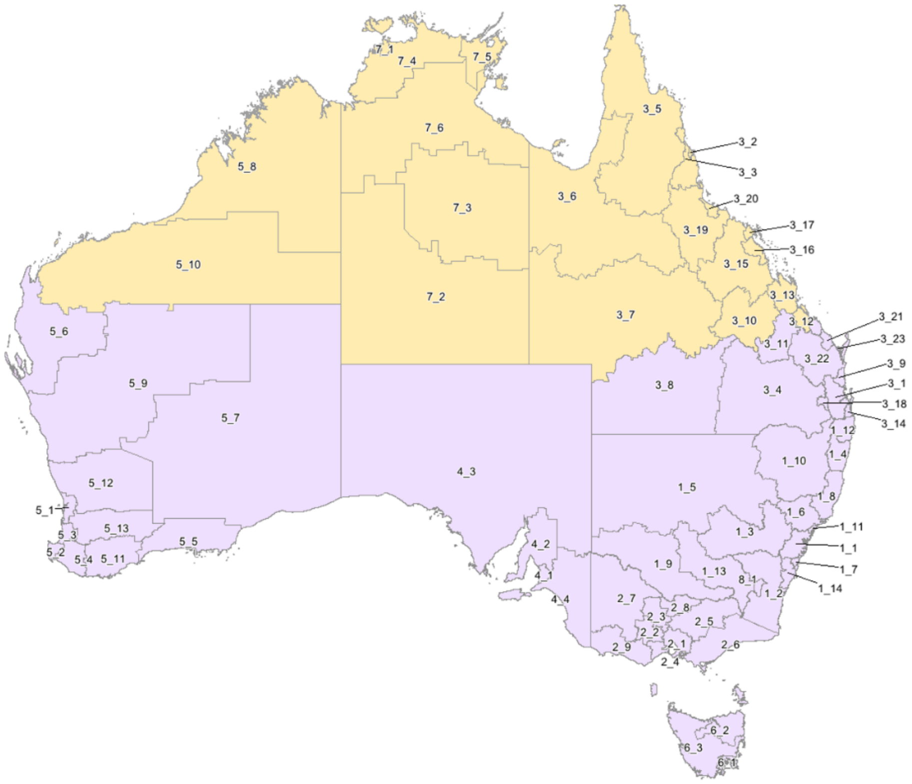
3.2.2 Accounting for infrastructure supply chains

The audit distinguishes infrastructure facilities and their values within increasingly complex supply chains. For example, the assessment of the value of port facilities is separated from the value of the land freight and rail transport networks and facilities that bring products from a primary producer to the port.

3.2.3 Accounting for infrastructure in Australian regions

In identifying Australia's infrastructure the audit has identified the geographic location of infrastructure within 73 regions of Australia (*audit regions*) – see Figure 32 for details. Figure 32 shows the audit regions and the division of Australia into 'Northern Australia' and 'Southern Australia' for reporting purposes. The Northern Australia audit conducted in parallel with this project by PricewaterhouseCoopers and GHD has focussed on infrastructure in Northern Australia.

Figure 32 **Audit regions, Northern Australia and Southern Australia**



Note: Audit codes listed in map are expanded on in Figure 22. For example, 1_1 represents the audit region Greater Sydney. The map is shaded in two colours: light purple depicts 'southern Australia' and the light orange depicts 'northern Australia'. There is also a Northern Australia Infrastructure Audit report which is part of Infrastructure Australia's Australian Infrastructure Audit.

Source: ACIL Allen Consulting, 2014

Rationale for using audit regions

The 73 audit regions have been used to define geographic regions for which economic projections for the demand for infrastructure in 2030-31 can be produced. This allows for the future demand for infrastructure services to be projected at a *regional level* and not just at the *national or state and territory levels*.

The number of audit regions and the geographic boundaries reflect the need to balance competing demands:

- having a greater number of audit regions would allow for greater precision in locating infrastructure and making projections of future demand for infrastructure services, however
- having fewer audit regions makes undertaking the population and economic projections workable within the project timeframe.

The selection and definition of audit regions was finalised in conjunction with Infrastructure Australia.

Definition of audit regions

The geographic boundaries of the 73 audit regions are based on the Australian Statistical Geography Standard (ASGS) used by the ABS.

The approach used in defining the regions differed for the Northern Australia and Southern Australia areas and involved the following:

- For Northern Australia: Western Australia and Northern Territory were divided by GCCSA and SA3 and Queensland was divided into a mix of GCCSA, SA4, SA3 and SA2 areas reflecting the need to meet various reporting criteria.
- For Southern Australia: States and Territories were divided by GCCSA and SA4 level data.

See Appendix in Part C for further information on how audit regions were defined.

3.3 Infrastructure categories

Table 4 shows the infrastructure subsectors distinguished in the AIA.

Table 4 **Infrastructure services examined in the AIA**

Infrastructure	Categories	Inclusions
Transport	National Highway and Key Freight Routes	The National Land Transport Network (NLTN) road (excluding roads inside capital cities). Key Freight Routes were identified with the assistance of the State and Territories during consultation.
	National Rail network	Rail and freight intermodal facilities that are available for hire.
	Ports	Port and port terminal facilities that are available for hire that are accessed by major shipping services.
	Airports	Airport facilities including aeronautical, transport, storage, logistical, commercial and retail facilities and services located in and adjoining airports.
Energy infrastructure	Electricity supply	Generation, transmission and distribution facilities
	Gas supply	Gas transmission and distribution pipelines
	Fuel	Petroleum product terminals
Telecommunications	Telecommunications	Services that are available for hire. A technology neutral approach is applied to examine the economic contribution of all telecommunications service providers regardless of technology.
Water and sewerage infrastructure	Water and sewerage	Urban water sources, bulk water supply for agricultural and industrial use. Water catchment, rivers, treatment facilities and desalination facilities, water channels and pipelines. Urban sewerage pipelines, treatment, storage, recycling and disposal facilities.
Urban transport	Roads	Urban road networks within capital cities, corridors and major links
	Buses/trams/light rail	Network services within areas within the largest capital cities, corridors and links within corridors
	Ferries	Routes and links within the largest capital cities
	Rail/light rail	Major corridors and links within the largest capital cities

Source: ACIL Allen Consulting, 2014

It should be noted that the Audit focuses on infrastructure services that make a nationally significant contribution to economic performance.

The Audit distinguishes infrastructure facilities in each sub-sector and reports data relating to those facilities to the extent available. There has been significant variation across infrastructure sectors in terms of data availability.

3.4 Measurements in the AIA

The AIA counts and assesses the following infrastructure attributes.

- **Facilities**: a description of the nature and the service provided by identified infrastructure.
- **Location**: the GIS data of specific facilities where these are able to be separately identified or a description of the area that is serviced by network facilities. The audit region in which the infrastructure facility is located is identified.
- **Capacity**: the rated service potential of infrastructure facilities.
- **Utilisation**: the amount of service provided in the audit year.
- **Direct Economic Contribution (DEC)**: the contribution of the infrastructure service measured using national accounts and industry data on the same basis as the contribution of businesses, industries and the economy at large.

This information is collected for a base year. The base year is 2010-11, the most recent year for which substantial information is available across all infrastructure categories throughout Australia (including census information). The information is collected and stored in the Audit data base.

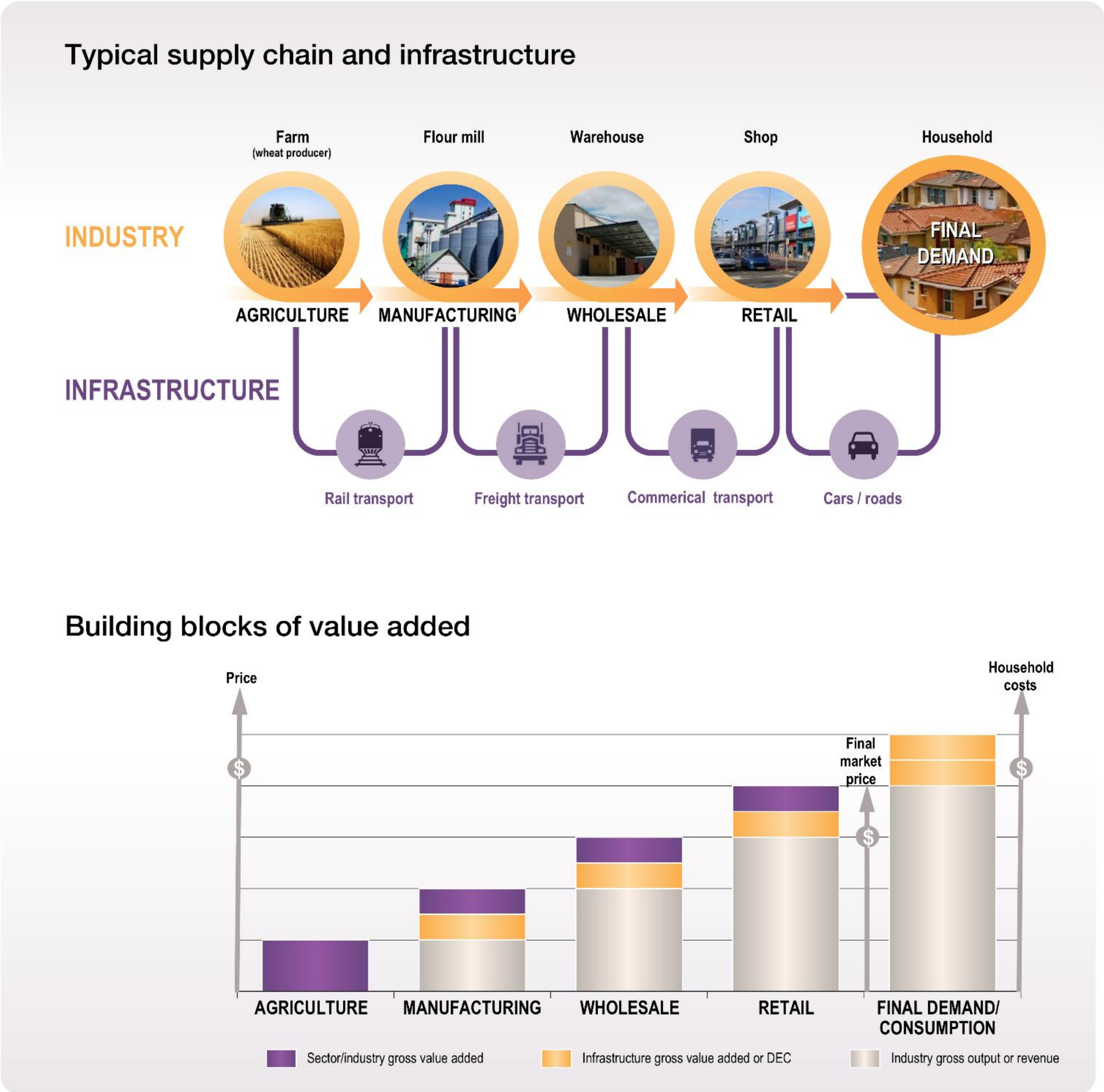
Key points about infrastructure assessed and counted in the AIA include:

- Infrastructure is defined by the service provided rather than being comprised of particular types of machinery or equipment. For example, private networks operated for the exclusive use of some businesses and governments are not counted as telecommunications infrastructure facilities.
- As a general rule, rather than measuring the cost of infrastructure, the audit focuses on identifying and assessing the values of services provided.
- Only services that are provided on a general offer to the wider public are included as infrastructure. Thus private facilities such as household rain water tanks or septic tank sewerage systems are not counted as infrastructure services. As a further example, Floating Production-storage and Offloading (FSPO) facilities that are owned and operated as part of vertically integrated LNG production activities which use ships and mooring facilities are not counted as Port infrastructure services in the AIA.
- The contribution of infrastructure is assessed by looking at the service provided. Thus in transport, the value of moving goods is examined excluding the value of the goods themselves.
- When assessing the service and economic contribution of infrastructure it is important to avoid double counting of inputs that are added by other links in supply chains that infrastructure services support. Economic statistics, especially national accounts data used to measure gross value added for businesses, industries and the national economy is specifically designed and collected to do this. Figure 33 shows how infrastructure services supports other links in supply chains and how the building blocks of value are added through the supply chain in national accounts data to avoid double counting.
- Counting the direct economic contribution of some infrastructure services, especially nationally significant roads and water, involves making estimates in order to capture the value of unpriced services and/or subsidies.

As an indicator of the direct economic contribution of infrastructure, this audit has assessed the gross value-added of the infrastructure service sectors (as defined in the national accounts) that are supported by the infrastructure facilities listed in Table 4.

Comprehensive discussions on how direct economic contributions for the infrastructure service sectors are calculated are provided in relevant infrastructure chapters in Part B and in the appendices in Part C

Figure 33 **Accounting for infrastructure in supply chains**



Note: This diagram simplifies the grains supply chain to emphasise the role of transport infrastructure in adding value to the output of many industries. Other infrastructure services such as bulk handling and storage also play a major role in the grains supply chain. IN addition other infrastructure services, in addition to transport, play a role in connecting supply chains and that some supply chains proceed through to export of supply rather than domestic consumption in Australia.

Source: ACIL Allen Consulting, 2014

3.5 Direct economic contribution

As an indicator of the direct economic contribution of infrastructure, this audit has assessed the gross value-added of the infrastructure service sectors (as defined in the national accounts) that are supported by the infrastructure facilities listed in Table 4. Estimating the direct value added of a particular activity/service to the economy is a common economic technique used to highlight the significance of a sector's activity/service to Australia's economy.

In this review, DEC has been used to measure the existing economic contribution of the services produced by specified infrastructure facilities to the Australian economy. Using a computable general equilibrium model of the Australia economy (*Global Tasman*), the DEC has been used to project the change in the demand for services from infrastructure to meet the expected needs and expectations of the community. Different infrastructure sectors are characterised by different growth projections.

The DEC concept provides IA, for the first time, with a tool for identifying on a consistent basis across (and within) sectors and regions, where policy and investment attention needs to be focussed to be confident that infrastructure is likely to be in place to meet Australia's economic needs.

The below box outlines in more detail the underlying basis used to calculate the DEC of infrastructure services.

Box 1 **Calculating infrastructure services DEC**

At its simplest, the infrastructure services DEC is calculated in much the same way as the Gross Value Added (GVA) of all other goods and services in the economy.

GVA = output – intermediate consumption.

Infrastructure services are not homogenous. Sometimes the data necessary to calculate DEC is not available reflecting differences in the underlying economics of infrastructure sectors. Where this is the case, it is generally necessary to apply different data and methods to calculate infrastructure DEC.

A key fact is that there are different ways to calculate DEC (reflecting the derivation of the DEC from national accounts information). In a simple closed market economy (without taxes, subsidies and trade) GDP, GVA and DEC can be calculated as follows:

- (Product) DEC = gross output – intermediate consumption
- (Income) DEC = Gross operating surplus + compensation of employees
- (Expenditure) DEC = final expenditures

Where:

  - Gross output = total value of sales or total revenue (price times quantity) at final prices
  - Intermediate consumption = input prices at purchasers' prices
  - Gross Operating Surplus = surplus generated by operating activities after the labour factor input has been recompensed
  - Compensation of employees = recompense of employed labour (labour factor)
  - Final expenditure = expenditure at final purchasers prices (consumers or export customer free on board)

In principle these three different approaches should produce the same value for DEC, although there are data issues that, in practice, can result in differences. The approach used often depends upon the data that is to hand.

Accounting and economic information systems differ significantly when looking at infrastructure services and it is often necessary to use available data and information that is not the same as the required to reflect the economic concepts.

In addition, in some infrastructure categories goods and services are not priced, or service provision attracts government subsidies. Infrastructure DEC projections take many of these complexities into account.

Source: ACIL Allen Consulting, 2014.

More detail on the way the DEC for the infrastructure service sectors are calculated are provided in relevant infrastructure chapters in Part B and in the Appendix in Part C

3.6 Infrastructure service quality

Service quality is a key element of infrastructure service provision and can be a driver of investment. The setting of a higher level of quality in service provision – e.g. reduced blackouts from line outages in electricity networks – may drive higher levels of investment in the relevant sector. Attempting to balance service quality and cost (i.e. price, from the end user's perspective) is a key element in the regulatory regimes in infrastructure sectors.

In markets, the quality of service provision may be reflected, in part, in the prices of services. A higher price may reflect a higher level of service while a lower price may reflect a lower level of service. In economically regulated services (such as water), the regulation of price may seek to reflect these market-like effects of quality on price.

Given its importance, how service quality is incorporated into the audit and into ACIL Allen's macroeconomic projections of future infrastructure service demand needs to be understood. This is because it is important to understand whether a projected level of future demand for infrastructure services presupposes that the quality of service is unchanged, increases or decreases.

In relation to the **audit**, service quality information is reported in the audit data set for infrastructure in some sectors (e.g. airports and communications) but not in others. In other sectors, service quality information might exist but not be reported at the level appropriate for this audit. In other instances, data was unavailable. For example, quality information may be purely private and not reported. In general, service quality information has been reported where that information is readily available and useful.

In relation to the **projections of infrastructure service demand**, the macroeconomic projections – which are used to project demand – are neutral in relation to quality of service. The CGE model *Tasman Global* incorporates capital being allocated to the maintenance and expansion of existing infrastructure through gross fixed capital formation.

4 Nationally significant infrastructure in Australia

This review which underlies Infrastructure Australia's (IA) Australian Infrastructure Audit (AIA) reports on the following key questions:

1. What infrastructure services are currently available in Australia? Where are they located?
2. What is the economic contribution of infrastructure services to the Australian economy?
3. What additional infrastructure services will be needed in the future?
4. What are the most valuable infrastructure service needs that must be filled if we are to realise our expectations of continued economic growth and the needs of growing communities?

This chapter addresses the first two questions by reporting the results of the review of nationally significant infrastructure across Australia for 2010-11. In doing so, this chapter details the estimated:

- capacity (supply) of nationally significant infrastructure by sector
- utilisation (demand) of nationally significant infrastructure by sector
- economic contribution of existing nationally significant infrastructure by sector (measured by the direct economic contribution (DEC)

Chapter 5 and Chapter 6 address the last two questions which relate to identifying Australia's future infrastructure needs.

4.1 Capacity and utilisation of nationally significant infrastructure

This section reports the capacity and utilisation of nationally significant infrastructure in Australia.

4.1.1 Capacity

Table 5 provides a summary of the capacity measurements for different types of infrastructure sectors across Australia.

Table 5 **Capacity of nationally significant infrastructure by sector**

Sector	Sector	Capacity Measurement	Units	National totals
National infrastructure				
Transport	Nationally significant roads	Length of roads (including key freight routes)	Kilometres (km)	34,656
	Ports	Handling capacity (throughput)	Million tonnes per annum (Mtpa)	1,417
		Handling capacity (throughput)	Million twenty-foot-equivalent-units (TEUs)	12
	Airports	Number of airports	Number of airports	276
	Railways	Percentage of available time with scheduled services (national average)	Per cent	41.7
Energy	Electricity	Generation installed capacity	Megawatts (MW)	54,012
		Transmission peak demand	Megawatts (MW)	41,104
		Distribution peak demand	Megawatts (MW)	37,099
	Gas transmission	Annual throughput	Petajoules per annum (PJ/a)	1,334
	Gas distribution	Annual throughput	Petajoules per annum (PJ/a)	344
	Petroleum terminals	Annual throughput	Megalitres (ML)	79,199
Water & sewerage	Water & sewerage	Dam capacity	Gigalitres (GL)	84,111
		Dam water in storage	Gigalitres (GL)	58,488
		Desalination capacity	Gigalitres (GL)	539
		Length of water mains	Kilometres (km)	213,518
		Length of sewer mains	Kilometres (km)	133,508
Telecommunications	Telecommunications	Availability of broadband	Broadband average availability rating (5=higher availability rating)	4.53 out of 5
		Quality of broadband	Broadband average quality rating (5 =higher quality rating)	1.88 out of 5
		3G mobile availability	Proportion of households with accessibility (%)	81.0
		4G mobile availability	Proportion of households with 4G coverage only (%)	59.0
Urban transport network				
Road		Vehicle kilometres travelled per day (million)		2,277.1
Rail		Passenger vehicle kilometres per day (million)		178.7
Bus		Passenger vehicle kilometres per day (million)		59.5
Ferry		Passenger vehicle kilometres per day (million)		2.8
Light rail / tram		Passenger vehicle kilometres per day (million)		21.8

Note: All metrics reported on a per annum basis excepted where clarified in the table. Natural gas pipelines are constrained by peak flow capacity rather than annual throughput capacity. The annual throughput estimates for gas pipeline provide din the table are not an indication of potential throughput capacity of the pipeline system. This is discussed in more detail in Part B.

Source: ACIL Allen Consulting, 2014

Multiple capacity measurements are reported for some of the water and sewerage and telecommunications sectors because the supply/availability can be measured in more than one way:

- The capacity of water and sewerage infrastructure could be defined in terms of the total availability of water stored in dams (for use when required), as well as in terms of the length of water mains used to connect consumers to water supply.
- Similarly, the capacity of telecommunications infrastructure as it relates to broadband internet, can be defined in numerous ways since there are several different ways in which broadband internet is made available to consumers (i.e. fixed internet and mobile internet).

In the case of the rail infrastructure sector, the audit data set does not currently report capacity and utilisation metrics. This review is still currently collecting information and data for rail. The key challenge to obtaining this data is identifying capacity and utilisation by link and by railway and linking to the economic value of rail infrastructure services. The audit data for rail, to date, reports on the economic contribution of rail infrastructure to the economy.

Capacity for each infrastructure services sector is discussed in detail in Part B of this report.

4.1.2 Utilisation

Table 6 provides a summary of the utilisation for different types of infrastructure across Australia.

Table 6 **Utilisation of nationally significant infrastructure by sector**

Sector	Sector	Utilisation Measurement	Units	National totals
National infrastructure				
Transport	Nationally significant roads	Traffic	Vehicles per day	1,871,211
	Ports	Handling capacity	Million tonnes (Mtpa) p.a.	1,051
		Handling capacity	Million twenty-foot-equivalent-units (MTEUs) p.a.	7
	Airports	Passenger movement	RPT[1] passengers p.a.	132,242,833
	Railways	Maximum percentage of available minutes utilised (national average)	Per cent	51.1
Energy	Electricity	Energy generated	Gigawatt hours (GWh) p.a.	228,195
		Energy transmitted	Gigawatt hours (GWh) p.a.	216,050
		Energy distributed	Gigawatt hours (GWh) p.a.	183,992
	Gas transmission	Annual throughput	Petajoules (PJ/a)	1,334[a]
	Gas distribution	Annual throughput	Petajoules (PJ/a)	344
	Petroleum terminals	Annual throughput	Megalitres (ML) p.a.	79,199
Water & sewerage	Water & sewerage	Water supplied	Megalitres (ML) p.a.	7,641,280
		Number of properties served (water)	Properties ('000)	8,538
		Sewerage collected	Megalitres (ML) p.a.	1,931,217
		Number of properties served (sewerage)	Properties ('000)	7,772
Telecommunications	Telecommunications	Volume of data downloaded	Terabytes (TB) p.a.	274,202[b]
		Business use of internet (placed orders via the internet)	Percentage of Australian businesses (%)	51.1[b]
		Household use of internet	Households ('000)	6,177
Urban transport network				
Road		Vehicle kilometres travelled per day (million)		420.7
Rail		Passenger vehicle kilometres per day (million)		45.7
Bus		Passenger vehicle kilometres per day (million)		16.7
Ferry		Passenger vehicle kilometres per day		299.5
Light rail / tram		Passenger vehicle kilometres per day (million)		3.6

1. RPT stands for Regular Public Transport
a. This is a simplified measure of utilisation of gas transmission pipeline. See relevant chapter in Part B of this report for details.
b. Figures sourced from ABS catalogues 8153.0 and 8129.0 since these values are only available as national totals. For this reason, these utilisation measures are not included in the final audit data set for telecommunications.

Note: p.a. – per annum. All metrics reported on a per annum basis except where clarified in the table.

Source: ACIL Allen Consulting, 2014

Utilisation by infrastructure services sectors is discussed in detail in Part B of this report.

Summary of capacity and utilisation of nationally significant infrastructure

The data set underlying IA's AIA indicates the following in terms of the existing capacity and utilisation of nationally significant infrastructure across Australia.

Australia's **urban transport networks** comprise those transport infrastructure services in urban areas made available to the public. These services include the road network, buses, rail, light rail/trams and ferries within Australia's capital cities.

The public transport component of these networks moved significant passengers per day in 2010-11: rail travel utilised 45.7 million passenger vehicle kilometres per day, bus travel utilised 16.7 million passenger vehicle kilometres per day, ferry travel utilised 300,000 passenger vehicle kilometres per day while light rail/trams utilised 3.6 million passenger vehicle kilometres per day. The road network is also heavily utilised with 420.7 million vehicle kilometres travelled per day.

The significant task of Australia's urban transport networks is not surprising given that these networks cover an area of Australia with a population of 17 million in 2010-11.

Nationally significant roads comprise the National Highways (spanning the non-capital city NLTN roads) and Key Freight Routes across Australia, identified with assistance from the State and Territory governments. Nationally significant roads do not encompass those roads analysed in the urban transport component of the AIA.

The Audit Data Set for nationally significant roads contain information about every link in these roads that have been assessed reflecting the volume of traffic that uses the roads and the condition of the roads.

Nationally significant roads involves a network of about 34,653 kilometres of roads comprising of those roads that connect all of Australia's capital cities and identified key freight routes. These nationally significant roads carried 1.87 million vehicles per day in 2010-11.

Each link of the National Highway has been rated with a rating of between 1 to 5 stars, with 1 star being the least safe and 5 stars being the safest. About 40 per cent of the National Highway has been rated as 1 or 2 stars.

The **ports** included in the data set provide an aggregate capacity to carry 1,417 million tonnes. At present these ports manage a throughput of 1,051 million tonnes per annum. On average, 74 per cent of capacity is being utilised (although spare capacity does differ significantly by port). Major ports are operated as businesses and managed to obtain commercial rates of return on investment. Many have been privatised. Different ports face different challenges.

The data set provides information that is specific to each port about factors such as channel depths. The aggregate picture suggests that there is capacity to handle the existing trade volumes.

While 276 **airports** have been identified and assessed in the data set, a small number of airports in the capital cities of Australia carry the majority of Regular Public Transport (RPT) passenger movements and aircraft arrivals and departures. The major airports in Australia are operated to obtain commercial returns on the capital invested and are subject to a "light handed" price regulation regime.

In total, the airports managed 132 million RPT passenger movements in the base year. The balance of capacity relative to demand (or utilisation) is reflected in various performance indicators especially those that reflect excessive congestion or delays. The data that is available for major airports suggests that there was sufficient capacity to meet demand in most airports in 2010-11. In some cases airport managers assess that the aeronautical capacity of their airport is many times larger than current demand (in the case of Canberra airport). There are some airports, however, where projected growth indicates capacity shortfalls in the short to medium term (for example, Sydney airport). Brisbane airport has already started building a new parallel runway that will be completed in 2020 which is expected to meet the increase in demand in the short-run.

Electricity supply is now determined on commercial terms throughout Australia. Electricity infrastructure is generally provided where the cost of supply can be brought into balance with the prices users and consumers are able to pay. The national total of installed capacity of generation, at 54,012 MW, is not fully utilised over a year as different facilities play different roles in the electricity market. Some 183,992 GWh of electricity was delivered to customers through distribution networks in 2010-11.

The data set shows that mainly remote regions of Australia are not currently supplied by electricity infrastructure. It is notable that a key issue with electricity supply in recent years has been a sharp increase in prices that has exceeded the average increase in prices reflected in the Consumer Price Index (CPI).

Gas supply is another area where supply and demand are brought into balance by prices set on a commercial basis. The data set identifies regions that do and do not have the opportunity to offtake gas from gas transmission networks. There is some speculation that there are factors at play that may result in gas shortfalls in some regions and states and/or rapid price adjustments in the near-to-medium term.

Looking at **water and sewerage** infrastructure, the data set indicates the balance between factors such as dam capacity and water demand in the base year in every region. As an indicator of capacity to deliver water services, it is noted that some 213,518 kilometres (km) of water mains are required. These supplied some 7,641,280 mega litres (ML) of water in 2010-11.

In some regions of Australia, especially remote regions, water is not provided through infrastructure services (individuals, communities and homesteads source their own water in these circumstances). Some progress has been achieved towards economic efficiency in water pricing but implementation of pricing reforms has been patchy across regions and subsidisation of urban and rural water infrastructure investments have confused and blurred industry incentives to invest optimally.

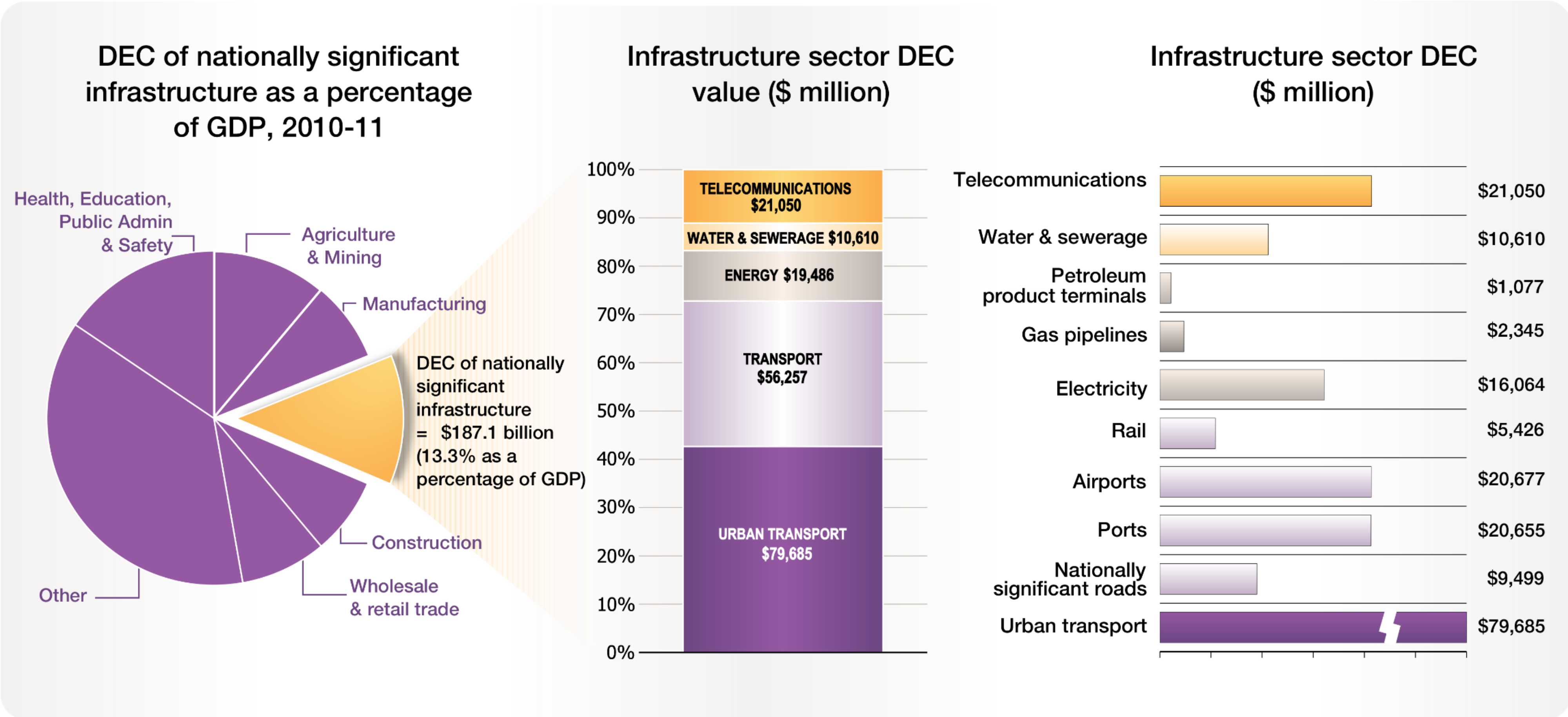
Looking at **telecommunications** infrastructure, the audit data set sets out detailed information about the quality of service and the access that premises have to high speed and reliable telecommunications throughout different regions. The data set highlights that the availability and quality of telecommunications infrastructure services is higher in the capital cities with more remote areas of Australia experiencing a lower level and quality of coverage. The rollout of the National Broadband Network (NBN) is seeking to address this digital disparity across Australia while providing access in a cost effective manner.

4.2 Economic contribution of nationally significant infrastructure

In 2010-11, Australia's nationally significant infrastructure produced services which had a direct economic contribution (DEC) of $187.1 billion to the Australian economy. This was equivalent to 13.3 per cent of Australia's Gross Domestic Product (GDP) in the same year.

Figure 34 shows the DEC of infrastructure services as a share of GDP and economic contribution by infrastructure sector in 2010-11.

Figure 34 **Economic contribution of nationally significant infrastructure in Australia (2010-11)**



Note: The DEC and GDP estimates are illustrative to show the relative order of the magnitude of the economic contribution of infrastructure services to the economy. The estimated DEC for urban transport includes all 8 capital city urban transport networks.

Source: ABS catalogue 5206.0 and ACIL Allen Consulting, 2014

In summary:

- The infrastructure sector which contributes the most to the Australian economy is the urban transport sector, with a total DEC of $79.7 billion or approximately 42.6 per cent of total DEC of infrastructure services.
- Of the four transport sub-sectors, airports and ports each contributed approximately $20 billion, while nationally significant roads, and rail infrastructure contributed $9.5 billion and $5.4 billion, respectively.
- The telecommunications sector contributed $21.05 billion in 2010-11, making up just under 20 per cent of total DEC, while the water and sewerage sector amounted to 5.7 per cent of total DEC at $10.6 billion.
- The energy sector contributed a total of $19.4 billion to the economy accounting for 10.4 per cent of total DEC in 2010-11. A substantial amount of DEC from energy-related infrastructure was from the electricity subsector, amounting to 82.4 per cent of DEC of the energy sector.

4.2.1 Economic contribution of nationally significant infrastructure by State and Territory (national infrastructure)

Figure 35 shows a summary of the DEC for each State and Territory (excluding urban transport) in level-terms and as a percentage of total jurisdictional DEC in 2010-11. As can be seen, DEC of each of the infrastructure sectors vary significantly by State and Territory.

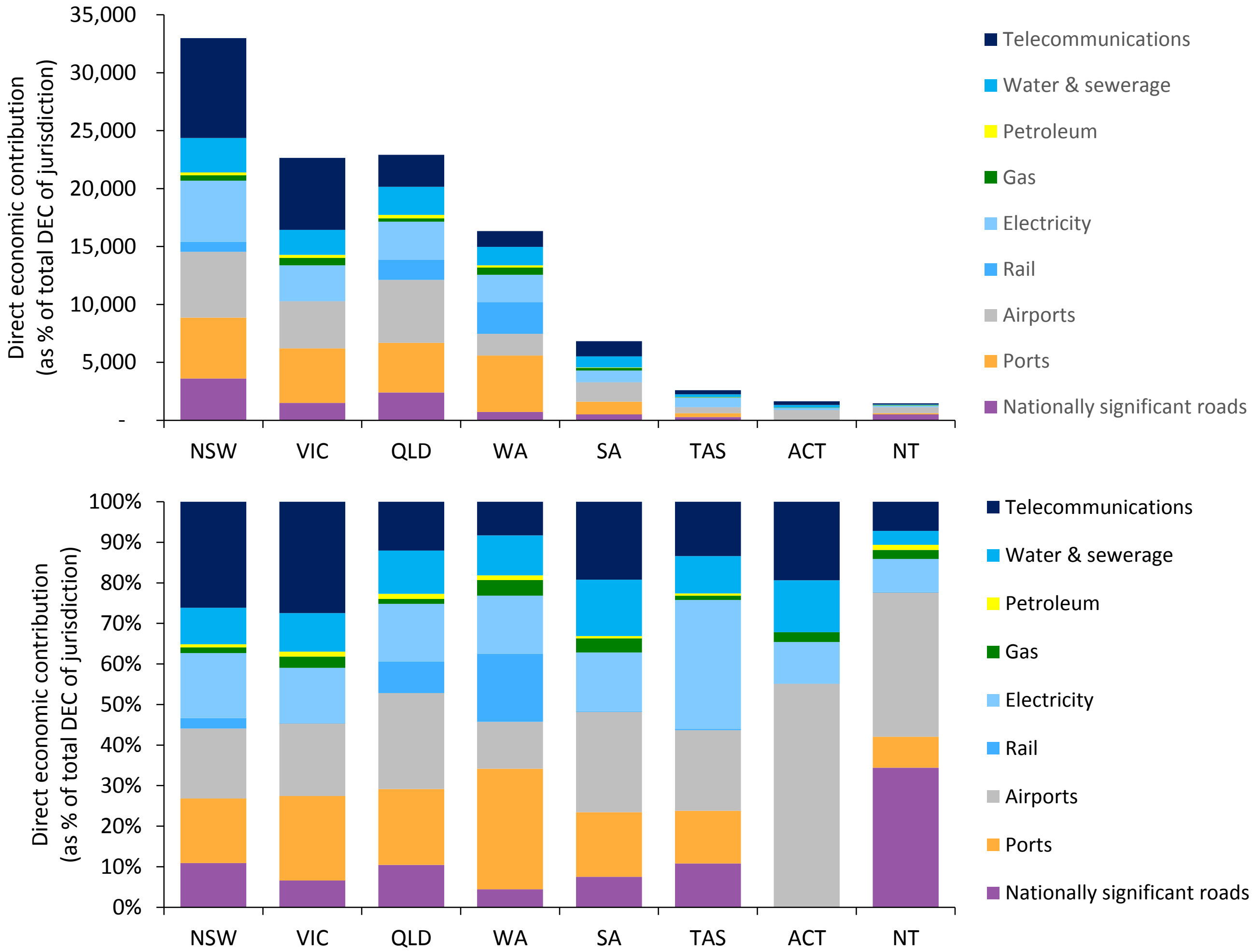
As can be seen, the DEC level of nationally significant infrastructure is driven by the population level of the respective jurisdictions. This is highlighted by:

- New South Wales currently having both the highest population and highest DEC of nationally significant infrastructure whereas the Northern Territory has the lowest population and lowest DEC of nationally significant infrastructure.
- The DEC-level of telecommunications services, which is the most ubiquitous of the infrastructure services, being highest in those States and Territories with the largest capital cities in terms of population. For example, the DEC of telecommunications services is highest in the Sydney region, followed by Melbourne.

Figure 35 also highlights that the distribution of the DEC of the infrastructure services is influenced by the characteristics of the State and Territory economies. For example:

- Port and rail services as a percentage of DEC are higher in Western Australia relative to the other States (i.e. New South Wales). This is because Western Australia's economy has a relative high share of mining activity and exports (which requires rail and ports to export minerals) due to its higher natural resource endowments.
- The relatively large DEC of the nationally significant roads and airports in Queensland reflects its sizable tourism industry and its dispersed population compared to other jurisdictions
- Telecommunications and airport services as a percentage of DEC are higher in the Australian Capital Territory relative to other States. This is due to the economy being characterised by a large public administration (i.e. large public servant population) and service-oriented industries.
- The larger economies (i.e. New South Wales and Victoria) have a more even spread of DEC across the different types of infrastructure services. This reflects these jurisdictions' more diversified economies.

Figure 35 **Direct economic contributions by State/Territory and infrastructure subsector in 2010-11**



Source: ACIL Allen Consulting, 2014

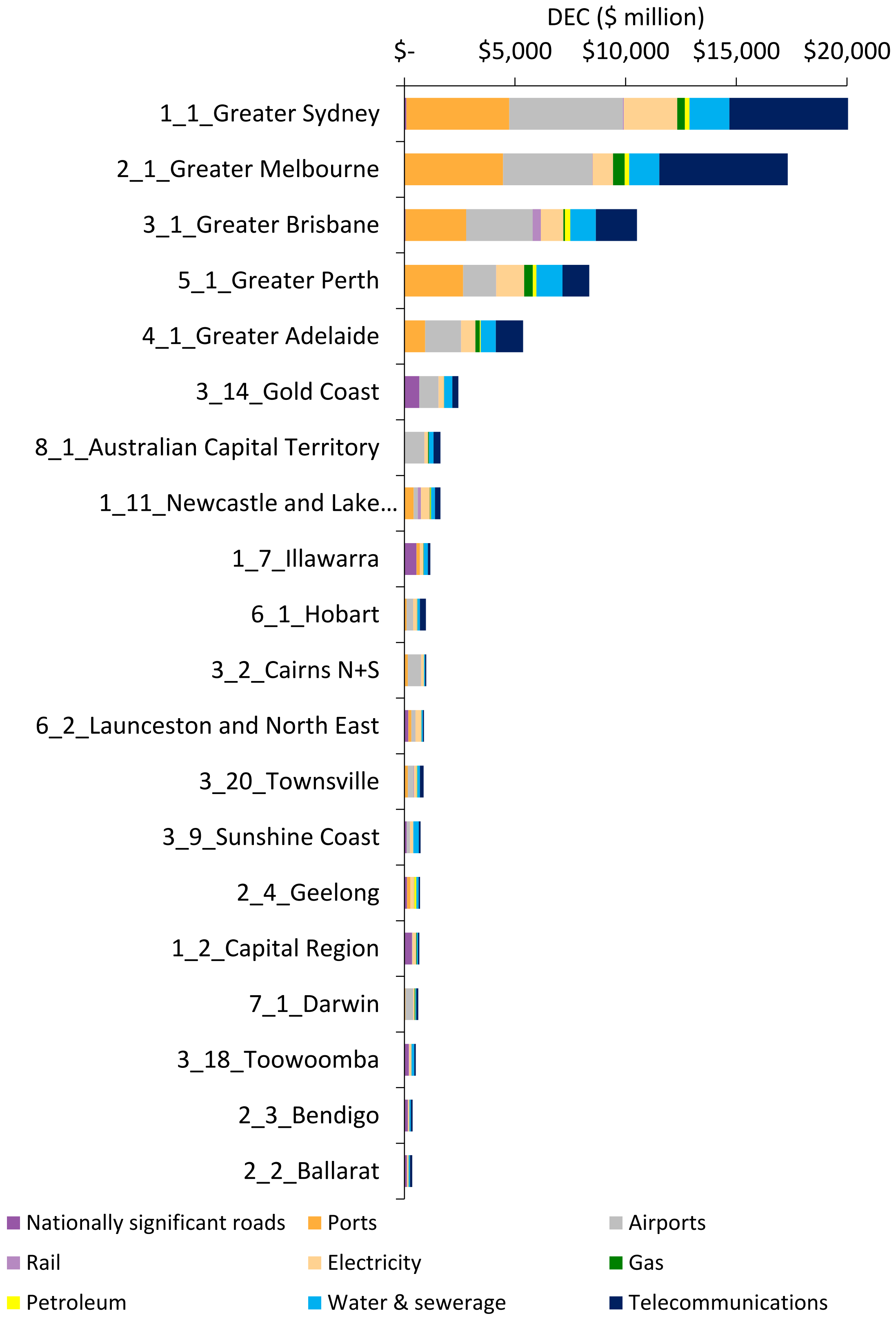
4.2.2 Nationally significant infrastructure by audit region

The economic contribution of nationally significant infrastructure differs depending upon the respective demographic characteristics (population size), industry composition and geographic opportunities and constraints.

Economic contribution of infrastructure in urban audit regions

The economic contribution of nationally significant infrastructure by Australia's top 20 urban audit regions is summarised in Figure 36. These findings are presented by size of the respective regions' DEC, and are for national infrastructure only (urban transport network presented below).

Figure 36 **DEC of infrastructure services subsectors by audit region in 2010-11 (excluding urban transport) – top 20 urban centres**



Source: ACIL Allen Consulting, 2014

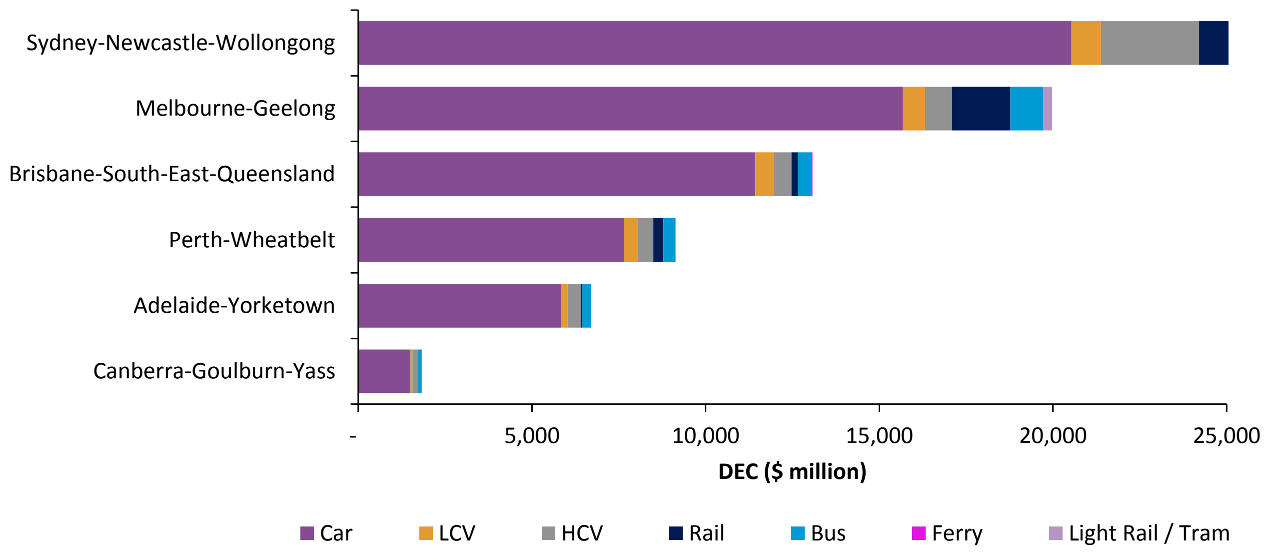
The large DEC estimates portrayed highlight the economic importance of the major cities which account for a very large proportion of national product. The major cities are the dominant producers of services which dominate the economy, they are gateways for the trade of goods and visitors and depend on a wide range of infrastructure services.

Urban transport network

Figure 37 shows the breakdown of DEC by mode of transport for each of the 6 major conurbation urban transport networks.

As can be seen, DEC derived from cars is by far the largest contributor to the economy in every region. A large amount of this is explained by the significant reliance people have on their vehicles as a mode of transport to reduce travel time compared to other modes of transport (such as buses, trains and ferries). Both urban and regional cities have road networks utilised by a large proportion of the residing population, translating into the large DEC measure as shown. Public transport travel on the other hand, accounts for a larger proportion of the overall urban transport network DEC in the larger capital cities compared to the non-capital cities.

Figure 37 **DEC of urban transport infrastructure services by 6 major conurbation urban transport networks 2010-11**



Note: LCV refers to Light Commercial Vehicles; HCV refers to Heavy Commercial Vehicles
Source: ACIL Allen Consulting, 2014

Economic contribution of infrastructure in non-urban audit regions

The economic contribution of nationally significant infrastructure in Australia's non-urban audit regions are shown in Figure 38 and Figure 39. They highlight the importance of certain non-urban regions in Australia being 'specialist' infrastructure service providers.

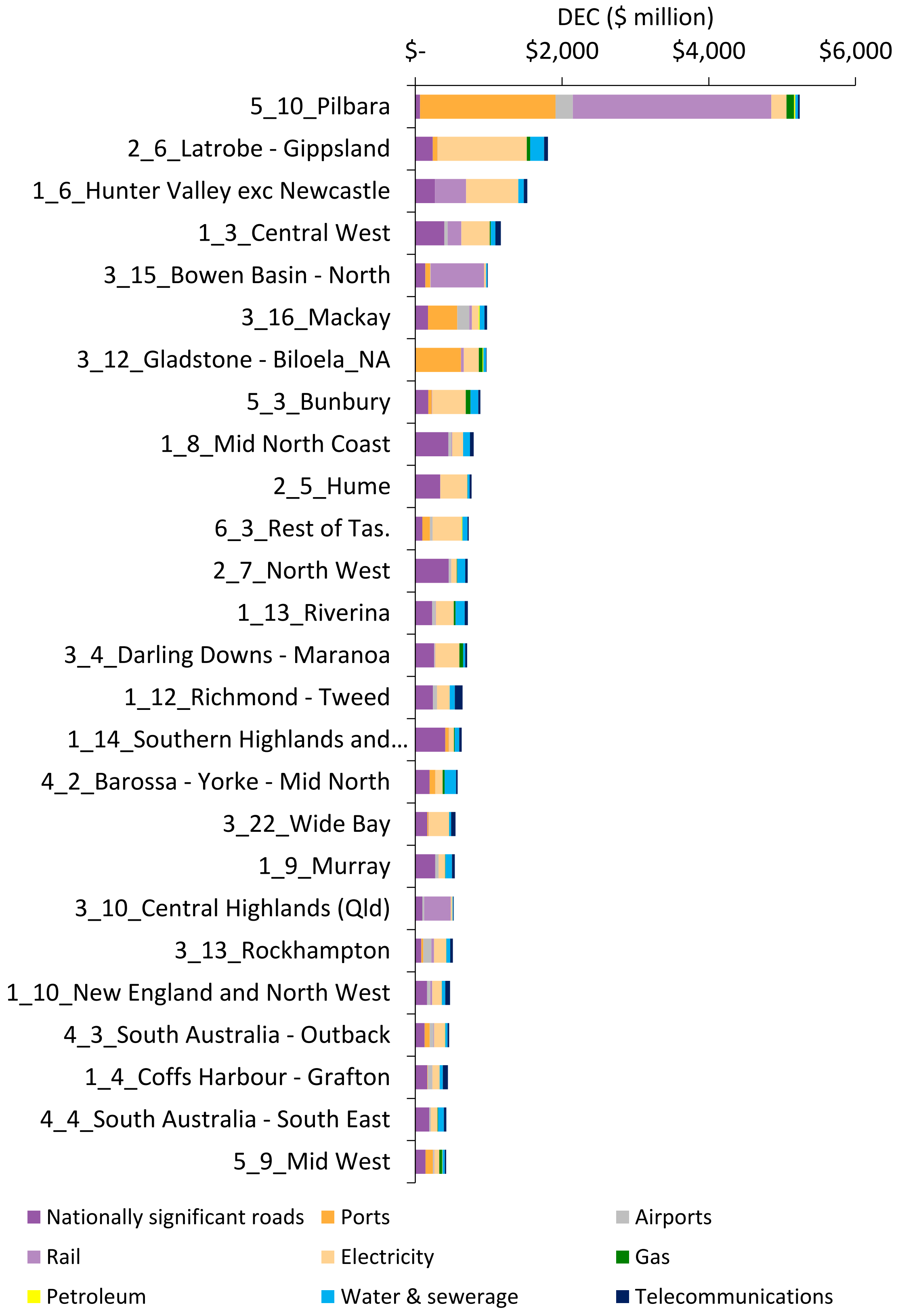
As shown Figure 38, the Pilbara region and the Latrobe Gippsland region are two clear examples of non-urban regions being specialist providers of infrastructure services. Both of these regions' economies are specialist providers of different types of infrastructure services.

The Pilbara region is the sixth highest region in Australian when measured according to its DEC of nationally significant infrastructure. Its economy is larger than other more urban areas (i.e. Geelong and Australian Capital Territory) despite its relative low population and less diversified economy. This is because of the significant value generated from its mining intensive economy and the economic value of port and rail infrastructure services needed for the mining industry and intensive export activity.

The Latrobe Gippsland region is the eighth highest region in Australian when measured by its DEC of nationally significant infrastructure. Its relatively high DEC is a result of this region's dominance in generating electricity for the Victorian (and Australian) economy. The DEC of electricity infrastructure services in the Latrobe Gippsland region accounts for 7.6 per cent of the total Australia-wide DEC of electricity infrastructure services.

Both the Pilbara and the Latrobe Gippsland regions are also examples of non-urban regions which are economically larger than urban centres (i.e. the Australian Capital Territory, Hobart, Cairns, Darwin, Newcastle and Geelong), but with less economic diversification.

Figure 38 **DEC of infrastructure services subsectors by audit region in 2010-11 (excluding urban transport) – other regions A**



Source: ACIL Allen Consulting, 2014

Figure 39 highlights that in the more regional areas of Australia, the transport infrastructure services account for a relatively higher share of these regions' DEC:

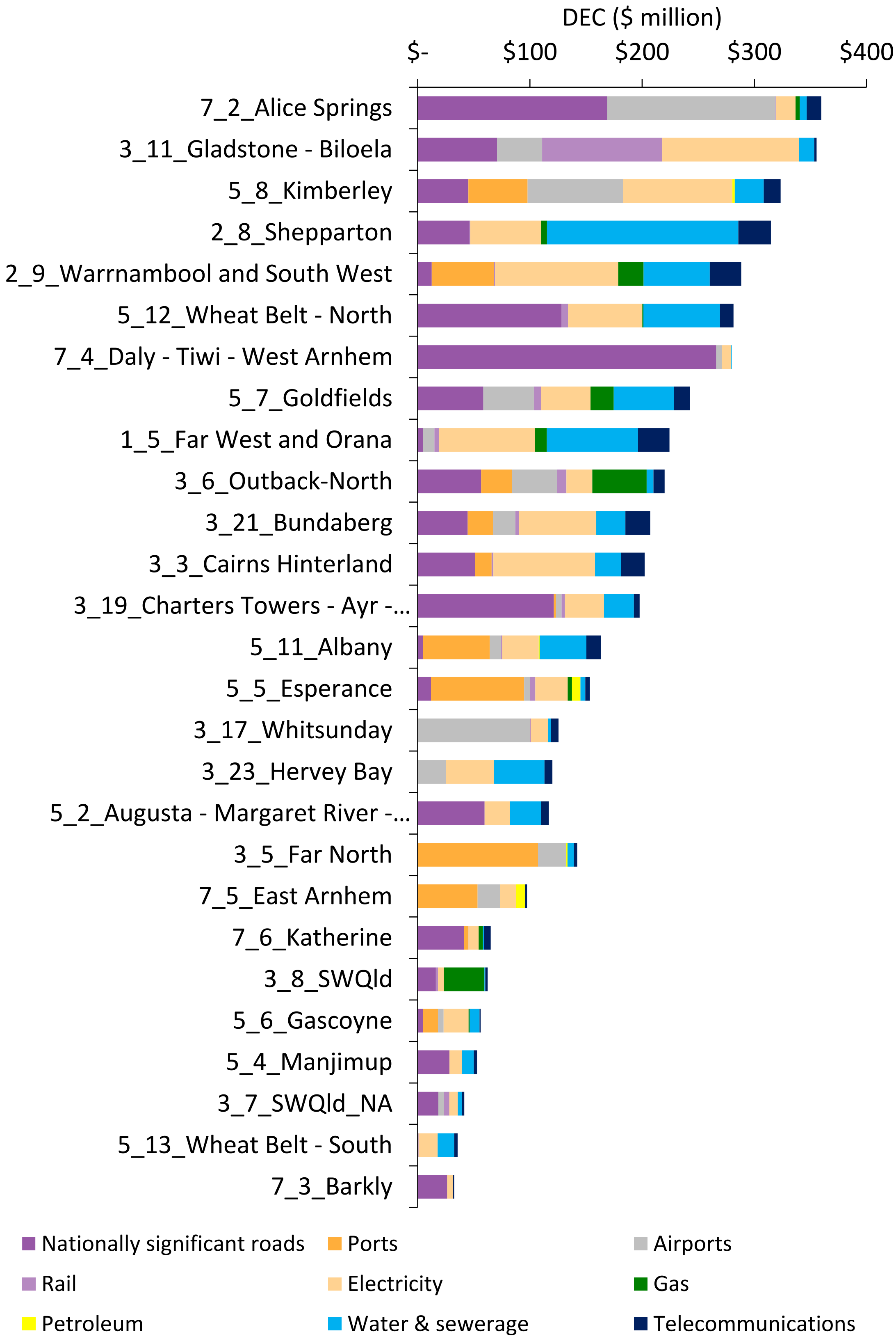
— Airport services in more regional areas account for a relatively higher share where there is significant tourism activity (for example, the Whitsunday and Alice Springs regions).
— Port infrastructure services account for a significant proportion of the DEC (in regional areas along the more northern parts of Australia's coastline).
— For more regional audit regions in northern Australia, without port or tourism activity, nationally significant roads accounts for a relatively high share of infrastructure services DEC.

Water infrastructure has a high DEC in rural regions such as Shepparton, Far West and Orana, and Warrnambool and South West. These can be explained by the water-intensive agriculture and farming industries that are important to those economies.

These observations highlight the importance of nationally significant infrastructure in connecting rural and remote regions to economic opportunities and markets.

Further detailed analysis of subsector DEC by audit region is provided in the relevant chapters in Part B of this report.

Figure 39 **DEC of infrastructure services subsectors by audit region in 2010-11 (excluding urban transport) – other regions B**



Source: ACIL Allen Consulting, 2014

5 Future infrastructure needs

This chapter answers two key questions:

- What additional infrastructure services will be needed in the future?
- What are the most valuable infrastructure service needs that must be filled if we are to realise our expectations of continued economic growth and the needs of growing communities?

This chapter begins by outlining projections of the factors that drive infrastructure needs. It then uses these projections to estimate the expected demand for infrastructure services. By doing so, the value of different infrastructure service needs are identified, by infrastructure sector and by region.

5.1 Top down projections

A top down approach has been taken in this report. That is, the analysis progresses from an assessment of the outlook for the global economy, the national economy, and regional economies down to different industries. It then assesses infrastructure sectors and infrastructure needs within audit regions. Figure 40 shows the top down progression.

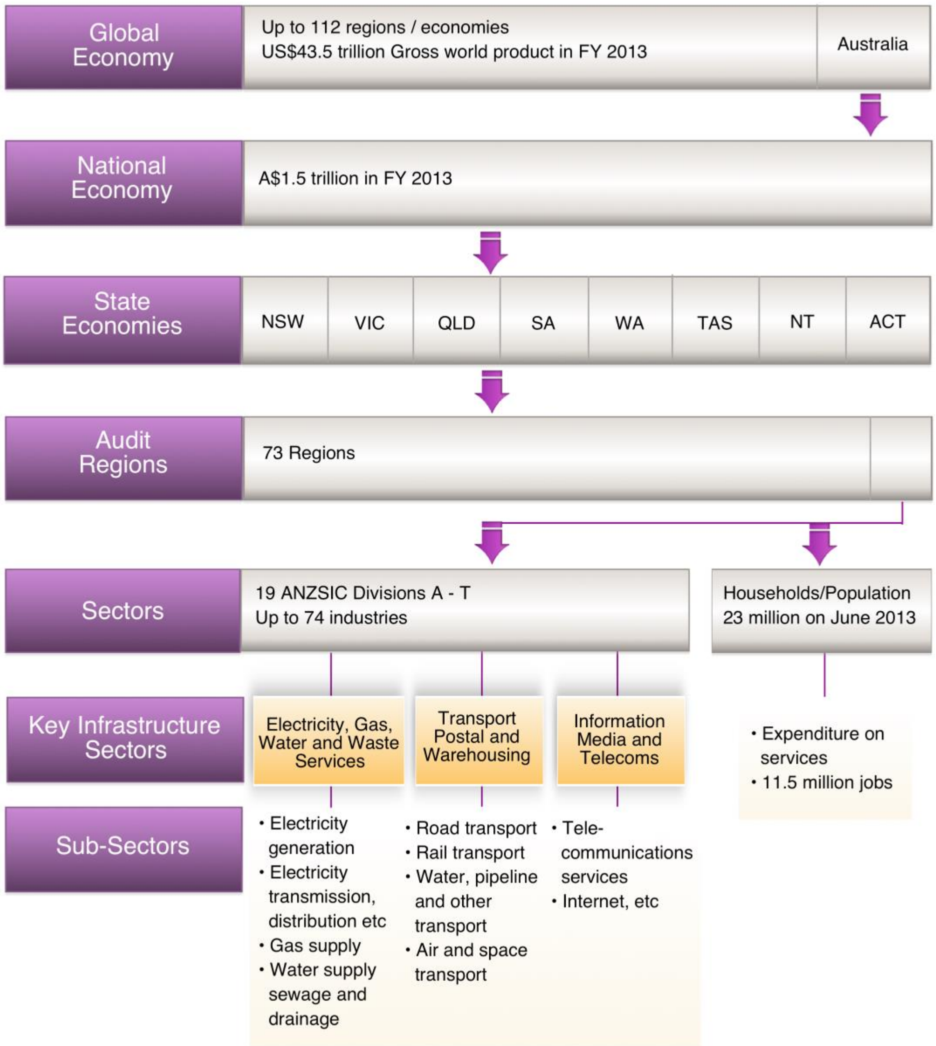
Projections have been prepared covering the period from 2010-11 to 2030-31.

Economic projections for the short-to-medium term period from 2010-11 to 2017-18 reflect actual outcomes recorded in official statistics where they are available. They also reflect various forecasts of the most recent performance of the economy and expected trends and the influence of expected policy settings.

Economic and population projections for the period from 2018-19 onwards use a broader framework that is better suited to making projections over the long term. In this longer term framework, Gross Domestic Product (GDP) growth is largely viewed as a function of population growth, participation rates (including unemployment rates) and labour productivity growth. This is summarised as the 3Ps (Population, Participation and Productivity). These factors underlie the projected change in real GDP for each region. Each of these elements is discussed in the following sections. Box 2 describes the 3Ps framework.

Forecasts using the 3Ps framework have been calculated within a Computable General Equilibrium (CGE) model of the Australian economy: the *Tasman Global* model owned and operated by ACIL Allen Consulting. CGE models evaluate how supply, demand and prices behave across the whole economy including infrastructure industries and industries that are users of infrastructure. *Tasman Global* is similar to models such as GTEM used by the Bureau of Resources and Energy Economics recently to evaluate *Australian Bulk Commodity Exports and Infrastructure* (2013) and MMRF used by the Commonwealth Treasury to assess the economy-wide implications of adopting a Carbon Price Mechanism. Details about the *Tasman Global* model are provided in Part C.

Figure 40 **Top down analysis of infrastructure**



Source: ACIL Allen Consulting, 2014

Box 2 **The 3P's framework and forming economic projections**

The 3Ps framework is widely used by government economic policy agencies and independent international economic managers. The Commonwealth Treasury draws on this framework when making its long term projections in the various intergenerational reports that examine the outlook for Australia into the very long term (Australian Government 2007 and 2010). The Productivity Commission also applied the 3Ps framework in its assessment of the implications of an ageing Australia (2005) and in other assessments of the underlying and structural outlook into the very long term.

In the 3Ps framework, real GDP growth is a function of growth in the following factors.

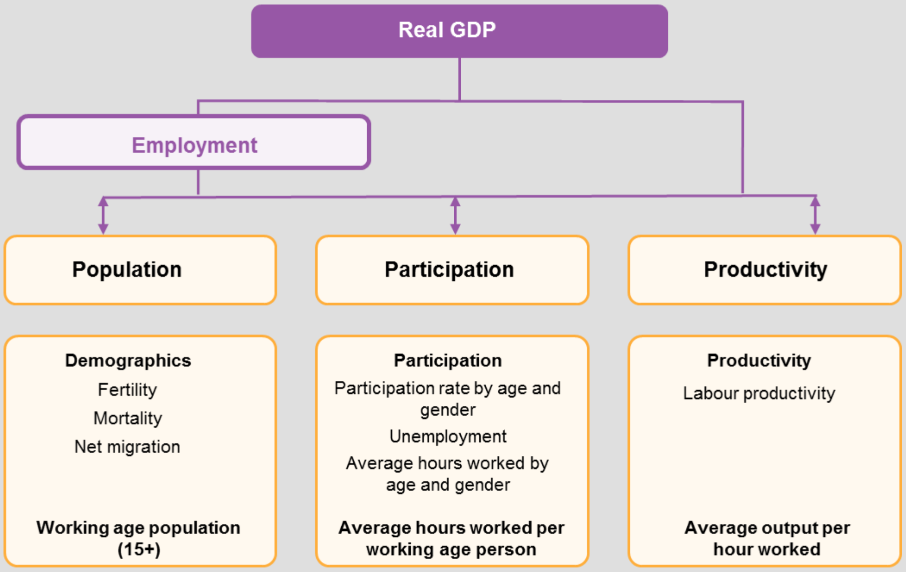
- Population — the number of people.
- Participation — the proportion of the population in the workforce.
- Productivity — output per unit of labour input.

The relationship of structural factors in the 3Ps framework is portrayed in the figure below.

Projections of the 3Ps are determined by demographic and economic assumptions.

- The demographic assumptions about fertility, mortality and migration affect the number of people of working age (population), and the age and gender composition of the population.
- The composition of the population in turn affects participation and hours worked because different age-gender cohorts have different patterns of participation and hours worked. Changes in these patterns of work of individual cohorts over time will also affect aggregate labour market participation.
- Future productivity is assumed to reflect historical experience and trends sustained into the longer term.

Figure 41 **The three Ps framework for structural projections of GDP**



Source: ACIL Allen Consulting, 2014, based on Commonwealth Treasury IGR, 2010.

Changes in population, participation and productivity will have a profound effect on the performance of the economy which could, in turn, be expected to alter the demand for infrastructure services and the nature and role of infrastructure services actually delivered in future. Of course, forecasts about fundamentals can be just as subject to risks and uncertainty as the economy itself. In order to assess the importance and implications of different assumptions about the 3Ps in the economic projections, a number of different scenarios have been prepared that specifically test key population/participation/productivity (PPP) parameters.

The analysis that follows focuses reports projections under a Baseline scenario. A further chapter of the report will show how sensitive the results of the analysis are to different economic and population growth assumptions.

5.2 The global economic outlook

The analysis in the Baseline scenario reflects a cautiously optimistic view about world economic growth. However, the scenario recognises that financial markets remain highly volatile, reflecting the lingering effects of the Global Financial Crisis (GFC) and other economic shocks. There are still many downside risks in the outlook. Overall, the Baseline scenario projects that key advanced economies pursue a policy mix and budget reforms that support genuine growth rather than continuing to rely heavily on monetary policy and unsustainable deficit spending heavily focussed on welfare programs.

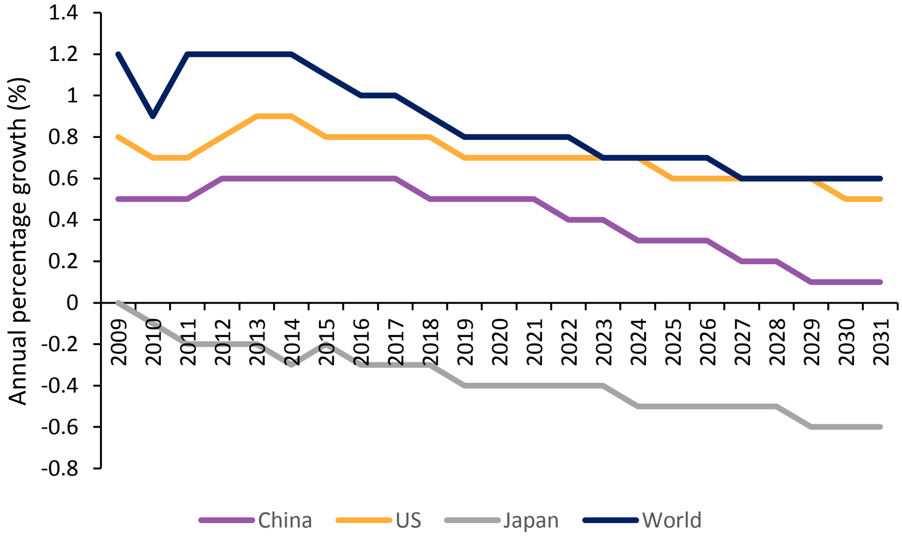
The short term projections assume an exit from monetary stimulus in the United States (US) and credible action on medium-term public debt sustainability. A rebalancing of the global economy, pressures for structural reform and continued efforts to reject a return to protectionism across all major economies underpin the projected return to 3.6 per cent growth in world output by 2015-16. This includes measures in China to rebalance their economy towards redirecting wealth flows internally to allow a sustainable increase in domestic consumption, as well as measures in deficit economies, such as the US, toward increasing domestic production.

Changes in the underlying PPP parameters drive the outlook in the medium-to-long-term. Population growth is projected to sustain a downtrend down in major economies.

- Population is already contracting in Japan and is projected to contract further over the projection period.
- China's population is also projected to be contracting by the end of the projection period. Ageing populations in the advanced economies reduce workforce growth which is projected to taper the rate of economic growth. The expected rapid onset of population ageing within the Chinese workforce and gradual maturing of the economy will compress growth rates.

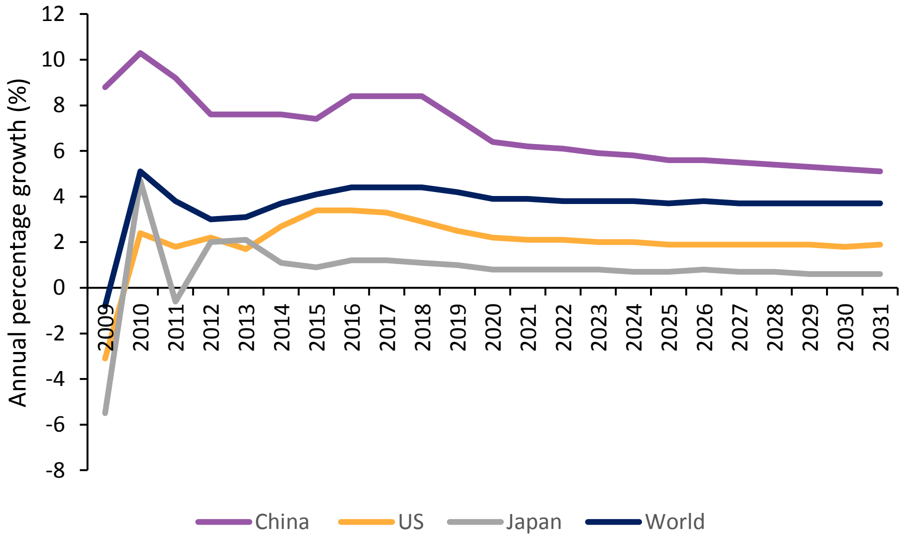
The rate of world economic growth is expected to obtain a lift in the short term to around 4 per cent per annum and then taper down into the longer term to around 3 per cent per annum.

Figure 42 **World and selected international countries' annual population growth (per cent)**



Source: Historical data from United Nations (World Population Prospects: The 2012 Revision) and IMF World Economic Outlook (July 2013). ACIL Allen Consulting, 2014 projections.

Figure 43 **World and selected international countries real GDP growth (per cent, year on year)**



Source: Historical data from IMF World Economic Outlook (July 2013). ACIL Allen Consulting, 2014 projections.

5.3 The Australian economic outlook

5.3.1 Population growth in Australia

Population growth is an important driver of economic growth through the supply of labour and the demand for final goods and services.

For the Baseline scenario, the Australian (and state) population is aligned to the most recent ABS Series B population projections[8]. These reflect key assumptions including:

- medium life expectancy at birth
- medium fertility (rate of 1.8)
- medium to large net overseas migration (240,000 persons per annum)
- medium flows in net interstate migration (corresponding to net interstate population reductions in some years in some states such as New South Wales)

Figure 44 shows the population growth between 2010-11 and 2030-31 for the Baseline scenario while Figure 45 shows the year on year growth in population for each Australian state and territory.

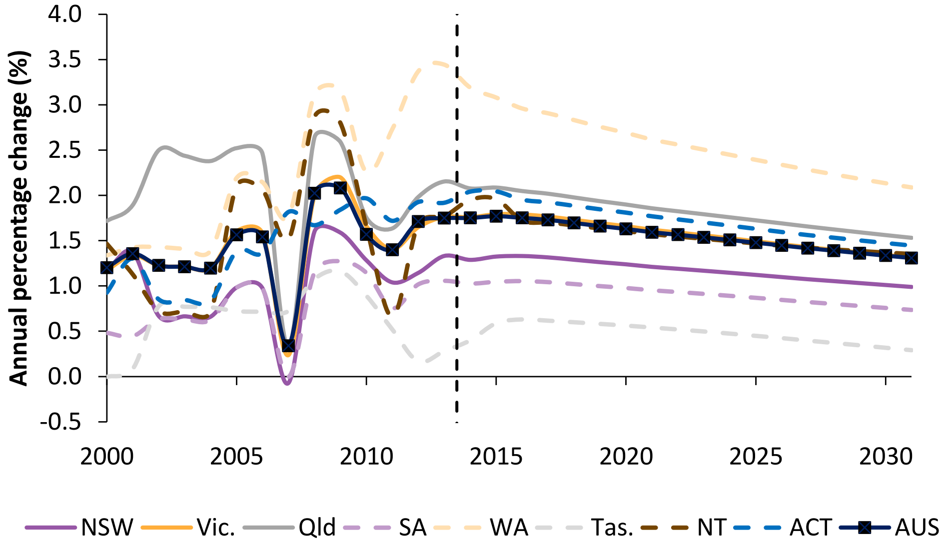
Figure 44 **Population growth under the Baseline scenario, Australia and State/Territories (percentage change 2010-11 to 2020-21 and 2030-31)**

Source: ABS Series B population projections (Catalogue number 3222.0)

Under the Baseline scenario, the Australian population is projected to increase by 36.5 per cent between 2010-11 and 2030-31 to reach 30.5 million people. The projections reflect a view that there will be population growth in every state of Australia. However, this growth will not be uniform. Western Australia's population is projected to grow by 68.7 per cent followed by Queensland's population which is projected to grow by 44.0 per cent over the long term forecast period. By contrast, the populations of Tasmania and South Australia have the lowest expected growth: 9.4 per cent and 20.3 per cent, respectively.

8 Catalogue number 3222.0, released 26 November 2013.

Figure 45 **Population growth for each Australian state and territory (per cent, year on year)**



Source: Historical data from ABS Catalogue number 3101.0. Projections from Series B in ABS Catalogue number 3222.0

Table 7 below presents the population levels at 2010-11 and 2030-31 under the Baseline scenario.

Table 7 **Population projections, Baseline scenario, 2010-11 to 200-31**

	June 2011	June 2031	Absolute population growth
New South Wales	7,218,529	9,128,665	1,910,136
Victoria	5,537,817	7,584,869	2,047,052
Queensland	4,476,778	6,445,737	1,968,959
South Australia	1,639,614	1,971,779	332,165
Western Australia	2,353,409	3,970,024	1,616,615
Tasmania	511,483	559,706	48,223
Northern Territory	231,292	316,657	85,365
ACT	367,985	520,412	152,427
Australia	**22,336,907**	**30,497,850**	**8,160,943**

Source: Historical data from ABS Catalogue number 3101.0. Projections from Series B in ABS Catalogue number 3222.0.

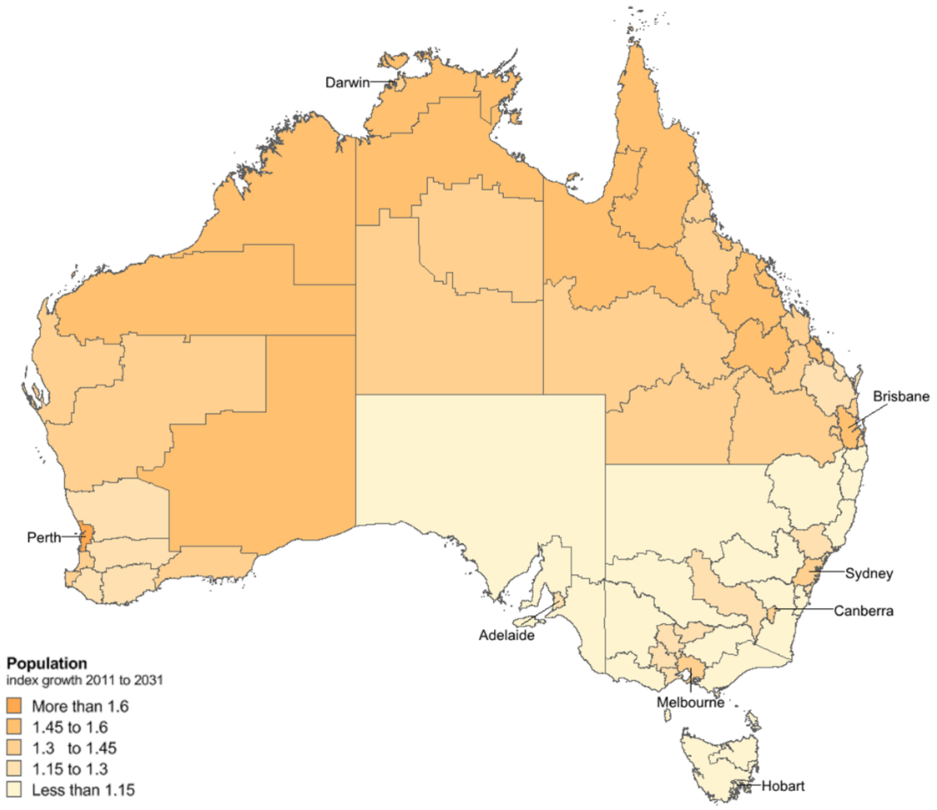
Regional population projections have been prepared for each of the 73 audit regions. These projections were aligned with the Australian Bureau of Statistics (ABS) estimated residential population in 2011 (from the census). Using the Series B assumptions for net interstate and international migration by age, by gender and mortality and fertility rates by age by gender for each region, ACIL Allen constructed demographic projections for each audit region. The regional projections provide a degree of responsiveness (essentially though intrastate migration) via adjustments to differences in projected economic activity while meeting the constraints in ABS projections for resident population within each greater capital city area and the balance of state.

Figure 46 shows the projected population growth between 2010-11 and 2030-31 across the 73 audit regions for the Baseline scenario. This figure indicates that the percentage population growth is projected to be strongest in the north and west of Australia.

Note that an index:

- of 1.0 means there is no change in the population since 2010-11
- greater than 1.0 indicates population growth since 2010-11
- less than 1.0 indicates a decline in the population since 2010-11

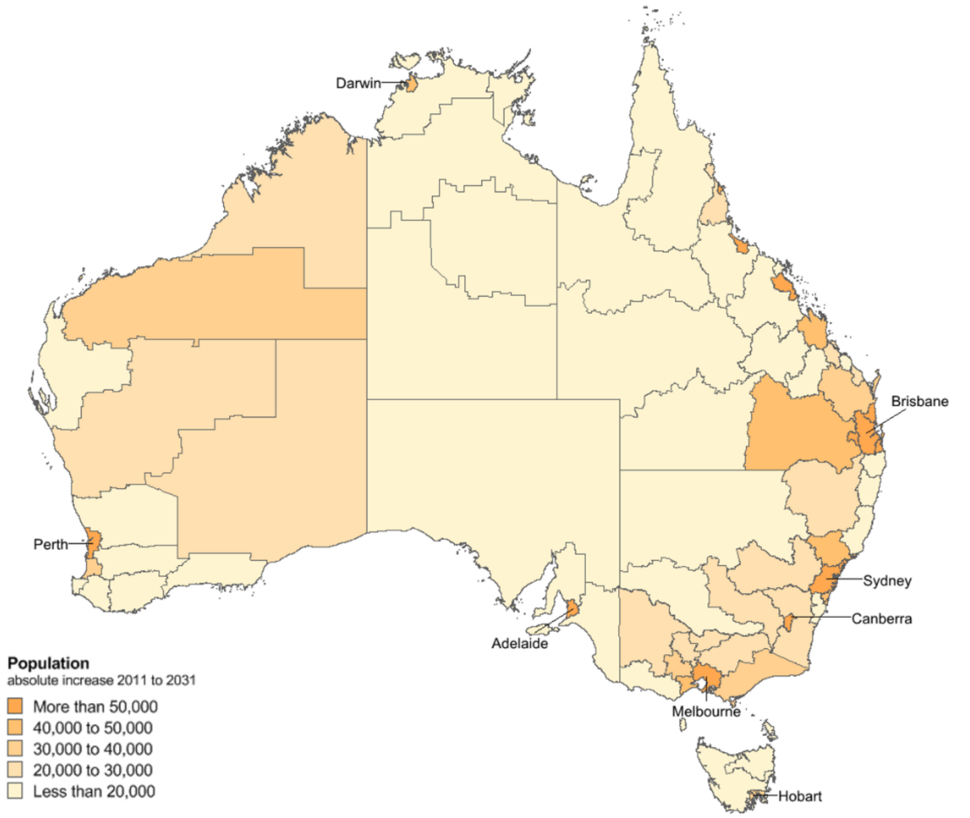
Figure 46 **Projected population growth, Baseline scenario, 2010-11 to 2030-31, index growth (2011=1.00)**



Source: ACIL Allen Consulting, 2014.

While relative population growth will be strongest in the north and west of Australia, this is generally from a relatively small base. Figure 47 shows that the change in the number of people added to a region between 2010-11 and 2030-31 is largest in the metropolitan areas and key economic growth 'hot spots' along the Queensland coast and in the Pilbara.

Figure 47 **Projected absolute population growth, Baseline scenario, 2010-11 to 2030-31, (numbers of population)**



Source: ACIL Allen Consulting, 2014.

The ABS series B projection has been used in the Baseline scenario as it provides a well-known and understood central (baseline) projection. It is important to acknowledge, as the ABS does, that future levels of fertility, mortality, overseas migration and internal migration are unpredictable and that demographic projections do not allow for major government policy decisions and economic factors which can affect future demographic behaviour and outcomes.

It is also acknowledged that statistics about demographic outcomes that have been released after the ABS series B projections suggest changes in Australia's population are being influenced by a broader range of factors in addition to those included in the demographic projections. That is, there may already have been significant amounts of deviation from the Baseline scenario projections provided when using the ABS Series B projections.

5.3.2 Participation and the supply of labour

Total labour force participation is projected to grow at a lower rate than the growth in the Australian population in the Baseline scenario.

The number of people in the workforce across Australia is projected to grow by 35 per cent between 2010-11 and 2030-31. This is less than the projected growth in Australia's population (37 per cent).

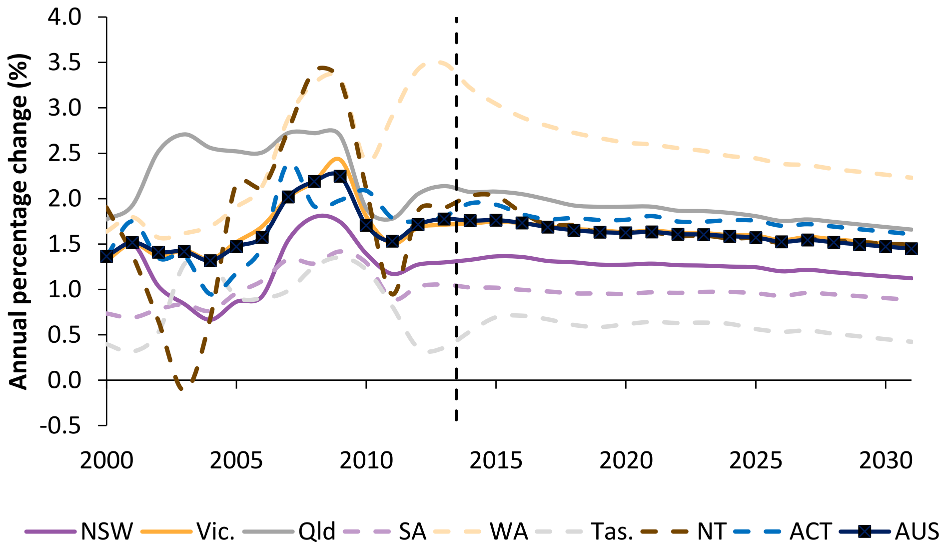
Participation rates by age and gender for each region are modelled explicitly in *Tasman Global* along with the average unemployment rate by gender. Unemployment and participation rates are largely interchangeable in affecting the number of people available for work.

The components are separately identified to allow a better representation of the labour market. In general, when unemployment is high, increases in labour demand can largely be supplied by reducing the unemployment rate but when unemployment is low, increases in labour demand will largely be met by increasing participation rates (and/or hours worked).

Changes in participation rates in the model are also shaped by changes in the real wages offered by employers in each region. Australia's average unemployment rates have been assumed to trend towards 5.5 per cent with all regions projected to converge to that rate by 2030-31.

The projections take into account continued changes in the composition of the workforce. The ageing of the population is a key factor reducing growth in the number of people of working age. The year-on-year working age population growth projections for each Australian State and Territory under the Baseline scenario are shown in Figure 48.

Figure 48 **Historical and projected working age population growth for each Australian State and Territory, Baseline scenario (per cent, year on year 2000-01 to 2030-31)**



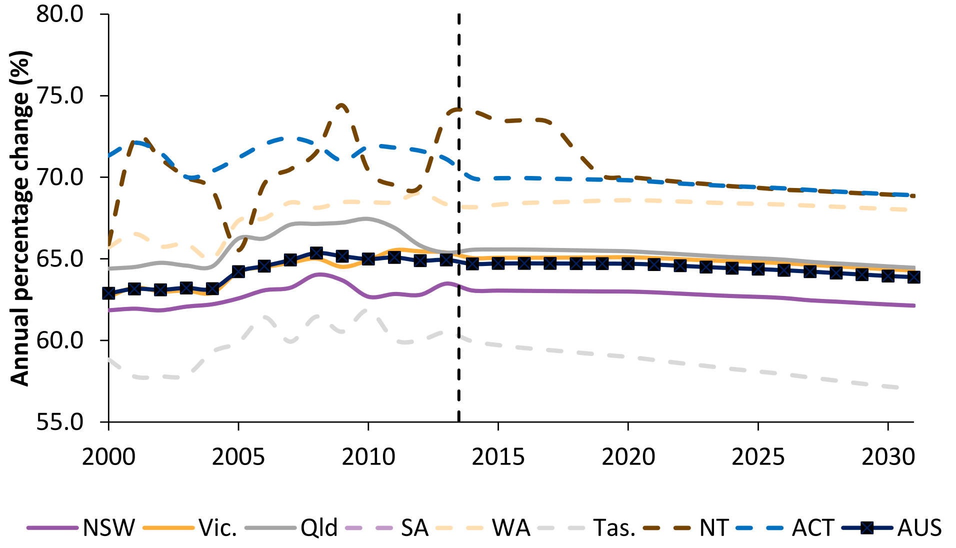
Note: Population aged 15+.

Source: Historical data from ABS Catalogue number 3101.0. Projections from Series B in ABS Catalogue number 3222.0.

A further key trend has been a steady increase in women's participation in the workforce, reflecting factors such as increased levels of educational attainment, greater acceptance of working mothers and greater access to child care. This trend has been partially offset by a fall in men's participation, driven in large part by a reduced attachment to the workforce in older men (aged over 55).

The projected average participation rates under the Baseline scenario are presented Figure 49. The total labour force participation rate is projected to fall from 65 per cent to around 63 per cent by the end of the projection period (2030-31).

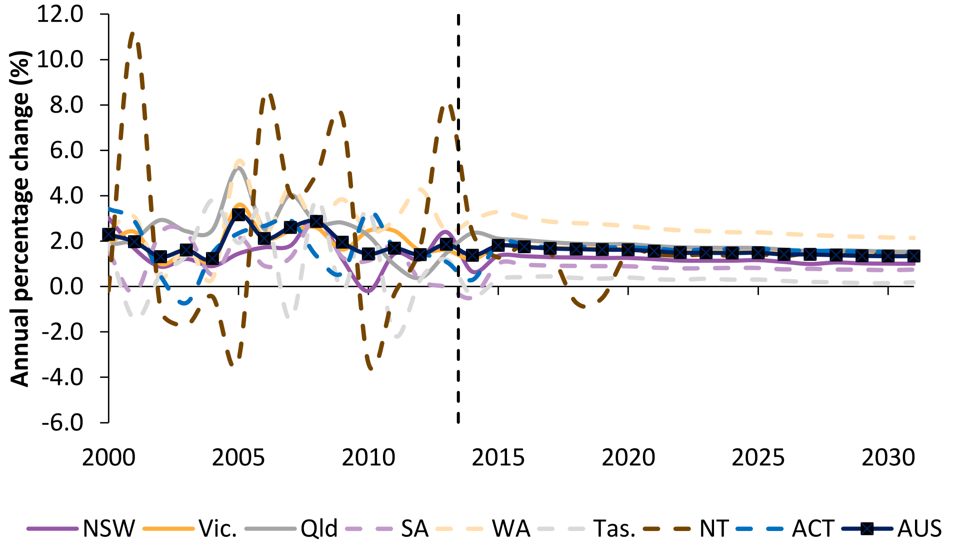
Figure 49 **Historical and projected average participation rates for each Australian state and territory, Baseline scenario, 2000-01 to 2030-31**



Source: Historical data from ABS Catalogue number 6202.0. ACIL Allen Consulting, 2014 projections.

Figure 50 presents the projected working population (that is, the workforce including employed people and those unemployed seeking work) for each Australian State and Territory. Australia's working population is projected to grow at 1.52 per cent per annum between 2010-11 and 2030-31.

Figure 50 **Historical and projected working population growth for each Australian state and territory, Baseline scenario (per cent, year on year), 2000-01 to 2030-31**



Source: Historical data from ABS Catalogue number 6202.0. ACIL Allen Consulting, 2014 projections.

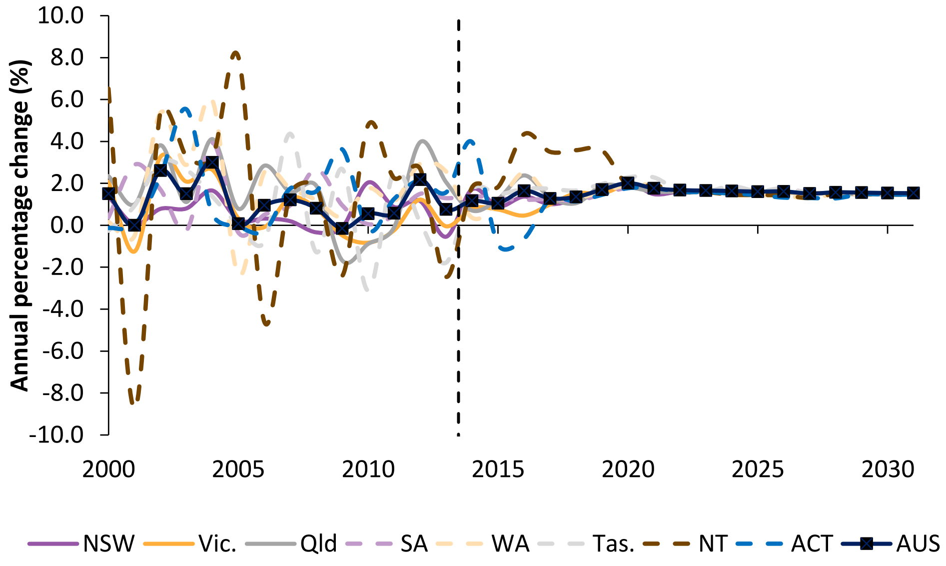
5.3.3 Productivity growth in Australia

Labour productivity is a measure of the quantity of goods and services produced per unit of time worked. Growth in labour productivity is highly variable on a year to year basis and is influenced by many developments in the economy, including changes in capital intensity and the composition of the work force.[9]

Over the past 30 years Australian labour productivity growth has averaged 1.75 per cent a year and 1.8 per cent over the past 40 years.[10] Near term labour productivity growth is based on projections of labour supply and real GDP.

In the Baseline scenario the annual growth in Australian labour productivity over the forecast period is projected to average just over 1.5 per cent a year (Figure 51).

Figure 51 **Historical and projected labour productivity growth, Baseline scenario (per cent change, year on year), 2000-01 to 2030-31**



Source: ABS catalogue number 5206.0 and ACIL Allen Consulting, 2014 projections

5.3.4 GDP growth in Australia

Australia's GDP is projected to increase from $1.41 trillion to $2.58 trillion (in real terms in 2010-11 prices) between 2010-11 and 2030-31. This is an increase of 84 per cent over that period, equating to a per annum growth rate of 3.1 per cent.

A summary of the drivers of growth in the PPP framework is provided in Table 8.

9 Treasury (2008), *Australia's Low Pollution Future: The Economics of Climate Change Mitigation*, www.climatechange.gov.au.

10 Treasury. (2010). *Intergenerational Report 2010: Australia to 2050: future challenges.* Canberra: Commonwealth of Australia.

Table 8 **3Ps Growth between 2010-11 and 2031: Baseline scenario**

	Index 2011=1.0	CAGR 2010-11 to 2030-31
Population	1.37	1.57%
Participation	1.35	1.52%
Productivity	1.36	1.54%
GDP	**1.84**	**3.09%**

Note: CAGR = Compound Annual Growth Rate
Source: ACIL Allen Consulting, 2014

The projected growth rate is slightly slower than growth experienced over the past 20 years (of 3.3 per cent a year). Just over half of the difference in growth between the projected growth rate and the historical growth rate is due to slower population growth and slower growth in aggregate labour supply. The remainder is due to slightly slower growth in average labour productivity compared to the past.

The economic performance of the Australian economy over recent decades is reported in Table 9.

Table 9 **Growth performance of Australian economy (average annual per cent growth)**

Decade	Population %	Employment %	Productivity %	Real GDP %
1960s	2.20	2.60	2.90	5.10
1970s	1.30	1.70	2.00	3.00
1980s	1.50	2.40	1.20	3.40
1990s	1.20	1.20	2.10	3.30
2000s	1.20	1.90	1.50	3.00
2010s	1.00	0.80	1.75	2.60

Source: Commonwealth Treasury, Intergenerational Report 2007.

The projected growth rate in GDP is broadly consistent with other long term projections of the Australian economy. A detailed assessment of the long term outlook for Australia produced by the OECD (2014) forecasts an average annual growth rate of 3.2 per cent over the period 2011 to 2031 (the OECD uses calendar years). Deloitte Access Economics has published a long term projection for the Australian economy that projects an average annual growth rate of 3.0 per cent over the period from 2015 to 2031 (Deloitte Access Economics, 2014).

The economic outlook reflected in the Commonwealth Treasury's most recent Intergenerational Report (IGR 2010) reflects lower economic growth than projected here. The IGR 2010 projects real GDP growth to slow to 2.7 per cent per annum over the next 40 years. This rate of growth is projected to comprise an average annual real GDP per person growth of 1.5 per cent and average annual growth in the total population of 1.2 per cent. The main differences between the economic projections in this report and the IGR 2010 are that the IGR has lower population growth and sharper reductions in labour market participation reflecting grave concerns about the impact of an aging population. The difference in the productivity projections is minor. The IGR 2010 is based on average productivity growth of 1.6 per annum while the Baseline scenario projection is 1.5 per cent per annum.

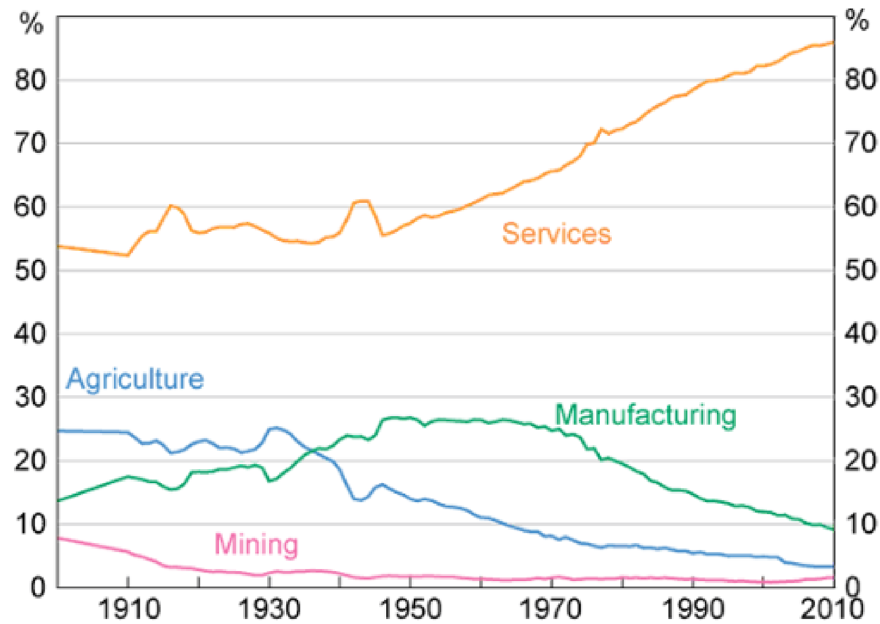
Since the IGR 2010 forecasts were assembled, Australia has sustained higher levels of immigration, there has been an uptick in fertility and there have been policy and other changes that may shape the workforce attachment of older workers. These factors will not halt the ageing of Australia's population or eliminate it, but they may have moderated its effect. The differences in the parameters used in the IGR 2010 and previous IGRs highlight that there is a range of uncertainty around the fundamental factors driving economic growth in the long term. Even seemingly small changes in these values have large implications for the level of economic activity (and the need for infrastructure). This also illustrates why it is necessary to conduct a sensitivity analysis to gain more information about the impact of changes in key demographic parameters that will always remain uncertain in practice.

5.3.5 Structural change in Australian industry

The structure of the Australian economy has shifted away from agriculture and manufacturing towards services (see Figure 52). Mining has grown in importance recently, although the long term trend in employment in mining has been towards a lower share of the total (Connolly and Lewis 2010).

In the terms of economic output (e.g. gross value added by industry) agriculture's share has fallen from 13 per cent in the 1960s to 3 per cent in the 2000s. Meanwhile services has increased from 59 per cent of output to 78 per cent over the same period (Riley, 2013).

Figure 52 **Structural change in employment by industry across Australia since 1900**

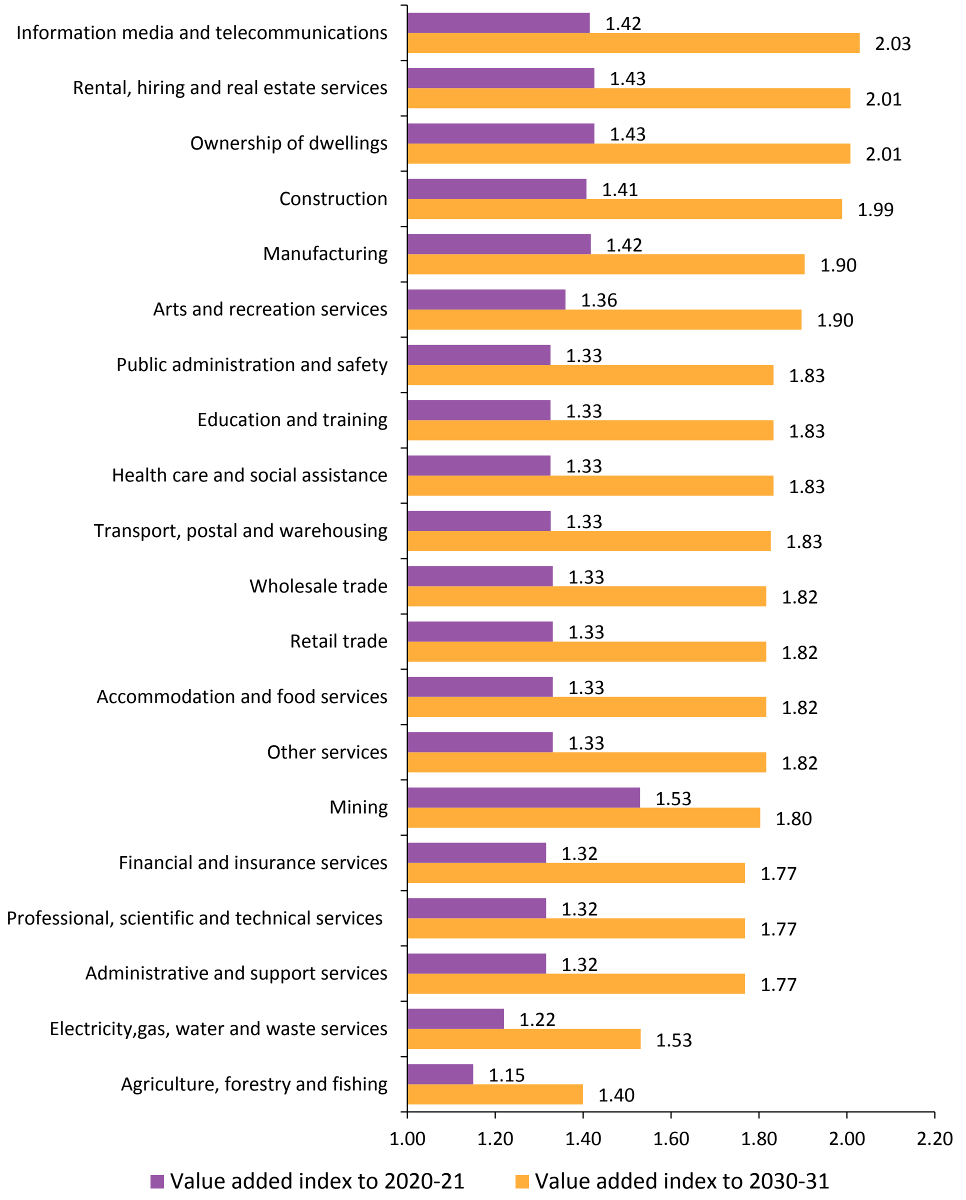


Source: Connolly and Lewis, 2010.

Many of the key trends in the long term structural shift in activity and employment are expected to continue in the economic projections. In particular, the industrial composition of projected economic growth is projected to continue.

Figure 53 details the change in value added by sector across Australia in terms of the change in the growth index between the base year (2010-11, and 2020-21 and 2030-31).

Figure 53 **Value added growth index (2011=1.00)**



Source: ACIL Allen Consulting, 2014.

The Baseline scenario projection factors in the continuation of the shift towards services with the shift towards IT and telecommunications at the head of the list, when sectors are sorted by relative growth, and Arts education and health are also at the upper end of the list.

Reflecting recent developments, such as the GFC, financial services which once would have been towards the top of the list is now viewed as having slower growth prospects. It may be surprising to see manufacturing towards the top of the list given the long term trends discussed earlier. Most of the projected growth in manufacturing is related to increases in LNG production that is coming on stream.

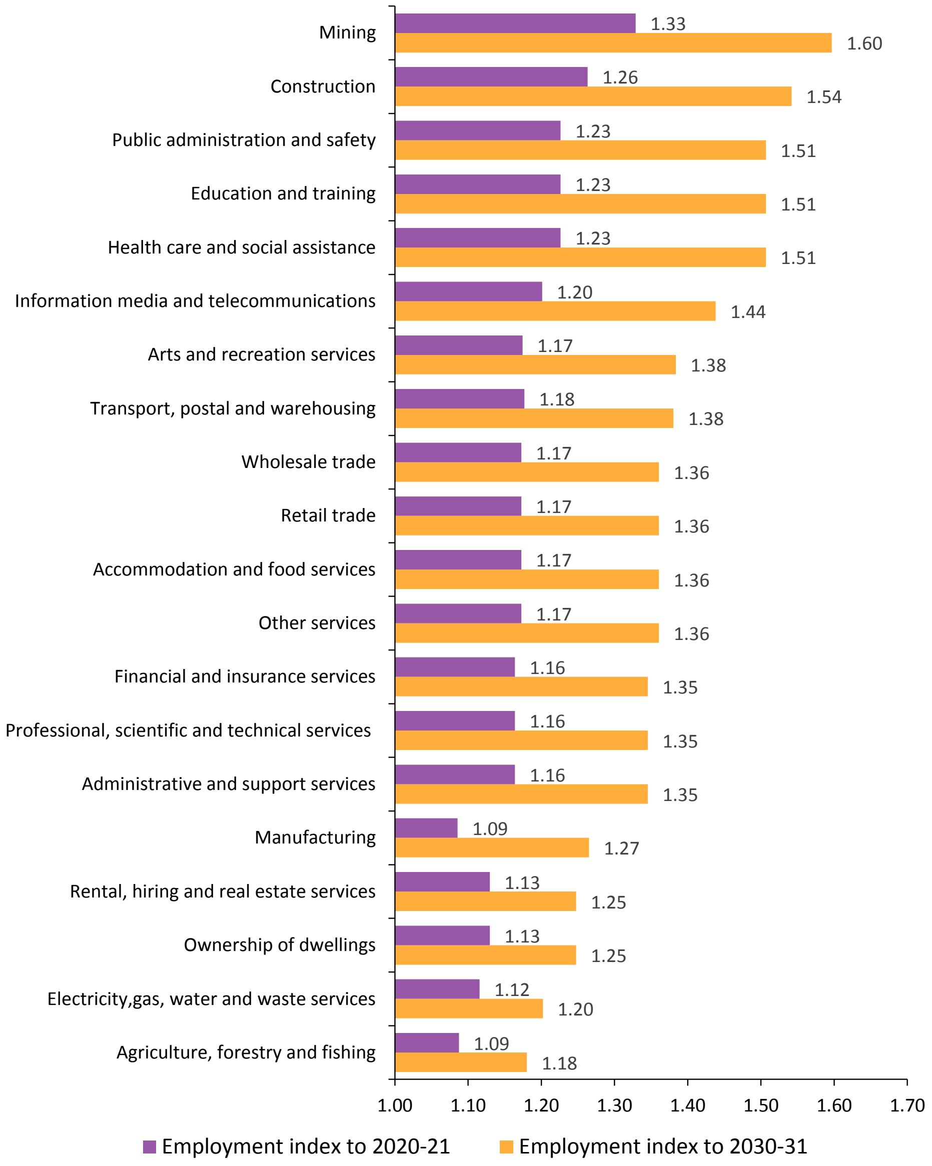
Electricity and agriculture are at the lower end of the list in terms of expected rates of growth in the Baseline scenario projections.

The structural change in the Australian economy will also shape the pattern of employment. The mining sector is projected to have the highest index employment growth between 2010-11 and 2030-31 (1.61 index), with construction having the second highest (1.54 index).

The agriculture, forestry and fishing sector is projected to have the lowest level of employment growth (1.18 index).

Figure54 details the change in the structure of employment by sector in the Baseline scenario projection.

Figure54 **Employment index change, June 2011 to June 2021/June 2031, sector (June 2011=1.00)**



Source: ACIL Allen Consulting, 2014.

5.4 The economic outlook by state and territory

Table 10 presents the real Gross State Product (GSP) and GDP levels for 2010-11 and 2030-31 under the Baseline scenario while Figure 55 presents real GDP growth by state and territory annual growth. Queensland, Western Australia and the Northern Territory are projected to experience stronger underlying growth due to continued growth in resources output, particularly LNG. States that are more reliant on more traditional manufacturing activities and agriculture have slower growth.

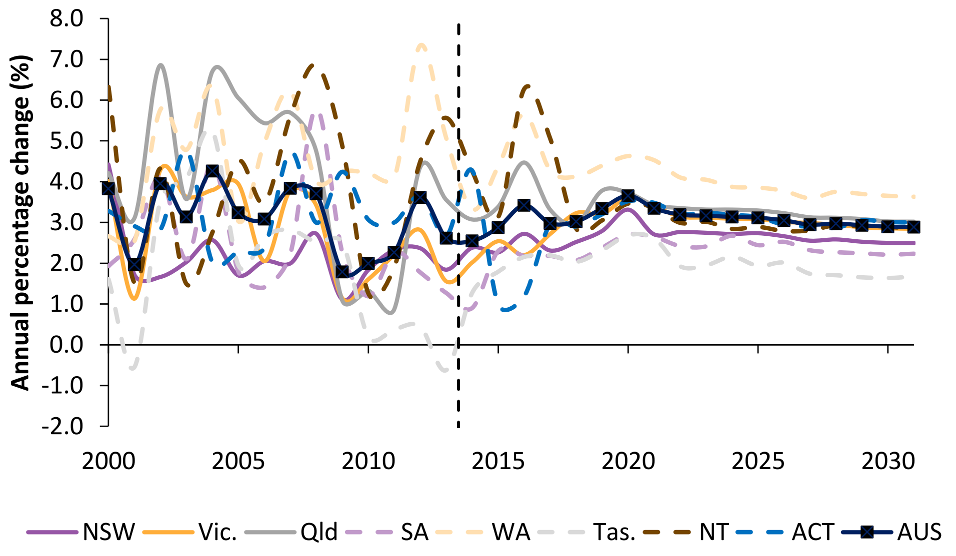
Background factors such as the ageing of the population negatively affect projected growth in Tasmania and South Australia.

Table 10 **Real GSP projections, Baseline scenario, 2010-11 to 2030-31**

	2010-11	2030-31	Average annual growth
	$m in 2010-11 prices	$m in 2010-11 prices	%
New South Wales	441,249	733,723	2.58
Victoria	312,834	550,015	2.86
Queensland	267,942	522,464	3.40
South Australia	89,789	138,938	2.21
Western Australia	221,852	513,007	4.28
Tasmania	24,232	34,358	1.76
Northern Territory	17,449	34,833	3.52
ACT	31,323	56,194	2.97
Australia (GDP)	**1,406,670**	**2,583,531**	**3.09**

Source: ABS Catalogue number 5204 and ACIL Allen Consulting, 2014 projections.

Figure 55 **Real GSP growth, Baseline scenario (per cent, year on year), 2000-01 to 2030-31**



Source: Historical data from ABS Catalogue number 5220. ACIL Allen Consulting, 2014 projections.

As shown in Figure 56, economic growth varies across the states and territories, with Western Australia projected to have the highest growth in GSP – 59 per cent between 2010-11 and 2020-21 and 131 per cent between 2010-11 and 2030-31. Western Australia, Queensland and the Northern Territory are all projected to have higher GSP growth rates than Australia's GDP growth rate.

Figure 56 **Growth in Gross State Product and Gross Domestic Product between 2010-11 and 2030-31, Index growth (FY2011 = 1.00) – Baseline scenario**

Source: ACIL Allen Consulting, 2014 economic projections.

5.5 Economic projections in regional Australia

Every audit region in Australia is projected to benefit from economic growth over the period to 2030-31 in the Baseline scenario. The level of economic activity in each audit region in 2030-31 is reported in Table 11.

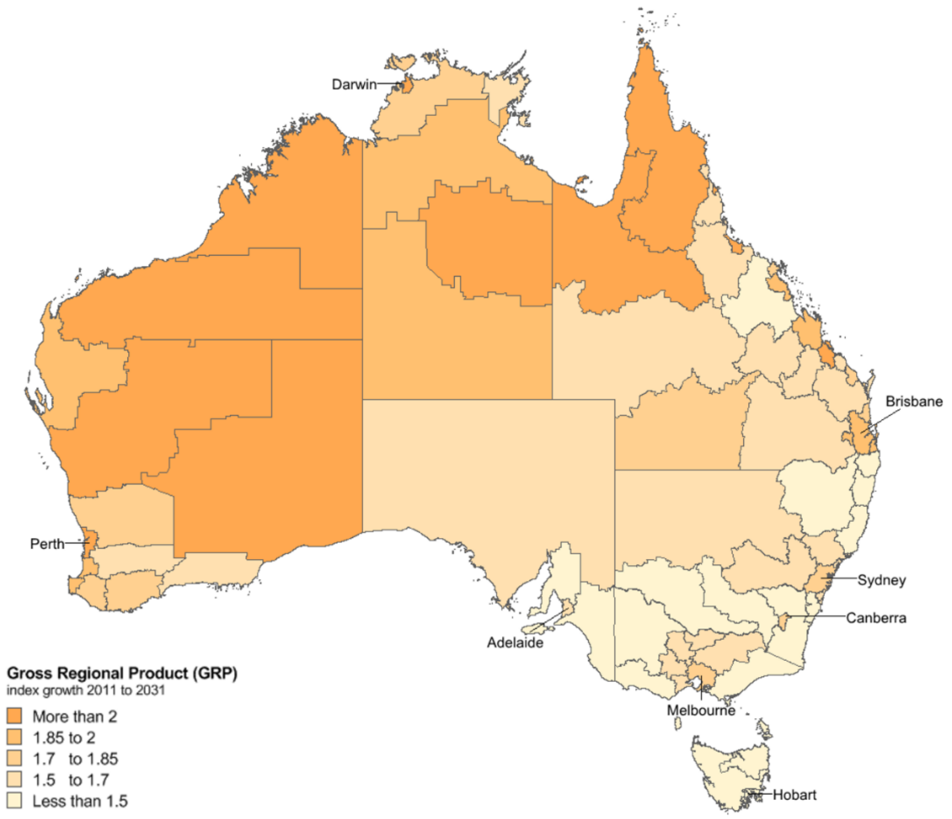
Table 11 **Estimated and projected gross value added at factor cost by audit region, Baseline scenario**

Audit region	GVA 2010-11 (2011 $m)	GVA 2030-31 (2011 $m)	Percentage growth (%)	Audit region	GVA 2010-11 (2011 $m)	GVA 2030-31 (2011 $m)	Percentage growth (%)
1_1_Greater Sydney	272,364	477,266	75.2	3_15_Bowen Basin - North	11,508	17,324	50.5
1_2_Capital Region	7,920	11,353	43.4	3_16_Mackay	6,155	11,632	89.0
1_3_Central West	11,394	17,381	52.5	3_17_Whitsunday	994	1,803	81.3
1_4_Coffs Harbour - Grafton	5,656	8,404	48.6	3_18_Toowoomba	6,133	12,093	97.2
1_5_Far West and Orana	5,429	8,638	59.1	3_19_Charters Towers - Ayr – Ingham	2,152	3,740	73.8
1_6_Hunter Valley exc Newcastle	16,249	25,240	55.3	3_20_Townsville	9,341	19,310	106.7
1_7_Illawarra	12,064	18,616	54.3	3_21_Bundaberg	3,074	5,475	78.1
1_8_Mid North Coast	7,485	10,727	43.3	3_22_Wide Bay	5,128	8,573	67.2
1_9_Murray	5,289	7,414	40.2	3_23_Hervey Bay	1,581	2,917	84.5
1_10_New England and North West	8,770	12,504	42.6	4_1_Greater Adelaide	60,449	96,963	60.4
1_11_Newcastle and Lake Macquarie	19,451	29,718	52.8	4_2_Barossa - Yorke - Mid North	4,485	6,094	35.9
1_12_Richmond - Tweed	9,010	12,836	42.5	4_3_South Australia - Outback	6,770	10,962	61.9
1_13_Riverina	8,152	11,983	47.0	4_4_South Australia - South East	8,617	11,479	33.2
1_14_Southern Highlands and Shoalhaven	5,673	8,278	45.9	5_1_Greater Perth	135,815	327,241	140.9
2_1_Greater Melbourne	216,216	398,802	84.4	5_2_Augusta - Margaret River - Busselton	2,015	3,830	90.0
2_2_Ballarat	5,637	8,917	58.2	5_3_Bunbury	6,835	12,978	89.9
2_3_Bendigo	5,950	9,296	56.2	5_4_Manjimup	919	1,588	72.8
2_4_Geelong	9,913	15,234	53.7	5_5_Esperance	1,332	2,259	69.6
2_5_Hume	7,181	10,942	52.4	5_6_Gascoyne	760	1,512	99.0
2_6_Latrobe - Gippsland	13,517	19,495	44.2	5_7_Goldfields	6,621	13,395	102.3
2_7_North West	7,587	10,897	43.6	5_8_Kimberley	3,429	7,618	122.2
2_8_Shepparton	5,180	7,909	52.7	5_9_Mid West	5,185	12,901	148.8
2_9_Warrnambool and South West	5,454	8,035	47.3	5_10_Pilbara	37,620	88,723	135.8
3_1_Greater Brisbane	118,519	233,233	96.8	5_11_Albany	2,710	4,723	74.3
3_2_Cairns N+S	6,939	14,004	101.8	5_12_Wheat Belt - North	3,304	7,175	117.1
3_3_Cairns Hinterland	3,656	6,245	70.8	5_13_Wheat Belt - South	2,406	3,475	44.4
3_4_Darling Downs - Maranoa	7,246	12,303	69.8	6_1_Hobart	10,476	15,397	47.0
3_5_Far North	1,620	3,505	116.3	6_2_Launceston and North East	5,835	7,833	34.2
3_6_Outback-North	4,244	9,278	118.6	6_3_Rest of Tas	5,537	7,706	39.2
3_7_SWQld_NA	771	1,305	69.3	7_1_Darwin	10,880	20,874	91.8
3_8_SWQld	493	847	71.7	7_2_Alice Springs	2,414	4,554	88.6
3_9_Sunshine Coast	12,487	22,486	80.1	7_3_Barkly	372	712	91.6
3_10_Central Highlands (Qld)	6,126	9,485	54.8	7_4_Daly - Tiwi - West Arnhem	783	1,470	87.6
3_11_Gladstone - Biloela	2,390	3,648	52.6	7_5_East Arnhem	988	1,603	62.3
3_12_Gladstone - Biloela_NA	3,721	17,779	377.8	7_6_Katherine	971	1,813	86.7
3_13_Rockhampton	4,869	9,266	90.3	8_1_Australian Capital Territory	28,951	51,473	77.8
3_14_Gold Coast	24,206	46,398	91.7				

Source: ACIL Allen Consulting, 2014

Figure 57 shows growth in the Gross Regional Product (GRP) of each of the 73 audit regions between 2010-11 and 2030-31 expressed as an index (2010-11=1.00).[11] This figure indicates that projected economic growth is high across the north and west of Australia.

Figure 57 **Growth in Gross Regional Product between 2010-11 and 2030-31, index growth (2010-11=1.00) – Baseline scenario**



Note: Gross Regional Product taken to be value added at factor cost. Taxes and government subsidies have not been included.
Source: ACIL Allen Consulting, 2014

The following tables show the growth expected by region and by economic sector between 2010-11 and 2030-31 (measured by value added). Key points from these tables and previous charts follow.

- Gladstone Biloela NA (Gladstone urban area) is the audit region that has the greatest growth in value add (an index of 6.3). The growth in value add in Gladstone reflects the very strong growth that is projected in the LNG industry (which is included in manufacturing with a growth index of 10.2).
- The Pilbara is projected to diversify its economic base with strong growth in manufacturing (including LNG), transport and telecommunications, supporting continued growth in mining. It is particularly notable that the diversification and broadening of the economic base in the Pilbara also includes growth in health, education, the arts, real estate and ownership of dwellings.

[11] The Gross Regional Product of an audit region has been determined by using data and projections for the value added at factor cost and that taxes and subsidies have been excluded.

- The capital city regions are generally areas where there is reasonably high economic growth across most of the major economic sectors of activity suggesting that they have a diversified and generally robust economic base.
- The consistent high value given to growth in mining across many regions of Australia aligns with the relatively high rates of growth for this sector discussed earlier in this chapter.
- It may be surprising to see that manufacturing appears as a relatively rapid growth sector for many regions across Australia given views about the continuation of the structural shift towards the services sector that has been underway for many years. The strongest and most consistent growth in manufacturing activity in the table is generally linked to activity such as LNG production and export in regions including Gladstone, Darwin and the Pilbara.
- Another sector that appears to offer consistent strong growth in many audit regions is information technology (IT) and telecommunications sectors. The projections indicate that growth in the sector is the most consistent and strongest in regional areas in northern and western parts of Australia.
- The areas that are not shaded in the figure are areas projected to have the lowest growth (the lowest 20 per cent) and the whitespace is concentrated in the more remote regions with a less diversified economic base that are not expected to be involved in major mining or energy developments.

The pattern of economic development suggested in Figure 57 above can be expected to have a profound influence on the future pattern of demand for infrastructure services to be examined in the Australian Infrastructure Audit.

Table 12 **Value Added Index Growth, Audit Regions (NSW & VIC), 2030-31, Sector (2010-11=1.0)**

Audit region	State	Agriculture, forestry and fishing	Mining	Manufacturing	Electricity, gas, water and waste services	Construction	Wholesale trade	Retail trade	Accommodation and food services	Transport, postal and warehousing	Information media and telecommunications	Financial and insurance services	Rental, hiring and real estate services	Professional, scientific and technical services	Administrative and support services	Public administration and safety	Education and training	Health care and social assistance	Arts and recreation services	Other services	Ownership of dwellings	Total
Greater Sydney	NSW	1.4	1.8	1.5	1.5	1.9	1.8	1.8	1.8	1.8	1.9	1.7	1.9	1.7	1.7	1.8	1.8	1.8	1.8	1.8	1.9	1.7
Capital Region	NSW	1.3	2.2	1.5	1.3	1.5	1.4	1.4	1.4	1.4	1.5	1.3	1.5	1.3	1.3	1.4	1.4	1.4	1.5	1.4	1.5	1.4
Central West	NSW	1.3	1.7	1.5	1.4	1.7	1.5	1.5	1.5	1.5	1.7	1.4	1.6	1.4	1.4	1.5	1.5	1.5	1.6	1.5	1.6	1.5
Coffs Harbour Grafton	NSW	1.4	2.0	1.5	1.3	1.5	1.5	1.5	1.5	1.3	1.5	1.4	1.6	1.4	1.4	1.5	1.5	1.5	1.4	1.5	1.6	1.5
Far West and Orana	NSW	1.2	2.2	1.5	1.3	1.7	1.5	1.5	1.5	1.5	1.7	1.5	1.7	1.5	1.5	1.6	1.6	1.6	1.6	1.5	1.7	1.6
Hunter Valley exc Newcastle	NSW	1.3	1.6	1.3	1.4	1.7	1.6	1.6	1.6	1.5	1.7	1.5	1.7	1.5	1.5	1.6	1.6	1.6	1.6	1.6	1.7	1.5
Illawarra	NSW	1.4	1.6	1.4	1.3	1.6	1.5	1.5	1.5	1.5	1.6	1.5	1.7	1.5	1.5	1.6	1.6	1.6	1.6	1.5	1.7	1.5
Mid North Coast	NSW	1.4	1.9	1.5	1.4	1.5	1.4	1.4	1.4	1.3	1.5	1.3	1.5	1.3	1.3	1.4	1.4	1.4	1.4	1.4	1.5	1.4
Murray	NSW	1.3	2.1	1.5	1.2	1.6	1.4	1.4	1.4	1.4	1.6	1.3	1.5	1.3	1.3	1.4	1.4	1.4	1.5	1.4	1.5	1.4
New England and North West	NSW	1.2	1.7	1.5	1.2	1.6	1.4	1.4	1.4	1.5	1.7	1.3	1.6	1.3	1.3	1.5	1.5	1.5	1.6	1.4	1.6	1.4
Newcastle and Lake Macquarie	NSW	1.4	1.7	1.4	1.4	1.6	1.5	1.5	1.5	1.5	1.6	1.4	1.7	1.4	1.4	1.6	1.6	1.6	1.5	1.5	1.7	1.5
Richmond Tweed	NSW	1.3	2.2	1.5	1.2	1.5	1.4	1.4	1.4	1.3	1.5	1.3	1.5	1.3	1.3	1.4	1.4	1.4	1.4	1.4	1.5	1.4
Riverina	NSW	1.3	2.2	1.5	1.3	1.7	1.5	1.5	1.5	1.5	1.7	1.4	1.6	1.4	1.4	1.5	1.5	1.5	1.6	1.5	1.6	1.5
Southern Highlands and Shoalhaven	NSW	1.4	1.8	1.5	1.2	1.5	1.4	1.4	1.4	1.4	1.5	1.4	1.6	1.4	1.4	1.5	1.5	1.5	1.4	1.4	1.6	1.5
Greater Melbourne	VIC	1.5	1.2	1.6	1.5	2.0	1.9	1.9	1.9	1.9	2.1	1.8	2.0	1.8	1.8	1.9	1.9	1.9	1.9	1.9	2.0	1.8
Ballarat	VIC	1.4	2.1	1.6	1.4	1.6	1.6	1.6	1.6	1.5	1.7	1.5	1.7	1.5	1.5	1.6	1.6	1.6	1.6	1.6	1.7	1.6
Bendigo	VIC	1.4	2.3	1.7	1.4	1.6	1.5	1.5	1.5	1.5	1.7	1.5	1.7	1.5	1.5	1.6	1.6	1.6	1.6	1.5	1.7	1.6
Geelong	VIC	1.5	1.7	1.5	1.3	1.6	1.5	1.5	1.5	1.5	1.7	1.4	1.6	1.4	1.4	1.6	1.6	1.6	1.6	1.5	1.6	1.5
Hume	VIC	1.4	2.0	1.6	1.4	1.6	1.5	1.5	1.5	1.4	1.6	1.4	1.6	1.4	1.4	1.5	1.5	1.5	1.5	1.5	1.6	1.5
Latrobe Gippsland	VIC	1.4	1.2	1.7	1.5	1.6	1.5	1.5	1.5	1.4	1.6	1.4	1.6	1.4	1.4	1.5	1.5	1.5	1.5	1.5	1.6	1.5
North West	VIC	1.3	2.3	1.7	1.2	1.6	1.4	1.4	1.4	1.5	1.7	1.4	1.6	1.4	1.4	1.5	1.5	1.5	1.6	1.4	1.6	1.5
Shepparton	VIC	1.3	1.9	1.6	1.3	1.7	1.5	1.5	1.5	1.5	1.7	1.5	1.7	1.5	1.5	1.6	1.6	1.6	1.6	1.5	1.7	1.5
Warrnambool and South West	VIC	1.3	1.4	1.5	1.3	1.6	1.5	1.5	1.5	1.4	1.6	1.4	1.6	1.4	1.4	1.5	1.5	1.5	1.6	1.5	1.6	1.5

Note: Darker shading indicates higher growth.

Source: ACIL Allen Consulting, 2014

Table 13 **Value Added Index Growth, Audit Regions (QLD & SA), 2030-31, Sector (2010-11=1.0)**

Audit region	State	Agriculture, forestry and fishing	Mining	Manufacturing	Electricity, gas, water and waste services	Construction	Wholesale trade	Retail trade	Accommodation and food services	Transport, postal and warehousing	Information media and telecommunications	Financial and insurance services	Rental, hiring and real estate services	Professional, scientific and technical services	Administrative and support services	Public administration and safety	Education and training	Health care and social assistance	Arts and recreation services	Other services	Ownership of dwellings	Total
Greater Brisbane	QLD	1.5	1.6	1.8	1.6	2.2	2.0	2.0	2.0	2.0	2.2	1.9	2.2	1.9	1.9	2.0	2.0	2.0	2.1	2.0	2.2	2.0
Cairns N+S	QLD	1.5	2.4	1.8	1.6	2.1	2.0	2.0	2.0	2.0	2.2	1.9	2.3	1.9	1.9	2.0	2.0	2.0	2.1	2.0	2.3	2.0
Cairns Hinterland	QLD	1.4	2.3	1.8	1.4	1.9	1.7	1.7	1.7	1.7	2.0	1.6	1.9	1.6	1.6	1.7	1.7	1.7	1.9	1.7	1.9	1.7
Darling Downs Maranoa	QLD	1.5	1.6	1.8	1.4	2.1	1.8	1.8	1.8	1.8	2.1	1.7	2.0	1.7	1.7	1.8	1.8	1.8	2.0	1.8	2.0	1.7
Far North	QLD	1.4	2.1	1.8	1.8	2.3	2.4	2.4	2.4	2.2	2.4	2.3	2.7	2.3	2.3	2.4	2.4	2.4	2.2	2.4	2.7	2.2
Outback North	QLD	1.2	2.4	1.3	1.8	2.1	2.2	2.2	2.2	1.9	2.5	2.0	2.8	2.0	2.0	2.1	2.1	2.1	2.3	2.2	2.8	2.3
SWQld NA	QLD	1.4	1.6	1.8	1.4	2.1	1.8	1.8	1.8	1.8	2.1	1.7	2.0	1.7	1.7	1.8	1.8	1.8	2.0	1.8	2.0	1.7
SWQld	QLD	1.4	1.6	1.7	1.4	2.1	1.8	1.8	1.8	1.8	2.2	1.7	2.1	1.7	1.7	1.8	1.8	1.8	2.1	1.8	2.1	1.7
Sunshine Coast	QLD	1.5	2.1	1.8	1.5	1.9	1.8	1.8	1.8	1.7	2.0	1.7	2.0	1.7	1.7	1.8	1.8	1.8	1.9	1.8	2.0	1.8
Central Highlands (Qld)	QLD	1.4	1.4	1.8	1.5	2.3	1.9	1.9	1.9	2.0	2.3	1.9	2.2	1.9	1.9	1.9	1.9	1.9	2.2	1.9	2.2	1.5
Gladstone Biloela	QLD	1.4	1.4	1.8	1.4	2.0	1.7	1.7	1.7	1.8	2.1	1.6	1.9	1.6	1.6	1.7	1.7	1.7	2.0	1.7	1.9	1.5
Gladstone Biloela NA	QLD	1.5	2.0	10.2	3.3	2.2	4.3	4.3	4.3	2.0	2.2	4.1	4.8	4.1	4.1	4.3	4.3	4.3	2.1	4.3	4.8	6.3
Rockhampton	QLD	1.5	2.0	1.8	1.5	2.1	1.9	1.9	1.9	1.8	2.1	1.9	2.2	1.9	1.9	1.9	1.9	1.9	2.0	1.9	2.2	1.9
Gold Coast	QLD	1.5	2.2	1.8	1.5	2.0	1.9	1.9	1.9	1.8	2.1	1.8	2.1	1.8	1.8	1.9	1.9	1.9	2.0	1.9	2.1	1.9
Bowen Basin North	QLD	1.4	1.4	1.8	1.4	2.2	1.8	1.8	1.8	1.9	2.2	1.8	2.1	1.8	1.8	1.8	1.8	1.8	2.1	1.8	2.1	1.5
Mackay	QLD	1.4	1.8	1.8	1.5	2.1	1.9	1.9	1.9	1.8	2.1	1.8	2.2	1.8	1.8	1.9	1.9	1.9	2.0	1.9	2.2	1.9
Whitsunday	QLD	1.4	1.7	1.8	1.4	2.0	1.8	1.8	1.8	1.9	2.0	1.7	2.0	1.7	1.7	1.8	1.8	1.8	1.9	1.8	2.0	1.8
Toowoomba	QLD	1.4	2.3	1.8	1.6	2.1	2.0	2.0	2.0	1.9	2.2	1.9	2.3	1.9	1.9	2.0	2.0	2.0	2.1	2.0	2.3	2.0
Charters Towers Ayr Ingham	QLD	1.4	2.4	1.8	1.4	2.0	1.7	1.7	1.7	1.7	2.1	1.6	1.9	1.6	1.6	1.7	1.7	1.7	2.0	1.7	1.9	1.7
Townsville	QLD	1.5	2.3	1.8	1.6	2.2	2.1	2.1	2.1	1.9	2.2	2.0	2.4	2.0	2.0	2.1	2.1	2.1	2.1	2.1	2.4	2.0
Bundaberg	QLD	1.5	1.9	1.8	1.5	1.9	1.7	1.7	1.7	1.7	2.0	1.7	2.0	1.7	1.7	1.8	1.8	1.8	1.9	1.7	2.0	1.8
Wide Bay	QLD	1.5	1.5	1.8	1.4	1.9	1.7	1.7	1.7	1.6	1.9	1.6	1.9	1.6	1.6	1.7	1.7	1.7	1.8	1.7	1.9	1.7
Hervey Bay	QLD	1.6	2.5	1.8	1.5	1.9	1.8	1.8	1.8	1.7	2.0	1.7	2.1	1.7	1.7	1.8	1.8	1.8	1.9	1.8	2.1	1.8
Greater Adelaide	SA	1.3	1.9	1.3	1.4	1.7	1.6	1.6	1.6	1.6	1.8	1.5	1.8	1.5	1.5	1.6	1.6	1.6	1.7	1.6	1.8	1.6
Barossa Yorke Mid North	SA	1.3	2.1	1.5	1.3	1.4	1.3	1.3	1.3	1.3	1.5	1.3	1.5	1.3	1.3	1.3	1.3	1.3	1.4	1.3	1.5	1.4
South Australia – Outback	SA	1.3	1.8	1.4	1.4	1.6	1.6	1.6	1.6	1.4	1.6	1.5	1.7	1.5	1.5	1.5	1.5	1.5	1.5	1.6	1.7	1.5
South Australia South East	SA	1.3	2.0	1.5	1.2	1.4	1.3	1.3	1.3	1.3	1.5	1.2	1.5	1.2	1.2	1.3	1.3	1.3	1.4	1.3	1.5	1.3

Note: Darker shading indicates higher growth in value added since 2010-11.

Source: ACIL Allen Consulting, 2014

Table 14 **Value Added Index Growth, Audit Regions (WA, TAS, NT, ACT), 2030-31, Sector (2010-11=1.0)**

Audit region	State	Agriculture, forestry and fishing	Mining	Manufacturing	Electricity, gas, water and waste services	Construction	Wholesale trade	Retail trade	Accommodation and food services	Transport, postal and warehousing	Information media and telecommunications	Financial and insurance services	Rental, hiring and real estate services	Professional, scientific and technical services	Administrative and support services	Public administration and safety	Education and training	Health care and social assistance	Arts and recreation services	Other services	Ownership of dwellings	Total
Greater Perth	WA	1.7	2.0	2.5	2.2	2.7	2.5	2.5	2.5	2.6	2.8	2.4	2.6	2.4	2.4	2.5	2.5	2.5	2.6	2.5	2.6	2.5
Augusta Margaret River Busselton	WA	1.5	1.3	2.5	1.7	2.1	1.8	1.8	1.8	1.9	2.1	1.7	1.9	1.7	1.7	1.8	1.8	1.8	2.0	1.8	1.9	1.9
Bunbury	WA	1.6	1.3	2.1	2.0	2.1	1.9	1.9	1.9	1.9	2.1	1.8	2.0	1.8	1.8	1.9	1.9	1.9	2.0	1.9	2.0	1.9
Manjimup	WA	1.6	2.0	2.6	1.4	1.8	1.5	1.5	1.5	1.7	1.9	1.5	1.6	1.5	1.5	1.6	1.6	1.6	1.7	1.5	1.6	1.8
Esperance	WA	1.4	1.7	2.3	1.7	2.1	1.6	1.6	1.6	2.0	2.1	1.5	1.7	1.5	1.5	1.6	1.6	1.6	2.0	1.6	1.7	1.6
Gascoyne	WA	1.5	1.9	2.3	1.9	2.1	2.0	2.0	2.0	2.1	2.3	1.9	2.1	1.9	1.9	2.0	2.0	2.0	2.1	2.0	2.1	2.0
Goldfields	WA	1.8	2.0	1.9	1.9	2.2	2.0	2.0	2.0	2.0	2.3	1.9	2.1	1.9	1.9	2.0	2.0	2.0	2.1	2.0	2.1	2.0
Kimberley	WA	1.5	2.0	2.7	2.0	2.4	2.4	2.4	2.4	2.4	2.6	2.2	2.5	2.2	2.2	2.3	2.3	2.3	2.4	2.4	2.5	2.2
Mid West	WA	1.6	3.2	2.2	1.7	2.1	1.8	1.8	1.8	1.9	2.1	1.7	1.9	1.7	1.7	1.8	1.8	1.8	2.0	1.8	1.9	2.0
Pilbara	WA	2.3	1.9	5.4	2.1	4.2	5.0	5.0	5.0	5.1	6.5	4.8	5.4	4.8	4.8	4.2	4.2	4.2	6.4	5.0	5.4	2.3
Albany	WA	1.5	1.9	2.5	1.5	2.0	1.6	1.6	1.6	1.9	2.0	1.5	1.7	1.5	1.5	1.6	1.6	1.6	1.9	1.6	1.7	1.7
Wheat Belt North	WA	1.5	3.7	2.5	1.4	1.9	1.5	1.5	1.5	1.8	1.9	1.5	1.6	1.5	1.5	1.5	1.5	1.5	1.8	1.5	1.6	1.7
Wheat Belt South	WA	1.5	1.2	2.1	1.3	1.9	1.4	1.4	1.4	1.8	2.0	1.4	1.5	1.4	1.4	1.5	1.5	1.5	1.8	1.4	1.5	1.5
Hobart	TAS	1.4	1.9	1.2	1.2	1.6	1.5	1.5	1.5	1.5	1.6	1.4	1.7	1.4	1.4	1.5	1.5	1.5	1.6	1.5	1.7	1.5
Launceston and North East	TAS	1.3	1.9	1.2	1.1	1.5	1.4	1.4	1.4	1.4	1.6	1.2	1.6	1.2	1.2	1.3	1.3	1.3	1.5	1.4	1.6	1.3
Rest of Tas	TAS	1.3	1.7	1.2	1.2	1.5	1.4	1.4	1.4	1.4	1.5	1.3	1.6	1.3	1.3	1.4	1.4	1.4	1.5	1.4	1.6	1.4
Darwin	NT	1.2	1.5	4.3	1.5	2.0	1.8	1.8	1.8	1.8	2.2	1.9	2.0	1.9	1.9	1.7	1.7	1.7	1.9	1.8	2.0	2.1
Alice Springs	NT	1.2	1.9	1.6	1.6	2.0	1.9	1.9	1.9	1.8	2.1	1.9	2.1	1.9	1.9	1.8	1.8	1.8	1.9	1.9	2.1	1.9
Barkly	NT	1.2	2.1	1.5	1.6	2.1	2.2	2.2	2.2	1.9	2.3	2.2	2.4	2.2	2.2	2.0	2.0	2.0	2.0	2.2	2.4	2.1
Daly Tiwi West Arnhem	NT	1.2	1.7	1.5	1.7	2.1	2.1	2.1	2.1	2.0	2.4	2.1	2.3	2.1	2.1	1.9	1.9	1.9	2.0	2.1	2.3	1.7
East Arnhem	NT	1.2	2.0	1.0	1.4	2.2	1.8	1.8	1.8	2.2	2.5	1.8	2.0	1.8	1.8	1.7	1.7	1.7	2.1	1.8	2.0	1.6
Katherine	NT	1.2	1.9	1.5	1.6	2.2	2.0	2.0	2.0	2.0	2.4	2.0	2.2	2.0	2.0	1.9	1.9	1.9	2.1	2.0	2.2	1.9
Australian Capital Territory	ACT	1.4	0.8	2.0	1.5	1.9	1.8	1.8	1.8	2.0	2.1	1.9	1.8	1.9	1.9	1.6	1.6	1.6	1.9	1.8	1.8	1.8

Note: Darker shading indicates higher growth in value added since 2010-11.

Source: ACIL Allen Consulting, 2014

5.6 Other assumptions and projections

5.6.1 Commodity growth assumptions

The growth in the production of key commodities are based on various sources:

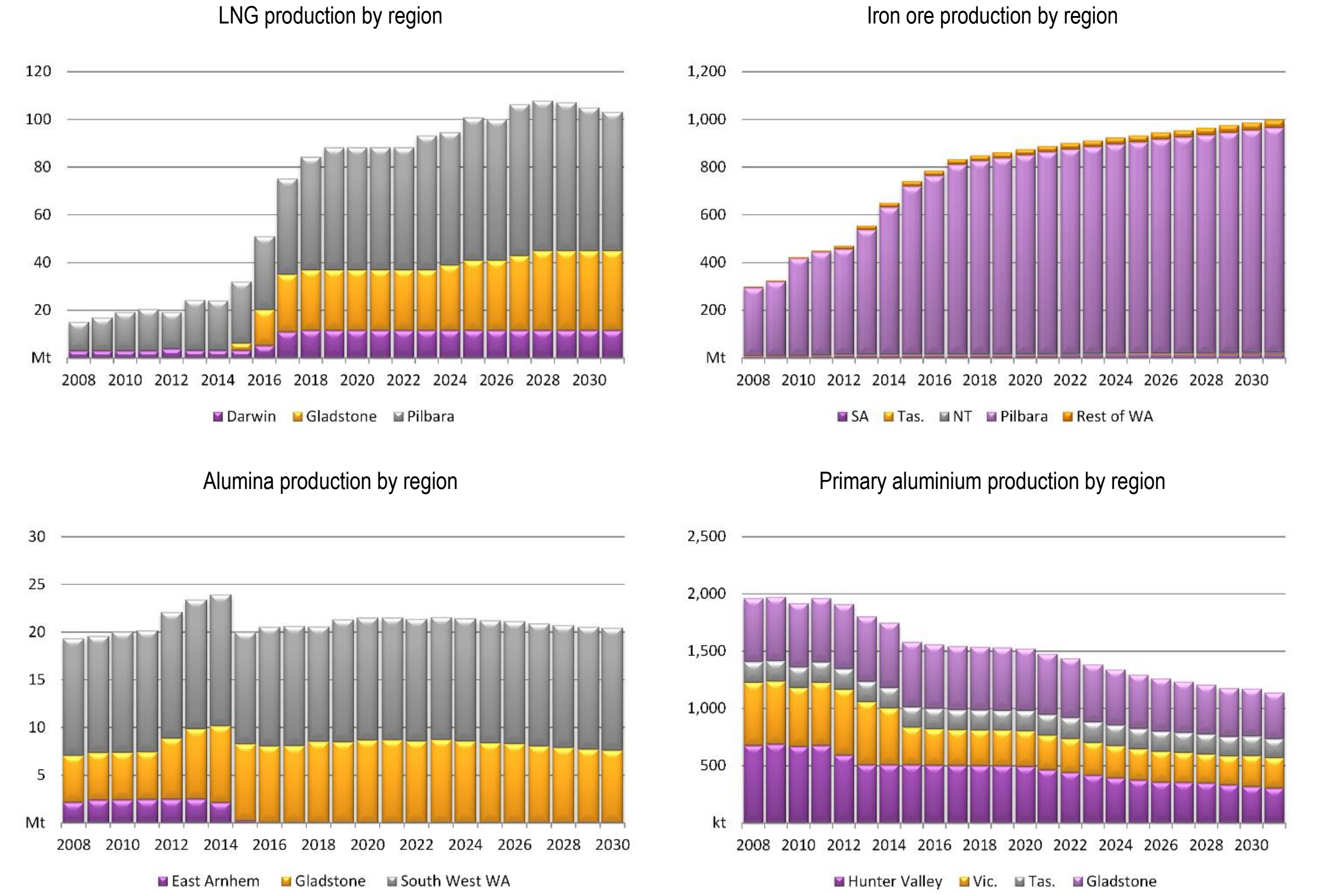
- LNG production levels are ACIL Allen assumptions with field costs and own-use energy demands taken from *GasMark* modelling.
- Near term projections of Australian production are based on BREE and ABARE commodity forecasts and planned and committed projects.

— Longer term projections are determined endogenously by *Tasman Global* based on global supply and demand.

The projections of major commodity production by region under the Baseline scenario are presented in Figure 58.

Recent closures of the Point Henry aluminium smelter and cessation of the Gove alumina operations are incorporated in the Baseline scenario as are the announced closures of Australian car makers. Australian petroleum refining capacity is assumed to remain constant over the projection period – although this may be optimistic given a range of domestic and international pressures to the ongoing viability of certain refineries.

Figure 58 **Projected production of selected major commodities, Baseline scenario**



Note: All years are financial years ending June 30.

Source: ACIL Allen Consulting, 2014.

5.6.2 The exchange rate

The outlook for the Australian exchange rate over the next four years follows the outlook for real commodity prices (notably iron ore and coal). The projected downward trend in prices from current levels for most commodities reflects the continuing production surge coupled with ongoing weakness in the world economy in general and in particular the Chinese economy. Over the medium term, real commodity prices are projected to reach a new equilibrium around or higher than pre-2006 prices. This reflects a higher marginal cost of mineral production across the world associated with continuing declines in ore grades being only marginally offset by future productivity increases.

Between 2010-11 and 2016-17, export volumes for steel-making coal are projected to increase by over 40 per cent, and by 65 per cent for energy coal, with copper increasing by 70 per cent and alumina by 30 per cent.

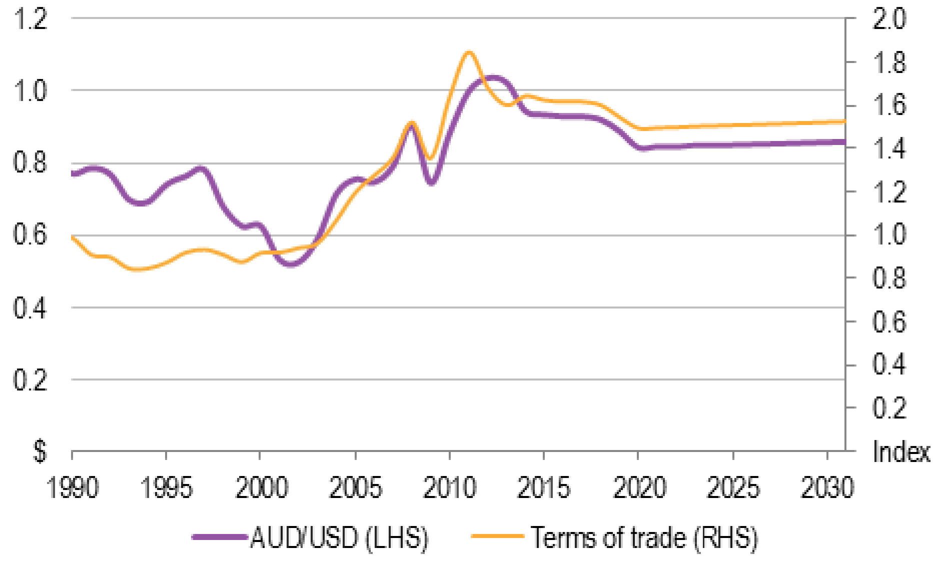
Export volumes of LNG will triple to more than 75 million tonnes by 2016-17. In the longer term, a return to the recent high iron ore prices is believed to be unlikely and will remain lower than their previous peak. This is a result of China's demand for steel cooling as the economy begins to mature and transition away from construction-based investment and toward a greater services-based economy.

Coupled with China’s ageing population, this slowdown is seen to be persistent and significant for the rest of the outlook period. Indian economic growth, although strong, is not projected to fully compensate for the slowdown in Chinese iron ore consumption.

With respect to LNG, we project that future international contracts will fall noticeably as the vast amounts of US shale gas are gradually redirected to export markets through a number of new LNG facilities. The current contracts will provide some buffer to realised Australian export prices from new facilities but there will be noticeable downward pressure compared to the prices negotiated between 2009 and 2012. The fall in the Australian dollar as a result of the fall in iron ore and coal prices will help alleviate the impact on the long term Australian dollar realised LNG price.

Notwithstanding the likely continuation of quantitative easing practices by central banks (particularly by the US Federal Reserve), the real exchange rate is expected to return to a long run average of between 70-85 US cents to the Australian dollar. Since the Asian Financial Crisis, the exchange rate between the AUD and the USD has broadly followed the terms of trade. A continuation of this relationship is the main driver of the projected exchange rates.

Figure 59 **Historical and projected AUD/USD exchange rate and Australian terms of trade, Baseline scenario**



Note: AUD/USD exchange rate is how many US dollars are purchased with one Australian dollar (excluding transaction costs). Historical data is simple average of monthly average nominal exchange rates. Projection reflects real exchange rate movements.

Source: Historical exchange rate data from Reserve Bank of Australia. ACIL Allen Consulting, 2014 projections.

5.6.3 Sectoral efficiency assumptions

The macroeconomic assumptions presented above imply an average annual change in productivity. Assumptions need to be made about the way these productivity changes are distributed across inputs and industries.

A range of specific assumptions were made with respect to certain inputs in certain industries with the remaining productivity changes distributed using the relative sectoral productivity growth rates presented by the Commonwealth Treasury (2008).

More specifically:

- The own-use of gas by LNG facilities, fuel use by road transportation technologies and fuel use by electricity generation in each state and territory were taken from ACIL Allen estimates.
- Efficiencies of certain physical transformation activities were assumed to be fixed (which in some cases may be an oversimplification of the underlying chemical processes). These include the amount of bauxite per unit of alumina; alumina per unit of primary aluminium; iron ore per unit of iron and steel; and oil per unit of petroleum products.
- An autonomous energy efficiency improvement (AEEI) of 0.5 per cent per year was imposed for all other energy demand. This rate is consistent with many other projection exercises including those commissioned by the Australian Greenhouse Office (AGO) and Department of Climate Change and Energy Efficiency (DCCEE) over the past decade or so.
- All remaining productivity improvements required to meet growth in real output were solved endogenously and distributed across all (non-specified) intermediate inputs based on the relative[12] sectoral labour growth assumptions presented by the Commonwealth Treasury (2008) and reproduced in Table 15. The relative efficiency of capital by sector was assumed to be the same as labour. Land was assumed to have twice the relative efficiency of labour while all other intermediates (primarily non-energy given the AEEI assumption) were assumed to have half the relative productivity improvements compared to labour.

[12] It should be noted that in *Tasman Global*, as in the Treasury (2008) modelling, the 'relative' productivity is distributed according to a power function. If we let a_{ij} be the relative distribution across input *i* and industry *j* of the efficiency improvement *E*, then it is distributed according to $E^{a_{ij}}$

Table 15 **Sectoral labour productivity distribution for non-specified inputs by industry and country**

Industry	US	EU25	China	FSU	Japan	India	Canada	Australia	Indonesia	Southern Africa	Other SE Asia	OPEC	Rest of world
Coal mining	1	1	1.3	0.5	0.5	1.5	1	1	1.4	1	1	1	1
Oil mining	1	1	0.75	0.5	0.5	1	1	1	0.75	1	0.75	1	1
Gas mining	1	1	0.75	0.5	0.5	1	1	1.4	0.75	1	0.75	1	1
Petroleum and coal	1	1	0.75	0.5	0.5	1	1	1.4	0.75	1	0.75	1	1
Electricity	1.25	1	0.75	0.5	0.5	0.5	1.25	1.4	0.75	1	0.75	1	1
Mining and chemicals	1.25	1	1	1	1.5	1	1.25	0.8	1	1	1	1	1
Manufacturing	1.25	1.5	1	1	1.5	1	1.25	1	1	1	1	1	1
Road transport	1.5	2	2	1	2	2	1.5	2	2	2	2	2	2
Water and air transport	0.75	1	0.5	0.5	1	0.5	0.75	1.4	0.5	1	0.5	1	1
Crops	0.75	1.5	1	1	0.5	0.5	0.75	1	0.75	1	0.5	1	1
Livestock	0.75	1.5	1	1	0.5	0.5	0.75	1	0.5	1	0.5	1	1
Fishing and forestry	0.75	1.5	1	1	0.5	0.5	0.75	2	0.5	1	0.5	1	1
Food	1.4	1.5	1	1	1	1	1.4	1	0.5	1	0.5	1	1
Services	1	1	0.75	0.75	1	0.75	1	1	0.75	1	0.75	1	1

Data source: Treasury 2008 section B.5.3.

5.7 Infrastructure service needs in 2030-31

5.7.1 National Infrastructure projections

GDP is projected to increase in real terms from $1,407 billion in 2010-11 to $2,583 billion in 2030-31 under the baseline economic projection (in 2010-11 prices). Over the same period, the Direct Economic Contribution (DEC) or value added from nationally significant infrastructure services and urban transport services is projected to increase from $187 billion per annum to $371 billion per annum (2010-11 prices).

As a proportion of GDP, the DEC of infrastructure services from nationally significant infrastructure and urban transport is projected to increase from 13.3 per cent in 2010-11 to 14.4 per cent in 2030-31. The Baseline projections imply that the Australian economy will become slightly more infrastructure dependent by 2030-31. This reflects the interaction of a complex series of drivers that bear differently upon each infrastructure sector or category as well as the component parts and regions in the economy at large that depend on infrastructure services.

Table 16 shows the DEC for nationally significant infrastructure sector services across Australia in 2010-11, the projected DEC in 2030-31 and the DEC sector growth index in 2010-11 and 2030-31.

The table shows that every category of nationally significant infrastructure is expected to expand and grow. This growth is expected to be faster than the rate of population growth in every infrastructure category, highlighting that infrastructure plays a significant role in responding to and supporting economic growth.

The outlook differs markedly for different infrastructure service sectors or categories. Key points are summarised below.

— Gas pipelines and ports are expected to more than double their DEC based on expected increases in bulk commodity and LNG exports.

- Telecommunications is also expected to double its DEC over the forecast period reflecting the continued shift to the digital economy supported by more widespread access to higher quality broadband telecommunications facilities.
- Ports, airports and telecommunications sectors are projected to be the largest drivers of economic contribution to the economy among the nationally significant infrastructure service categories examined in this report with each growing to around $40 billion per annum by 2030-31.
- It is difficult to draw insight from the results for Nationally significant roads and rail infrastructure for many reasons including the observation that the measurements for the National Highway do not include key freight journeys reaching into cities and key centres of economic activity and rail is limited to the “below” rail infrastructure.
- The projected growth in the DEC from water infrastructure and electricity growth reflect a combination of increased demand from consumers and industry (including agricultural demand for rural water).
- The projected growth in the DEC of petroleum product terminals reflects a balance between falling intensity of fuel use per capita and increases in the share of the market served by fuel imports.
- The projected DEC for urban transport networks across Australia will more than double reflecting increasing population, economy and increased demand for mobility.

More details about the projections for each infrastructure category examined are provided in Part B of this report.

Table 16 **DEC of Infrastructure sectors, Australia, 2010-11 and 2030-31, Baseline scenario**

Infrastructure	DEC 2010-11 ($m)	DEC 2030-31 Baseline scenario ($m)	Index 2030-31 (2010-11 DEC=1.00)
Nationally significant infrastructure			
Nationally significant roads	9,499	15,571	1.64
Ports	20,655	41,889	2.03
Airports	20,677	40,928	1.98
Rail	5,426	9,466	1.74
Electricity	16,064	26,149	1.63
Gas pipelines	2,345	4,686	2.00
Petroleum product terminals	1,077	1,722	1.60
Water infrastructure	10,610	15,939	1.50
Telecommunications	21,050	42,261	2.01
Sub total	**107,403**	**198,611**	**1.85**
Urban transport			
Urban transport networks – (6 capital city conurbations)	78,250	175,104	
Urban transport networks – (ACIL Allen Consulting estimates for Darwin & Hobart)	1,435	2,916	
TOTAL urban transport networks	**79,685**	**178,020**	**2.23**
AUSTRALIA-WIDE TOTAL	**187,088**	**376,631**	**2.01**
Top down indicators			
Australian population			1.37
Australian economy			1.84

Source: ACIL Allen Consulting, 2014

5.7.2 Infrastructure economic outlook by region

Projected DEC by region

Table 17 shows the projected DEC by nationally significant infrastructure sector for each audit region and the total DEC for infrastructure for each audit region in 2030-31. The cells have been colour coded to highlight the highest and lowest infrastructure needs reflected in terms of infrastructure service value added (which is also the DEC for each infrastructure category).

The tables indicate that the major urban areas, especially the Greater Capital City regions obtain the greatest economic contribution (DEC) from infrastructure services in total.

Table 17 **Projected Direct Economic Contribution of subsector by audit region, Baseline scenario 2030-31, ($m)**

Audit Region	Nationally significant roads	Ports	Airports	Rail	Electricity	Gas	Petroleum	Water & Sewerage	Telecommunications	Total
1_1_Greater Sydney	143	7,566	9,445	61	3,762	490	286	2,019	14,610	38,383
1_2_Capital Region	520	-	22		262	40	-	67	98	1,009
1_3_Central West	612	-	72	307	584	19	-	74	124	1,794
1_4_Coffs Harbour - Grafton	229	8	89	4	159	-	-	52	102	643
1_5_Far West and Orana	9	-	16	5	133	15	-	102	47	327
1_6_Hunter Valley exc Newcastle	442	-	-	640	1,118	-	-	115	78	2,392
1_7_Illawarra	854	206	-	4	254	20	-	197	182	1,716
1_8_Mid North Coast	621	-	58	9	244	-	-	108	73	1,112
1_9_Murray	390	-	68	1	129	6	-	99	63	756
1_10_New England and North West	234	-	71	44	192	1	-	52	107	701
1_11_Newcastle and Lake Macquarie	-	577	284	185	635	31	52	213	395	2,372
1_12_Richmond - Tweed	328	-	80	2	268	-	-	80	158	917
1_13_Riverina	345	-	73	9	356	32	-	151	73	1,039
1_14_Southern Highlands and Shoalhaven	569	60	-	4	105	14	-	75	52	878
2_1_Greater Melbourne	-	7,796	8,016	27	1,397	585	293	2,192	11,949	32,256
2_2_Ballarat	176	-	-	0	116	5	-	72	173	543
2_3_Bendigo	241	-	-	1	110	-	-	85	126	563
2_4_Geelong	194	200	-	0	265	9	128	182	111	1,090
2_5_Hume	501	-	-	3	566	3	-	52	45	1,170
2_6_Latrobe - Gippsland	354	88	-	2	1,887	51	-	241	85	2,708
2_7_North West	692	-	48	4	108	7	-	132	58	1,049
2_8_Shepparton	71	-	-	1	95	6	-	221	49	442
2_9_Warrnambool and South West	21	77	-	1	164	25	-	74	45	407
3_1_Greater Brisbane	99	4,969	6,151	559	1,508	97	391	1,775	4,130	19,680
3_2_Cairns N+S	61	215	1,219	9	180	-	15	90	108	1,896
3_3_Cairns Hinterland	85	24	-	2	128	-	-	36	41	316
3_4_Darling Downs - Maranoa	467	-	19	5	457	62	-	42	54	1,106
3_5_Far North	0	207	55	-	-54	-	2	11	7	228
3_6_Outback-North	130	52	86	20	43	61	-	10	25	427
3_7_SWQld_NA	39	-	10	8	11	-	-	6	5	78
3_8_SWQld	29	-	-	3	7	45	-	1	4	90
3_9_Sunshine Coast	186	-	255	3	225	-	-	382	158	1,209
3_10_Central Highlands (Qld)	206	-	50	520	34	-	-	14	19	843
3_11_Gladstone - Biloela	129	-	74	152	164	-	-	19	4	542
3_12_Gladstone - Biloela_NA	12	1,115	-	78	654	1,667	23	190	14	3,754
3_13_Rockhampton	165	47	217	61	252	1	1	91	77	910
3_14_Gold Coast	1,270	-	1,659	12	371	11	-	653	563	4,539

Audit Region	Nationally significant roads	Ports	Airports	Rail	Electricity	Gas	Petroleum	Water & Sewerage	Telecommunications	Total
3_15_Bowen Basin - North	286	121	10	1,047	37	-	-	25	16	1,541
3_16_Mackay	348	696	325	53	139	-	22	99	76	1,757
3_17_Whitsunday	-	-	188	1	22	-	-	4	13	228
3_18_Toowoomba	356	-	-	25	173	5	-	199	162	921
3_19_Charters Towers - Ayr - Ingham	207	3	9	4	47	-	-	37	11	319
3_20_Townsville	53	232	530	41	190	10	24	232	375	1,687
3_21_Bundaberg	74	36	37	4	101	0	-	38	45	335
3_22_Wide Bay	266	26	-	7	395	0	-	41	118	854
3_23_Hervey Bay	-	-	46	-	66	0	-	68	15	195
4_1_Greater Adelaide	-	1,419	2,738	7	1,032	244	50	1,039	2,188	8,717
4_2_Barossa - Yorke - Mid North	270	95	-	0	159	32	-	196	32	784
4_3_South Australia - Outback	196	97	84	8	242	4	3	38	35	708
4_4_South Australia - South East	257	-	32	0	138	11	-	90	52	580
5_1_Greater Perth	-	6,364	4,112	12	3,001	648	323	2,452	3,343	20,254
5_2_Augusta - Margaret River - Busselton	107	-	-	-	50	-	-	41	15	214
5_3_Bunbury	332	83	-	11	1,049	108	-	161	61	1,804
5_4_Manjimup	53	-	-	-	24	-	-	13	6	97
5_5_Esperance	27	154	10	7	56	7	15	6	8	289
5_6_Gascoyne	11	27	11	-	47	1	-	13	3	112
5_7_Goldfields	134	-	102	10	101	35	-	66	31	478
5_8_Kimberley	94	120	206	-	213	-	4	45	40	722
5_9_Mid West	280	182	16	6	151	67	7	49	39	796
5_10_Pilbara	148	8,279	604	5,457	240	64	33	139	71	15,033
5_11_Albany	12	105	20	1	68	-	1	55	27	290
5_12_Wheat Belt - North	218	-	-	8	136	2	-	85	24	473
5_13_Wheat Belt - South	-	-	-	1	32	-	-	18	5	56
6_1_Hobart	-	137	452	1	198	20	7	135	448	1,399
6_2_Launceston and North East	264	169	268	6	283	18	1	66	82	1,157
6_3_Rest of Tas.	142	130	51	1	458	6	10	82	27	906
7_1_Darwin	-	93	667	2	93	61	19	105	178	1,218
7_2_Alice Springs	348	-	280	1	26	9	-	8	27	699
7_3_Barkly	51	-	-	0	8	1	-	0	2	62
7_4_Daly - Tiwi - West Arnhem	531	-	10	0	12	-	-	1	-	554
7_5_East Arnhem	-	104	40	-	18	-	13	0	5	180
7_6_Katherine	79	8	-	0	13	10	-	2	13	124
8_1_Australian Capital Territory	-	-	1,943	0	246	22	-	316	656	3,184

Note: Red shading indicates a relatively large projected increase in DEC value while yellow shading indicates a relatively low projected increase in DEC value. Blank cells indicate that DEC values for infrastructure at corresponding audit region was zero or less than $1 million.

Source: ACIL Allen Consulting, 2014

Table 18 indicates the growth in DEC as measured by an index in 2030-31 by nationally significant infrastructure sector by audit region. The projected growth in urban transport by region and model are outlined in more detail in the stand-alone urban transport report. Key observations include the following:

- All regions have an increasing infrastructure DEC between 2010-11 and 2030-31.
- The 3_12_Gladstone_Biloela_NA audit region (Gladstone urban area) exhibits the greatest index growth (7.10).
- The 4_2_Barossa-Yorke-Mid North region exhibits the lowest index growth (1.31).
- Gas in the 3_12_Gladstone_Biloela_NA region has the highest index growth (33.53) and the water sector in that region has the second highest index (5.33).

It should be noted that the projected service needs or gaps show the indicative increase in the services that are needed to meet the expected demand increase in the future. These services may be filled in a number of ways including:

- Making use of existing reserve or spare capacity that may be available in the infrastructure facilities in relevant regions
- Making better use of existing capacity (squeezing productivity out of existing facilities)
- Meeting or altering demand through non-infrastructure oriented solutions
- Expanding infrastructure services proportionally to the increase in demand

Table 18 Projected 2030-31 DEC growth index by audit region (2010-11 = 1.00), Baseline scenario

Audit Region	Nationally significant roads	Ports	Airports	Rail	Electricity	Gas	Petroleum	Water & Sewerage	Telecommunications	Average
1_1_Greater Sydney	1.50	1.63	1.84	1.42	1.56	1.40	1.41	1.12	1.91	1.53
1_2_Capital Region	1.48		1.48	1.06	1.55	1.40		1.24	1.53	1.39
1_3_Central West	1.55		1.60	1.64	1.51	1.40		1.21	1.65	1.51
1_4_Coffs Harbour - Grafton	1.39	1.29	1.48	1.05	1.63			1.18	1.50	1.36
1_5_Far West and Orana	1.85		1.62	1.19	1.56	1.40		1.25	1.68	1.51
1_6_Hunter Valley exc Newcastle	1.63			1.51	1.57			1.54	1.66	1.58
1_7_Illawarra	1.55	1.40		1.58	1.57	1.40		1.06	1.64	1.46
1_8_Mid North Coast	1.37		1.44	1.02	1.61			1.16	1.46	1.34
1_9_Murray	1.44		1.51	1.09	1.46	1.40		1.11	1.58	1.37
1_10_New England and North West	1.46		1.57	1.70	1.45	1.40		1.15	1.65	1.48
1_11_Newcastle and Lake Macquarie		1.37	1.57	1.23	1.59	1.40	1.41	1.23	1.61	1.43
1_12_Richmond - Tweed	1.37		1.46	1.03	1.57			1.13	1.50	1.34
1_13_Riverina	1.50		1.62	1.21	1.47	1.40		1.20	1.70	1.44
1_14_Southern Highlands and Shoalhaven	1.39	1.28		1.07	1.60	1.40		1.18	1.53	1.35
2_1_Greater Melbourne		1.75	1.99	1.48	1.51	1.10	1.49	1.60	2.06	1.62
2_2_Ballarat	1.53			1.18	1.56	1.10		1.32	1.66	1.39
2_3_Bendigo	1.54			1.19	1.55			1.30	1.66	1.45
2_4_Geelong	1.52	1.42		1.18	1.52	1.10	1.49	1.73	1.66	1.45
2_5_Hume	1.48			1.13	1.54	1.10		1.79	1.61	1.44
2_6_Latrobe - Gippsland	1.49	1.37		1.12	1.55	1.10		1.27	1.60	1.36
2_7_North West	1.51		1.60	1.17	1.45	1.10		1.22	1.66	1.39
2_8_Shepparton	1.53			1.19	1.49	1.10		1.30	1.69	1.38
2_9_Warrnambool and South West	1.65	1.40		1.15	1.49	1.10		1.25	1.61	1.38
3_1_Greater Brisbane	1.79	1.81	2.05	1.53	1.48	1.25	1.66	1.54	2.22	1.70
3_2_Cairns N+S	1.90	1.78	2.03	1.44	1.53		1.66	1.75	2.16	1.78
3_3_Cairns Hinterland	1.66	1.60		1.26	1.41			1.57	1.95	1.58
3_4_Darling Downs - Maranoa	1.81		1.90	1.37	1.38	1.25		1.46	2.08	1.61
3_5_Far North	1.73	1.93	2.20		1.67		1.66	1.96	2.33	1.93
3_6_Outback-North	2.30	1.88	2.15	2.38	1.87	1.25		1.71	2.50	2.01
3_7_SWQld_NA	2.13		1.92	1.60	1.39			1.48	2.50	1.84
3_8_SWQld	1.79			1.56	1.40	1.25		1.51	2.00	1.58
3_9_Sunshine Coast	1.68		1.82	1.25	1.50			1.54	1.95	1.62
3_10_Central Highlands (Qld)	2.15		2.01	1.44	1.38			1.61	2.38	1.83
3_11_Gladstone - Biloela	1.83		1.84	1.42	1.34			1.40	2.00	1.64
3_12_Gladstone - Biloela_NA	1.88	1.81		1.98	3.20	33.53	1.66	5.33	2.33	6.47
3_13_Rockhampton	2.04	1.74	1.97	1.58	1.51	1.25	1.66	1.77	2.14	1.74
3_14_Gold Coast	1.87		1.94	1.32	1.49	1.25		1.78	2.09	1.68

Audit Region	Nationally significant roads	Ports	Airports	Rail	Electricity	Gas	Petroleum	Water & Sewerage	Telecommunications	Average
3_15_Bowen Basin - North	2.07	1.82	1.93	1.44	1.37			1.53	2.29	1.78
3_16_Mackay	2.00	1.75	1.97	1.55	1.50		1.66	1.52	2.11	1.76
3_17_Whitsunday			1.88	1.33	1.43			1.46	1.86	1.59
3_18_Toowoomba	1.85			1.46	1.51	1.25		1.76	2.19	1.67
3_19_Charters Towers - Ayr - Ingham	1.71	1.68	1.86	1.40	1.35			1.39	2.20	1.66
3_20_Townsville	1.97	1.82	2.08	1.56	1.55	1.25	1.66	1.88	2.23	1.78
3_21_Bundaberg	1.67	1.62	1.84	1.31	1.47	1.25		1.45	2.05	1.58
3_22_Wide Bay	1.64	1.59		1.28	1.43	1.25		1.56	1.93	1.53
3_23_Hervey Bay			1.84		1.54	1.25		1.51	2.14	1.66
4_1_Greater Adelaide		1.51	1.70	1.25	1.58	1.23	1.32	1.53	1.77	1.49
4_2_Barossa - Yorke - Mid North	1.38	1.25		1.01	1.55	1.23		1.26	1.45	1.31
4_3_South Australia - Outback	1.55	1.37	1.58	1.17	1.67	1.23	1.32	1.19	1.59	1.41
4_4_South Australia - South East	1.36		1.43	1.02	1.52	1.23		1.15	1.49	1.31
5_1_Greater Perth		2.40	2.76	1.75	2.37	1.67	1.97	2.09	2.76	2.22
5_2_Augusta - Margaret River - Busselton	1.80				2.24			1.48	2.14	1.92
5_3_Bunbury	1.86	1.85		1.39	2.29	1.67		1.53	2.18	1.82
5_4_Manjimup	1.89				2.15			1.27	2.00	1.83
5_5_Esperance	2.27	1.86	2.06	1.48	1.93	1.67	1.97	1.30	2.00	1.84
5_6_Gascoyne	2.23	2.00	2.12		2.10	1.67		1.47	3.00	2.08
5_7_Goldfields	2.29		2.28	1.51	2.28	1.67		1.22	2.21	1.92
5_8_Kimberley	2.08	2.28	2.42		2.18		1.97	1.75	2.67	2.19
5_9_Mid West	2.00	1.83	1.07	1.32	2.26	1.67	1.97	1.49	2.05	1.74
5_10_Pilbara	2.24	4.49	2.57	2.02	1.16	0.62	1.97	3.74	2.96	2.42
5_11_Albany	2.64	1.77	2.01	1.26	2.07		1.97	1.32	2.08	1.89
5_12_Wheat Belt - North	1.70			1.30	2.05	1.67		1.25	2.00	1.66
5_13_Wheat Belt - South				1.26	1.89			1.18	1.67	1.50
6_1_Hobart		1.34	1.53	1.12	1.15	1.60	1.21	1.23	1.62	1.35
6_2_Launceston and North East	1.45	1.29	1.45	1.10	1.09	1.60	1.21	1.11	1.55	1.32
6_3_Rest of Tas.	1.46	1.26	1.45	1.05	1.17	1.60	1.21	1.17	1.50	1.32
7_1_Darwin		1.71	1.94	1.51	1.44	2.53	1.70	2.49	2.14	1.93
7_2_Alice Springs	2.06		1.87	1.23	1.51	2.53		1.27	2.08	1.79
7_3_Barkly	1.96			1.29	1.61	2.53		1.93	2.00	1.89
7_4_Daly - Tiwi - West Arnhem	2.00		1.97	1.32	1.49			1.82		1.72
7_5_East Arnhem		1.95	2.01		1.25		1.70	1.60	2.50	1.84
7_6_Katherine	1.91	1.89		1.34	1.44	2.53		1.78	2.17	1.86
8_1_Australian Capital Territory			2.16	0.84	1.47	0.56		1.51	2.08	1.43

Note: Red shading indicates a relatively large projected increase in DEC value while yellow shading indicates a relatively low projected increase in DEC value. Blank cells indicate that DEC values for infrastructure at corresponding audit region was zero or less than $1 million. Shading has been applied by infrastructure sector (i.e. along the columns).

Source: ACIL Allen Consulting, 2014

v

5.8 Infrastructure additions

By comparing the projected 2030-31 DECs for infrastructure services with the 2010-11 DECs, 'gaps' or 'additions' can be identified. Broadly speaking, larger gaps indicate where investment may need to take place to meet the future demand for infrastructure services.

A higher DEC in 2030-31 than in 2010-11, indicated by a gap, may be due to one or more of the following:

- delivery of a greater 'quantity' of service by 2030-31
- a higher price for the delivery of the service by 2030-31
- a reduction in the cost of provision of services by 2030-31 (increased efficiency).

The identification of a DEC gap is just one factor potentially pointing to a need for infrastructure investment. In particular, it does not automatically imply that any particular project should proceed.

5.8.1 National additions

Between 2010-11 and 2030-31, the DEC gap is projected to be $184 billion per annum for nationally significant infrastructure and urban transport services across Australia. Table 19 shows that the gap in the DEC ranges from a low of $644 million per annum for petroleum product terminals to a high of $21.2 billion per annum for ports (in real 2010-11 prices).

Table 19 **Gap in DEC of infrastructure sectors across Australia, 2010-11 and 2030-31 ($ millions)**

Infrastructure	DEC 2010-11 ($m)	DEC 2030-31 Baseline scenario ($m)	Increase in DEC between 2010-11 and 2030-31 ($m)
Nationally significant infrastructure			
Nationally significant roads	9,499	15,571	6,072
Ports	20,655	41,889	21,234
Airports	20,677	40,928	20,251
Rail	5,426	9,466	4,040
Electricity	16,064	26,149	10,085
Gas pipelines	2,345	4,686	2,341
Petroleum product terminals	1,077	1,722	645
Water infrastructure	10,610	15,939	5,329
Telecommunications	21,050	42,261	21,211
Sub total	**107,403**	**198,611**	**91,208**
Urban transport			
Urban transport networks (all 8 capital cities' urban transport networks)	**79,685**	**178,020**	**98,335**
Total			
Grand total	**187,088**	**376,631**	**189,543**

Source: ACIL Allen Consulting, 2014.

5.8.2 Additions by region and by infrastructure category

Regional additions

Table and Table 21 indicates the value of the gap in the DEC for infrastructure sectors between 2010-11 and 2030-31 for each audit region. The largest increases can be viewed as infrastructure service provision hotspots.

Table 20 **Increase in DEC by audit region, 2010-11 to 2030-31, Baseline scenario ($m)**

Audit Region	Nationally significant roads	Ports	Airports	Rail	Electricity	Gas	Petroleum	Water & Sewerage	Telecommunications	Total
1_1_Greater Sydney	48	2,924	4,311	18	1,346	140	84	211	6,956	16,039
1_2_Capital Region	170		7		93	11		13	34	328
1_3_Central West	216		27	120	197	6		13	49	628
1_4_Coffs Harbour - Grafton	65	2	29		61			8	34	199
1_5_Far West and Orana	4		6		47	4		20	19	102
1_6_Hunter Valley exc Newcastle	172			217	407			40	31	866
1_7_Illawarra	302	59		1	92	6		10	71	542
1_8_Mid North Coast	168		18		93			14	23	316
1_9_Murray	118		23		41	2		10	23	217
1_10_New England and North West	74		26	18	59			7	42	226
1_11_Newcastle and Lake Macquarie		157	103	35	235	9	15	40	149	743
1_12_Richmond - Tweed	88		25		97			9	53	273
1_13_Riverina	115		28	2	113	9		25	30	321
1_14_Southern Highlands and Shoalhaven	159	13			39	4		12	18	245
2_1_Greater Melbourne		3,339	3,985	9	475	53	97	826	6,149	14,933
2_2_Ballarat	61				42			18	69	190
2_3_Bendigo	84				39			20	50	193
2_4_Geelong	66	59			91		42	77	44	379
2_5_Hume	162				200			23	17	402
2_6_Latrobe - Gippsland	116	24			671	5		51	32	898
2_7_North West	235		18		33			23	23	334
2_8_Shepparton	24				31			51	20	127
2_9_Warrnambool and South West	8	22			54	2		15	17	119
3_1_Greater Brisbane	44	2,228	3,146	194	492	19	155	624	2,271	9,173
3_2_Cairns N+S	29	94	619	3	62		6	38	58	909
3_3_Cairns Hinterland	34	9			37			13	20	114
3_4_Darling Downs - Maranoa	210		9	1	127	12		13	28	400
3_5_Far North		99	30		-21			6	4	118
3_6_Outback-North	73	24	46	12	20	12		4	15	207
3_7_SWQld_NA	21		5	3	3			2	3	36
3_8_SWQld	13			1	2	9			2	27
3_9_Sunshine Coast	75		115		75			134	77	476
3_10_Central Highlands (Qld)	110		25	158	9			5	11	319
3_11_Gladstone - Biloela	59		34	45	42			5	2	187
3_12_Gladstone - Biloela_NA	6	500		39	450	1,618	9	154	8	2,783
3_13_Rockhampton	84	20	107	22	85			40	41	399
3_14_Gold Coast	591		804	3	121	2		286	293	2,101

Audit Region	Nationally significant roads	Ports	Airports	Rail	Electricity	Gas	Petroleum	Water & Sewerage	Telecommunications	Total
3_15_Bowen Basin - North	148	55	5	319	10			8	9	554
3_16_Mackay	174	298	160	19	46		9	34	40	780
3_17_Whitsunday			88		7			1	6	102
3_18_Toowoomba	164			8	58	1		86	88	405
3_19_Charters Towers - Ayr - Ingham	86	1	4	1	12			10	6	121
3_20_Townsville	26	105	275	15	68	2	10	109	207	815
3_21_Bundaberg	30	14	17	1	32			12	23	128
3_22_Wide Bay	104	10		2	118			15	57	305
3_23_Hervey Bay			21		23			23	8	75
4_1_Greater Adelaide		477	1,126	1	380	45	12	358	954	3,354
4_2_Barossa - Yorke - Mid North	74	19			57	6		41	10	207
4_3_South Australia - Outback	70	27	31	1	97			6	13	245
4_4_South Australia - South East	68		10		47	2		12	17	155
5_1_Greater Perth		3,711	2,622	5	1,733	260	159	1,278	2,130	11,898
5_2_Augusta - Margaret River - Busselton	48				28			13	8	97
5_3_Bunbury	153	38		3	591	44		56	33	918
5_4_Manjimup	25				13			3	3	44
5_5_Esperance	15	71	5	2	27	3	7	1	4	136
5_6_Gascoyne	6	13	6		25			4	2	56
5_7_Goldfields	76		57	3	57	14		12	17	236
5_8_Kimberley	49	68	121		115		2	19	25	399
5_9_Mid West	140	82	1	1	84	27	3	16	20	375
5_10_Pilbara	82	6,433	369	2,750	34	-39	16	102	47	9,793
5_11_Albany	8	46	10		35			13	14	127
5_12_Wheat Belt - North	90			2	70			17	12	191
5_13_Wheat Belt - South					15			3	2	20
6_1_Hobart		35	157		26	8	1	25	172	424
6_2_Launceston and North East	82	38	83		23	7		7	29	269
6_3_Rest of Tas.	45	27	16		65	2	2	12	9	177
7_1_Darwin		38	323		29	37	8	63	95	593
7_2_Alice Springs	179		130		9	6		2	14	340
7_3_Barkly	25				3					30
7_4_Daly - Tiwi - West Arnhem	265		5		4					275
7_5_East Arnhem		51	20		4		5		3	83
7_6_Katherine	37	4			4	6			7	59
8_1_Australian Capital Territory			1,043		78	-17		107	340	1,551

Note: Red shading indicates a relatively large projected increase in DEC value while yellow shading indicates a relatively low projected increase in DEC value. Blank cells indicate that DEC values for infrastructure at corresponding audit region was zero or less than $1 million. Shading has been applied by infrastructure sector (i.e. along the columns).
Source: ACIL Allen Consulting, 2014

Table 21 **Increase in DEC for urban transport by mode and audit region, 2010-11 to 2030-31, Baseline scenario ($ million)**

Conurbation	Car	LCV	HCV	Rail	Bus	Ferry	Light Rail / Tram	Total
Sydney-Newcastle-Wollongong	18,958	887	2,664	2,122	1,320	41	140	26,131
Melbourne-Geelong	15,068	151	639	3,147	979		804	20,789
Brisbane-South-East-Queensland	16,257	130	563	605	407	53	13	18,028
Perth-Wheatbelt	21,052	1,089	1,151	717	476			24,484
Adelaide-Yorketown	4,933	151	338	76	164		6	5,668
Canberra-Goulburn-Yass	1,454	50	133		117			1,753

Source: ACIL Allen Consulting, 2014.

6 Sensitivity analysis of future infrastructure needs

There is inevitably some uncertainty about the fundamental factors shaping the outlook for the global and Australian economies and the subsequent projections of infrastructure needs. In order to assess and test the sensitivity of the results to key parameters in the economic and demographic projections a range of scenarios have been developed. These include:

1. Baseline scenario
2. Higher population scenario
3. Higher productivity scenario

The urban transport analysis is explicitly excluded from this chapter. This is because projections for urban transport were only completed for the Baseline scenario due to the complexity of the analysis.

6.1 Baseline scenario

The Baseline scenario was introduced in Chapter 5 and relates the economic outlook with population projections derived from the Australian Bureau of Statistics (ABS) series B and with mid-range productivity growth.

The Baseline scenario is designed to identify future infrastructure needs given a picture of reasonable economic performance in the Australian economy. The Baseline scenario assumes demand for goods and services is being driven by:

- reasonable economic projections given recent economic trends; and
- reasonable or central case demographic change in the community.

The Baseline scenario forms a benchmark that is intended to be the central or (plausible) view of the future.

6.2 Higher population growth scenario

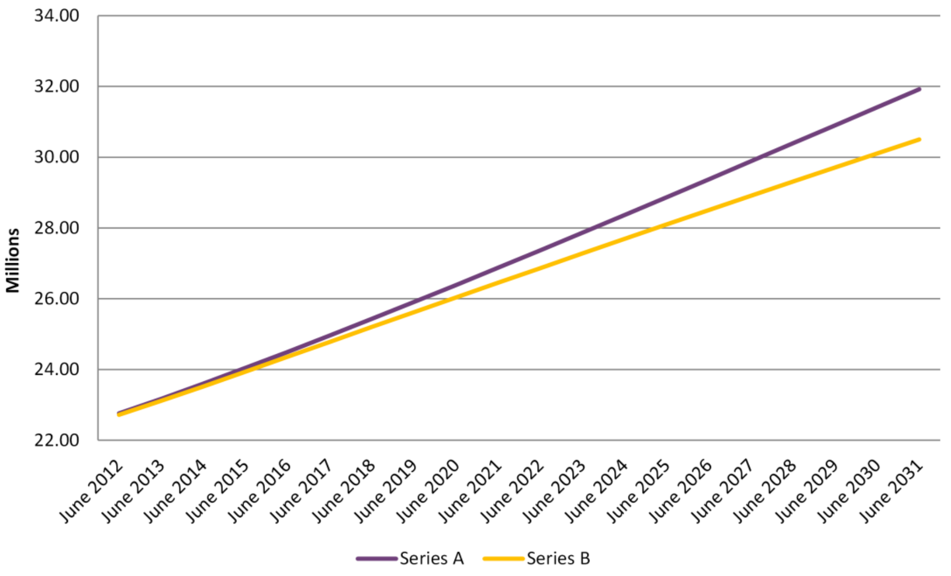
The Higher population growth scenario analyses the outlook given an increase in people in Australia (relative to the Baseline scenario). The increase in population growth is reflected in this scenario through the use of the current ABS Series A demographic projections.

The ABS Series A projection involves a mix of key assumptions including:

- high fertility rates
- high net overseas migration
- high net interstate migration.

Figure 60 below indicates how Australian population growth between June 2012 and June 2031 varies between the ABS Series A and Series B projections: population across Australia at June 2031 is 4.66 per cent higher in ABS Series A than in ABS Series B.

Figure 60 **Australian population projections to 2031 — ABS Series A and Series B**



Source: ABS, Catalogue 3222.0 - Population Projections, Australia, 2013

For some States/Territories and regions, Series A does not depict the highest population outcome analysed by the ABS. This is because of the interaction of factors such as interstate migration and immigration.

The economy is expected to change in this scenario reflecting the greater number of people producing a larger workforce and raising demand for goods and services, including infrastructure services.

The point of the Higher population scenario is to assess how sensitive results are to changes in the population.

6.3 Higher productivity scenario

The Higher productivity scenario holds population growth to the same level as achieved in the Baseline scenario but also introduces greater productivity in infrastructure services.

The rationale for the Higher productivity scenario arises from recent policy discussions about the drivers of higher economic growth and the role that reform can play in improving and enhancing the value that is obtained from infrastructure investment and raising the competitiveness of the economy.

Box 3 **Infrastructure and economic growth**

Driving economic growth

At the G20 Finance Ministers and Central Bank Governors meeting held in Sydney in February 2014 the G20 Finance Ministers and Central Bank Governors committed to implement policies to grow collective GDP by more than 2 per cent above the current trajectory over the next five years.

The G20 Finance Ministers and Central Bank Governors indicated that they were committed to creating a climate that facilitates higher investment, particularly in infrastructure. They viewed this as being crucial for the global economy's transition to stronger growth in the short and medium term. They indicated that they will undertake reforms to remove constraints to private investment by establishing sound and predictable policy and regulatory frameworks and emphasising the role of market incentives and disciplines. These, along with other actions to promote long-term private sector investment, maximise the impact of public sector capital expenditure, will be an important part of G20 growth strategies and the Brisbane Action Plan.

The Treasurer Joe Hockey has indicated that the centrepiece of the G20 agenda under the Australian chair would be "to undertake domestic reforms that tangibly improve the investment environment and so unlock private sector investment, particularly in the area of infrastructure".

Infrastructure investment

The G20 Monitor a publication of the G20 Studies Centre at the Lowy Institute for International Policy recently focused on the role of the G20 in infrastructure. Key points discussed include:

- The G20 has committed to facilitating higher investment in infrastructure
- The public sector is constrained by high debt levels and there is no shortage of private capital available – if this pool of funds can be unlocked
- The most fundamental task is not about the source of funds but in ensuring that the right infrastructure projects are selected
- Without reforms there is a risk that more spending will increase the cost of infrastructure to users, taxpayers and the community generally and lead to the provision of wasted infrastructure
- There is a risk that we are not making the most efficient use of existing infrastructure
- Better pricing of infrastructure services (new and existing) would ensure that they are used more efficiently
- Better pricing would also assist in the transition from public to private provision, funding and financing

Source: G20 Finance Ministers and Central Bank Governors, 2014, "Communiqué, Meeting of Finance Ministers and Central Bank Governors, Sydney, 22-23 February 2014" and Callaghan, M., 2014, "Overview" in "Infrastructure, tax, energy", G20 Monitor, Number 10, May 2014.

The Higher productivity scenario is constructed to reflect the situation where policy reforms and improved investment raise productivity in infrastructure to the point where the improvement produces a 1 per cent growth premium. That is, a 1 per cent increase in output (i.e. GDP) above the baseline economic projection by 2030-31.

This growth increment does not represent the full commitment to growth made by the G20. That would imply an increase in Australia's growth rate of around 3 to 5 per cent per annum over the next five years. The 1 per cent premium is selected to reflect a possible contribution that infrastructure services alone could make to the achievement of the broader target. It is also notable that the growth premium occurs later than the specific G20 target. Infrastructure investment and efficiencies typically involve making changes to large complex systems which take some time to plan and implement. In addition, it takes time for the changes to take effect and change the wider economy.

It may be noted that Australia has some experience with a successful series of reforms improving the efficiency and removing anti-competitive regulatory factors in infrastructure provision. This series of reforms commenced with the findings of the National Competition Policy reform Committee chaired by Professor Fred Hilmer in 1992.

Studies undertaken by the Productivity Commission have concluded that the Hilmer reforms had a substantial impact on productivity growth, helping to underpin the strong period of economic growth Australia enjoyed in the 1990s and early 2000s. These were estimated to increase GDP in the longer term by 0.97 of a per cent. That is, they provided a permanent lift in GDP of around 1 per cent.

The analytical task of the Higher productivity scenario is to illustrate:

- changes in infrastructure services that are necessary to achieve to achieve the proposed economic growth;
- how much each of the major changes contributes towards achievement of the proposed economic growth; and
- the implications of proposed changes for the economic performance of upstream and downstream industries, different regions and Australia in terms of employment and prices.

The analytical task consists mainly of identifying relevant changes in infrastructure services, including these changes against the baseline projection that is already factored into the model and measuring the impact of these changes and the contribution that they make.

Most of the changes in infrastructure services will be assessed in terms of expected changes in productivity that are likely to arise. This will be assessed using techniques that are similar to those that the Productivity Commission used in anticipating the effect of broad-based reforms such as those expected from the Hilmer reforms (Industry Commission 1999). Similarly to the assessment of the Hilmer reforms, this assessment has been conducted within a very tight time frame and the assessment involves many simplifying assumptions.

Key changes included in the assessment are listed below.

- More efficient use of the existing National Highway especially for heavy vehicle/freight. This may involve assessment of measures that enable use of greater technical efficiency that are carried through to greater economic efficiency (often apparent in terms of lower resource use or lower prices).
- More efficient use of the existing urban transport facilities (especially greater use of congestion charges in major urban road networks and fully cost reflective prices for alternative transport modes).
- Application of policies, regulation and reform of existing policies that enables more efficient use of energy infrastructure services (spanning electricity and gas supply services).
- More efficient use of existing water and sewerage infrastructure services (especially more use of prices that are fully cost reflective).
- Greater competition and contestability in the provision of telecommunications services (raising competition and reducing prices for users and costs for the economy).

The Baseline scenario's projection reflects the ABS series B population projection and the Higher Productivity scenario would also use the ABS Series B projection. This controls for the effect of changes in population and labour supply, ensuring that the focus of the scenario results on the difference that infrastructure services can make to the achievement of economic alone.

6.4 The economic outlook in the 3 scenarios

The key differences between the 3 scenarios and their impact on the Australia's economic outlook is summarised in Table 22.

Table 22 **GDP and 3 Ps in 3 scenarios Growth Index, 2030-31 (2010-11=1.00)**

	Baseline scenario	High population scenario	High productivity scenario
		Index 2010-11=1.0	
Population	1.37	1.43	1.37
Participation	1.35	1.40	1.35
Productivity	1.36	1.36	1. 37
GDP	**1.84**	**1.90**	**1.85**
		Cumulative annual growth rate	
Population	1.57%	1.79%	1.57%
Participation	1.52%	1.68%	1.53%
Productivity	1.54%	1.55%	1.59%
GDP (CAGR)	**3.09%**	**3.25%**	**3.14%**
GDP (2010-11 $ billion)	**2,583**	**2,667**	**2,609**

Note: key changes in parameters that shape the scenario are circled.

Source: ACIL Allen Consulting, 2014 projections.

In the Baseline scenario, GDP growth has an index value of 1.84, indicating that the Australian economy is projected to be 84 per cent larger in 2030-31 than it was in 2010-11. This is achieved as a function of growth in the 3 Ps, population (37 per cent), participation (35 per cent) and productivity (36 per cent).

In the Higher population scenario, the population is projected to increase by 43 per cent over the years to 2030-31. This represents around 5-6 per cent more people resident in Australia by 2030-31 than in the Baseline scenario. This also drives an increase in the workforce (which grows by 42 per cent over the period to 2030-31). No change in productivity per worker is factored into this scenario so productivity per worker remains the same as the baseline. The impact of these changes is an increase in economic growth. GDP increases by 90 per cent between 2010-11 and 2030-31 in this scenario.

In the Higher productivity scenario, the population and participation rates are no different to the Baseline scenario. The key difference is the increase in productivity. This is 37 per cent higher in 2030-31 in this scenario and compares to an increase of 36 per cent in the Baseline scenario. This may seem to be a small increase, but this change has large implications. The change in GDP in this scenario is an increase of 85 per cent compared to the level of activity in 2010-11. This small increase in the index represents an increase in the level of real GDP of $27 billion, which is 1 per cent higher than the level of GDP in 2030-31 projected in the Baseline scenario.

The Higher productivity scenario portrays how a significant share of the G20 growth premium target can be achieved through an increase in the productivity of infrastructure services.

6.5 Differences in industrial structure

The impact of productivity and population changes can be seen in the data about industry growth in the different scenarios. Figure 61 shows the difference in the industry value added between scenarios 2 and 3 compared to the Baseline scenario. A positive score in this table for each industry indicates the amount of growth expected for each industry that is above the Baseline growth index in 2030-31. Thus a score of positive 0.05 for the ownership of dwellings in the Higher population scenario indicates that this industry is projected to be 5 per cent larger in this scenario than the Baseline scenario.

From the results shown in the Figure 61 it is apparent that growth is widely based in the Higher population scenario. Increased population increases labour supply and demand that induces an expansion for every sector. The increase is largest for the manufacturing sector, suggesting that it obtains the greatest benefit from the increase in labour supply and domestic demand.

The growth outlook under the Higher productivity scenario is not as large as in the Higher population scenario. In this scenario there is a large difference between the direct and indirect impacts. The direct effects amount to an increase in productivity in a subset of the economy represented by infrastructure service industries. These industries reduce their costs which they generally pass on to customers in terms of price reductions. The infrastructure industries also free up capital and labour resources for use by other industries. Without other changes these impacts would reduce the size of infrastructure industries in proportion to the efficiency gains.

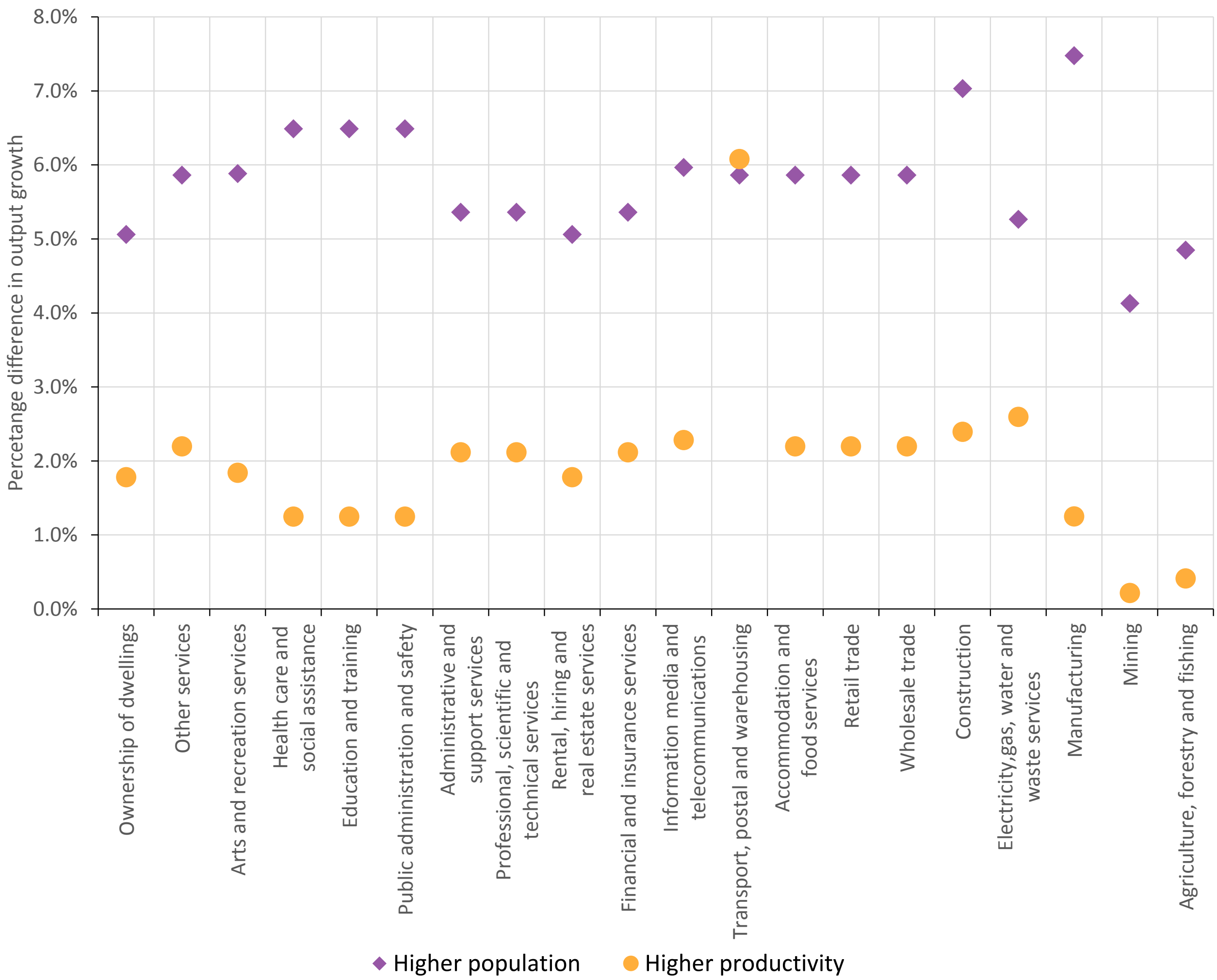
The indirect changes in the Higher productivity scenario are quite complex and uneven in their effect. Some industries respond to lower infrastructure service costs and increased factors (such as labour) that are available by reducing their own costs and raising their competitiveness which allows them to expand their own output. This effect seems to be most notable in terms of service sector industries such as retail, wholesale trade, accommodation and others which grow even though they are not directly impacted by the productivity gain.

Agriculture, mining and manufacturing make gains in in this scenario, but these are relatively small. It seems that the increase in productivity flows through to an increase in the real exchange rate moderating the increase in external competitiveness enjoyed by these sectors which are very trade exposed.

In some infrastructure service industries the increase in demand from lower prices and increased industrial activity drives an increase in demand that is sufficient to offset the reduction in prices charged. This seems to be the case in the electricity, gas and water utilities sectors.

These differences in industry gains can be expected to have some influence on the economy's need for infrastructure services in the future and the composition or mix of infrastructure that is in most demand.

Figure 61 **Differences in industry growth by scenario (scenario growth index, 2030-31)**



Source: ACIL Allen Consulting, 2014 estimates

6.6 Regional economic projections by scenario

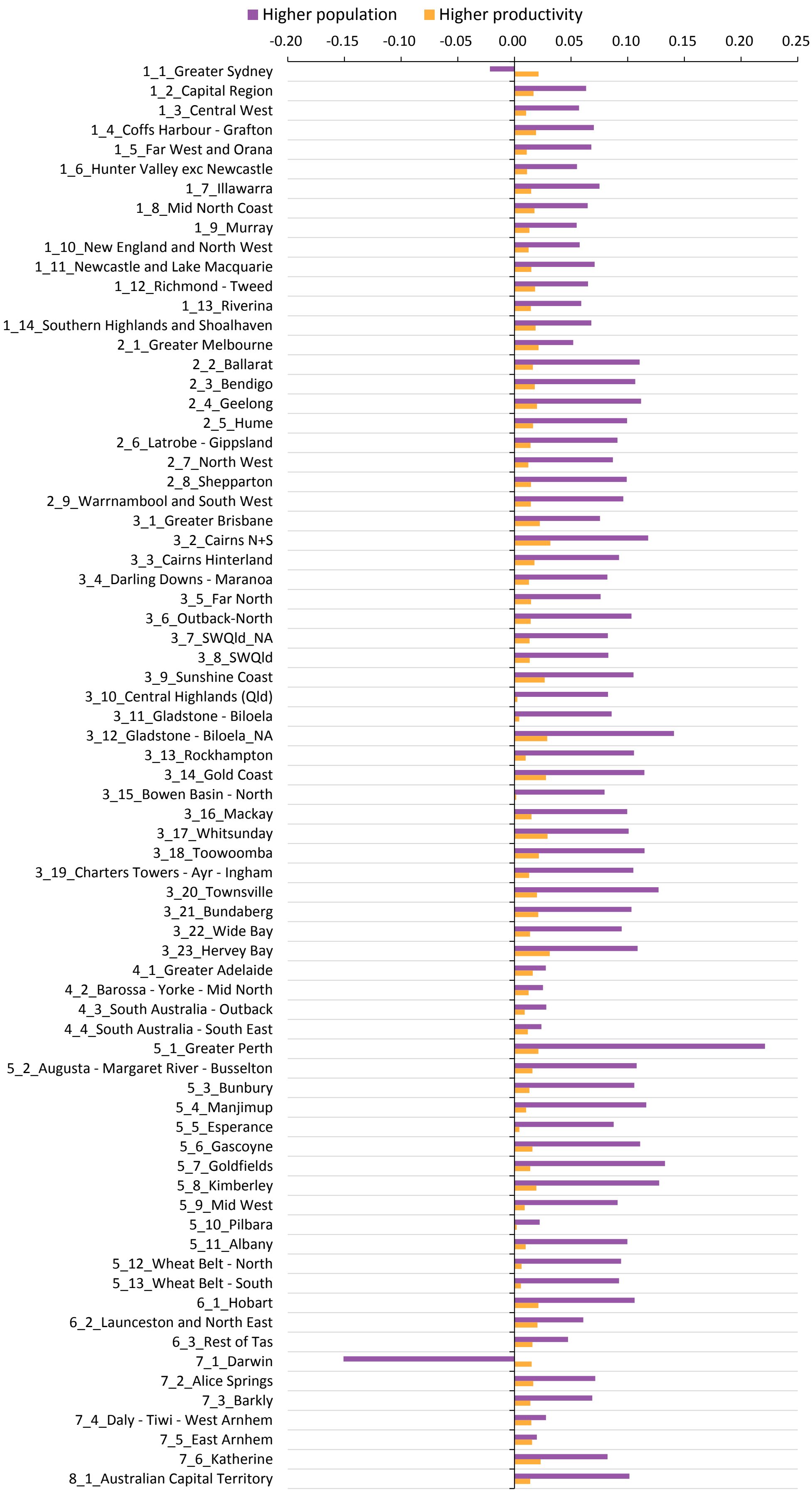
A key observation from the sensitivity analysis is that just as every industry has greater economic growth with higher population growth and higher productivity growth, almost every region in Australia is projected to grow more under these scenarios when compared to the Baseline scenario.

The increase in regional value added is smaller in the Higher productivity growth scenario than in the Higher population growth scenario. This is because the Higher population growth scenario adds around 5 per cent more people in most regions between 2010-11 and 2030-31, while the productivity growth scenario is targeting an increase in productivity in a small proportion of the whole economy.

There are notable exceptions to the higher growth outlook in the Higher population scenario. In the Sydney and Darwin regions economic output in 2030-31 in the higher population scenario will be lower than the Baseline scenario. This is due mainly to the use of the ABS Series A population projections to drive this scenario which factor in lower population in those capital city regions than in the Baseline scenario which uses ABS Series B projections. The difference in the demographic outlook in these cities in the ABS series is due to differences in the rates of Net Internal Migration between other regions.

The differences in the economic growth outlook in the audit regions between the scenarios is reflected in Figure 62.This shows the difference in the regional economic growth index for the Higher population scenario and Higher productivity scenario compared to the Baseline scenario.

Figure 62 **Difference in regional value added (growth index 2030-31 from Baseline scenario in 2030-31)**



Source: ACIL Allen Consulting, 2014

6.7 Projected infrastructure needs

6.7.1 National Infrastructure needs

Infrastructure needs are expected to grow in the period between 2010-11 and 2031 under all three scenarios. The projected amount of infrastructure services required of nationally significant infrastructure is noted in Table 23. The table also shows the additional infrastructure services required by infrastructure sector.

Table 23 **Nationally significant infrastructure needs in 3 scenarios: Infrastructure DEC in $2010-11**

Scenario	Nationally significant roads	Ports	Airports	Rail	Electricity	Gas	Petroleum	Water infrastructure	Telecommunications	Total
Levels ($m in 2010-11)										
2010-11	9,499	20,655	20,677	5,426	16,064	2,345	1,077	10,610	21,050	107,403
Baseline scenario (2030-31)	15,571	41,889	40,928	9,466	26,149	4,686	1,722	15,939	42,261	198,611
Higher population scenario (2030-31)	16,567	43,454	42,310	9,668	26,809	4,766	1,783	16,551	43,348	205,257
Higher productivity scenario (2030-31)	15,584	42,355	42,481	9,442	26,885	4,702	1,740	16,128	42,760	202,077
Gap/infrastructure additions ($m in 2010-11)										
Baseline scenario	6,072	21,234	20,251	4,041	10,086	2,341	644	5,329	21,211	91,209
Higher population scenario	7,068	22,799	21,633	4,242	10,746	2,421	706	5,941	22,298	97,855
Higher productivity scenario	6,085	21,700	21,804	4,016	10,822	2,357	662	5,518	21,710	94,674

Source: ACIL Allen Consulting, 2014 projections.

Table 24 summarises the projected national DEC to 2030-31 for each scenario, as well as their share as a percentage of projected GDP in each scenario.

Table 24 **Projected DEC as percentage of GDP, all scenarios**

Scenario	Total DEC	DEC as share of GDP (%)
Levels ($m in 2010-11)		
2010-11	107,403	7.64%
Baseline	198,611	7.69%
High population	205,257	7.70%
Higher productivity	202,077	7.74%
Gap/infrastructure additions ($m in 2010-11)		
Baseline	91,209	3.53%
High population	97,855	3.67%
Higher productivity	94,674	3.63%

Source: ACIL Allen Consulting, 2014.

Future infrastructure service needs are sensitive to changes in assumptions about population growth.

— Infrastructure services are projected to grow the most in the Higher population scenario indicating that the projections are sensitive to changes in population.

- The overall increase in infrastructure services that are required to support the needs of a larger population of $97 billion (in 2010-11 real prices) grows roughly in line with the growth in the economy in the scenario.
- Some infrastructure sectors are more responsive to changes in population growth than others. The projections for the national highway are the most responsive to changes in population. The sectoral implications are examined in more detail in Part B of the report.

Changes in infrastructure productivity also change the projections for infrastructure needs in the future.

- The projected need for infrastructure in the Higher productivity scenario increases compared to the Baseline scenario indicating that the projections are sensitive to changed productivity in infrastructure provision.
- The changes in infrastructure needs in the Higher productivity scenario are not as large as those in the Higher population scenario and sometimes results in reductions in DEC compared to the Baseline in some infrastructure sectors.
- The DEC in different infrastructure sectors grows by different rates compared to the Baseline scenario results (see Table 23). This reflects direct and indirect changes in the wider economy in response to changes in infrastructure productivity. In some sectors Higher productivity reduces infrastructure service prices which encourages other sectors to expand and grow the economy. In some cases this also stimulates an increase in demand for infrastructure services. In other cases the growth in demand for infrastructure services is just equal to or less than the value of the productivity gains in the infrastructure services. This results in no change in the infrastructure DEC (or even small reductions in infrastructure DEC) relative to the baseline. This response depends more upon the demand and supply conditions in the infrastructure sector customers than the infrastructure industry.
- The analysis suggests that the nationally significant infrastructure sectors that can expect a greater than average growth dividend from productivity increases are airports and electricity infrastructure services. More details about the industry response to changed productivity conditions is outlined in Part B.

Part B

DETAILED FINDINGS BY SECTOR

7 Transport – Airports

KEY FINDINGS

This airport audit covers 276 airports across Australia. It focuses on the government owned and privatised airports (not defence and privately owned airports/airstrips).

This audit focuses on the economic contribution of the service provided by the airport infrastructure, not the value of goods carried by the airports (or the costs for constructing the airports).

Airports play a key role in facilitating the tourism activity, industrial production (input materials and final products delivery) and business and social travels of the Australian community. In 2010-11, airports across Australia reported 132 million Regular Public Transport passengers per annum.

The economic contribution of the airports is $20.7 billion in 2010-11. New South Wales is the state with the largest economic contribution ($5.68 billion) followed by Queensland and Victoria. The capital city airports usually have a larger economic contribution.

Larger and busier airports tend to have lower on-time performance (e.g., Sydney and Brisbane airports).

As businesses become more strongly linked to suppliers and customer markets beyond their immediate vicinity, they are increasingly reliant on air-based services to move workers and freight. The increasing dependence on airports is reflected in the AIA's projections on the DEC of airports for 2030-31.

The economic contribution of airports across Australia in 2031-31 is projected to be $40.9 billion (3.46 per cent growth per annum form 2010-11). The greatest projected increase in demand is for the large capital city airports. Sydney airport is expected to have the highest projected in demand followed by the Melbourne, Brisbane (planning to build new airport), Perth, Adelaide and Canberra airport (just built new airport).

If airports could not expand to cope with the expected growth in demand, airlines will raise fares and freight charges as flights reach capacity and new airlines (e.g. low cost carriers) will be unable to obtain landing slots, particularly during peak periods. This would reduce consumer welfare and the competitiveness of businesses across the country, thereby leading to significant negative social and economic impacts.

To meet the projected increase in demand for the range of activities taking place within the airport compound, airport operators will need to undertake progressive upgrades in one or more of the following types of airside and landside infrastructure over the next two decades:

- runways, taxiways, aprons and aircraft parking bays
- navigation aids and safety systems
- maintenance, Repair and Overhaul (MRO) facilities
- terminal facilities, including gates, baggage handling, customs and immigration, airline lounges, food and retail outlets
- landside transport and vehicle parking facilities

Sensitivity analysis was also carried out to project demand for airports in 2031 for the Higher population and Higher productivity scenarios. The projected increase in the economic contribution of airports between 2010-11 and 2030-31 is $42.3 billion for Higher population scenario and $42.5 billion for the Higher productivity scenario (against $40.9 billion for Baseline scenario). All airports but Sydney and Darwin airports have a larger economic contribution under the Higher population scenario than the Baseline scenario due to slower population growth assumptions in these cities.

7.1 Airports in scope

Airports are an integral part of the national economic infrastructure in Australia. Located in major urban centres and regional areas, they are critical to linking Australia with the rest of the world, as well as the connection of communities and the enhancement of broader economic performance. This is particularly so because of Australia's geography, which is characterised by the spatial dispersion of its smaller cities and towns.

The airport sector in Australia is a diverse one. Approximately 250 of the total audited airports receive Regular Public Transport (RPT) services and more than 2,000 smaller airfields and land strips around the country. Overall activity is concentrated in the large airports - the top 10 busiest airports (the eight capital city airports plus Gold Coast Airport and Cairns Airport) contribute to more than 80 per cent of total passenger traffic in Australia.

Airports in Australia belong to one of four main categories:

- privatised airports (through long-term Federal leases)
- government (local/state) owned regional airports
- defence-owned airports
- privately-owned airstrips.

Only those belonging to the first two categories are included in the detailed list of airports presented in Section 7.3.1.

7.2 Airports in Australia

7.2.1 The significance of airports to economic activity

Airports are often large and strategic economic precincts. They comprise an operational 'core' (the central operation of an airport facility including its runway infrastructure, terminals and critical aviation safety and security) as well as a myriad of activities that include retail and tourism services, airline operations, general aviation and aircraft maintenance, transport and broader (non-aeronautical) commercial activities (see Figure 63).[13]

A key unique feature of airports is that these activities represent a much greater proportion of economic activity than the operational core of airports. This is particularly so at larger airports, which typically encompass a comparatively higher proportion of ancillary and non-core precinct activities than smaller airports.[14]

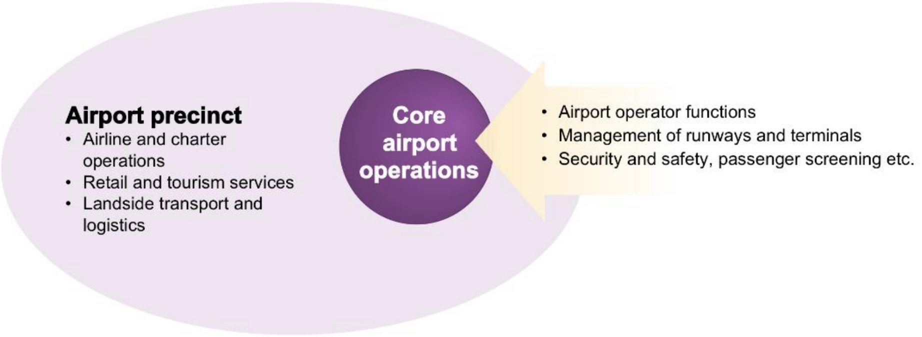
This is because larger airports tend to outsource more activities (such as security and cleaning) and they can effectively harness gains from economic agglomeration, thereby becoming strategic hubs with a critical mass of diversified retail, freight and logistics, and aviation activities that leverage the airports' connective links.[15]

[13] Australian Airports Association, *Connecting Australia: The economic and social contribution of Australia's airports*. May 2012.

[14] For example, previous modelling by ACIL Allen indicated that economic contribution of the operator of Perth Airport generated only 13.9 per cent of the total value of economic activities at that airport in 2010-11.

[15] *Ibid.*

Figure 63 **Key components of an airport**



Source: Reproduced from the Australian Airports Association report *Connecting Australia: The economic and social contribution of Australia's airports*.

While smaller airports operate in a different economic environment with a narrower commercial base, they are core infrastructure installations critical to the social and economic integration of regional communities. They enable people living in these communities to gain access to medical care, education, justice, government services, and a range of recreational activities that are not available in their local area.

In resource-rich states such as Western Australia, airports are critical to the success of the resource sector and the industries that support it (such as construction) where a large proportion of the workforce comprises Fly-In Fly-Out (FIFO) employees. FIFO commuting to work is not only a major economic facilitator for Western Australia, it is also a social facilitator. FIFO is often chosen by workers rather than being mandated by employers.

By facilitating aviation, airports also confer considerable benefits to individuals. Without aviation, personal travel beyond about 300 kilometres would become more difficult. People would travel less, and part of the time away would be wasted on long periods of travelling in cars, buses or trains. This would reduce the personal "connectivity" with friends and relatives, the ability to attend important personal events such as reunions, weddings and funerals and reduce the opportunity for holidays, cultural and sports trips.

In addition, there are important forward-linkage benefits that aviation (and hence airports) enables in the wider economy and society – positive developments in other industries that would not take place, or would be smaller, if there were no airports or aviation.

These catalytic benefits arise because of the reductions in transport costs and improvements in transport quality due to aviation. Aviation allows day-return or overnight business trips, short leisure trips (for example, long weekends) and urgent freight deliveries, that otherwise would either be impossible or difficult. The airport improves the "connectivity" of the area in which it is located with the rest of Australia and the world.

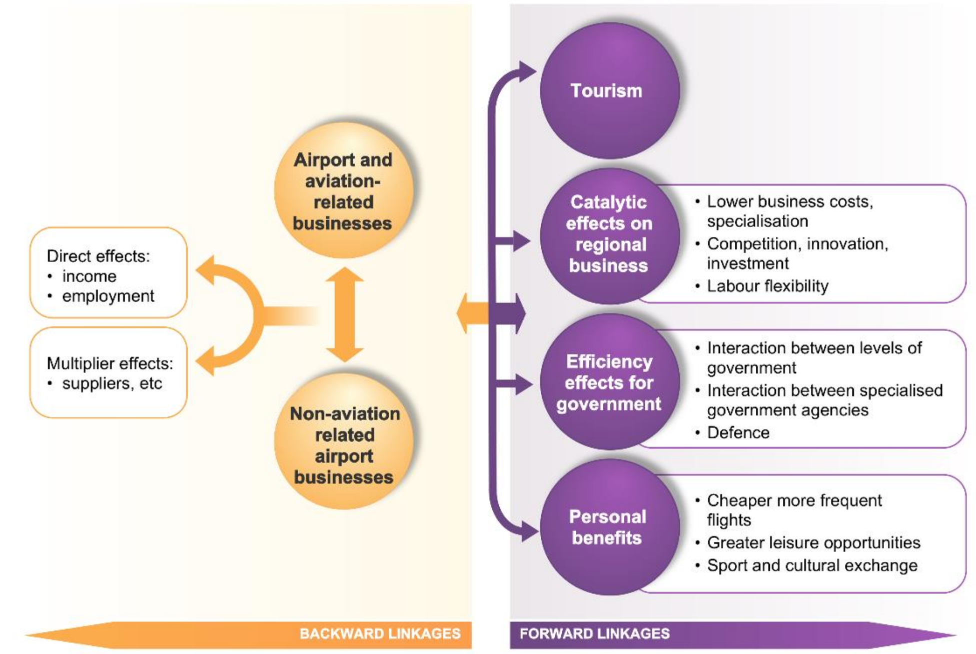
The catalytic benefits of aviation and airports show up in many ways:

— lower costs of doing business because of the ease of travel over distances that would be onerous by road
— greater competition because of readier access to alternative suppliers
— greater innovation because of access to a wider range of human skills and interaction between them
— improved ability to bring in, or send out, specialised labour
— a more flexible labour market
— improved ability to deal with temporary shortages of personnel or of goods (e.g. spare parts)

— economies of scale and specialisation
— increased investment because it is easier to become more familiar with the potential place of investment, potential clients and collaborators
— more efficient interaction between different levels of government.

These benefits (shown in Figure 64), for which aviation is the catalyst, improve productivity in the economy. That is, with a given level of resources it becomes possible to produce more value. Aviation is a driver of economic growth as well as a beneficiary of it. Over time there is a dynamic impact on the economy. The initial effects on productivity expand the more productive sectors relative to the rest, and thus contribute to higher economic growth than would otherwise be the case without airport services and infrastructure.

Figure 64 **Benefits of airports and aviation — forward and backward linkages**



Source: ACIL Allen Consulting, 2014

The catalytic benefits of aviation and airports are too pervasive to quantify accurately. Overseas estimates, based on broad assumptions, suggest that the catalytic impacts are at least as important as the base impacts (and possibly considerably more).

7.2.2 Regulation, policy and governance context

Australia's airport sector has undergone significant structural change over the past few decades. Privatisation and corporatisation, particularly those involving the larger airports, have helped drive new infrastructure developments, improved operational efficiencies and enhanced commercial focus.

Prior to 1997, Australia's major airports were operated and managed by the Federal Airports Corporation (FAC), a self-regulated Government-owned business enterprise. Between 1997 and 2003, the Australian Government sold long term leases over the 22 FAC-operated airports to the private sector (50-year leases with options to renew for a further 49 years).[16]

[16] This section is drawn from information provided in the Australian Government Department of Infrastructure and Regional Development's web page on the economic regulation of airports (see http://www.infrastructure.gov.au/aviation/airport/airport_economic_regulation/economic_regulation.aspx).

In privatising these airports, the then Government recognised that some had significant market power. Therefore, price regulation was introduced. Since the introduction of this regulation, the nature of the regulation and the number of airports regulated has changed (see Box 1). The regulatory framework was initially put in place for a five-year period, with various reviews completed since then.

As part of its 2012 inquiry, the Productivity Commission recommended that quality of service monitoring continue until June 2020. It also recommended that the objective criteria should be reviewed and updated by June 2013. The ACCC completed its review and released its revised Guideline for quality of service monitoring at airports in June 2013.

Box 4 **Evolution of airport price regulation since 1997**

The privatisation of airports from 1997 was accompanied by price regulation measures under which increases in aeronautical charges were capped for the first five years. Increases for certain aeronautical charges were limited to a notified percentage less than the Consumer Price Index (CPI). The CPI-X regime encouraged efficiencies in airport operations. Applications for annual price increases were assessed and agreed by the ACCC before becoming effective. The price cap did not apply to Government mandated security requirements (where direct costs were passed through) and ACCC agreement could be sought for additional charges to fund necessary new investment.

The ACCC also monitored the quality of services at airports as a complement to the price caps that assisted in deliberations on proposed price increases.

In response to the 2002 Productivity Commission report into price regulation of aviation services, price capping was replaced by price monitoring at the seven major airports (Adelaide, Brisbane, Canberra, Darwin, Melbourne, Perth and Sydney Kingsford-Smith).

Price monitoring of the five major airports (Adelaide, Brisbane, Melbourne (Tullamarine), Perth and Sydney (Kingsford-Smith) airports) continued from 1 July 2007 in response to the Productivity Commission's 2007 report, *Review of Price Regulation of Airport Services*. Implementation of this regime included the amendment of the *Airports Regulations 1997* to slightly expand the definition of aeronautical services and facilities. In 2008 the range of airport services monitored by the ACCC were expanded to include short-term and long-term car parking services at the major airports.

In December 2009, a second tier of economic regulation was announced for implementation in the four next largest leased federal airports. Canberra, Darwin, Gold Coast and Hobart Airports self-disclose various pricing, quality of service and complaints handling procedures and outcomes through the airports' websites.

A Productivity Commission inquiry into airport economic regulation was released on 30 March 2012. That inquiry found that Adelaide Airport had limited market power and the airport was removed from mandatory price and quality of service monitoring by the ACCC, effective 30 June 2012. Adelaide Airport now reports on its pricing and quality of service outcomes under the second tier reporting system alongside Canberra, Darwin, Gold Coast and Hobart airports.

Prices and the quality of services at the four major leased federal airports – Sydney, Melbourne, Brisbane and Perth – continue to be monitored annually by the Australian Competition and Consumer Commission (ACCC) in accordance with the *Airports Act 1996 and Competition and Consumer Act 2010*.

Source: ACIL Allen Consulting, 2014

7.3 Audit of existing airport infrastructure

7.3.1 Overview of the audit dataset

The audit dataset for the AIA contains 276 airports (see Table 1) with location/geographic information, of which:

- 272 airports have information on the number of runways, runway lengths and runway surfaces
- 102 airports have total RPT passenger movement data
- 87 airports have DEC estimates
- 34 airports have on-time performance data
- 5 airports have ACCC capacity-utilisation indicator data.

Table 25 **Airports included in the audit dataset**

NEW SOUTH WALES

- Albury Airport
- Armidale Airport
- Ballina-Byron Gateway Airport
- Balranald Airport
- Bankstown Airport
- Bathurst Airport
- Bourke Airport
- Brewarrina Airport
- Broken Hill Airport
- Camden Airport
- Cessnock Airport
- Cobar Airport
- Coffs Harbour Airport
- Clarence Valley Regional Airport (Grafton Airport)
- Collarenebri Airport
- Cooma-Snowy Mountains Airport
- Coonabarabran Airport
- Coonamble Airport
- Cootamundra Airport
- Corowa Airport
- Cowra Airport
- Deniliquin Airport
- Dubbo City Regional Airport
- Forbes Airport
- Glen Innes Airport
- Goulburn Airport
- Griffith Airport
- Gunnedah Airport
- Hay Airport
- Inverell Airport
- Kempsey Airport
- Lightning Ridge Airport
- Lismore Airport
- Lord Howe Island Airport
- Merimbula Airport
- Moree Airport
- Moruya Airport
- Mudgee Airport
- Narrabri Airport
- Narrandera Airport
- Narromine Airport
- Newcastle (Williamtown) Airport
- Nyngan Airport
- Orange Airport
- Parkes Airport
- Port Macquarie Airport
- Sydney Airport
- Tamworth Airport
- Taree Airport
- Wagga Wagga Airport

VICTORIA

- Ararat Airport
- Avalon Airport
- Bacchus Marsh Airfield
- Bairnsdale Airport
- Ballarat Airport
- Benalla Airport
- Bendigo Airport
- Birchip Airport
- Barwon Heads Airport
- Corryong Airport
- Donald Airport
- Echuca Airport
- Essendon Airport
- Hamilton Airport
- Hopetoun Airport
- Horsham Airport
- Kerang Airport
- Latrobe Valley Airport
- Leongatha Airport
- Mallacoota Airport
- Mangalore Airport
- Maryborough Airport
- Melbourne Airport
- Mildura Airport
- Moorabbin Airport
- Mount Hotham Airport
- Nhil Airport
- Orbost Airport
- Porepunkah Airfield
- Portland Airport
- Robinvale Airport
- Saint Arnaud Airport
- Sea Lake Airport
- Shepparton Airport
- Stawell Airport
- Swan Hill Airport
- Wangaratta Airport
- Warracknabeal Airport
- Warrnambool Airport
- West Sale Airport
- Wycheproof Airport
- Yarram Airport
- Yarrawonga Airport

SOUTH AUSTRALIA

- Adelaide Airport
- Ceduna Airport
- Cleve Airport
- Coober Pedy Airport
- Cowell Airport
- Kingscote (Kangaroo Island) Airport
- Kimba Airport
- Leigh Creek Airport
- Loxton Airport
- Mount Gambier Airport
- Naracoorte Airport
- Olympic Dam Airport
- Parafield Airport
- Port Augusta Airport
- Port Lincoln Airport
- Port Pirie Airport
- Renmark Airport
- Streaky Bay Airport
- Waikerie Airport
- Whyalla Airport
- Wudinna Airport

TASMANIA

- Burnie Airport
- Devonport Airport
- Flinders Island Airport
- Hobart International Airport
- King Island Airport
- Launceston Airport
- Smithton Airport
- St Helens Airport
- Strahan Airport

NORTHERN TERRITORY

- Alice Springs Airport
- Ayers Rock Airport
- Bathurst Island Airport
- Darwin International Airport
- Elcho Island Airport
- Gove Airport
- Groote Eylandt Airport
- Maningrida Airport
- Tennant Greek Airport

QUEENSLAND

- Abingdon Airport
- Agnew Airport
- Alpha Airport
- Aramac Airport
- Archerfield Airport
- Arrabury Airport
- Aurukun Airport
- Barcaldine Airport
- Bedouries Airport
- Biloela (Thangool) Airport
- Birdsville Airport
- Blackall Airport
- Bluewater Airport
- Boigu Island Airport
- Bowen Airport
- Brisbane Airport
- Bundaberg Airport
- Burketown Airport
- Cairns Airport
- Caloundra Airport
- Camooweal Airport
- Charleville Airport
- Charters Towers Airport
- Chillagoe Airport
- Chinchilla Airport
- Clermont Airport
- Cloncurry Airport
- Coconut Island Airport
- Coen Airport
- Cooktown Airport
- Cunnamulla Airport
- Darnley Island Airport
- Dirranbandi Airport
- Donnington Airpark (Woodstock Airport)
- Doomadgee Airport
- Dunk Island Airport
- Edward River Airport
- Emerald Airport
- Gayndah Airport
- Georgetown Airport
- Gladstone Airport
- Gold Coast Airport
- Goondiwindi Airport
- Gympie Airport
- Hamilton Island Airport
- Hervey Bay Airport
- Horn Island (Thursday Island) Airport
- Hughenden Airport
- Innisfail Airport
- Iron Range (Lockhart River) Airport
- Karumba Airport
- Kingaroy Airport
- Kowanyama Airport
- Kubin Airport
- Lizard Island Airport
- Lockhart River Airport
- Long Reach Airport
- Mackay Airport
- Marbuiag Island Airport
- Mareeba Airfield
- Maryborough Airport
- Moranbah Airport
- Mornington Island Airport
- Mount Isa Airport
- Murray Island Airport
- Muttaburra Airport
- Normanton Airport
- Northern Peninsula (Bamaga) Airport
- Palm Island Airport
- Proserpine/Whitsunday Coast Airport
- Quilpie Airport
- Richmond Airport
- Redcliffe Airport
- Rockhampton Airport
- Roma Airport
- Springvale Airport
- St George Airport
- Stanthorpe Airport
- Sunshine Coast Airport
- Taroom Airport
- Thargomindah Airport
- Toowoomba Airport
- Townsville Airport
- Warwick Airport
- Weipa Airport
- Whitsunday (Airlie Beach) Airport
- Windorah Airport
- Yam Island Airport
- Yorke Island Airport

WESTERN AUSTRALIA

- Albany Airport
- Balgo Hill Airport
- Bunbury Airport
- Broome International Airport
- Busselton Regional Airport
- Carnarvon Airport
- Christmas Creek Airport
- Cue Airport
- Cunderdin Airport
- Derby Airport
- East Kimberley Regional airport Kununurra Airport)
- Esperance Airport
- Fitzroy Crossing Airport
- Forrest Airport
- Geraldton Airport
- Halls Creek Airport
- Jandakot Airport
- Jurien Bay Airport
- Kalbarri Airport
- Kalgoorlie-Boulder Airport
- Karratha Airport
- Katanning airport
- Lake Gregory Airport
- Laverton Airport
- Learmonth Airport
- Leinster Airport
- Leonora Airport
- Manjimup Airport
- Margaret River Airport
- Meekatharra Airport
- Morawa Airport
- Mount Magnet Airport
- Mullewa Airport
- Newman Airport
- Norseman Airport
- Onslow Airport
- Paraburdoo Airport
- Perth Airport
- Port Hedland International Airport
- Ravensthorpe Airport
- Rottnest Island Airport
- Shark Bay Airport
- Solomon Airport
- Springvale Airport
- Tom Price Airport
- Warburton Airport
- Wiluna Airport
- Wyndham Airport

AUSTRALIAN CAPITAL TERRITORY

- Canberra Airport

Source: ACIL Allen Consulting, 2014

7.3.2 Capacity and utilisation of airports

Airport capacity can be characterised as the maximum throughput of passengers per unit time.[17] The throughput of passengers per unit depends on:

- aircraft type
- number, length and material of runway[18]
- terminal size and design
- air traffic control facilities (including navigational aids)[19]
- external constraints (e.g. noise abatement procedures, aircraft movement caps, curfews).

However, as noted in the *Joint Study on Aviation Capacity for the Sydney Region* released by the Australian Government in 2012, there is no single straightforward measure of the practical capacity of an airport. Demand varies dramatically across peak and non-peak periods. Operational capacity is affected not only by the physical attributes of the infrastructure, but also by factors such as weather conditions, environmental constraints, airspace configuration and the operational choices of the operators. These factors change through time. Capacity pressures build incrementally and their effects are not always obvious. Capacity pressure costs include delays and lost opportunities for new services.

On-time performance

As airports in Australia generally do not publish maximum throughput figures, ACIL Allen has compiled indicators that serve as proxies for airport capacity relative to utilisation, using data published by the (ACCC). These are:

- on-time performance for departures and arrivals (from BITRE on-time statistics, available for 34 out of the 276 airports in the audit dataset)
- average maximum system delay by month of the year (from ACCC data for the five price- and quality-monitored airports: Sydney Airport, Melbourne Airport, Brisbane Airport, Perth Airport and Adelaide Airport)
- average quality ratings by airlines on the availability of airside services and facilities, with separate ratings for runways, taxiways, aprons, aircraft parking and ground handling (from ACCC data on the five monitored airports).

The on-time performance for arrivals and departures of the 34 airports for which such data are compiled by BITRE is shown in Figure 65. The data indicate that Port Lincoln Airport and Mount Isa Airport had exceptionally good on-time performances in 2010-11 while Sunshine Coast Airport had the poorest performance that year.

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17 Productivity Commission, *Economic Regulation of Airport Services*, Productivity Commission Inquiry Report No. 57, 14 December 2011.

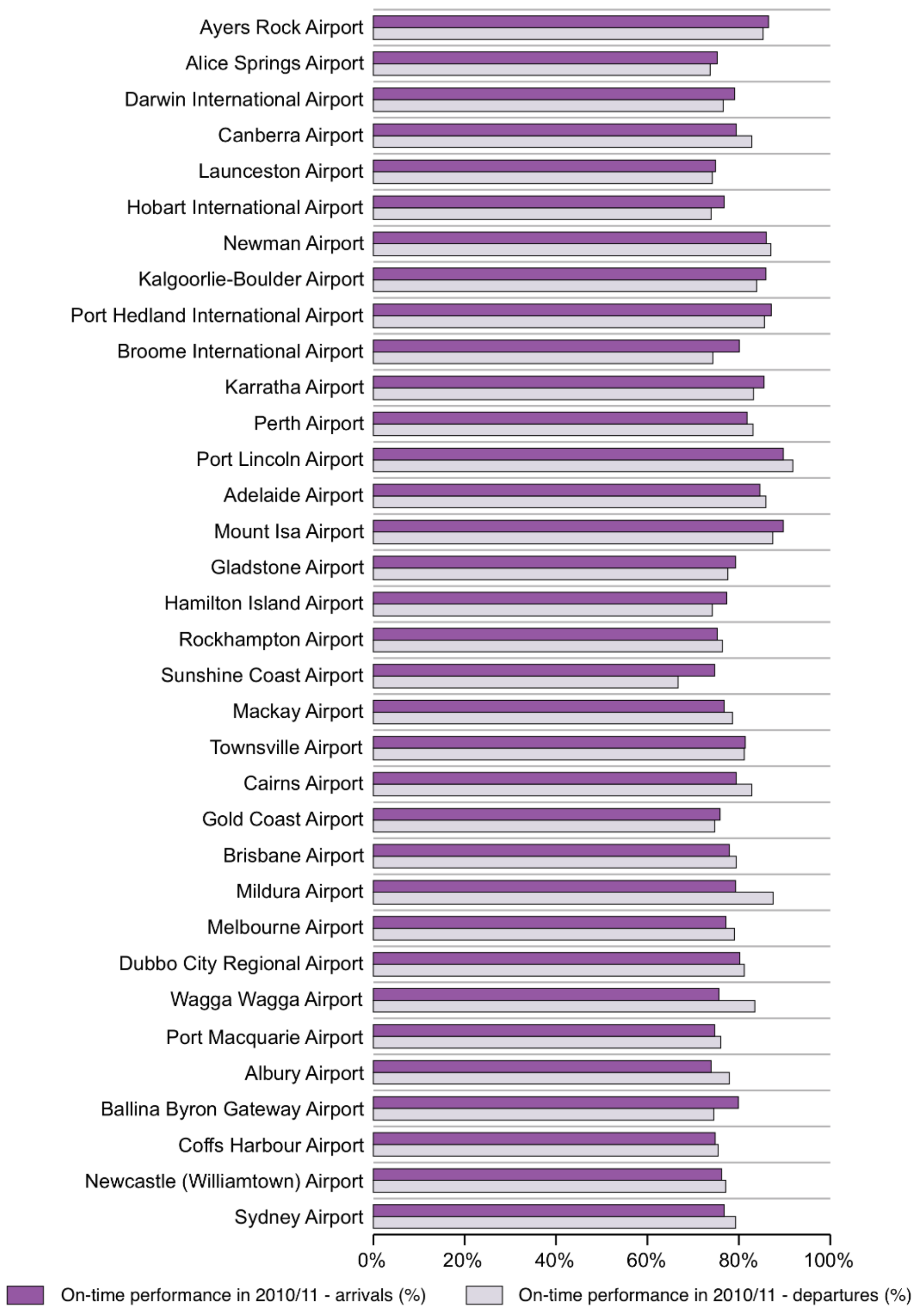
18 The audit dataset contains information on the number of runways, runway lengths and runway surfaces for 272 airports. This information provides an indication of the number of aircraft movements and aircraft types that can be handled at an airport.

19 For example, Melbourne Airport has a Category III Instrument Landing System (ILS) which allows suitably equipped aircraft to land in poor visibility conditions such as fog. The other major airports in Australia only have Category II or Category I ILS.

It should be noted that on-time performance measures are an imperfect indicator of utilisation relative to capacity, as weather (for example) is also a major factor behind delays. However, reserve capacity can help reduce the impact of weather on delays. In addition, the airports themselves believe that delay statistics provide useful information about capacity. According to Melbourne Airport's 2013 Master Plan,

> "Airside capacity is typically defined as the level of demand at which delays begin to exceed acceptable levels. While there is no standard for acceptable delays, Melbourne Airport has adopted an average six-minute delay to aircraft, as a trigger for new capacity enhancement measures, to maintain its reputation and objective of providing a high level of customer service." (p.74)

Figure 65 **On-time performance of airports, 2010-11**



Source: BITRE airport on-time statistics

Availability of airside services and facilities

The airlines' ratings of the availability of airside services and facilities in 2010-11 at the five airports monitored by the ACCC are shown in the first five rows of Table 26.

The ratings were generally highest at Brisbane Airport, followed by Adelaide Airport, and lowest at Perth Airport (which likely reflects Perth Airport's struggle to cope with rapid demand increases arising from the resources boom).

The average maximum system delay (which is reported to the ACCC on a monthly basis by the monitored airports) is shown in the penultimate row of Table 26. In many of the months in the 2010-11 financial year, the average maximum system delay was the longest at Sydney Airport, likely arising from a large amount of aviation activity taking place within a land-constrained airport site.

Table 26 **Indicators of capacity relative to utilisation for five monitored airports, 2010-11**

	Sydney Airport	Melbourne Airport	Brisbane Airport	Adelaide Airport	Perth Airport
Availability of airside services and facilities — **runway**	Satisfactory – good	Satisfactory – good	Good	Good	Satisfactory – good
Availability of airside services and facilities — **taxiways**	Satisfactory – good	Satisfactory – good	Good	Good	Satisfactory
Availability of airside services and facilities — **aprons**	Satisfactory	Satisfactory – good	Good	Satisfactory – good	Satisfactory
Availability of airside services and facilities — **parking**	Satisfactory	Poor – satisfactory	Good	Satisfactory	Satisfactory
Availability of airside services & facilities — **ground handling**	Satisfactory	Satisfactory	Good	Satisfactory	Satisfactory
Average maximum system delay by month **(minutes)**	11 to7	5 to 20	9 to 14	Not available	6 to 11
Average peak hour arrival demand **(movements per hour)**	65	48	44	Not available	35

Source: ACCC Airport Monitoring Report, 2010-00

In this AIA, the utilisation of Australian airports in 2010-11 has been reported using the following indicators:

- average peak hour arrival demand (with data available for four of the five ACCC monitored airports)
- total passenger movements (from BITRE statistics, available for 102 of the airports in the audit data set).

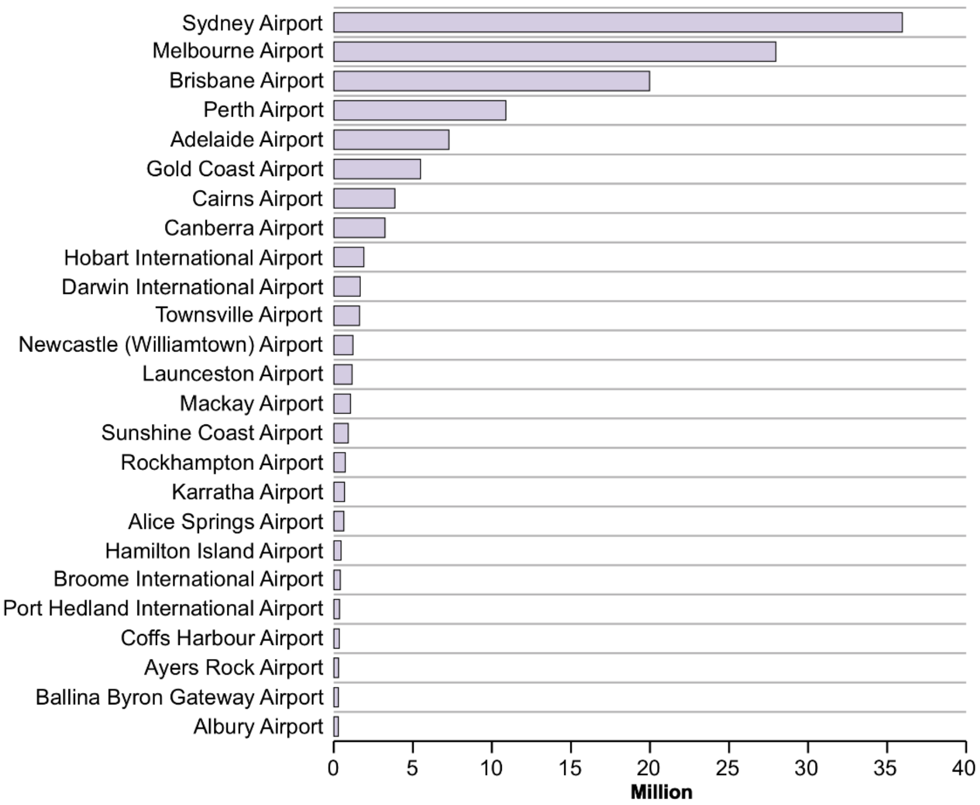
The final row in Table 26 shows the average peak hour arrival demand (measured in movements per hour) at the ACCC-monitored airports in 2010-11. Not surprisingly, this was highest at Sydney Airport (65 movements per hour), followed by Melbourne Airport (48 movements per hour) and Brisbane Airport (44 movements per hour).

Passenger movements

The total passenger movements at the 25 busiest airports in Australia in 2010-11 (as measured by passenger movements) are shown in Figure 66.

Total passenger movements, which encompass passenger movements on scheduled domestic, regional and international flights, was highest at Sydney Airport (35.96 million), followed by Melbourne Airport (27.96 million) and Brisbane Airport (19.97 million).

Figure 66 **Total annual passenger movements at 25 busiest airports in Australia, 2010-11**



Source: BITRE

7.3.3 DEC of airports in 2010-11

The direct economic contribution (DEC) of an airport is a measure of the value of the economic activities of the airport operator as well as those of aviation-related airport tenants and non-aviation airport tenants. This is consistent with the definition of an airport set out previously in Section 7.2.1.

ACIL Allen believes that taking a constricted view of an airport that takes into account only the services rendered by the airport operator would result in a severe under-estimate of the economic (and social) contribution of airports in Australia.

National DEC

The DEC of airports across Australia in 2010-11 was $20.7 billion (in 2010-11 dollars). This is obtained by summing the DEC of all airports in the audit dataset. (The methodology for estimating the DEC of each airport is explained in the 'DEC by airport' sub-section below.)

Previous modelling by Deloitte Access Economics for the Airport Operators Association found that approximately 18.4 per cent of the total value added of airports in Australia is generated by core airport operations.

Applying this proportion to our results suggests that the DEC associated with core airport operations across Australia was approximately $3.8 billion in 2010-11, with the economic activities of the wider airport precincts accounting for the remaining $16.9 billion.

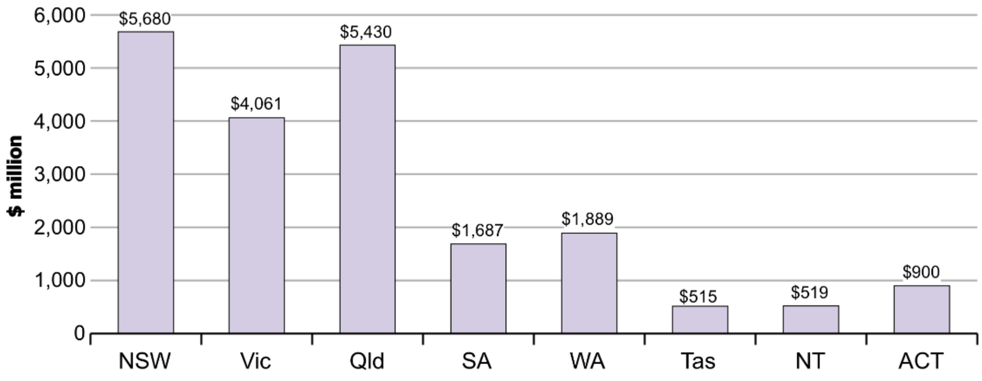
DEC by state/territory

The reported DEC estimates of airports for the three highest states are:

- NSW - $5.68 billion in 2010-11 dollars
- Queensland - $5.43 billion in 2010-11 dollars
- Victoria - $4.06 billion in 2010-11 dollars

The DEC of airports by state/territory in 2010-11 is shown in more detail in Figure 67. This is obtained by summing the projected DEC of all airports in each state/territory.

Figure 67 **DEC of airports in 2010-11 by state/territory ($m, 2010-11 dollars)**

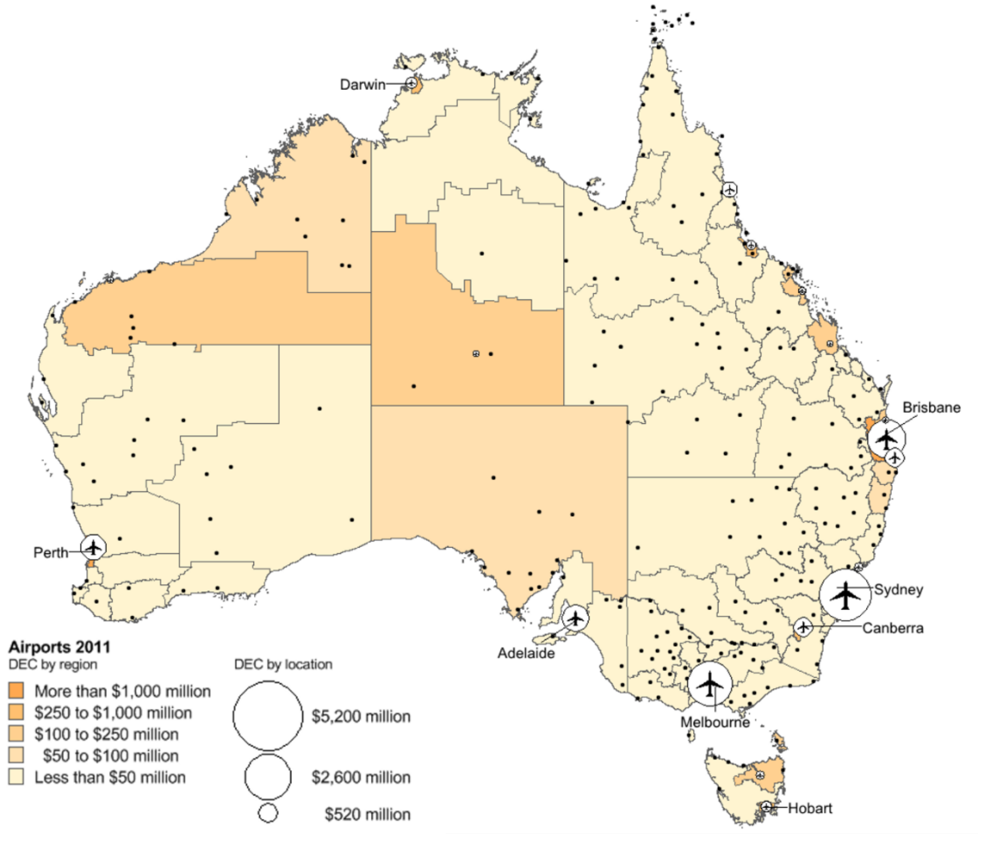


Source: ACIL Allen Consulting, 2014

DEC by audit region

The map Figure 68 shows that the audit regions with a high airport DEC tend to be capital city regions and regions incorporating major regional centres around the coast. The exceptions are the Pilbara region in Western Australia (where airports such as Karratha, Port Hedland and Paraburdoo have significant FIFO activity) and the Alice Springs audit region in the Northern Territory (with two major airports – Alice Springs Airport and Ayers Rock Airport- serving as gateways for tourists to the region).

Figure 68 **DEC of airports by audit region**



Source: ACIL Allen Consulting, 2014

DEC by airport

The methodology employed by ACIL Allen for estimating the DEC of each airport is explained below.

The DEC of Sydney Airport, Melbourne Airport, Brisbane Airport, Perth Airport, Adelaide Airport, Canberra Airport, Darwin International Airport, Newcastle Airport, and Cairns Airport have been reported based on economic impact studies that these airports have commissioned as inputs into their 20-year master plan reports. These economic impact studies generally involve input-output analysis and (CGE) modelling based on data collected from customised surveys of airport operators and airport tenants. As these studies were undertaken in different years, appropriate adjustments have been made based on CPI inflation and changes in total passenger movements between the year of the study and 2010-11.

The DEC of Melbourne Airport was estimated by regression analysis using the data points of other major airports because the estimate contained in the economic impact study commissioned by Melbourne Airport is extremely low relative to the estimated DEC of Sydney Airport and Brisbane Airport (likely due to differences in the scope of airport activities included in the analysis)

The DEC of the remaining airports where total passenger movement statistics are available have been estimated using the Cairns Airport study's results with scaling by relative total passenger movements in 2010-11.

Cairns Airport was selected as the basis for the scaling exercise because it is a mid-sized airport that does not stand out in any particular way (and is therefore likely to be more representative of a wider range of airports). It has a mix of regional and domestic services as well as a small proportion of international services. It is not a capital city airport and does not have a large business park (unlike airports such as Canberra Airport).

ACIL Allen has investigated alternative approaches to estimating the DEC of airports for which economic impact studies have not been commissioned by their airport operators (see Box 5).

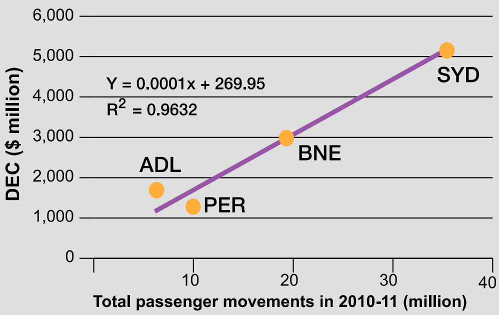
Box 5 **Alternative approach to estimating DEC of airports**

ACIL Allen investigated the idea of using simple (univariate) regression analysis to characterise the relationship between DEC and total passenger movements at an airport. The sample of airports in the analysis are those for which credible economic contribution studies have been commissioned: Sydney Airport (Deloitte Access Economics) Melbourne Airport (SKM) , Brisbane Airport (Deloitte Access Economics), Perth Airport (ACIL Allen Consulting), Adelaide Airport (Hudson Howells), Canberra Airport (ACIL Tasman), Cairns Airport (Cummings Economics), Darwin International Airport (ACIL Tasman), Newcastle Airport (URS) and Alice Springs Airport. (ACIL Tasman).

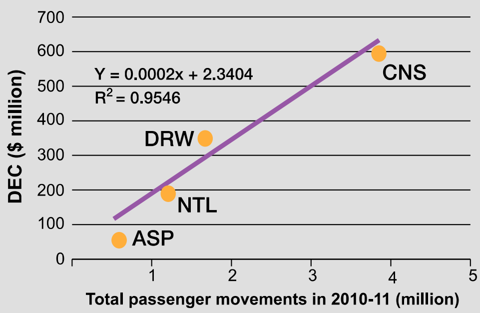
The airports were separated into two groups: the large airports (Sydney, Melbourne, Brisbane, Perth and Adelaide, each with passenger movements in excess of 7 million in 2010-11) and the smaller ones (Cairns, Canberra, Darwin, Newcastle and Alice Springs, with passenger movements of less than 4 million in 2010-11). Initial analysis identified Melbourne Airport as an outlier in the first group and Canberra Airport as an outlier in the second group. The DEC estimate for Melbourne Airport is very low relative to those of Sydney and Brisbane airports. While it is possible that the activities of airlines were excluded from SKM's analysis this cannot be ascertained from reading the airport's master plan report. Canberra Airport has a very high DEC relative to its passenger numbers as it has a very large business park. These two airports were thus excluded from the subsequent analysis.

The results of this analysis are shown in the two charts below. As the economic studies for the airports were undertaken in different years, they have been made comparable by adjusting for CPI inflation and the change in passenger movements between the year of the study and 2010-11. The charts show that the fitted relationship is surprisingly strong (as evidenced by the high R squared statistic), given the small number of data points and the fact that the studies are undertaken by a diverse group of consultants using perhaps somewhat different methodologies.

Large airports excluding Melbourne



Smaller airports excluding Canberra



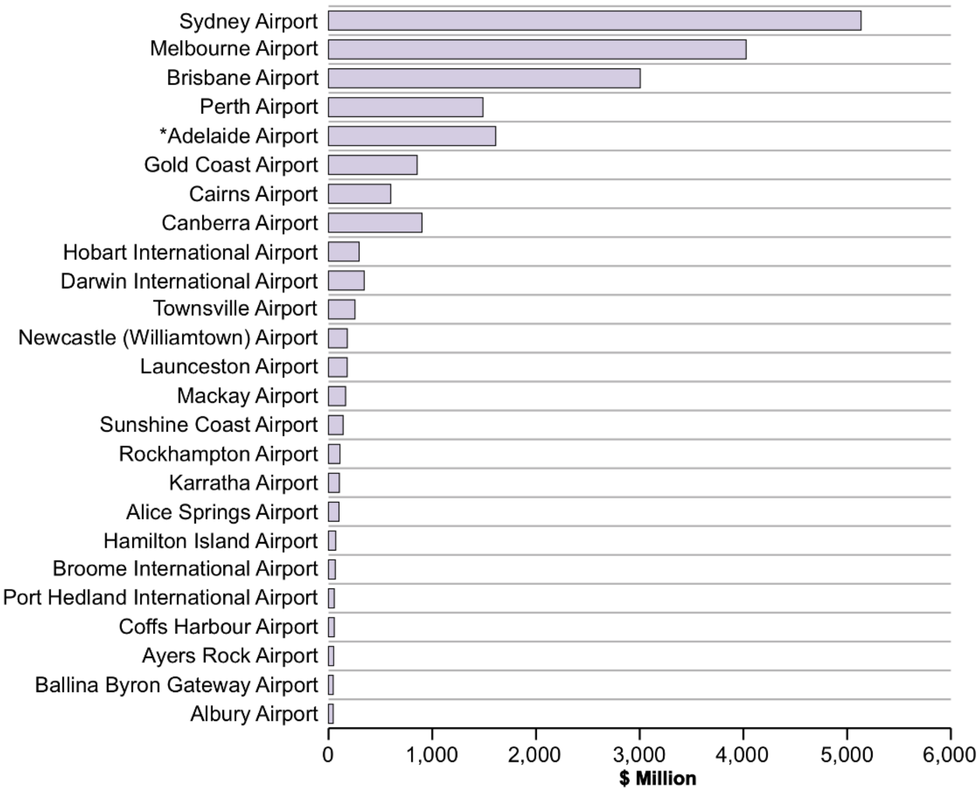
The vast majority of the airports for which the DEC needs to be interpolated correspond to the second group. As can be seen in the second chart, the line of best fit passes very close to the origin. This means that using the Cairns Airport DEC to estimate the DEC of the airports for which studies have not been undertaken, by simply looking at their total passenger movements relative to Cairn's, would produce a very similar result to estimating their DEC using the fitted regression line.

Source: ACIL Allen Consulting, 2014

In the audit data set, we have provided DEC estimates of 87 airports. The estimated DEC of an airport is ascribed to the audit region in which it is physically located.

The estimated DEC of the 25 busiest airports in 2010-11 (encompassing the activities of the airport operators, their aviation-related airport tenants and non-aviation airport tenants) is shown in Figure 69. Sydney Airport had the highest DEC in 2010-11 ($5.13 billion), followed by Melbourne Airport ($4.03 billion) and Brisbane Airport ($3.00 billion).

Figure 69 **DEC of 25 busiest airports in 2010-11 ($ million)**



Note: Raw data on DEC of airports were adjusted to account for the different years in which the economic studies were undertaken.
* The DEC estimate for Adelaide Airport likely includes some indirect economics impacts as well
Source: Deloitte Access Economics (Sydney Airport and Brisbane Airport), Hudson Howells (Adelaide Airport) ACIL Allen Consulting (Perth Airport, Canberra Airport and Darwin Airport), Cummings Economics (Cairns Airport)

7.4 Projections for airport services

ACIL Allen Consulting has projected forecast demand for airport services between 2010-11 and 2030-31. The reported forecasts relate to:

- airport passenger movements
- the direct economic contribution of airport services

7.4.1 Projected baseline scenario airport passenger movements in 2030-31

The baseline scenario forecasts for airport passenger movements used BITRE's forecasts of air passenger movements. BITRE's forecasts of air passenger movements were developed using econometric models, which were specified in terms of population, real income — proxied by real (GDP) — exchange rates, real domestic airfares and the prices of domestic and overseas travel and accommodation. Separate forecasting models were developed for domestic passenger movements and international movements of Australian residents and overseas visitors, reflecting the different factors influencing domestic and international passenger travel.

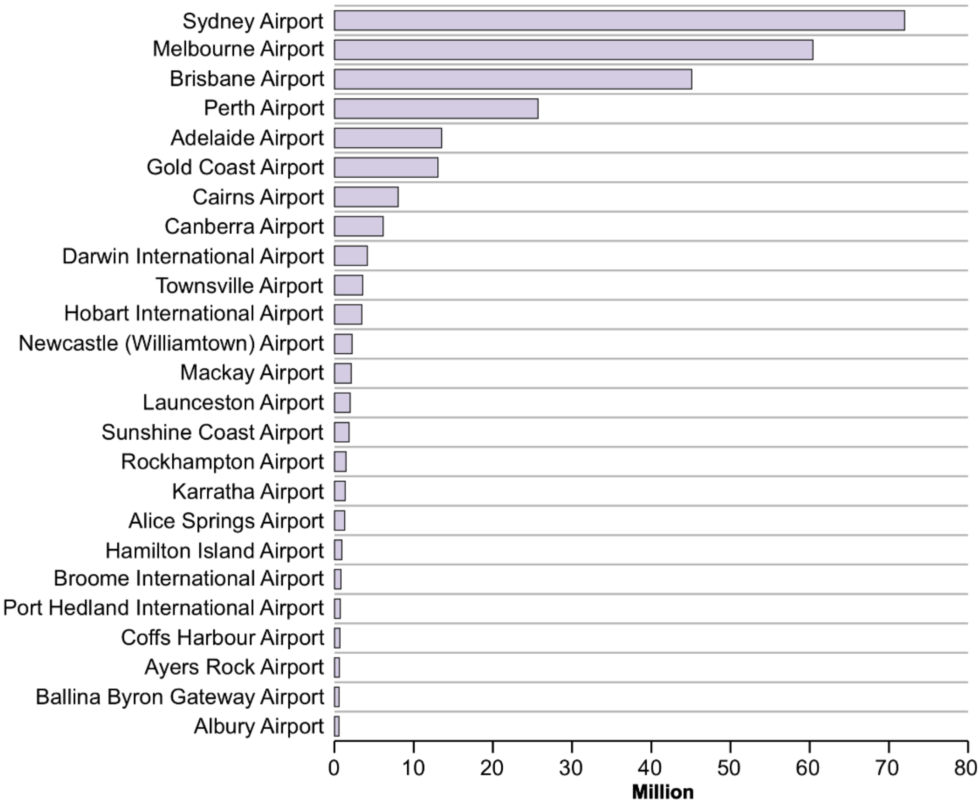
The econometric models were estimated by BITRE using historical data from 1991–92 to 2010–11, except for the international passenger movements at Gold Coast Airport where international operations data limited estimation to historical data from 1994–95 to 2010–11.

For passenger growth projections, BITRE forecasts of passenger growth were used for the following airports: Sydney, Melbourne, Brisbane, Perth, Adelaide, Gold Coast, Cairns, Canberra, Darwin, Hobart, Newcastle, Townsville and Launceston.[20]

For the remaining airports where BITRE forecasts are unavailable, passenger movements in 2030-31 were projected using passenger movements in 2010-11 and the average growth rate of five non-capital city airports (Gold Coast, Cairns, Newcastle, Townsville and Launceston) as forecasted by BITRE.

The **projected total passenger movements** (on scheduled regional, domestic and international flights) at the 25 busiest airports in Australia in 2030-31 (ranked by passenger movements) are shown in Figure 70.

Figure 70 **Baseline scenario forecasts of total annual passenger movements at the 25 busiest airports, 2030-31**



Source: BITRE, ACIL Allen Consulting, 2014

Total passenger movements, which encompass passenger movements on scheduled domestic, regional and international flights, are expected to be highest at Sydney Airport (71.98 million, or 200 per cent growth), followed by Melbourne Airport (60.40 million) and Brisbane Airport (45.11 million).

7.4.2 Baseline scenario projections for DEC of airports in 2030-31

The 'baseline scenario' projections for the DEC of airports assumes that there is Australian population growth in line with the Australian Bureau of Statistics' (ABS) Series B projections at the national, state and capital city levels.

[20] BITRE, *Air passenger movements through capital and non-capital city airports to 2030-31*, Research Report 133, 2012.

The underlying economic projections used in this report are based on national, state/territory and audit region projections developed using ACIL Allen's in-house CGE model *Tasman Global*. These projections cover the period 2010-11 to 2030-31 (see Appendix provided in Part C for more detail on the 'baseline scenario' forecast assumptions and parameters).

National DEC

The DEC of airports across Australia in 2030-31 is projected to be $40.9 billion (in 2010-11 dollars), which is growth of 3.46 per cent per annum. This overall growth in the economic contribution of airports is higher than the expected growth in GDP of 3.1 per cent per annum for the same period. This indicates that the economic contribution of the airport services sector is higher in 2030-31 than in 2010-11.

This is obtained by summing the projected DEC of all airports in the audit dataset (the projection methodology is explained in the 'DEC by airport' sub-section below).

DEC by state/territory

The projected DEC of airports by state/territory in 2030-31 is shown in Figure 71.

Figure 71 **Projected DEC of airports in 2030-31 by state/territory ($m, 2010-11 dollars)**

Source: ACIL Allen Consulting, 2014

Queensland is projected to have the largest DEC in 2030-31 (approximately $10.94 billion in 2010-11 dollars), followed by New South Wales ($10.28 billion in 2010-11 dollars) and Victoria ($8.06 billion in 2010-11 dollars).

DEC by airport

The projected DEC of airports in 2030-31 is based on their economic contribution in 2010-11, scaled by appropriate growth factors generated by ACIL Allen's CGE modelling using the Tasman Global model – see Box 3 for detail on the methodology for the baseline scenario projections.

Box 6 **Methodology for baseline forecasts of DEC by airport**

The DEC of airports can be broken down into three components:

- the economic contribution of the airport operator
- the economic contribution of aviation-related tenants
- the economic contribution of non-aviation tenants.

The projected growth in the economic contribution of the airport operator between 2010-11 and 2030-31 is derived from the audit region-specific value added growth factor generated by Tasman Global for the ‘Transport Support Services and Storage’ sector, as this sector encompasses the ‘Airport Operations and Other Air Transport Support Services’ sub-sector. For example, for the ABS Series B projection scenario, the Tasman Global value added growth factor for this sector is 1.63 for the Greater Sydney audit region.

The projected growth in the economic contribution of aviation-related tenants at an airport is derived from the audit region-specific growth factor generated by Tasman Global for the ‘Air and Space Transport’ sector. For the ABS Series B projection, the Tasman Global value added growth factor for this sector is 1.93 for the Greater Sydney audit region.

Finally, the projected growth in the economic contribution of non-aviation tenants at an airport is derived from the audit region-specific overall value added growth factor across all sectors generated by Tasman Global. For the ABS Series B projection, the Tasman Global value added overall growth factor for the Greater Sydney audit region is 1.74. For each audit region, the overall growth factor is the weighted average of the growth factors for each sector in Tasman Global.

Based on detailed modelling previously undertaken by ACIL Allen for Perth Airport, the following weights are assigned to the economic contributions of the airport operator, aviation-related airport tenants and non-aviation airport tenants respectively: 0.139, 0.590 and 0.271.

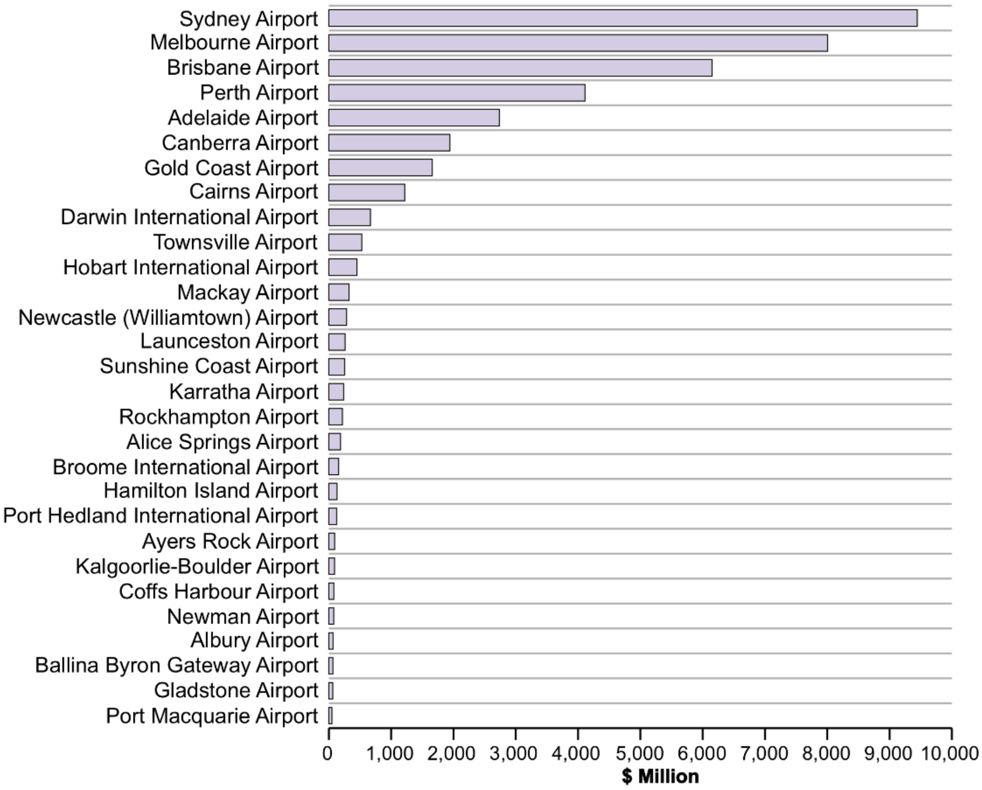
These weights are assumed to be invariant across airports, and are multiplied by the three value-added growth factors to generate an overarching growth factor for each airport. This overarching growth factor, when multiplied by that airport’s DEC in 2010-11, yields the airport’s DEC in 2030-31. For example, the overarching growth factor for Sydney Airport is 1.840. With a DEC in 2010-11 of $5,134 billion, the projected DEC for Sydney Airport in 2030-31 is therefore $9,445 billion in 2010-11 dollars.

Source: ACIL Allen Consulting 2014

The projected DEC of the 25 airports with the highest DEC in 2030-31, encompassing the activities of the airport operators, their aviation-related airport tenants and non-aviation airport tenants, is shown in Figure 72.

Sydney Airport is expected to have the highest DEC in 2030-31 ($9,445 billion in 2010-11 dollars), followed by Melbourne Airport ($8.1 billion in 2010-11 dollars), and Brisbane ($6,158 billion in 2010-11 dollars).

Figure 72 **Projected direct economic contribution of top 25 airports by DEC, 2030-31 ($ million, 2010-11 dollars)**



Source: ACIL Allen Consulting, 2014

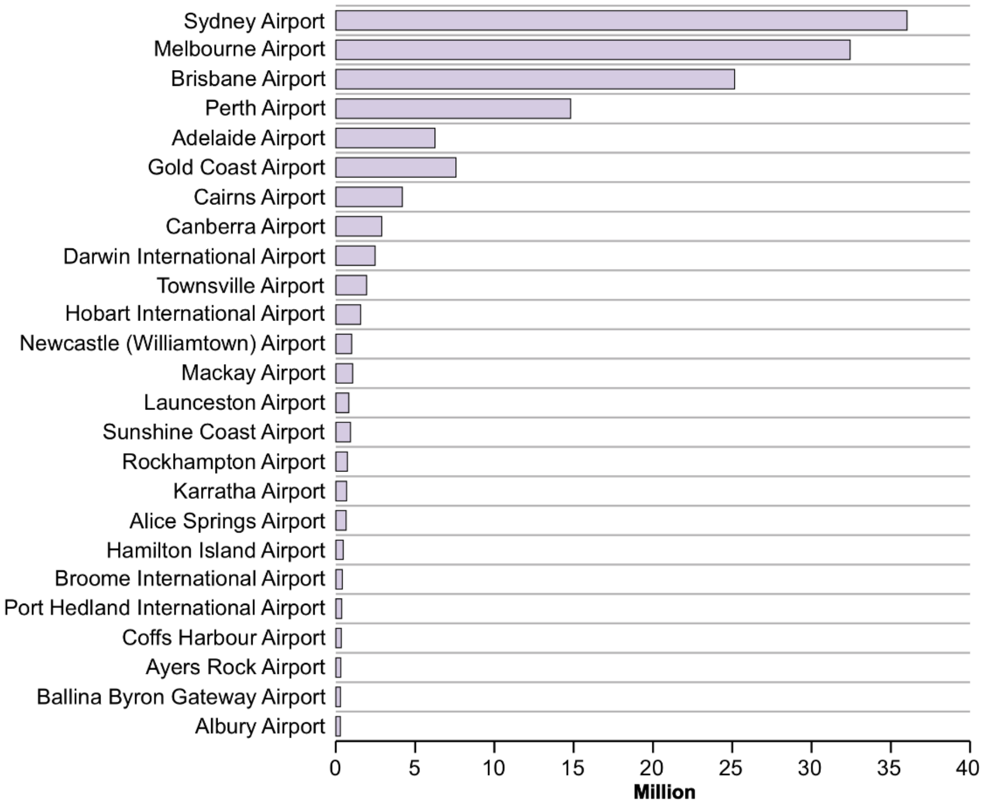
7.5 Projection of DEC and additional needs for airports

This section discusses the gap in airport passenger movements and DEC between 2010-11 and 2030-31 in the Baseline scenario.

7.5.1 Airport passenger movements needs

The **projected increase in total passenger movements** (on-schedule regional, domestic and international flights) between 2010-11 and 2030-31 at the 25 busiest airports in Australia in 2030-31 is shown in Figure 73.

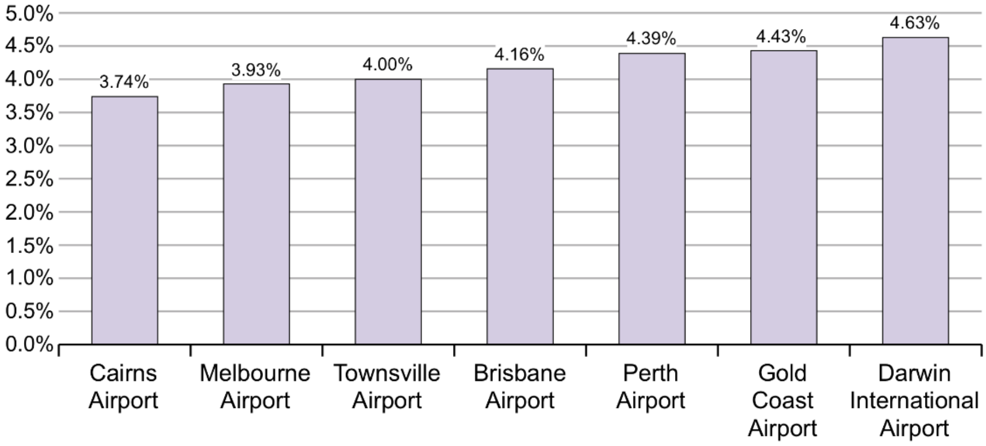
Figure 73 **Projected increase in total passenger movements between 2010-11 and 2030-31 at the 25 busiest airports in 2030-31**



Source: ACIL Allen Consulting, 2014

Based on BITRE forecasts, the fastest growing airports in Australia between 2010-11 and 2030-31 in terms of total passenger movements are shown in Figure 74.

Figure 74 **Fastest growing airports in Australia between 2010-11 and 2030-31 by total passenger movements**



Source: BITRE, ACIL Allen Consulting, 2014

With the exception of Melbourne Airport, the seven fastest growing airports are located in Queensland, Western Australia or the Northern Territory. This finding is consistent with ACIL Allen's CGE modelling results based on the ABS Series B population projections.

According to the modelling of the Australian economy, growth in employment between 2010-11 and 2030-31 is expected to be strongest in:

— Western Australia (by 71 per cent over this period)
— Northern Territory (by 49 per cent over this period)
— Queensland (47 per cent).

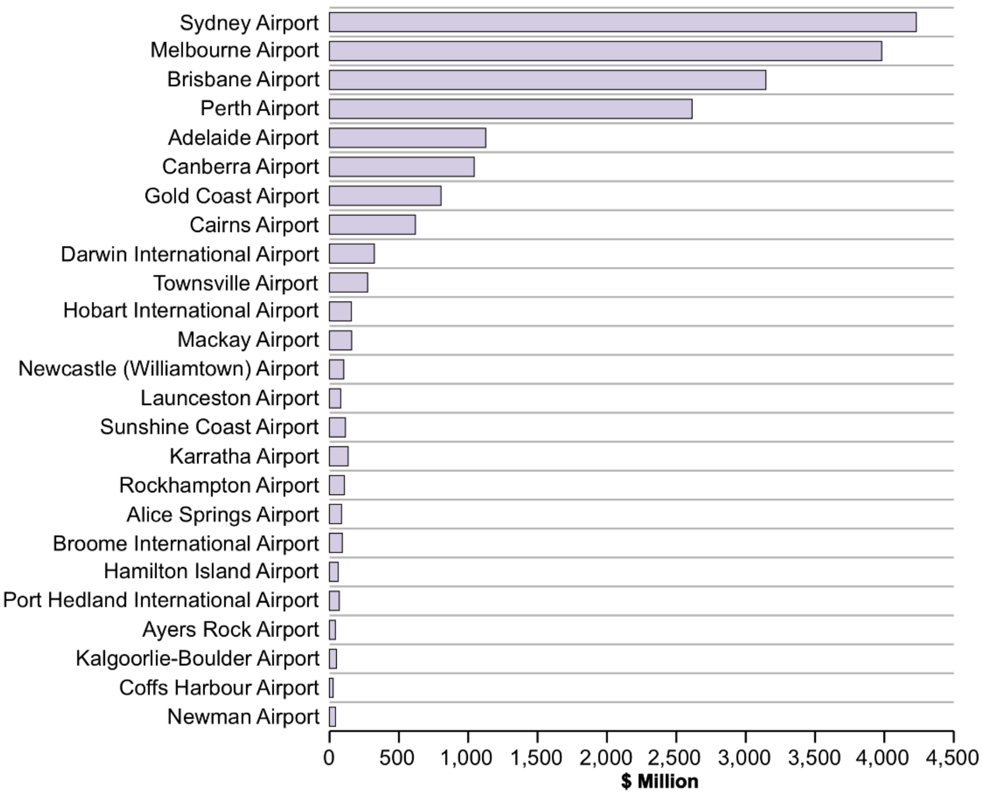
In addition, the modelling indicates that Gross State Product (GSP) growth is highest in Western Australia (increasing by approximately 130 per cent between 2010-11 and 2030-31), followed by Northern Territory (100 per cent) and Queensland (95 per cent).

7.5.2 DEC gaps

The **projected increase in DEC** between 2010-11 and 2030-31 for the 25 busiest airports in Australia in 2030-31 is shown in Figure 75.

The greatest projected increase in airport demand is for Sydney Airport (encompassing the activities of the airport operator, its aviation-related tenants and non-aviation tenants). It is expected to increase by approximately $4.23 billion (in 2010-11 dollars). The corresponding increases at the Melbourne, Brisbane, Perth, Adelaide, Canberra, Gold Coast and Cairns airports are expected to be $3.98 billion, $3.15 billion, $2.61 billion, $1.13 billion, $1.04 billion, $0.80 billion and $0.62 billion (in 2010-11 dollars) respectively.

Figure 75 **Projected increase in DEC between 2010-11 and 2030-31 for the 25 airports with the highest DEC in 2030-31 ($ millions, 2010-11 dollars)**



Source: ACIL Allen Consulting, 2014

7.6 Sensitivity analysis of projections for airport infrastructure needs and DEC

In order to illustrate how the outlook for infrastructure services could vary given different rates of change in the economy, additional scenarios were modelled and reported in relation to:

- airport passenger movements
- the direct economic contribution of airport services

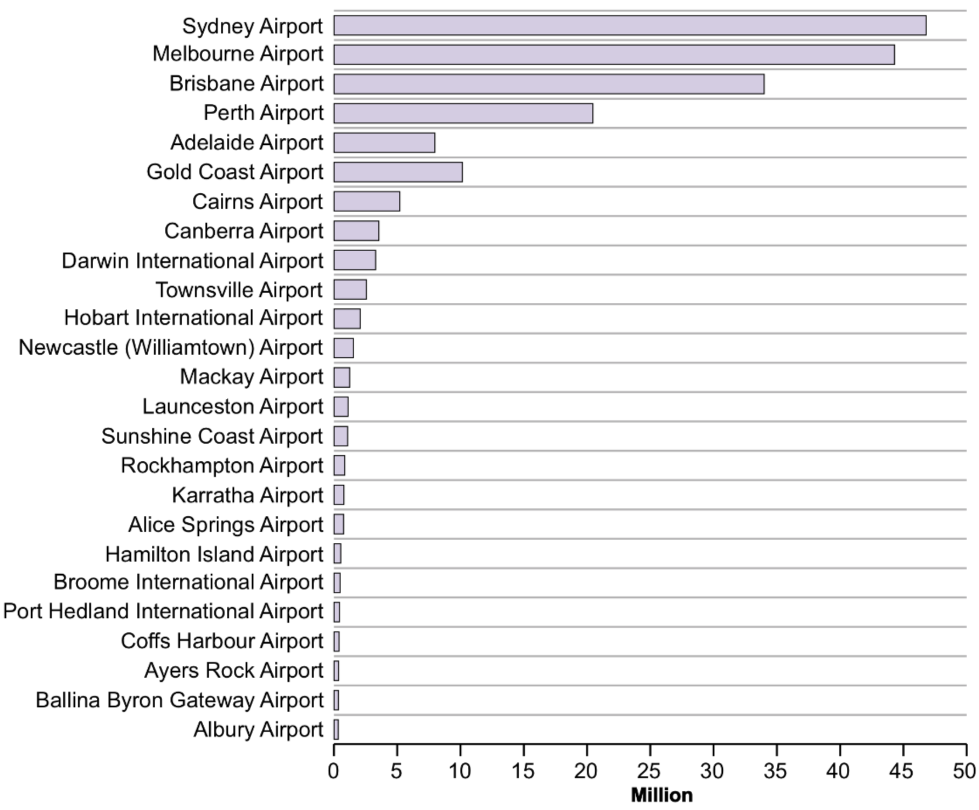
These additional projections indicate how future demand for airport services may vary under different economic scenarios.

7.6.1 Projected airport passenger movements in 2030-31

To estimate how the projected airport passenger movement for airports in 2030-31 could vary as a result of different economic scenarios, BITRE's high economic growth scenario was adopted.

The projected increase in total passenger movements (on scheduled regional, domestic and international flights) between 2010-11 and 2030-31 at the 25 busiest airports in Australia under BITRE's high economic growth scenario is shown in Figure 76.

Figure 76 **Projected increase in total passenger movements between 2010-11 and 2030-31 at the 25 busiest airports under BITRE's high economic growth scenario**

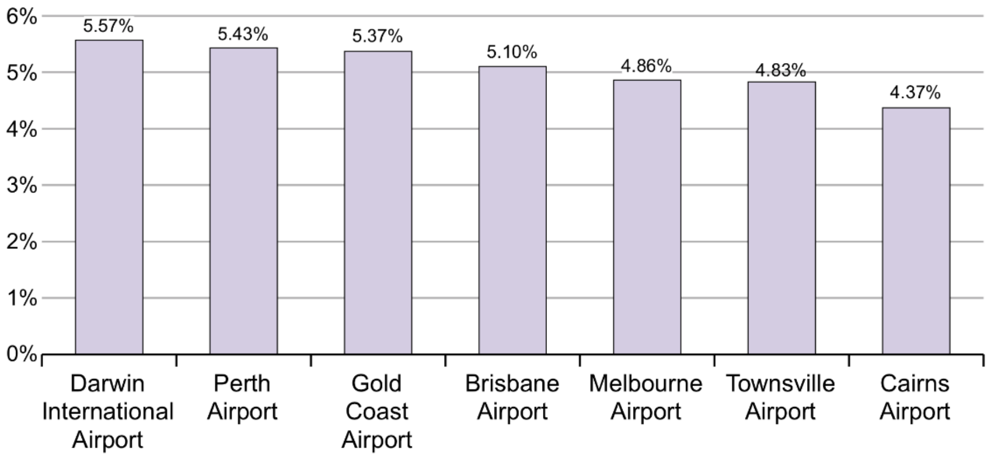


Source: ACIL Allen Consulting, 2014

The increases at the Sydney, Melbourne, Brisbane, Perth and Adelaide airports are expected to be 46.79 million, 44.29 million, 34.00 million, 20.46 million and 7.98 million respectively over the 2010-11 to 2030-31 period.

Based on BITRE's high economic growth forecasts, the fastest growing airports in Australia between FY2011 and FY2031 in terms of total passenger movements are shown in Figure 77. Under this scenario, Darwin International Airport is expected to grow at a CAGR of 5.57 per cent between 2010-11 and 2030-31 (compared with 4.63 per cent under BITRE's baseline scenario).

Figure 77 **Fastest growing airports in Australia between 2010-11 and 2030-31 by total passenger movements under BITRE's high economic growth scenario**



Source: BITRE, ACIL Allen Consulting, 2014

7.6.2 Projected airports DEC in 2030-31

To estimate how the projected DEC for airports could vary as a result of different economic scenarios, two additional alternative scenarios have been modelled:

- 'Higher population growth scenario' – Scenario 2: which assumes that Australia's population growth is higher (compared with the baseline scenario) and is aligned with ABS Series A projections
- 'Higher productivity growth scenario' – Scenario 3: which assumes that there is higher factor productivity in the infrastructure sectors to obtain a 1 per cent higher growth in Australian real GDP by 2030-31 (relative to the output growth obtained in the 'baseline scenario').

These additional two scenarios indicate how future demand for airport services are expected to vary under different economic scenarios.

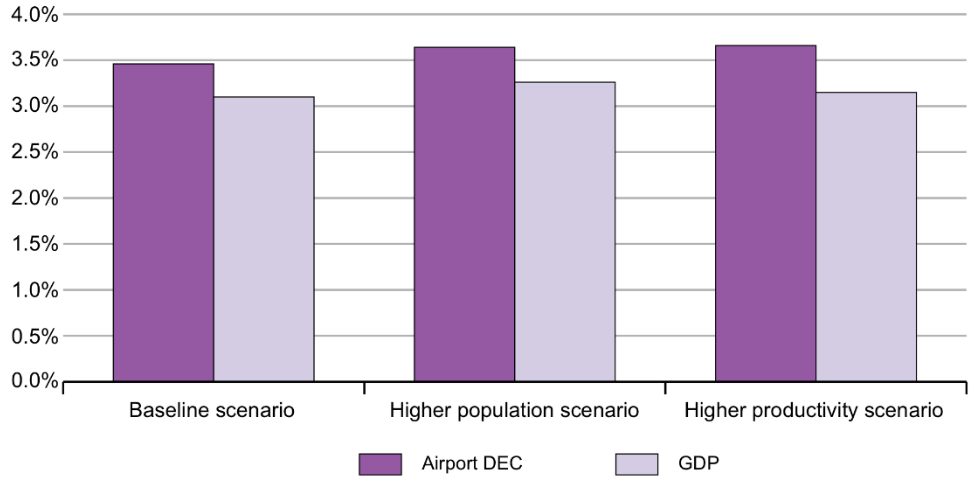
The procedure for estimating the DEC of airports in these two additional scenarios is the same as that used in the baseline scenario, except that the value added growth factors from Tasman Global under the baseline scenario are replaced by the corresponding value added growth factors from Tasman Global under the two scenarios.

DEC is projected to rise between 2010-11 and 2030-31 by:

- $40.9 billion in the Baseline scenario
- $42.3 billion in the Higher population scenario
- $42.5 billion in the Higher productivity scenario

The per annum growth in airport DEC between 2010-11 and 2030-31 is higher than the projected per annum growth in GDP under all 3 projections – see Figure 78.

Figure 78 **Compound annual growth rate of projected airport DEC and GDP in 2030-31 ($ million, 2010-11 dollars) – 3 scenarios**



Source: ACIL Allen Consulting, 2014

The projected increase in DEC between 2010-11 and 2030-31 for the 25 busiest airports in Australia in 2030-31 for the Baseline scenario, the Higher population growth scenario and the Higher productivity growth scenario is shown in Figure 79.

In the higher population growth scenario, Sydney Airport is expected to have the highest DEC in 2030-31 ($9.36 billion in 2010-11 dollars), followed by Melbourne ($8.23 billion in 2010-11 dollars) and Brisbane Airport ($6.39 billion in 2010-11 dollars).

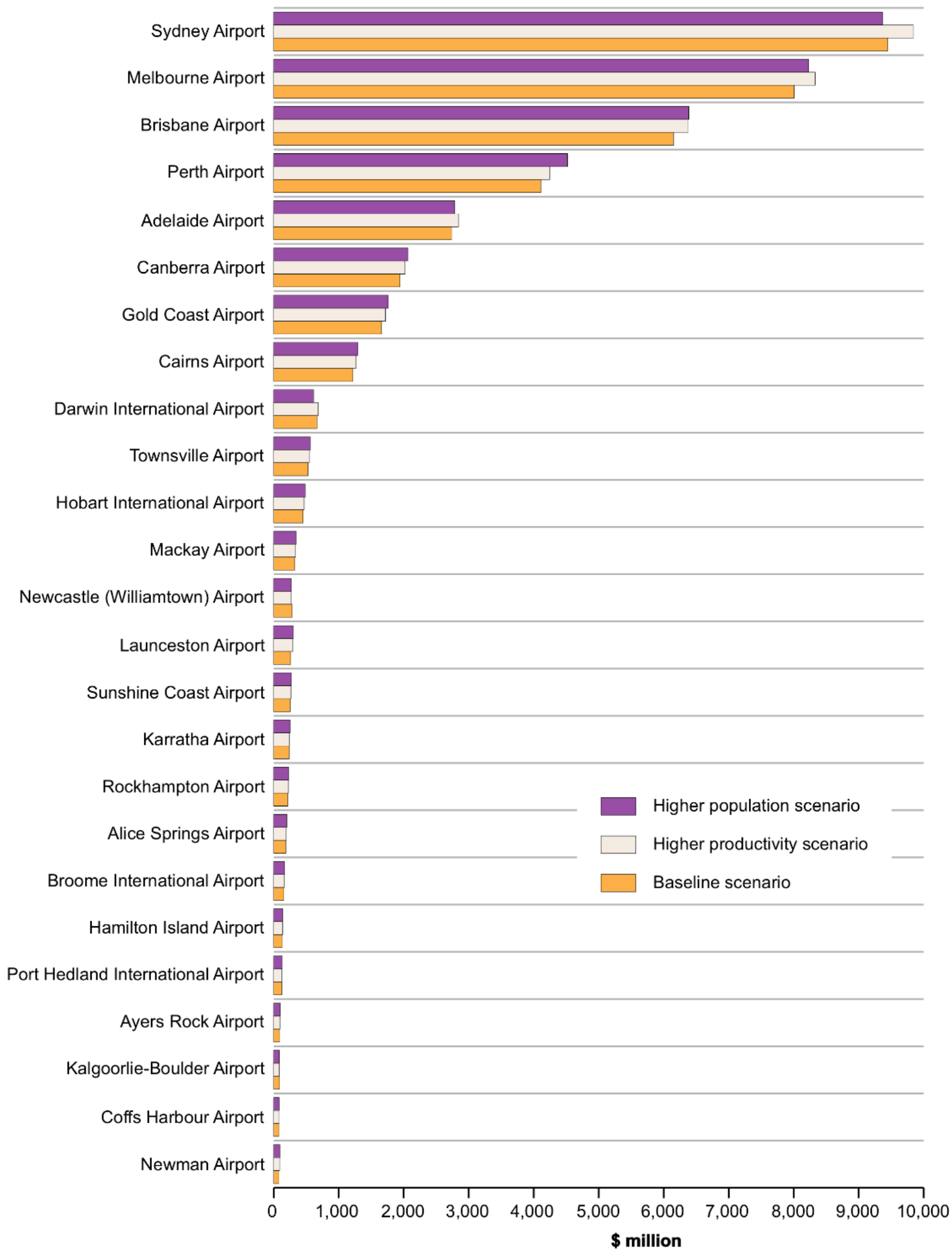
Among the 25 airports projected to have the highest DEC among all Australian airports in 2030-31, all but two have a higher DEC under the higher population growth scenario than under the baseline scenario.

The exceptions are Sydney Airport and Darwin International Airport. This is largely because, unlike most regions across Australia, population growth in Sydney and Darwin between 2010-11 and 2030-31 is lower in the ABS Series A demographic projection that underpins the Higher population growth scenario than in the ABS Series B demographic projection that underpins the baseline scenario.

In the Higher productivity growth scenario, Sydney Airport is expected to have the highest DEC in 2030-31 ($9.84 billion in 2010-11 dollars), followed by Melbourne ($8.33 billion in 2010-11 dollars) and Brisbane Airport ($6.38 billion in 2010-11 dollars).

Among the 25 airports projected to have the highest DEC among all Australian airports in 2030-31, all have a higher DEC under the Higher population growth scenario than under the baseline scenario. Among these 25 airports, only Sydney Airport, Melbourne Airport and Darwin International Airport have a higher DEC under the Higher demographic growth scenario than under the higher productivity growth scenario.

Figure 79 **Projected airport DEC for top 25 busiest airports in 2030-31 ($ million, 2010-11 dollars) – 3 scenarios**



Source: ACIL Allen Consulting, 2014

7.7 Issues and implications of findings

As noted by the Australian Airports Association, the dependence of Australians on air services (and hence airports) is increasing.[21] This is driven, in part, by growth in leisure tourism (especially outbound) activities and the regional expansion of strategic resource and agriculture activities. In addition, overall demand for air services has increased because of the development of more globalised and intra-national business supply chains. As businesses become more strongly linked to suppliers and customer markets beyond their

[21] Australian Airports Association, *Connecting Australia: The economic and social contribution of Australia's airports*. May 2012.

immediate vicinity, they are increasingly reliant on air-based services to move workers and freight. The increasing dependence on airports is reflected in the AIA's projections on the DEC of airports for 2030-31.

If airports could not expand to cope with the expected growth in demand, airlines will raise fares and freight charges as flights reach capacity and new airlines (e.g. low cost carriers) will be unable to obtain landing slots, particularly during peak periods. This would reduce consumer welfare and the competitiveness of businesses across the country, thereby leading to significant negative social and economic impacts.

To meet the projected increase in demand for the range of activities taking place within the airport compound, airport operators will need to undertake progressive upgrades in one or more of the following types of airside and landside infrastructure over the next two decades:

- runways, taxiways, aprons and aircraft parking bays
- navigation aids and safety systems
- maintenance, repair and overhaul (MRO) facilities
- terminal facilities, including gates, baggage handling, customs and immigration, airline lounges, food and retail outlets
- landside transport and vehicle parking facilities

All leased federal airports in Australia (except for Tennant Creek and Mount Isa) – which constitute virtually all of the nationally significant airports in the country – are subject to a planning framework in the *Airports Act 1996*. As part of the planning framework, airports are required to prepare a Master Plan that incorporates an Environment Strategy. The Master Plan is a 20-year strategic vision for the airport site which is renewed every five years. The Master Plan includes future land uses, types of permitted development, and noise and environmental impacts. The Environment Strategy sets out the airport's strategy to manage environmental issues within a five-year period and beyond. In addition, the airports are required to develop a Major Development Plan for major airport developments on the airport site.

An airport Master Plan is the principle blueprint for the future coordinated development of the airport. It is designed to establish the strategic vision for the economic and efficient use of the airport over the planning period. Once the AIA is completed, the Master Plans of nationally significant airports can be analysed to gain a sound understanding as to the likelihood that these airports are investing sufficiently in infrastructure developments to meet the projected increase in demand for their services (particularly, their aviation-related services) as highlighted by the AIA projections.

As the nationally significant airports are privatised, their commercial focus means that incentives are expected to be in place to encourage infrastructure investments that will avert the emergence of service delivery gaps which inhibit regional and national economic growth. This assumes that the airports are not physically constrained or constrained in any other way (e.g. by excessive regulation). However, with respect to Sydney Airport the *Joint Study on Aviation Capacity in the Sydney Region* found that underlying limitations of the airport site means airside infrastructure, even with the investments proposed in the *Sydney Airport Master Plan 2009*, will be unable to meet the projected aircraft movements for the medium and longer term, notwithstanding the use of larger aircraft and increased load factors.

8 Transport – Nationally significant roads

KEY FINDINGS

The audit of Nationally Significant Roads (NSR) comprises;

- the National Highway (NH). The NH refers to is the NH system that connects the key urban centres in Australia. This excludes the part of the NH that falls into the 8 capital cities because these links will be analysed in the 'urban transport' component of this audit; and
- Key Freight Routes (KFR). The KFR were identified by the State and Territory governments and most of them are intrastate roads located outside the urban areas.

15 of the audit regions across Australia do not have any part of the NH running through them. The NH in this audit covers 50 of the 73 audit regions. 40 of the 73 audit regions have KFR running through them (no KFR were identified by the State and Territory governments in the remaining 33 audit regions).

This audit focuses on the economic contribution of the service provided by the NSR infrastructure, not the value of goods carried by the NSR (nor the costs of constructing the NSR).

The NSR plays a key part in facilitating production processes for Australian industries and enables social and economic activities of the Australian society.

Interstate links on the NH cover 20,022 kilometres across the nation and enables 71 billion vehicle kilometres travelled per day. The KFR covers 14,635 kilometres and enables 24 billion vehicle kilometres travelled per day.

Queensland and Western Australia have on average a higher proportion of safer roads. In contrast, Northern Territory and Tasmania have on average a lower quality NH. Road quality information is not available for NSR.

The direct economic contribution of NSR in 2010-11 was $7.5 billion for the NH in 2010-11; and $1.9 billion for the KFR.

The direct economic contribution is projected to rise to $12.1 billion in 2030-31 for the NH; and $3.5 billion for the KFR (under the Baseline scenario).

The projected growth in the direct economic contribution of the NH is slightly lower than the projected growth in GDP while the projected growth rate of the KFR is greater than projected GDP growth.

This is because the outlook for the NH is shaped by light vehicle utilisation growth which is driven by population growth and heavy vehicle utilisation growth which is projected to be lower due to the increased productivity of heavy vehicles. The increased productivity of 'trucks' means that the NH is absorbing the increased freight task through improved efficiency (that is, fewer trucks are needed to move more freight tonnage on the national highway). However, for the KFR, the higher than projected GDP growth is primarily a result of the different calculation method for the KFR maintenance costs compared to the NH. This difference in methodology makes the growth of KFR less directly comparable with the economic parameters (e.g., GDP).

The economic contribution of the NSR is projected to grow at a slower rate than other transport infrastructure services (i.e. port and rail infrastructure services) in the economy. This is because these other transport infrastructure services sectors are expected to benefit from exogenous demand growth factors (i.e. export demand for minerals) as these sectors more directly support the export of bulk commodities.

Sensitivity analysis was carried out to examine how the projections change because of changes in projected population growth or other economic parameters. The direct economic contribution of the NH is projected to be $12.8 billion in the Higher population scenario and $12.1 billion in the Higher productivity scenario for 2030-31; and is projected to be $3.7 billion and $3.5 billion respectively in the Higher population scenario and Higher productivity scenario for KFR. The Higher productivity scenario produces only a marginally higher economic contribution for the KFR compared to the Baseline scenario as the additional transport task is absorbed by higher road transport productivity.

8.1 Nationally significant roads in scope

This chapter presents the direct economic contribution (DEC) of nationally significant roads and discusses its underlying economic driver.

The nationally significant roads (NSR) comprise:

- national highway (NH)
- key freight routes (KFR).

These two categories of roads were selected due to their significance to the Australian transport network.

National highway

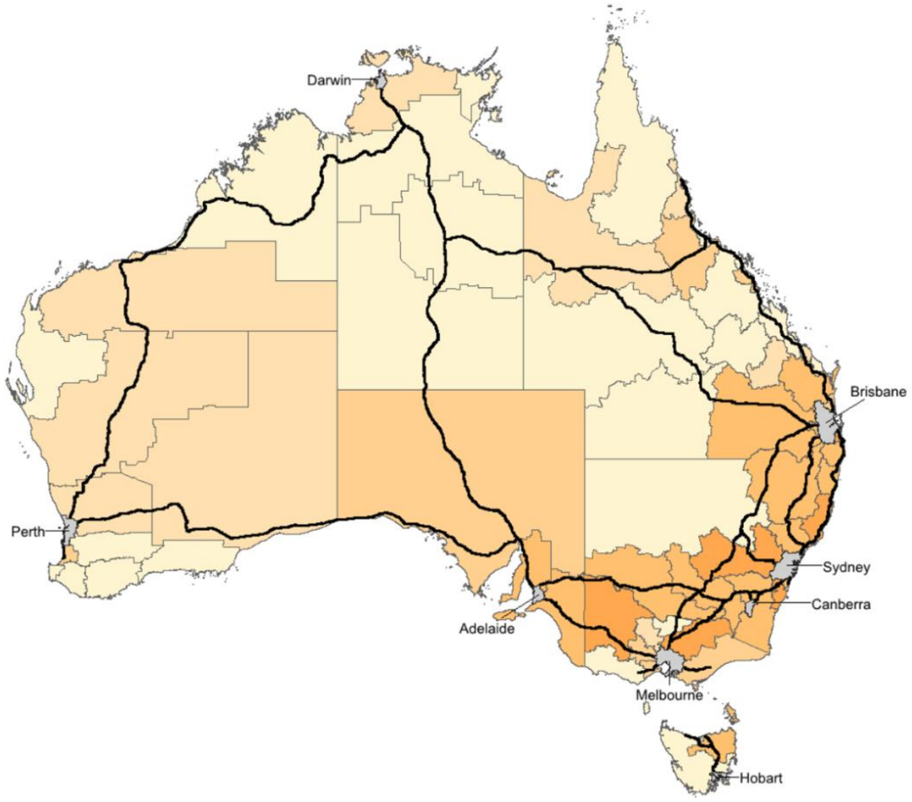
The conventional definition of the National Highway System comprises roads that have specifically been declared to be NH by the Commonwealth government. Since 1974, various Acts defined NH as roads, or a series of connected roads, that were the primary connection between two state or territory capital cities, as well as between Brisbane and Cairns, and between Hobart and Burnie.

The current official definition of NH is as defined in National Land Transport Network (NLTN), by the Bureau of Industry, Transport and Regional Economics (BITRE 2013) in the *Australian Infrastructure Statistics Yearbook 2013* and other publications.

The NLTN is a single integrated network of land transport linages of strategic national importance. The NLTN is based on national and inter-regional transport corridors including connections through urban areas, links to key roads, rail, ports and airports.

For the purpose of the Australian Infrastructure Audit (AIA), the NH includes the NLTN but excludes links that fall into the capital cities of all states. This is to avoid double counting for these road links as they will be captured as part of the urban transport sector of the Audit. The NH which this Audit refers to is shown in Figure 80

Figure 80 **Map of the National Highway Network**



Note: The National Highway is comprised of NLTN non-urban interstate corridors and road links.
Source: ACIL Allen Consulting based on GeoScience Australia.

Key freight routes

Key freight routes were included at the request of State and Territory governments. These roads were chosen based on the State and Territory governments' judgment of their importance to the transport network. A large proportion of the KFR play important roles in facilitating industrial production by connecting industrial sites and export points (e.g., connecting a mine to a port).

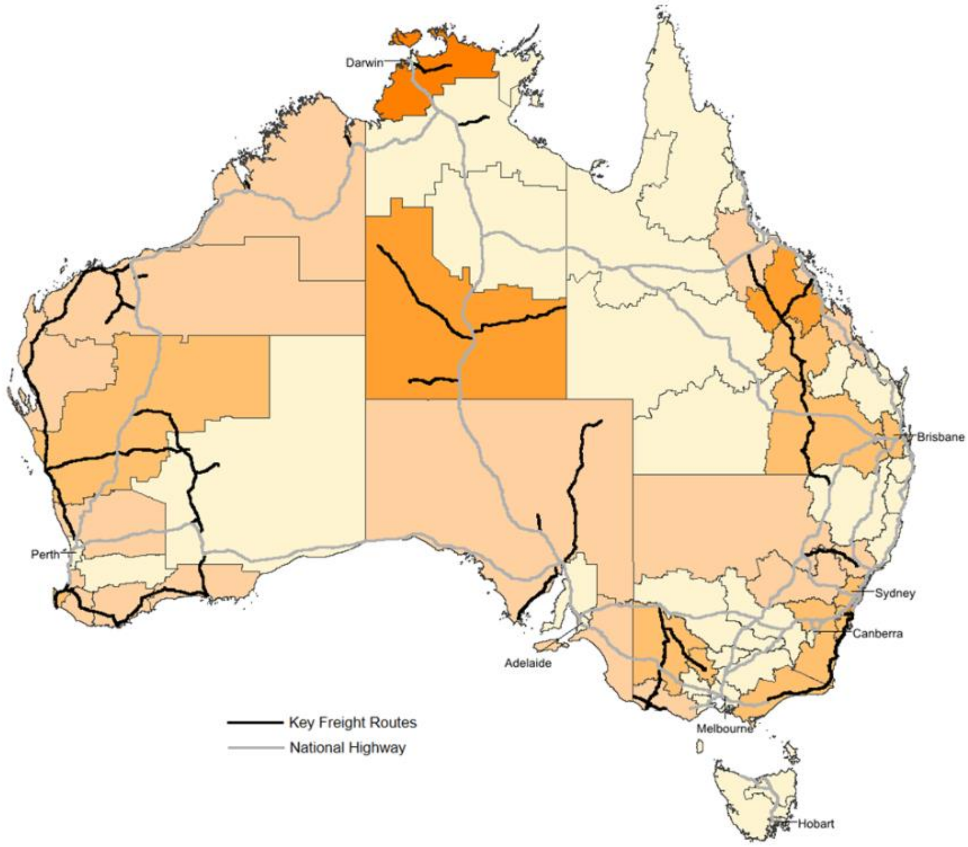
Most of these KFR are not in the capital cities. Only three KFR fall in the audit regions that are part of the urban transport analysis. In these three cases, there is double counting. However, this is insignificant and these KFR only account for 1.2 per cent of the total KFR in length. These KFR are listed in the road capacity audit section of this report.

Overall, the KFR are roads that bear significant traffic and play a pivotal role in facilitating intra-regional (or state) economic activities. This purpose is slightly different to the NH, the purpose of which is mainly to connect the key cities (and states). It needs to be noted that KFR exhibit a higher reliance on heavy vehicles relative to other local roads (e.g., rural roads and other suburban roads that are not included in this audit given their relatively lower level of traffic). The NH, however, carries both a higher volume of passenger and freight traffic than the KFR.

In addition to facilitating freight transport, KFR also support passenger travel. As for roads in general, passenger traffic is a higher share than heavy vehicles for the KFR.

The key freight routes selected are mapped in Figure 81.

Figure 81 **Map of the Key Freight Routes Network**



Note: The KFR are selected by State and Territory governments based on their judgement of the importance of the roads.
Source: ACIL Allen Consulting based on GeoScience Australia.

Scope of this analysis

This audit focuses on the economic contribution of the service provided by the NSR (NH and KFR) infrastructure. In other words, this audit measures the willingness-to-pay for using the NSR services by the road users. This is not to be confused with the value of goods carried by the NSR infrastructure or the costs of constructing the NSR.

The NSR plays a pivotal role in the economic and social activities of the Australian community. It facilitates the production process and enables the business and community to travel between key Australian cities. The efficiency of the NSR is critical for the international competitiveness of the Australian industry and the wellbeing of the Australian community.

This audit aims to address the gap in information that traditionally exists in the road transport sector by estimating the DEC of the NSR. Infrastructure Australia stated[22] that there is a lack of identification for roads and some descriptions of national facilities or networks lack credibility because they omit major locations such as Chullora or Newcastle. Attempts to identify NSR in the past have largely been for the purposes of funding by the Australian Government (e.g., the NH and Auslink programs were designed to identify important roads for Commonwealth funding). This audit does not estimate the DEC for all roads (and audit regions) in Australia given its focus (emphasis on NSR that does not fall in the capital cities).The audit's output granularity (e.g., link or audit region level data) will aid understanding of the economic contribution of the NSR to the Australian economy.

[22] Infrastructure Australia. State of Play Report. 2013

Projections for the DEC to 2030-31 are based on different growth scenarios to identify areas where future investment is needed to meet the economy's demand for the NSR. The Audit aims to provide valuable insights for future policy and investment decision-making.

8.2 Nationally significant roads in Australia

8.2.1 The significance of nationally significant roads to Australia

The NSR in Australia plays an important role by:

- facilitating the production processes for industry
- enabling activities of both business and the community.

Facilitation of production processes

A region's industrial and employment base is closely tied to the quality of the transportation system. Efficient and dependable transportation infrastructure allows businesses to receive inputs at their production facilities and to transport finished goods to market in an efficient manner. An efficient transportation system also allows business to lower their transportation costs, which lowers production costs and enhances productivity and profits.

Australia's dispersed population and production centres makes the efficiency of its inter-regional transport vital to the country's economic performance. One of the key parts of the inter-regional transport is the NH. It connects all mainland states and territories of Australia, including the nation's largest and most important cities. The KFR, on the other hand, plays an important role in facilitating intra-regional travel (e.g., connecting a mine to an export point such as a port).

Efficient and high quality NSR enables firms to ship goods more cheaply (through more direct routes and safer trips) and to improve service quality (as delivery schedules become more reliable). Subsequently, more timely and reliable deliveries allow firms to use the NSR routes to minimise their stationary inventories, thereby reducing inventory and storage costs and enhancing productivity.

Collectively, this translates into higher productivity for the nation as a whole. With Australia's freight task (in tonnes) expected to double[23] between 2010-11 and 2030-31, it is essential to have a well-planned and sustainable freight network in Australia, of which the NSR is a significant component.

Like other infrastructure sectors, the NSR is also a facilitator for other sectors in the economy and has a direct impact on the productivity of other sectors through their use of the NSR services, mainly through freight movements. The economy used \$26 billion[24] worth of road transport services as inputs in 2009-10 for the delivery of intermediate materials and final output, of which approximately 96 per cent[25] is estimated to be attributable to NSR transport (of which 52 per cent attributable to NH and 44 per cent attributable to KFR in

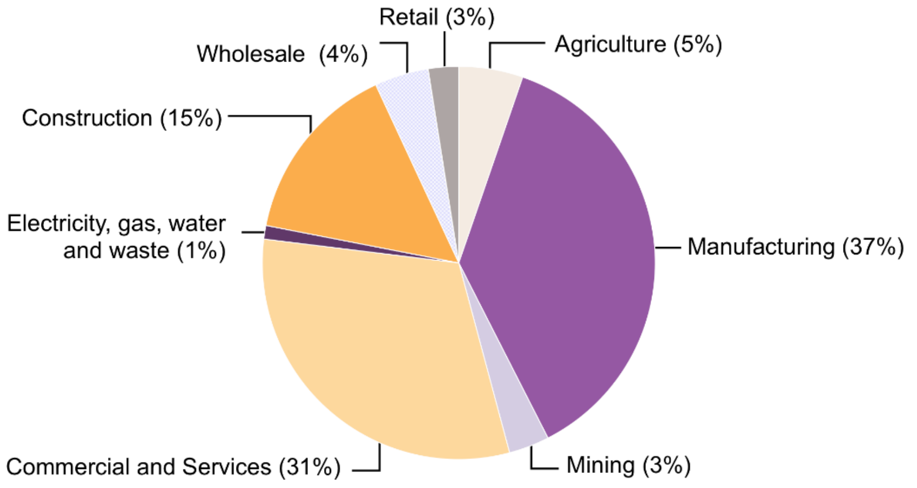
[23] NSW Long Term Transport Master Plan, 2012.

[24] Australian National Accounts 2009/10 (series number: 5209.0.55.001). It needs to be noted that this referrers to total road transport, a proportion of which is related to the NSR.

[25] This is an estimate (measured in tonne kilometers) based on Australian Bureau of Statistics publication 'Freight movement' (series number: 9220.0) in 2002. Interstate road freight (in tonne kilometers) is used as a proxy for freight carried by the NH; intrastate road freight excluding within-capital-city movements is used as a proxy for freight carried by the KFR. Actual data on the NH and KFR measures are scarce.

tonne kilometre terms). Each industry's use of road transport as a proportion of total road transport[26] as inputs is shown in Figure 82.

Figure 82 **Use of road transport by sector**



Source: Australian National Accounts 2009-10 (series number: 5209.0.55.001)

There is a degree of competition between road freight and rail and between water and air freight for long distance interstate freight transport[27]. The road fright sector dominates[28] the Australian market for non-bulk freight (e.g., containerised goods such as Fast Moving Consumer Goods), leveraging advantages in price, speed, convenience and reliability. Therefore, the Australian NSR is critical infrastructure that facilitates Australia's non-bulk freight tasks.

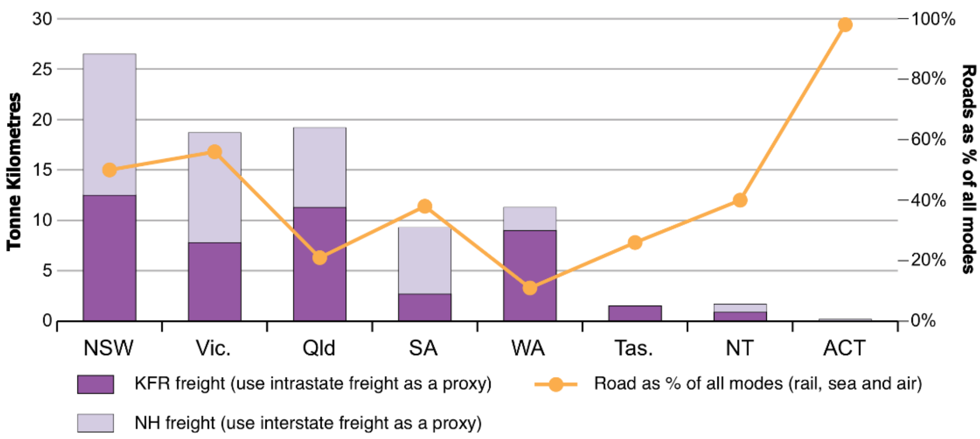
The estimated tonne kilometres carried by NSR (broken down by NH and KFR using proxies) and share of the NSR as a percentage of total freight services (road, rail, sea and air) is in Figure 83.

[26] It needs to be noted t hat this referrers to total road transport, a proportion of which is related to the services provided by NSR. This is used as an indicative measure for the use of national highway by sector, for which data is scarce.

[27] BITRE: National road network intercity traffic projections to 2030.

[28] IBIS World Industry Report 14610: Road Freight Transport in Australia, April 2014.

Figure 83 **Nationally significant roads freight task and share of total transport modes**



Source: The interstate and intrastate tonne kilometres are used to proxy the freight tasks carried by the NH and KFR respectively. The estimated KFR freight task may include some trips that falls into the urban areas (e.g., capital cities); limited data is available to separate this urban component from the intrastate estimate. Data uses Australia Bureau of Statistics publication 'Freight movements' in 2002 (series number: 9220.0, page 15).

Enabler of business and community activities

The NSR play a pivotal role in the business and community activities of the Australian people. Due to limited data and the difficulties in quantifying its value added associated with these non-production activities, the importance of the Australia's nationally significant road infrastructure SNR is usually overlooked in this space.

The number of Australians using private vehicles for interstate travel can provide an indication of the importance of the NSR - mostly for the NH with some KFR travel where the KFR infrastructure spans across states. Pure passenger use of KFR cannot be estimated (or proxied) due to the lack of data. Interstate private vehicles travel (as a proxy for private use of NSR) enabled over 10 million trips[29] 2012-13, making up 37 per cent of total interstate trips (compared to 55 per cent by air transport and 9 per cent by other transport). Private vehicle trips[30] to each state compared to air and other transport for interstate travel is shown in Figure 84. The cost associated with road transport makes up 12 per cent of total travel expenditure (which includes accommodation).

Given the importance of the NSR to the Australian economy, understanding the economic contribution of the NSR to the Australian economy by audit region is invaluable. Determining its contribution at the level of the audit regions assists with identifying areas within the NSR which are efficient and those possibly requiring increased investment.

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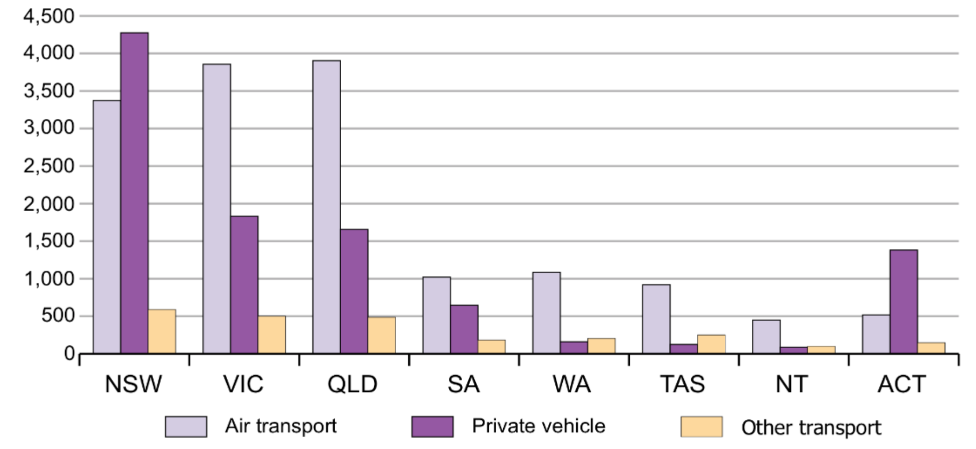
[29] June 2013 quarterly results of National Visitor Survey by Austrade.

[30] It needs to be noted that this method as a proxy for private use of national highway is likely to underestimate the contribution of national highway as the interstate visitor data used only counts over-night visitors and thus omits day-return visitors.

Figure 84 **Interstate private vehicle trip compared to air and other transport by state/territory (as destinations)**



Source: June 2013 quarterly result of National Visitor Survey by Austrade.

8.2.2 Drivers of demand for nationally significant roads

Two purposes of the NSR (facilitating industrial production and enabling household business and community activities) drive two different types of demand for the NSR:

- demand by heavy (freight) vehicles (for the former purpose) and
- demand by light vehicles (for the latter purpose).

Given the differences, the demand drivers for heavy and light vehicles are discussed separately.

Heavy vehicle transport demand

The demand for heavy vehicle transport is driven by trade where input materials and final products are transported to production sites and consumption or export points. That is, the volume of goods held and in transit in the Australian economy (the outputs produced in the economy)[31].

Given that the fundamental driver for heavy vehicle transport demand are the outputs produced in the economy, forecast annual Gross Domestic Product (GDP) growth can be used to indicate the growth in demand for heavy vehicle transport. Using a consensus forecast[32] of an annual GDP growth rate of 3 per cent from 2014 onwards with a base of 2.5 per cent (in 2014), this indicates that GDP in 2031 is 1.6 times bigger than that in 2014. BITRE[33] projects the total national road freight task will be 1.8 times larger in 2030-31 compared to 2010-11.

In addition to GDP growth the demand for heavy vehicle transport is also a function of heavy vehicle productivity for a given amount of goods to be delivered.

Heavy vehicle productivity represents the load (in tonnes) a truck can carry for a given trip. Higher productivity means fewer trips need to be made to deliver a fixed quantity of goods.

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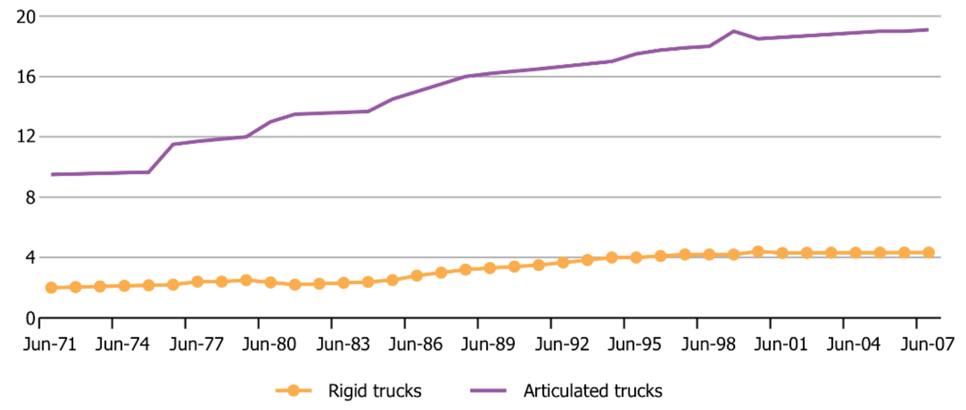
31 IBIS World Industry Report 14610: Road Freight Transport in Australia, April 2014.

32 Average from multiple sources such as the Australian Treasury and BIS Shrapnel.

33 BITRE. Freightline 1. 2014. This audit estimates a growth factor of 1.6 for national highway transport from 2010-11 compared to the 1.8 by BITRE. The difference can be partly explained by the different categories of road transport the two sources refer to – BITRE studied road freight while this audit focuses on the national highway subset of road transport and include both passenger and freight.

In other words, it allows the freight industry to 'do more with less'. Truck productivity has grown steadily through 1970s to mid-1990s and has slowed afterwards as shown in Figure 85.

Figure 85 **Truck productivity 1971 – 2007**



Source: BITRE – Road Truck Productivity, 2008.

Recent data[34] confirms that the gains in truck productivity from technological developments are petering out.

Technological productivity gains stem from innovation in engineering which has increased truck size, thereby allowing higher tonnage carriage. This has been enhanced by road engineering improvements, such as smoother curving and stronger pavements, which have also enabled heavier trucks to travel more safely on the NSR. This development has helped to reduce the number of crash-related costs. Growing trends in the adoption of just-in-time delivery by business in the recent decade has reduced storage and inventory costs while also increasing the demand for more productive trucks and a higher quality NSR. Given this, truck productivity is expected to continue to grow in the decades ahead, but at a slower rate.

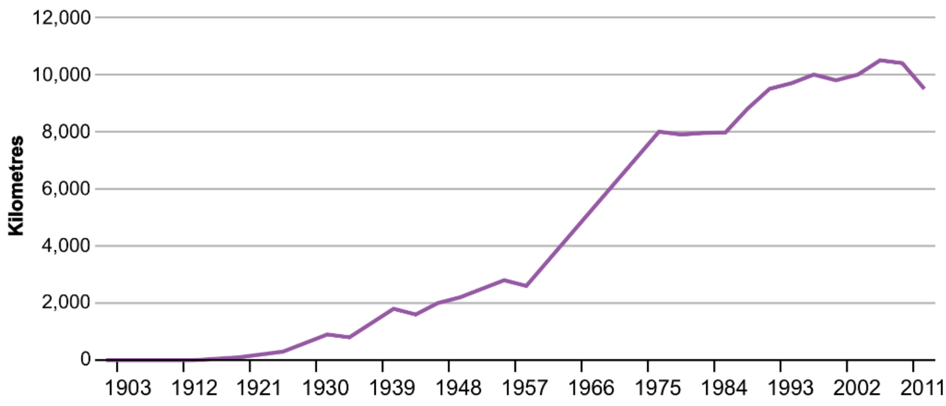
Light vehicle transport demand

Light vehicles primarily travel on the NSR for business or community activities by Australian households. This type of travel can be decomposed into kilometres travelled per person and population.

Kilometres travelled per person grew strongly until the early 1980s and slowed down throughout the 1090's and 2000's. Since 2005, kilometres travelled per person have fallen as shown in Figure 86.

[34] IBIS World Industry Report 14610: Road Freight Transport in Australia, April 2014.

Figure 86 **Kilometres travelled per person**



Source: BITRE – Traffic Growth in Australia, 2012.

The falling trend in kilometres travelled per person since 2005 can be explained[35] by private vehicle ownership saturation, higher fuel prices and stagnating real household income. This trend is expected to continue over the next decade due to saturating private vehicle ownership that has been experienced by most developed countries.

Another demand driver of light vehicle travel is population. Population is projected to grow steadily by most of the demographic forecasting agencies (e.g., Australia Bureau of Statistics). Population growth is expected to be strong in all Australian states except for New South Wales.

Given the diminishing trend in kilometres travelled per person, the growth key driver for light vehicle transport demand is expected to be population in the coming decades.

8.2.3 Regulatory, policy and governance context

Funding

Funding for the National Highway

In 1974, the Commonwealth Government declared a series of capital city road links (with new links added to the network over time) as NH and provided funding to them (to the state governments as grants) till 2005[36]. During this period, the Commonwealth Government fully funded all maintenance, rehabilitation and construction for the NH (except for Westlink M7 which was formally known as the Western Sydney Orbital). The M7 is a toll road funded, built, and operated under a public-private partnership.

From 1 July 2005, the Commonwealth's funding of the NH was replaced by the Auslink funding program. Auslink funds the NH as part of a national link, which is a strategic interstate route that connects all major ports, airports and freight distribution centres.

Auslink consists of a rolling system of five-year funding commitments. The Commonwealth will work with the respective state and local governments to nominate the routes and projects on these routes to be funded.

35 BITRE: Traffic Growth in Australia, 2012.

36 Australian National Audit Office. Management of National Highway System Program, 2001.

The Commonwealth Government has indicated that it will continue to fund the existing NH links in 2005.[37] This is mainly through the road-related taxations and charges the Commonwealth government collects such as the excise on fuel. However, the Commonwealth Government also encourages funding from other parties, including state, territory and local governments and public–private partnerships. For example, the Pacific Highway and the Calder Highway are now part of the National Network, but new projects are being funded 50/50 by Commonwealth and state/territory governments. The NH is toll-free. State and Territory governments are not able to levy tolls on routes declared to be NH without the consent of the Minister.

Commonwealth funding for the national link, a subset of which is the NH, between 2008 and 2013 is provided in Figure 87.

Figure 87 **Commonwealth funding for the national link[38] (incl. NH) for period 2008-09 – 2013-14 ($ millions)**

Source: Road Safety Committee – Inquiry into Federal – State road funding arrangements.

Other government funding programs also have implications for the NH. For example, the National Black Spot Program by Auslink[39] provides funding to improve poor quality roads likely to cause accidents. This funding has resulted in safety-related upgrades of the identified NH.

AUSRAP[40] introduced road safety Key Performance Indicators (KPIs) such as the 'Engineering Safety Star Ratings' for each of the links on the national highway to track performance of the highway and inform investment decisions. The star rating system rates the NH from 1 star (lowest quality road) to 5 stars (highest quality road) as an indicator for the safety of driving on the NH. These safety related initiatives (e.g., star ratings) have economic benefits as they help to reduce the costs to the economy (e.g., crash costs to vehicles and goods carried) and community (e.g., lost productivity and human lives) from road trauma. This Audit reports the star ratings for each of the links on the NH.

37 Department of Parliamentary Services. Auslink Bill 2004.

38 This chart is for the national link as a whole, a subset of which is the NH. Individual NH data is not available. The national link includes the NH network along with all key air ports, ports, and railway connecting the capital cities.

39 Australian Government Budget 2005-06.

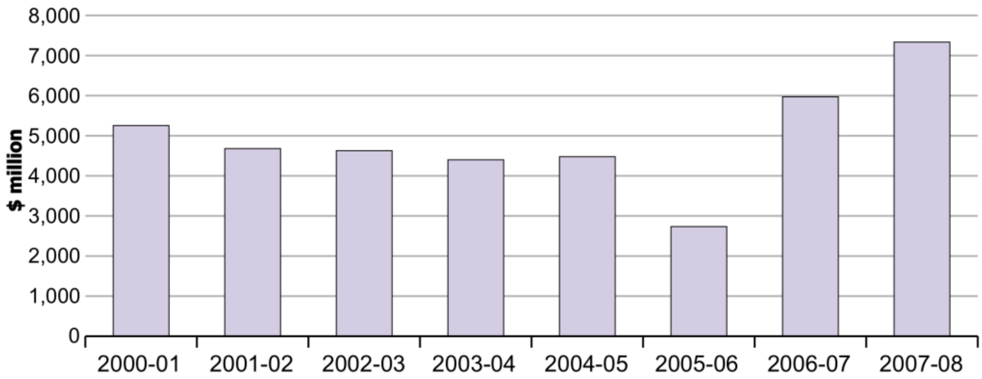
40 AUSRAP. Australian road assessment program – how safe are our roads (rating Australia's National Network for risk)? 2011.

Funding for Key freight routes

The funding arrangement of the KFR is less systematic compared to the NH. This is partly due to the selection of these KFR is primarily based on the individual State and Territory governments' judgement (of the importance of the roads). As a result, the KFR are made up of roads of varying characteristics and have different management and funding systems. In contrast, NH is a nationally declared system of roads and has clearly defined funding arrangement across different levels of jurisdictions.

Despite the scatter of the KFR and their funding arrangements, a vast majority of them are funded by the State and Territory governments. Figure 88 shows the state funding for roads for Australia (at national level) from 2001-02 to 2007-08, a subset of which is the funding for the KFR. It is not possible to separate the pure funding for KFR from total road funding due to limited data. Maintenance cost is on average 15 per cent of total road funding at national level.

Figure 88 **State funding for the roads[41] (incl. KFR) for period 2001-02 – 2008-09 ($ millions)**



Source: Road Safety Committee – Inquiry into Federal – State road funding arrangements.

Regulation

Most of the regulations related to the NSR are around vehicle-targeted national safety standards such as speed limits and Higher Mass Limits (HML) for heavy vehicles. Most of these vehicle-targeted regulations apply to all road types although detailed rules may differ depending on road. For example, different HMLs apply depending on the quality of particular roads, rather than being specific to the NSR. Some of these measures are likely to change over time. For example, HML have increased in the last decades as a result of higher quality roads (e.g., stronger pavement and smoother curving) and heavy vehicle engineering improvement (e.g., higher configuration vehicles such as B triple and road trains). Increased HML allows trucks to carry higher tonnage and consequently, increase the productivity of road transport.

Curfew regulations apply to some of the NSR links that are located near residential areas. Heavy vehicles are not allowed to operate during night time (hours vary across links) on the part of the links that subject to the curfew regulation.

[41] This chart is for the national link as a whole, a subset of which is the national highway. Individual national highway data is not available. The national link includes the national highway network along with all key air ports, ports, and railway connecting the capital cities.

Going forward, government regulation[42] and strategies around the NSR are likely to evolve to reflect the following:[43]

- treating freight links as part of an integrated cross-modal network (rather than independent modes)
- developing funding methods that reflects the users' willingness to pay and encourage private funding (e.g., Public - Private Partnership)
- increasing efficiency of heavy vehicles by improving Higher Mass Limits (regulated by National Heavy Vehicle Regulator)
- reducing red tape (e.g., deregulation).

8.3 Audit of existing nationally significant roads

8.3.1 Capacity, utilisation and DEC of nationally significant roads

This section reports:

- current infrastructure used to provide NSR transport services
- volume of services supplied/utilised
- direct economic contribution of the NSR infrastructure across Australia.

Metrics on capacity, utilisation and DEC of the NSR at the state and regional level provide an indication of the availability of the NSR to meet expected future demand and to identify future investment priorities.

Capacity of nationally significant roads

Capacity of the National Highway

The capacity of the NH is measured by the length of the NH. The Audit reflects information about the length of the NH derived by the Australian Road Assessment Program (AUSRAP). AUSRAP has examined the NH with a speed limit of 90 kilometres and above, at 100 meter intervals.

The conventionally defined NH connects the major population centres in Australia and runs through 50 of the 73 audit regions. The 15 audit regions which do not have any parts of the NH running through them are primarily located in rural areas such as far west and Orana in New South Wales, far north Queensland and Esperance in Western Australia. The NH links that fall in the capital cities of all states (8 capital cities in total) are included in the urban transport component of the Audit and excluded here to avoid double-counting. Therefore, the NH by the definition of this audit runs through 50 of the 73 audit regions. The Australian Capital Territory does not have any highway links in this part of the Audit because they are included in the urban transport part of the AIA).

The length of NH by audit region is shown in Figure 89.

The NH covers 20,022 kilometres across the nation. The capacity of the NH by state/territory is shown in Figure 90. Remote regions such as Queensland and Western

42 National Transport Commission. Performance Based Standards – COAG Decision Regulation Impact Statement – Standing Council on Transport and Infrastructure. 2011.

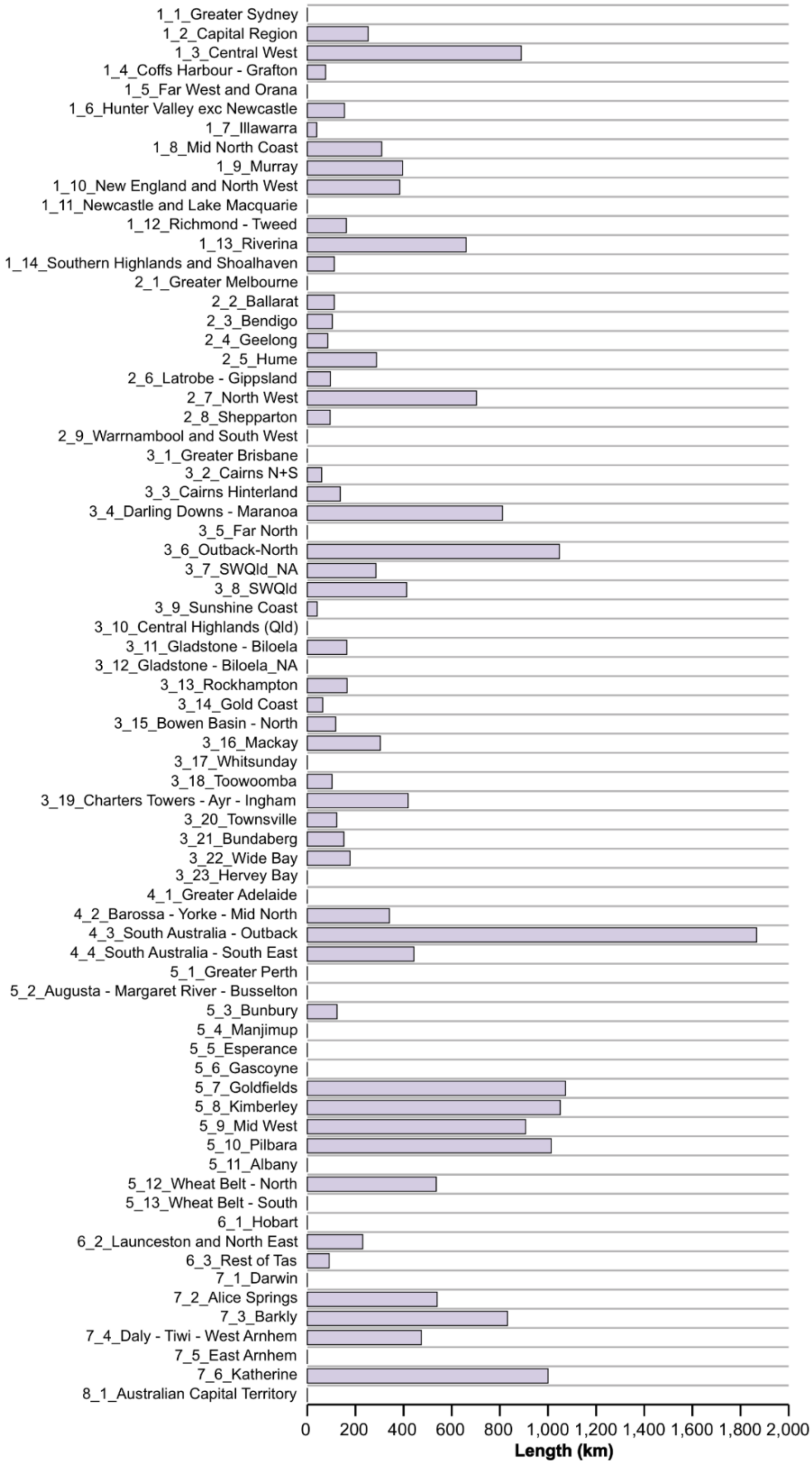
43 National Transport Commission. Heavy Vehicle National Law: Regulation Impact Statement. 2011.

Australia have the longest NH, followed by New South Wales. Smaller states like Tasmania have the shortest NH.

The cause for a region exhibiting zero capacity is either:

- that the NH does not run through that audit region;
- that the NH runs through an audit region which is included in the urban transport audit component of this review.

Figure 89 **National Highway length by audit region in 2010-11 (kilometres)**



Note: Capacity=0 for capital city audit regions for the NH because these links are included in the urban transport component of the AIA. This is to avoid double counting.

Source: ACIL Allen Consulting, 2014

Figure 90 **National Highway capacity by state/territory in 2010-11 (kilometres)**

Source: ACIL Allen Consulting, 2014

Capacity of Key freight routes

As for the NH, the capacity of the KFR is measured by the length of the KFR. The length information for the KFR is obtained from a variety of sources, including jurisdiction level publications (Queensland, Victoria, and Northern Territory), consultant reports (Northern Territory partially) and measured road length using Google Earth (New South Wales, South Australia and Western Australia). Detailed data sources are documented in the methodology section in the Appendix.

The KFR were selected by the State and Territory governments based on their judgement of the roads considered to be significant to the transport network, especially freight network. The selected KFR routes cover 40 of the 73 audit regions. Audit regions with zero capacity means no KFR ran through these audit regions.

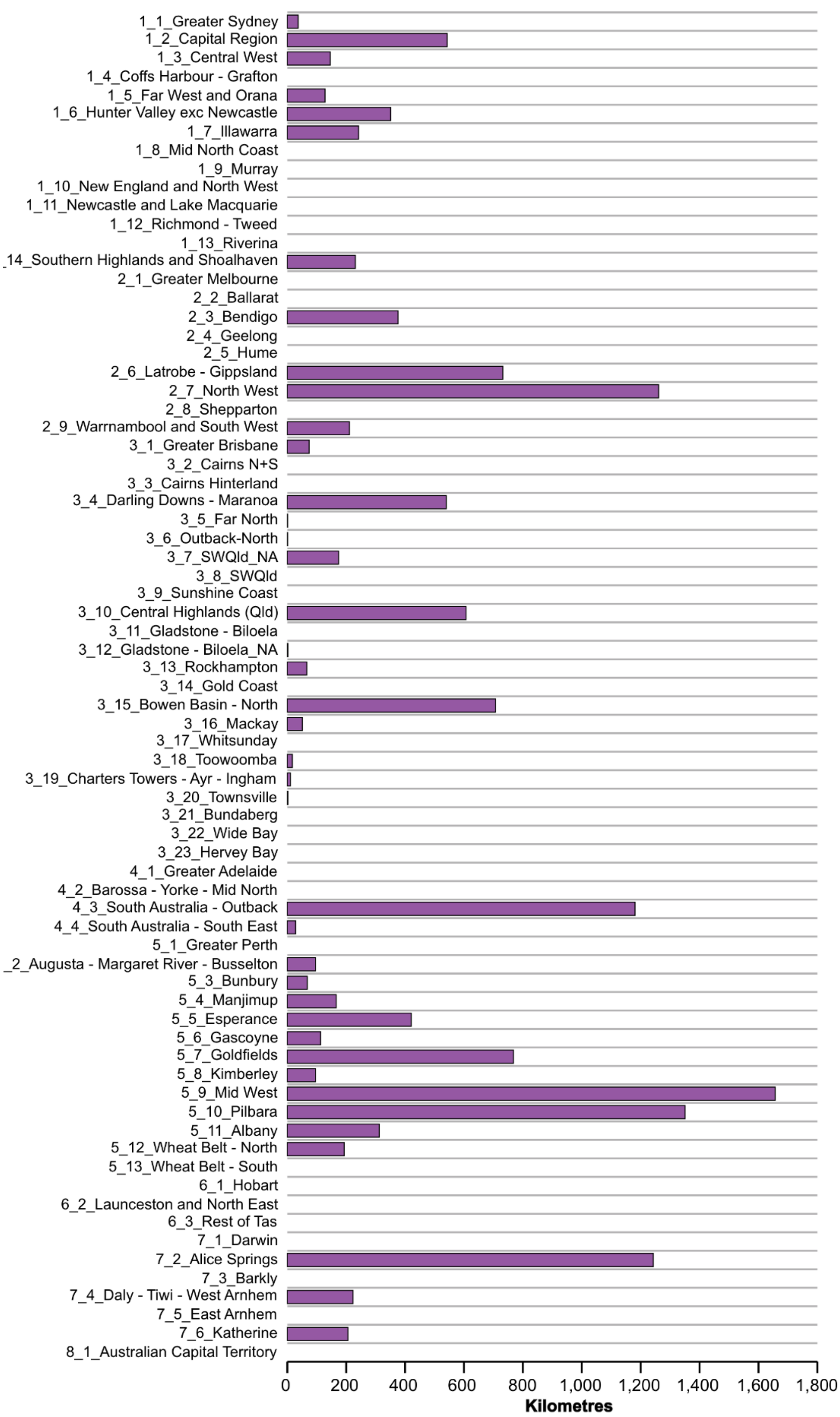
Most KFR are roads outside the key urban centres (as urban roads are analysed separately in the urban transport component of the Audit) except for the Greater Sydney and Greater Brisbane audit regions. The routes listed in Table 27 are those which fall in the audit regions that are part of the urban transport analysis; and therefore, exhibits double counting. However, given the relatively small impact of these routes (a combined 1.5 per cent of the total KFR in length despite larger in utilisation that will be discussed later on), this audit has decided to include these routes in this NSR audit to retain a fuller set of roads that has been selected by the State and Territory governments.

Table 27 **Key freight routes falling in capital city audit regions**

Name of road (section belongs to)	From	To	Audit region
Cunningham Highway	Warwick	Maryvale	Greater Brisbane
Hume Highway	Wollongong	Wilton	Greater Sydney
Princes Highway	Sutherland (Loftus)	Helensburgh	Greater Sydney

The length of KFR by audit region and state are shown in Figure 91 and Figure 92 respectively. The KFR covers 14,635 kilometres across the nation. As expected, states with major export points such as nationally significant ports (e.g., Western Australia and Victoria) have longer KFR to facilitate the export activity.

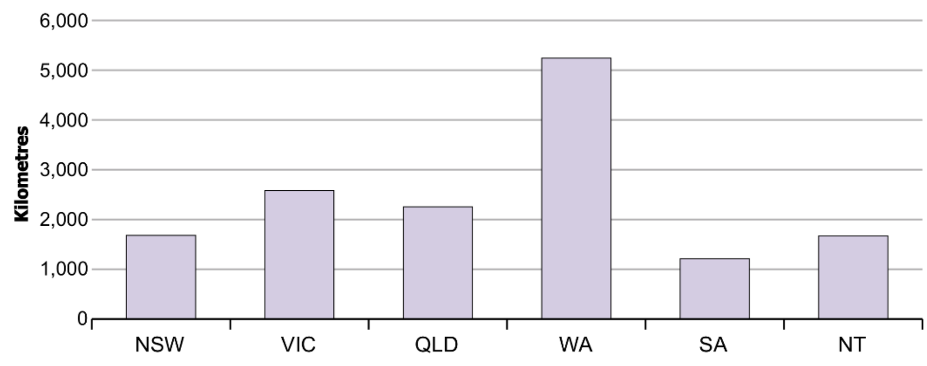
Figure 91 **Key freight routes length by audit region in 2010-11 (kilometres)**



Note: Capacity=0 for audit regions where no KFR were selected by the State and Territory governments.

Source: ACIL Allen Consulting, 2014

Figure 92 **Key freight routes capacity by state/territory in 2010-11 (kilometres)**



Source: ACIL Allen Consulting, 2014

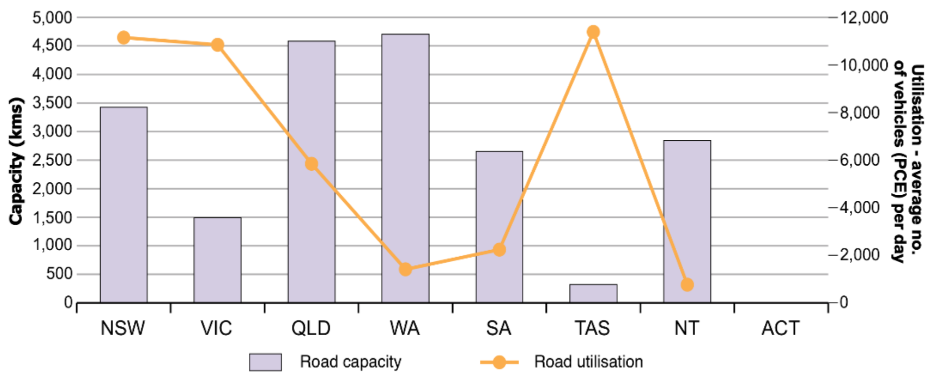
Utilisation of NSR

Utilisation of NH

Utilisation of the NH is measured in average daily traffic level per kilometre, or vehicles kilometre per day. Across Australia, the average traffic level was estimated to be 2,602 light vehicles and 948 heavy vehicles per day per kilometre. This gives a total traffic of 71 billion vehicle kilometres travelled per day.

Figure 93 maps the utilisation of the NH against its capacity. As expected, densely populated states such as Tasmania, New South Wales and Victoria have a higher utilisation of the NH compared to the more sparsely populated state like South Australia and Western Australia. Tasmania has a less developed passenger rail network compared to the other states, which also is likely to contribute to its residents' higher reliance on motor vehicles as a means of travel.

Figure 93 **National Highway utilisation against capacity by state/territory in 2010-11 (kilometres)**

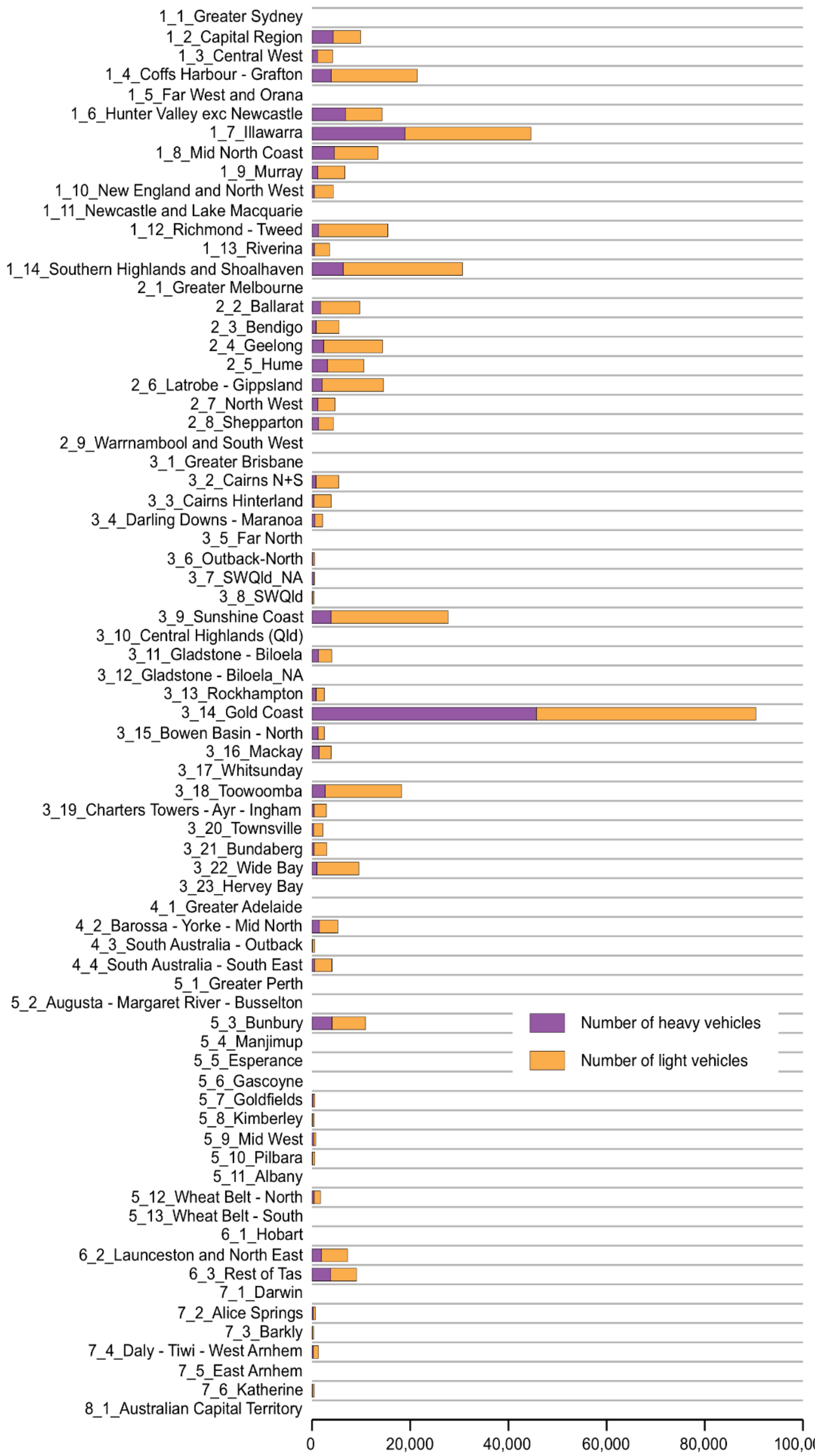


Note: Passenger Car Equivalent (PCE) factor is 2.5 here, which means 1 heavy vehicle is equivalent to 2.5 passenger cars.

Source: ACIL Allen Consulting, 2014

The utilisation of the NH by audit region is shown in Figure 94. It indicates that the Gold Coast has the highest traffic for both light and heavy vehicles followed by Illawarra. These are key urban areas (after the major capital cities) and therefore, have higher traffic volumes running through them. Pilbara is traditionally regarded as an economically significant region but shown to have small traffic in terms of the number of vehicles per kilometre. This is because the NH does not run through the key routes (around the ports) that carry the majority of the economic activities.

Figure 94 **Number of vehicles per kilometre for the National Highway by audit region in 2010-11**



Note: The number of vehicles for capital city audit regions for the NH is zero because these links are included in the urban transport component of the AIA.

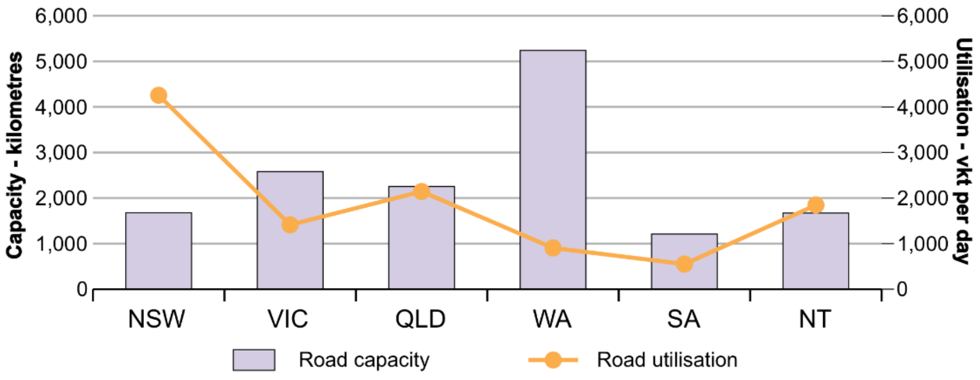
Source: ACIL Allen Consulting, 2014

Utilisation of Key Freight Routes

Utilisation of the KFR is also measured in average daily traffic level per kilometre, or vehicles kilometre per day. The sources for the traffic count data are from each jurisdiction's publications on traffic information. Detailed data sources are documented in the methodology section in the Appendix.

Utilisation by state and audit regions is presented in Figure 95 and Figure 96 respectively. Across Australia, the average traffic level was estimated to be 1,339 light vehicles and 309 heavy vehicles per day per kilometre. This gives a total traffic of 24 billion vehicle kilometres travelled per day. Utilisation tends to be higher in states where there are larger urban centres (e.g., New South Wales) that are usually associated with higher traffic.

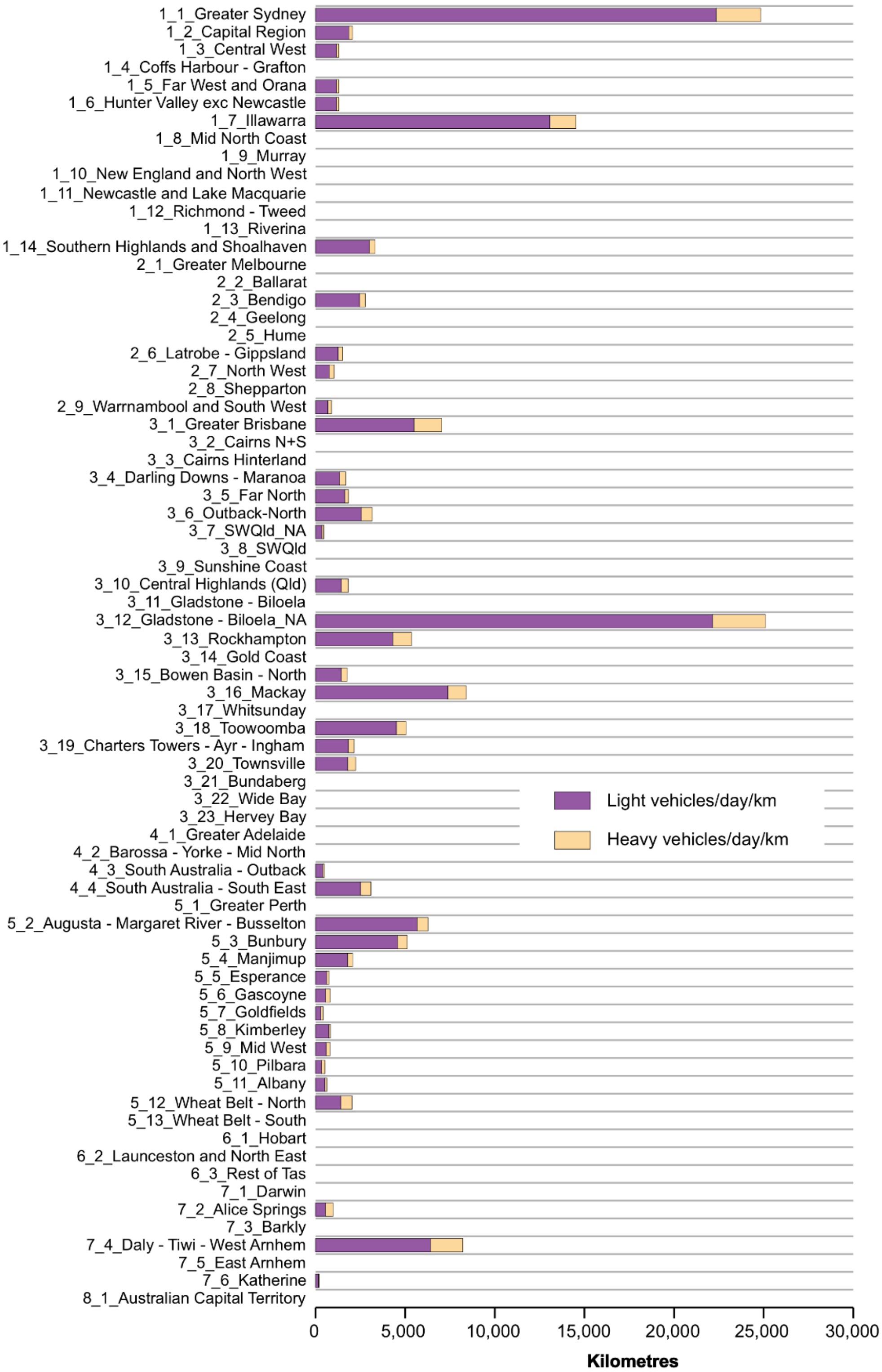
Figure 95 **Key Freight Routes utilisation against capacity by state/territory in 2010-11 (kilometres)**



Note: Passenger Car Equivalent (PCE) factor is 2.5 here, which means 1 heavy vehicle is equivalent to 2.5 passenger cars

Source: ACIL Allen Consulting, 2014

Figure 96 **Number of vehicles per kilometre for Key Freight Routes by audit region in 2010-11**



Note: Audit regions with zero utilisation are due to no routes in those audit regions were selected as KFR.

Source: ACIL Allen Consulting, 2014

Direct economic contribution of NSR

Direct economic contribution of National Highway

The total DEC generated by the NH was $7.5 billion in 2010-11. The DEC for the NH by state/territory in 2010-11 is shown in Figure 97.

Figure 97 **National Highway DEC by state/territory in 2010-11 ($millions)**

Source: ACIL Allen Consulting, 2014

The estimated DEC is a function of:

- value of goods and services produced
- less the value of inputs used in production.

In contrast to many other road infrastructure services, the NH is not subject to a direct user charge (that is, a toll). The value of usage is estimated using economic techniques. The value road users obtain from the use of the road is estimated by calculating the shadow toll.

The shadow toll comprises costs that road users have incurred when using the road. It shows what they actually have paid in terms of their own costs when they make a decision to use the highway. Shadow tolls for road users include:

- vehicle operating costs (VOC)
- travel time (TT).

Similar to other infrastructure services, it is necessary to subtract the cost of other inputs from the gross output estimate in order to obtain an estimate of gross value added. In the case of the NH, the intermediate inputs consumed through the use of roads can be measured in terms of:

- the goods used in production, which is essentially VOC
- road maintenance costs (RM).

The DEC for NH is thus obtained by:

DEC= VOC + TT – VOC – RM

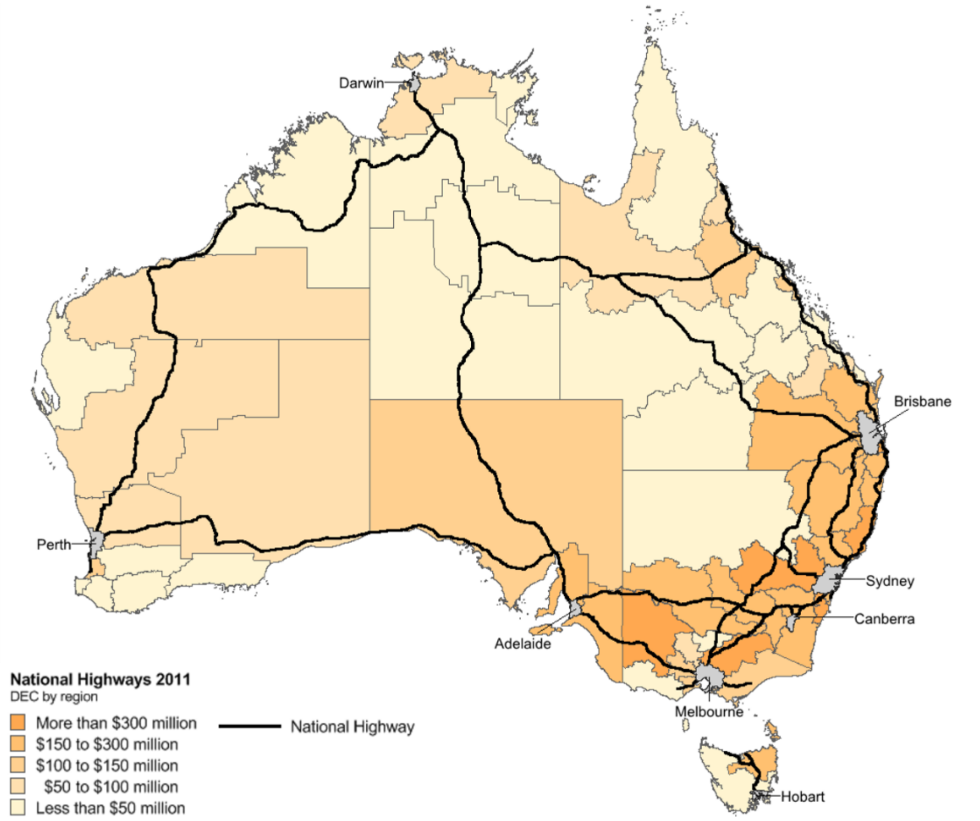
VOC cancels out leaving:

DEC = TT – RM

The economic contribution of the NH in New South Wales in 2010-11 is the highest at $2.9 billion in 2010-11. This accounts for 38 per cent of the Australia-wide DEC of the NH. The economic contribution of the NH in the Northern Territory is the lowest with a DEC of around $167 million.

Figure 98 maps the DEC of the NH across Australia in 2010-11.

Figure 98 **National Highway DEC across Australia in 2010-11**



Note: DEC=0 for capital city audit regions for the NH because the DEC for these links are included in the urban transport component of the AIA. This is to avoid double counting.

Source: ACIL Allen Consulting, 2014

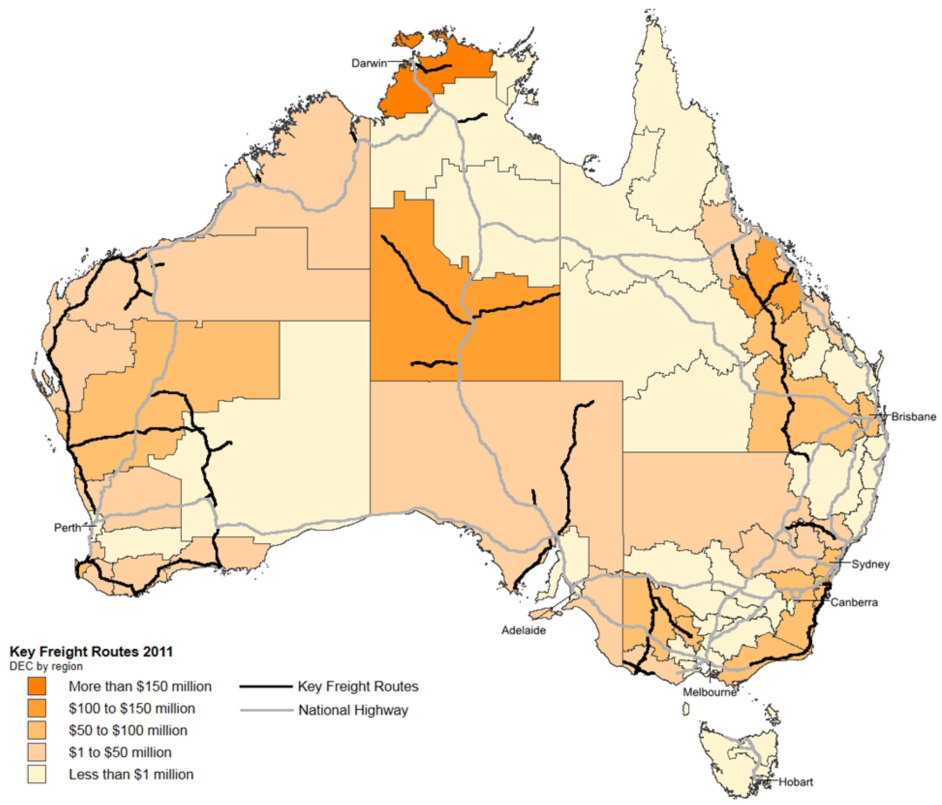
The Gold Coast audit region had the largest DEC in 2010-11, followed by the Mid North Coast and Central West in New South Wales. This is partly due to these regions being populated centres (or closer to populated centres) and the higher capacity of NH in these regions (with increased traffic flowing through them). The NH DEC for capital city audit regions is zero because the DEC for these links is included in the urban transport component of the AIA. This is to avoid double counting in the AIA.

Direct economic contribution of Key Freight Routes

The estimation of DEC for the KFR broadly follows the same methodology as for the NH described above. The only difference is the way maintenance costs were calculated. For the NH, the maintenance costs were calculated based on the utilisation of road by heavy vehicles, because the wear-and-tear of the NH is driven by heavy vehicles (the more heavy vehicles driving through the road, the higher the maintenance costs). However, for KFR, the maintenance costs were calculated as a function of the capacity (the longer the road, the higher the maintenance costs). This is because the KFR have less traffic (for both light and heavy vehicles) and the maintenance usually incurs as a result of basic periodical maintenance (e.g., due to the aging of the road) and is less affected by the traffic of the road.

Figure 99 maps the DEC by audit region across Australia in 2011. The Goldfields audit region in Western Australia has a DEC of -$3 million in 2010-11. This is a result of the lower utilisation of some Goldfields roads (affecting the calculation of DEC through the value of travel) relative to their maintenance. Negative DEC is expected for roads with lower traffic level.

Figure 99 **Key Freight Routes DEC across Australia in 2010-11**



Note: DEC=0 for capital city audit regions for the KFR because the DEC for these links are included in the urban transport component of the AIA. This is to avoid double counting.

Source: ACIL Allen Consulting, 2014

Figure 100 presents DEC by state/territory in 2011. New South Wales, Queensland and Victoria have a relatively higher level of DEC primarily driven by their higher traffic level (utilisation) near the urban centres. The pattern here for KFR is broadly consistent with that for NH.

Figure 100 **Key Freight Routes DEC by state/territory in 2010-11 ($millions)**

Source: ACIL Allen Consulting, 2014

8.3.2 Safety star rating

Table 28 presents the proportion of NH (by length) in each state by the AusRAP safety star rating level (1 to 5 represents the worst to best roads). Queensland and Western Australia have on average a higher proportion of safer roads. In contrast, Northern Territory and Tasmania have on average a lower quality national highway and this may be partly a result of the higher road utilisation in these states (wear and tear of the roads).

Table 28 **Road safety star rating (by state/territory)**

	1-Star Safety Rating	2-Star Safety Rating	3-Star Safety Rating	4-Star Safety Rating	5-Star Safety Rating
NSW	0.11	0.46	0.42	0.01	-
Vic	0.02	0.33	0.60	0.04	-
Qld	0.01	0.31	0.64	0.03	-
WA	0.05	0.23	0.69	0.04	-
SA	0.13	0.22	0.59	0.06	-
Tas	0.23	0.50	0.24	0.02	-
NT	0.27	0.32	0.36	0.05	-
ACT	-	-	-	-	-

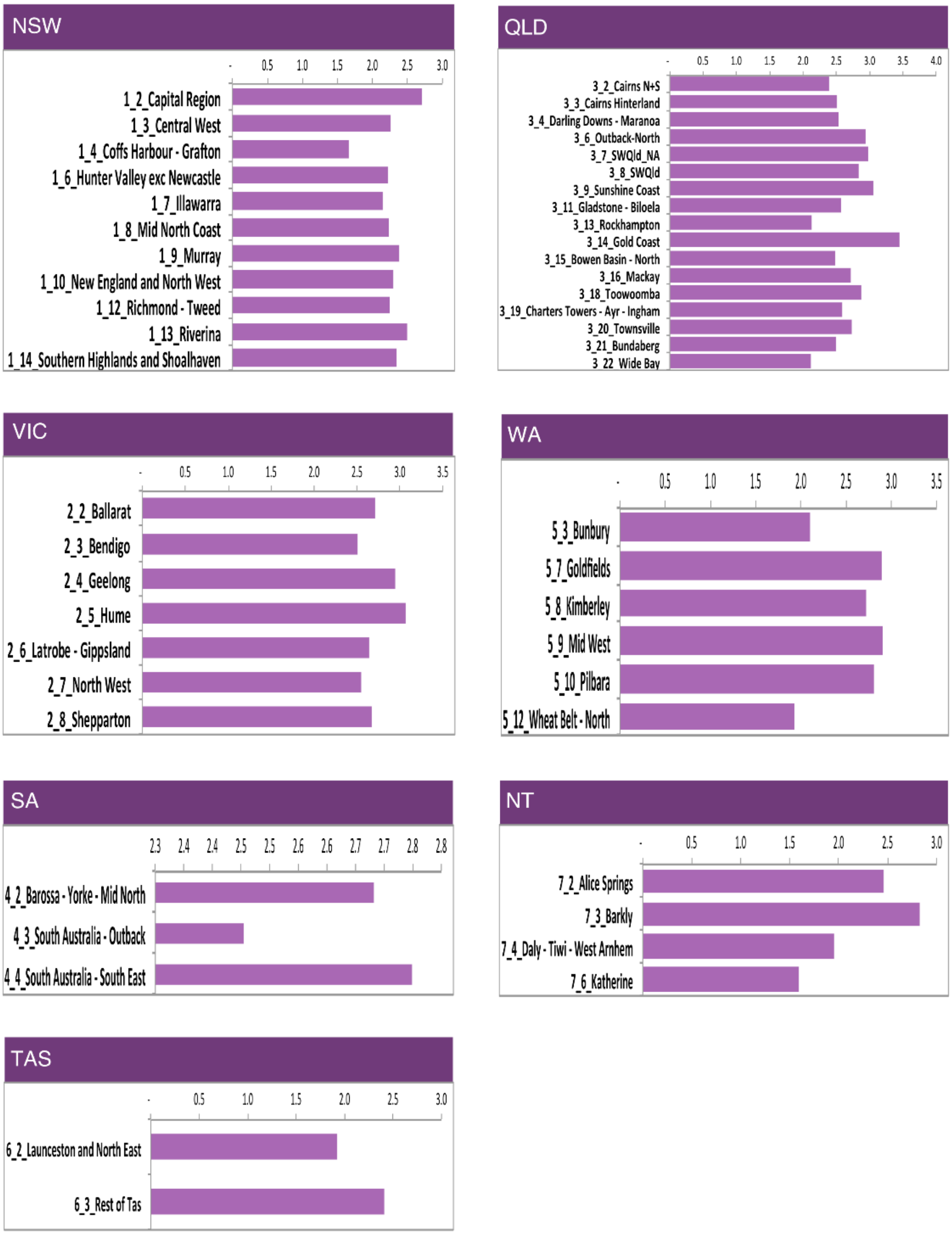
Source: ACIL Allen Consulting, 2014

An aggregate road safety index was also developed to capture the overall safety condition of the NH. The index was developed as the weighted sum[44] of the 5-star rating levels (weights 1 to 5 are given to each of the 5 star levels). Table 29 presents the aggregate safety index for all audit regions by state. This result is in line with the detailed star rating by star rating levels in Table 28.

The equivalent road quality information is not available for KFR.

[44] For example, the safety index for NSW = (NSW star level 1 x 1) + (NSW star level 2 x 2) + …+ (NSW star level 5 x 5) =(0.12 x 1) + (0.45 x 2) + (0.42 x 3) + (0.01 x 4) + (0 x 5) = 2.32

Table 29 **Road safety index for the National Highway (by audit region)**



Source: ACIL Allen Consulting, 2014

8.4 Projections for Nationally significant road services

This section summarises the projected demand for NSR services between 2010-11 and 2030-31.

The underlying economic projections used in this audit are based on national, state/territory and audit region projections developed using ACIL Allen's Tasman Global model of Australia's economy. These projections cover the period 2010-11 to 2030-31.

Consistent with the earlier discussion, economic drivers of NSR demand include:

- Population: influences the NSR demand through the utilisation of NSR by light vehicles

  The 'Baseline scenario' forecasts for NSR services assumes light vehicle grows in line with the Australian population, that is, Australian Bureau of Statistics' (ABS) Series B projections at the national, state and capital city levels
- Real Output: influences the NSR demand through the utilisation of NSR by heavy vehicles (freight). The 'Baseline scenario' forecasts for NSR services assumes heavy vehicle grows in line with the Real Output.

8.4.1 Projected DEC of Nationally significant roads

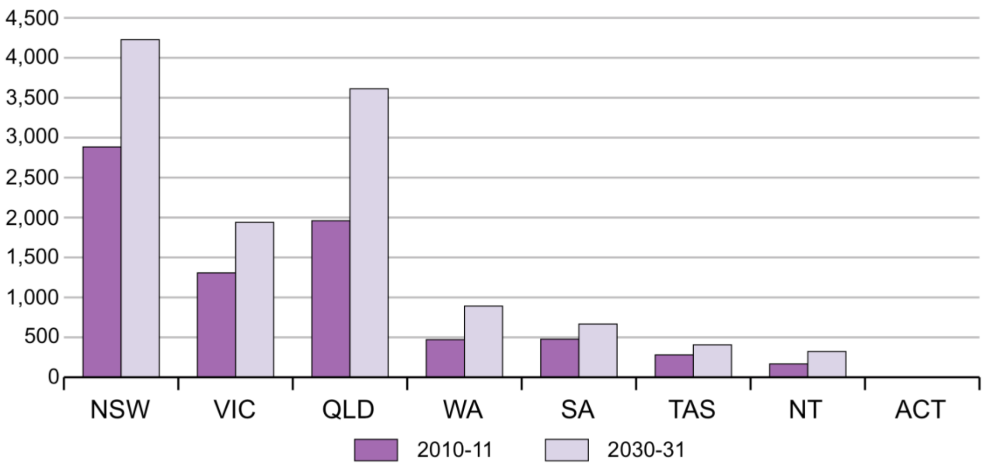
DEC projection for National Highway

The economic contribution of the NH is projected to rise to $12.1 billion in 2030-31 (Baseline scenario). The projected growth is slightly lower than the projected growth in GDP. This is because the outlook for the NH is shaped by light vehicle utilisation growth which is driven by population growth and heavy vehicle utilisation growth which is projected to be lower due to the increased productivity of heavy vehicles. The increased productivity of 'trucks' means that the NH is absorbing the increased freight task through improved efficiency (that is, fewer trucks are needed to move more freight tonnage on the national highway).

The economic contribution of the NH is also projected to grow at a slower rate than other transport infrastructure services (i.e. port and rail infrastructure services). This is because these other transport infrastructure services sectors are expected to benefit from exogenous demand growth factors (i.e. export demand for minerals) as these sectors supporting the export of bulk commodities.

The Baseline scenario projection for NH DEC in 2030-31 by state/territory and audit region is shown in Figure 101. This projection reflects the combined impact of population growth (through light vehicles) and Real Output growth (through heavy vehicles).

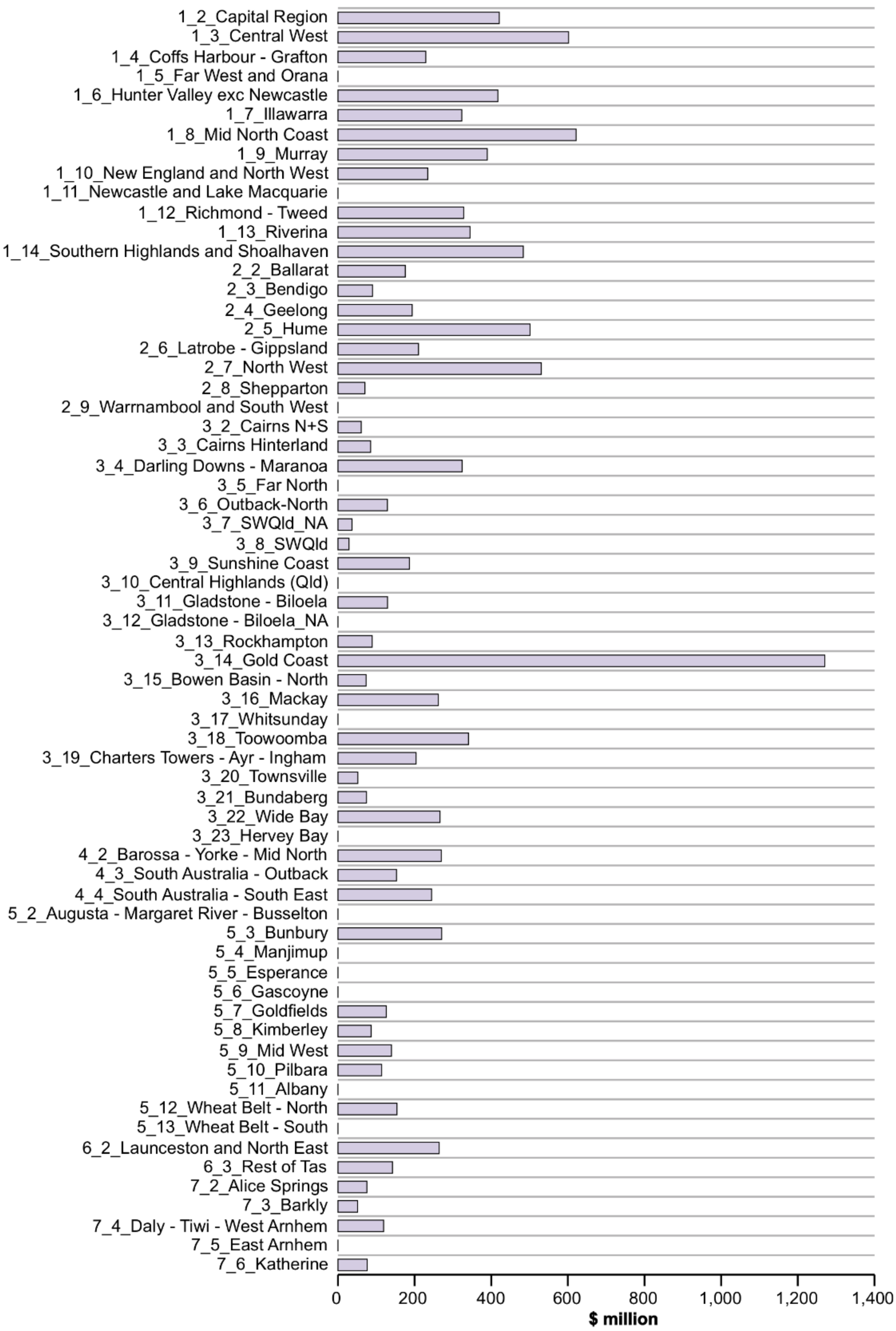
Figure 101 **Projected DEC National Highway by state/territory in 2030-31 ($ million in 2010-11 dollars)**



Source: ACIL Allen Consulting, 2014

Figure 102 lists in detail the DEC of the NH across Australia in 2030-31.

Figure 102 **National Highway DEC by audit region in 2030-31 ($ million in 2010-11 dollars)**



Source: ACIL Allen Consulting, 2014

Figure 102 shows the relative importance of the NH to the more remote regions in Australia, and highlights the importance of infrastructure services connecting communities in these regions to other parts of Australia.

DEC projection for Key Freight Routes

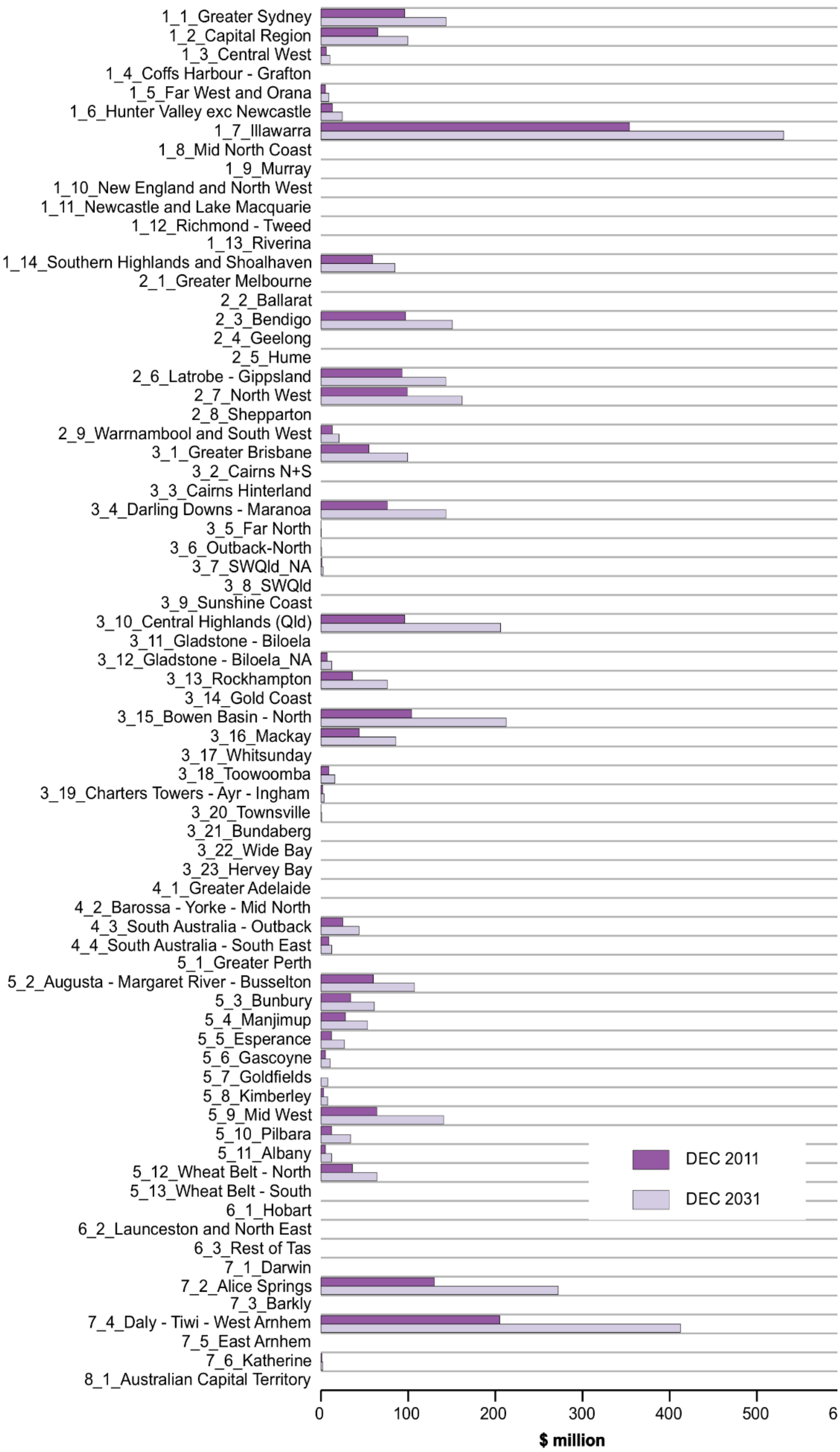
The baseline projections for KFR DEC in 2030-31 by state/territory and audit region are shown in Figure 103. This projection reflects the combined impact of population growth (through light vehicles) and Real Output growth (through heavy vehicles).

Figure 103 **Projected DEC Key Freight Routes by state/territory in 2030-31 ($ million in 2010-11 dollars)**

Source: ACIL Allen Consulting, 2014

Figure 104 lists in detail the DEC of the KFR across Australia in 2030-31.

Figure 104 **Key Freight Routes DEC by audit region in 2030-31 ($ million in 2010-11 dollars)**



Source: ACIL Allen Consulting, 2014

8.5 Sensitivity analysis for nationally significant road infrastructure needs projections

In order to illustrate how the outlook for infrastructure services could vary given different rates of change in the population and economy, two additional alternative scenarios have been modelled:

- 'Higher population growth scenario' – Scenario 2: which assumes that Australia's population growth is higher (compared with the Baseline scenario) and is aligned with ABS Series A projections;
- 'Higher productivity growth scenario' – Scenario 3: which assumes higher factor productivity in the infrastructure sectors in obtaining 1 per cent higher growth in Australian real GDP by 2030-31 (relative to the output growth obtained in the 'Baseline scenario').

These additional two scenarios indicate how future demand for the NSR may vary under different economic scenarios (through their influences on light and heavy vehicle growth). The economic assumptions used for the corresponding scenario are summarised in Table 30.

Table 30 **Economic assumptions for sensitivity analysis**

Matrix affected	Baseline	Higher population	Higher productivity
Light vehicle index factor	ABS population series B	ABS population series A	ABS population series B
Heavy vehicle index factor	Real Output growth	Real Output growth	Real Output growth

Source: ACIL Allen Consulting, 2014

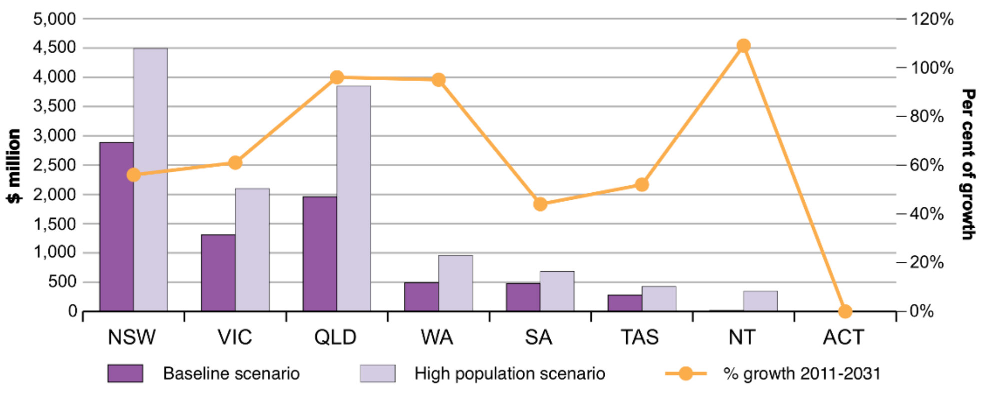
8.5.1 Higher population scenario

NH projection under the Higher population scenario

Figure 105 presents the results for the Higher population scenario compared against the Baseline scenario. The impacts of higher population on the DEC vary across states. Population has a larger impact as measured by the percentage change in DEC on states such as Northern Territory, Queensland and Western Australia. This is due to the expected higher population growth in these states compared to states like New South Wales where population growth is expected to slow down.

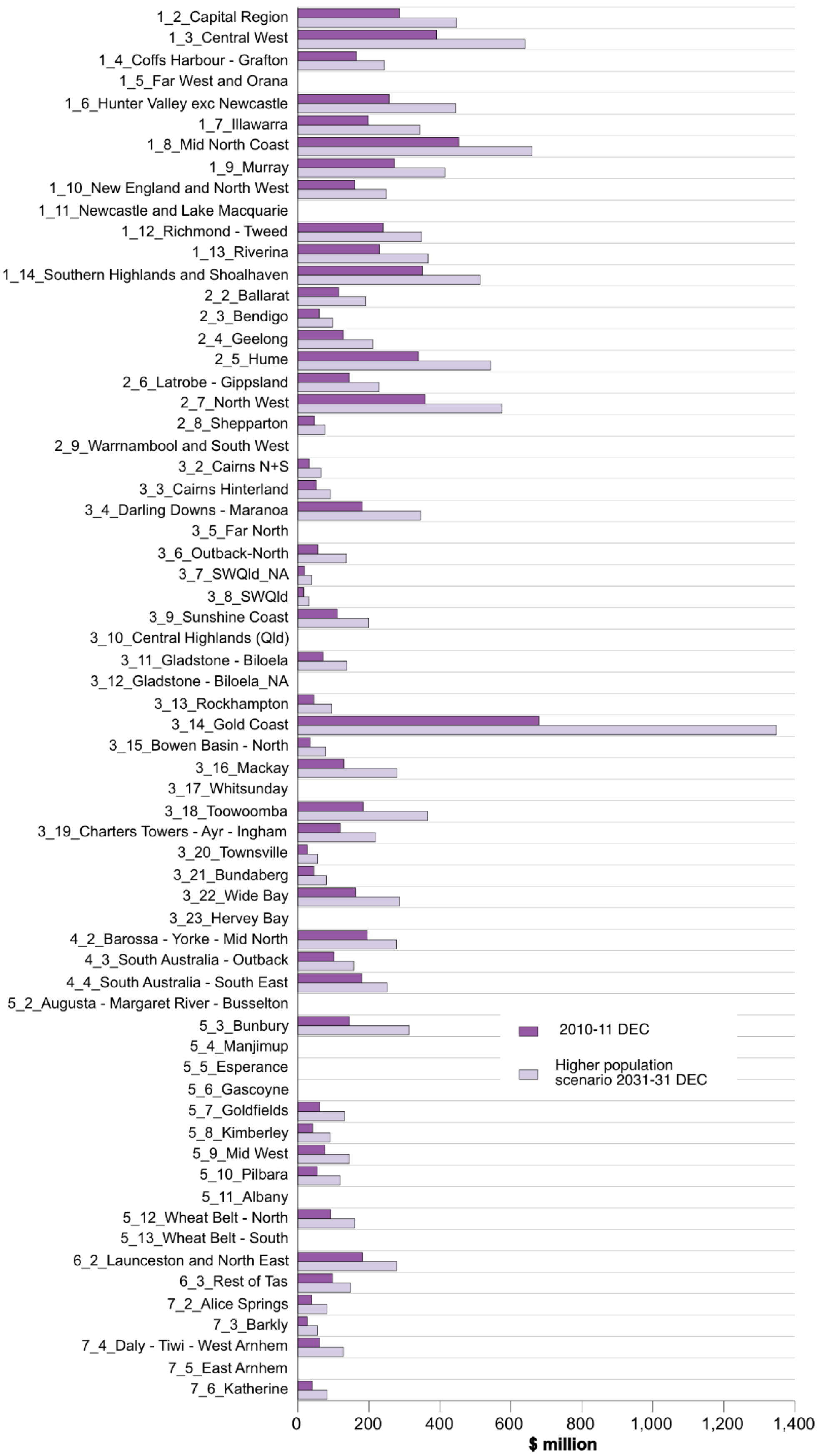
Figure 106 below presents the projection for the NH DEC in 2030-31 using the Higher population scenario.

Figure 105 **Projected National Highway DEC for Baseline scenario and Higher population scenario**



Source: ACIL Allen Consulting, 2014

Figure 106 **National Highway DEC by audit region – Higher population scenario ($ million in 2010-11 dollars)**



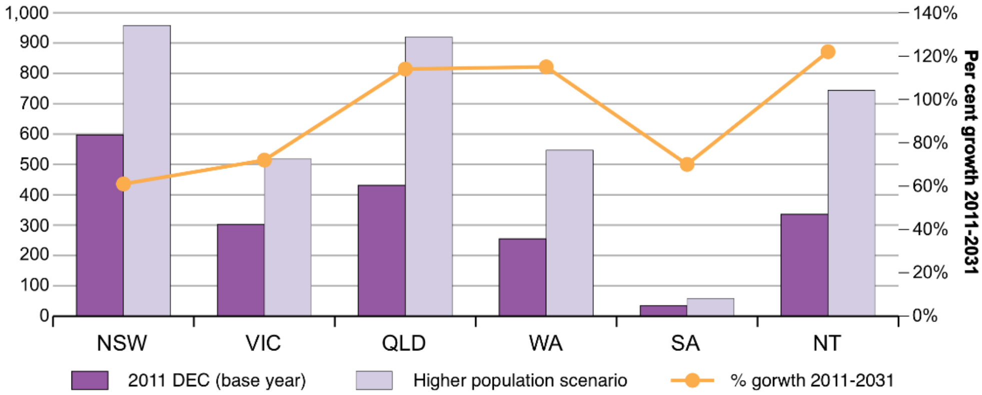
Source: ACIL Allen Consulting, 2014

Key Freight Routes projection under the Higher population scenario

Figure 107 presents the results for the Higher population scenario compared against the Baseline scenario. The impacts of higher population on the DEC vary across states. As for the NH, population has a larger impact as measured by the percentage change in DEC on states such as Northern Territory, Queensland and Western Australia due to the expected higher population growth.

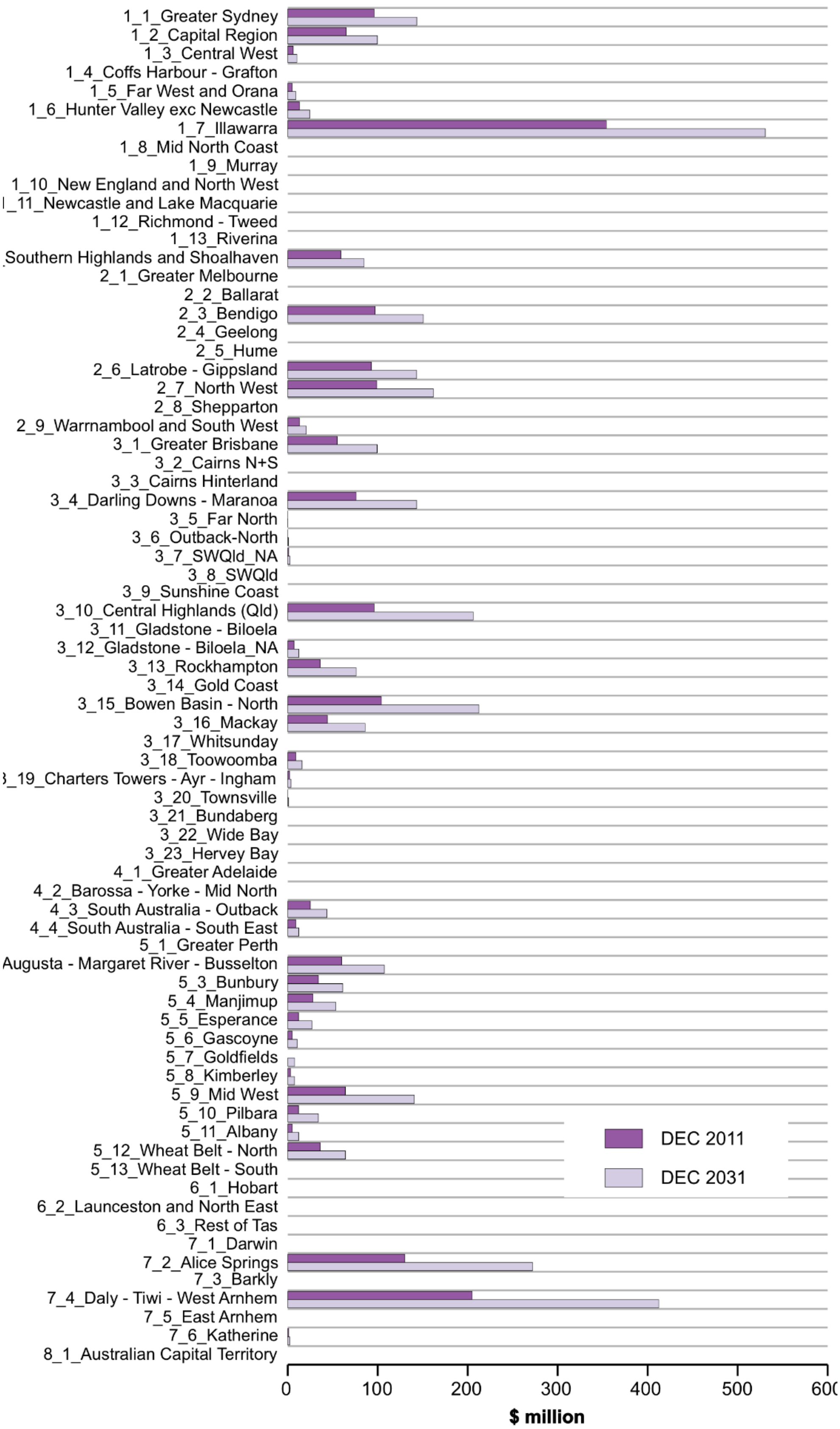
Figure 108 below presents the projection for the NH DEC in 2030-31 using the Higher population scenario.

Figure 107 **Projected KFR DEC for Baseline scenario and Higher population scenario**



Source: ACIL Allen Consulting, 2014

Figure 108 **Key Freight Routes DEC by audit region – Higher population scenario ($ million in 2010-11 dollars)**



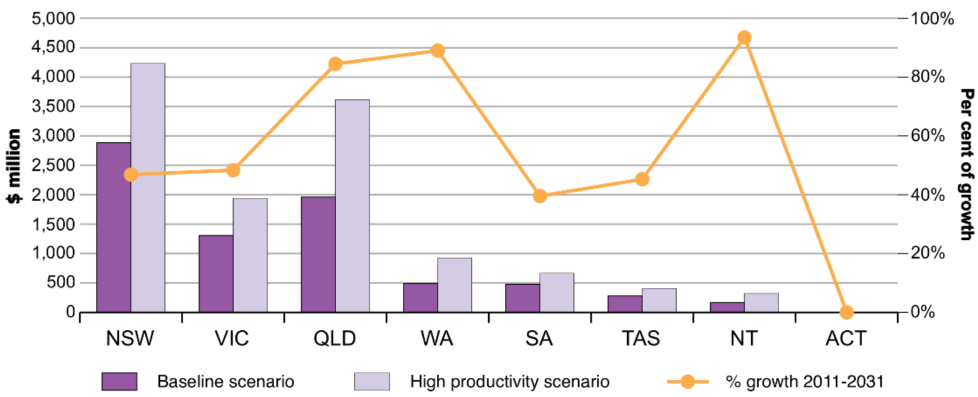
Source: ACIL Allen Consulting, 2014

8.5.2 Higher productivity scenario

National Highway projection under the Higher productivity scenario

Figure 109 presents the results for the Higher productivity scenario compared against the Baseline scenario. The impact of higher productivity on the DEC varies across states with Northern Territory, Queensland and Western Australia the fastest growth states. This may reflect the economic outlook in Australia where economic output driven by the service industry such as New South Wales and Victoria has reached a plateau, while those states/territories with resources are projected to grow quickly as the mines in these areas transition from construction to production.

Figure 109 **Projected NH DEC for Baseline scenario and Higher productivity scenario ($ million in 2010-11 dollars)**

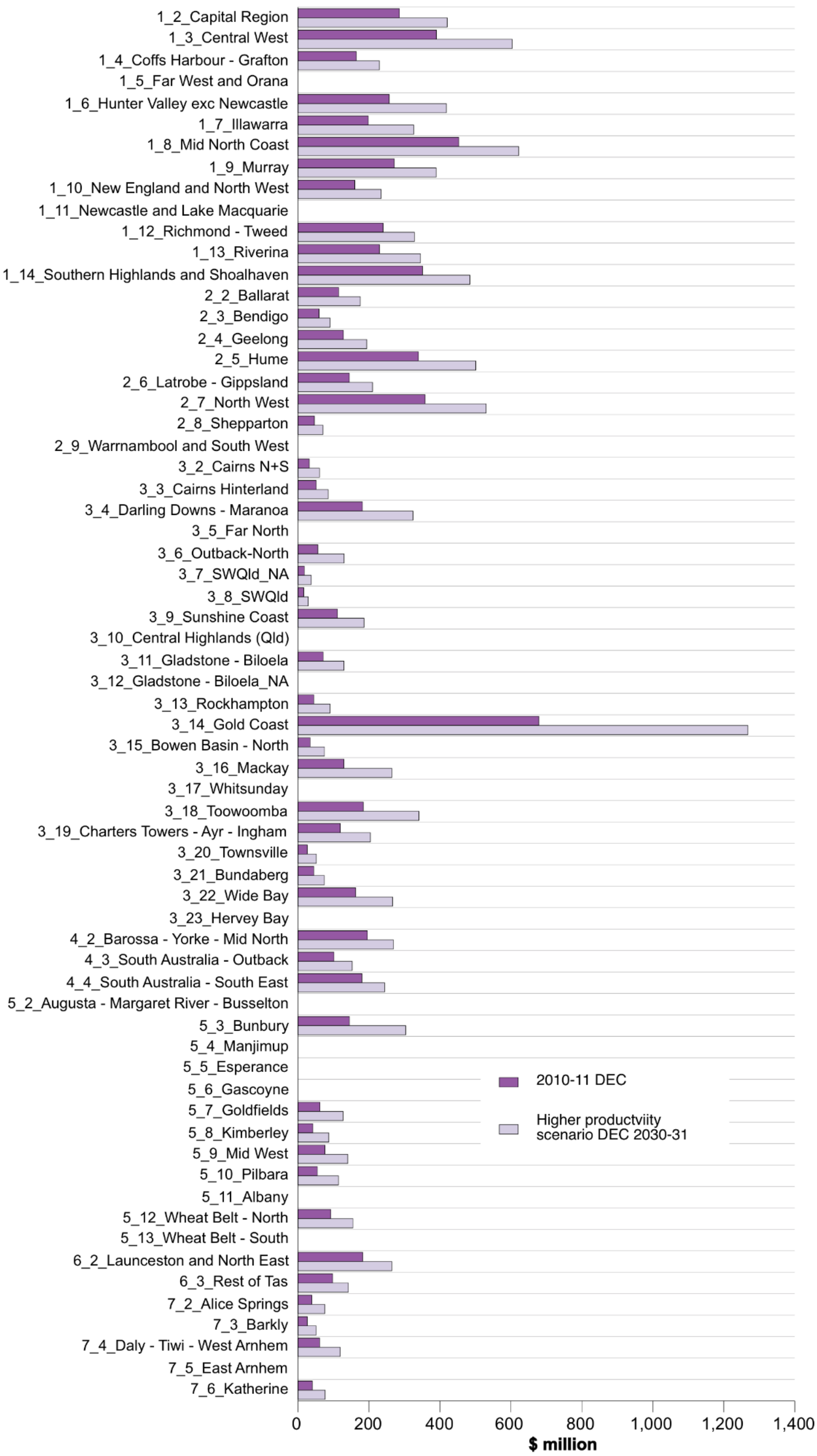


Source: ACIL Allen Consulting, 2014

The Higher productivity scenario compared to the Baseline scenario by audit region is presented in Figure 110.

The noticeable differences between the Higher population scenario and Higher productivity scenario against the Baseline scenario are: Western Australia is projected to grow faster relative to the other states under the Higher productivity scenario than under the Higher population scenario. This may be explained by the larger proportion of freight vehicles in Western Australia (21 per cent) compared to the Australia-wide average of 19 per cent, which tends to be driven by productivity growth.

Figure 110 **National Highway DEC by audit region – Higher productivity scenario ($ million in 2010-11 dollars)**

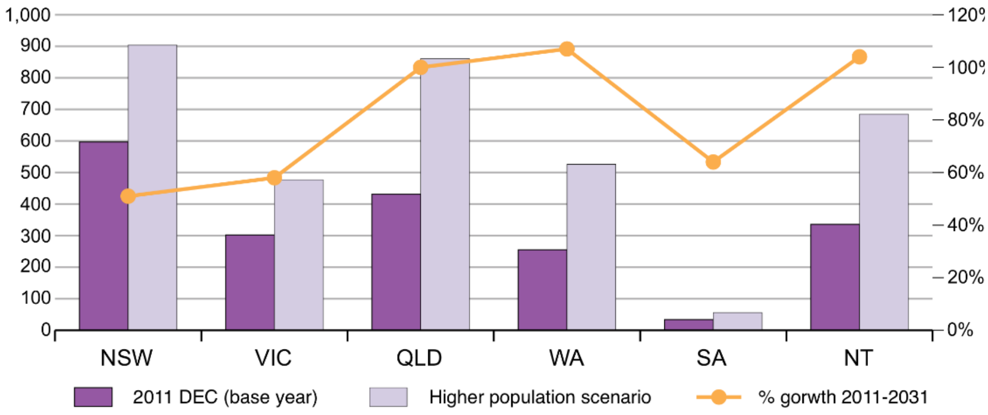


Source: ACIL Allen Consulting, 2014

Key Freight Routes projection under the Higher productivity scenario

Figure 111 presents the results for the Higher productivity scenario compared against the Baseline scenario. The impact of higher productivity on the DEC varies across states as for the NH with Northern Territory, Queensland and Western Australia being the fastest growth states. This likely reflects the higher expected transport demand in these mining associated states as their mines transition from construction to the production phases.

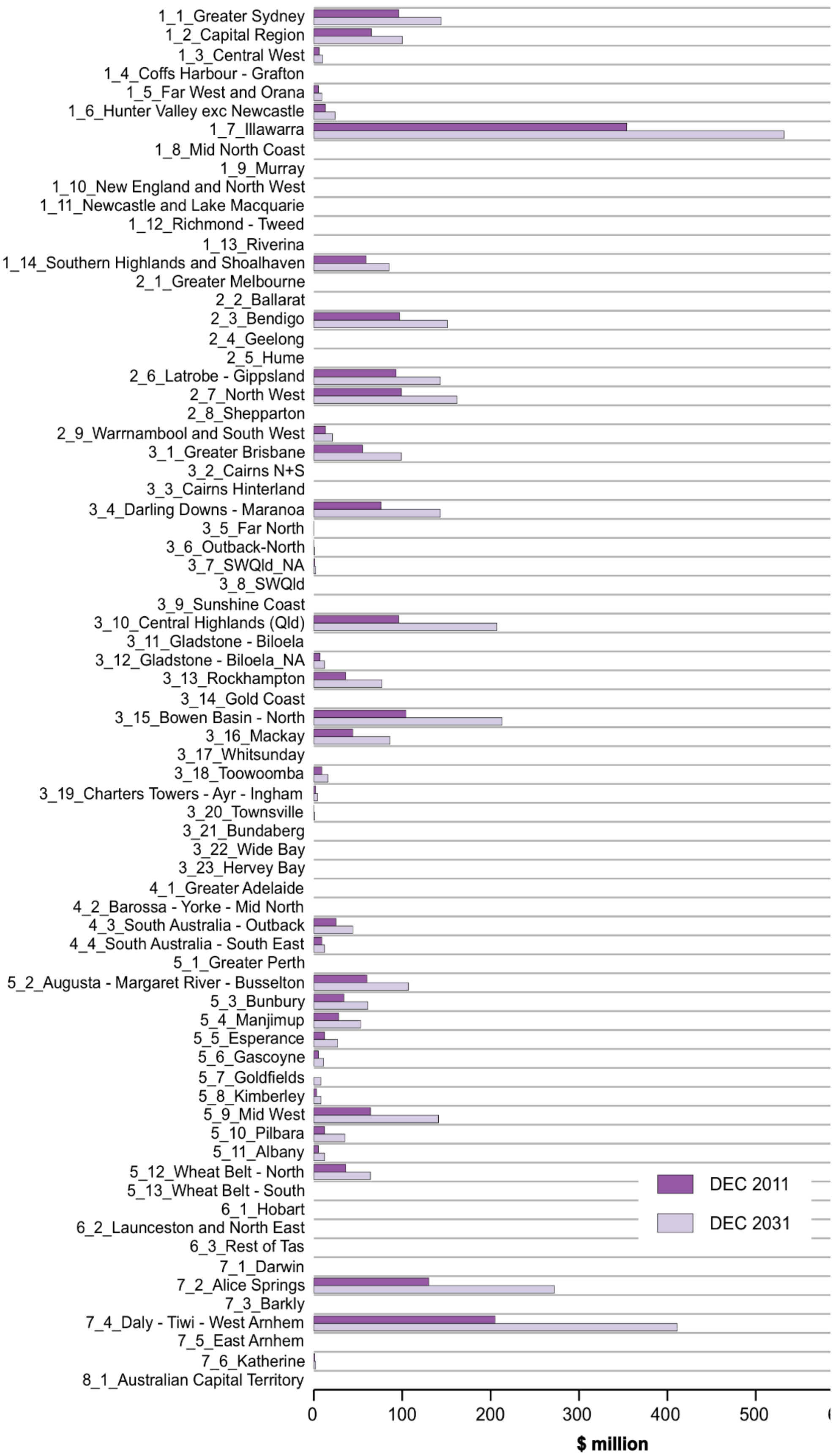
Figure 111 **Projected Key Freight Routes DEC for Baseline scenario and Higher productivity scenario ($ million in 2010-11 dollars)**



Source: ACIL Allen Consulting, 2014

The Higher productivity scenario compared to the Baseline scenario by audit region is presented in Figure 112.

Figure 112 **Key Freight Routes DEC by audit region – Higher productivity scenario ($ million in 2010-11 dollars)**



Source: ACIL Allen Consulting, 2014

8.6 Implications of findings

The DEC projections for the NH and KFR are presented in Figure 113 and Figure 114 respectively (next page).

In summary, the Higher population scenario results in the largest DEC while the Higher productivity scenario leads to only marginally bigger DEC compared to the Baseline scenario. The Higher population scenario has uneven impacts across states with New South Wales being the least affected given its slow projected population growth.

The sensitivity analysis shows that DEC appears to be less responsive (for both NH and KFR) to productivity increases (Table 31). This is because higher productivity in the road transport infrastructure sector means that it is 'doing more with less'. In other words, more productive roads absorb the increased freight task through improved efficiency (e.g., fewer trucks are needed to move more freight tonnage due to larger truck size or reduced truck trips as a result of better quality/better designed roads).

The growth rates for the KFR are higher under all scenarios compared to the NH between 2010-11 and 2030-31. This is because:

— KFR on average have a higher proportion of light vehicles and therefore, it is primarily driven by the population projection (whose projected growth rate is higher than productivity growth rate)
— a larger proportion of the KFR are located in states with higher population growth (e.g., Western Australia) compared to the NH;
— of the difference in the way in which maintenance costs were calculated. For the NH, maintenance costs were calculated as a function of road utilisation by heavy vehicles, which is projected to grow in line with the projected utilisation growth rate. However, for the KFR, maintenance costs were driven by road capacity (length of road), and is kept constant from 2010-11 to 2030-31. As a result, the DEC for the KFR (difference between value of travel and maintenance costs) is projected to grow faster given its smaller maintenance costs.

Table 31 **DEC projection for Australia (by scenario)**

	NH - total Australian DEC ($millions)	NH growth 2010-11 to 2030-31 (per cent)	KFR - total Australian DEC ($millions)	KFR growth 2010-11 to 2030-31 (per cent)
2010-11 Baseline	7,545	-	1,954	-
Baseline scenario in 2030-31	12,065	59.9%	3,506	79.4%
Higher population scenario in 2030-31	12,822	69.9%	3,745	91.7%
Higher productivity scenario in 2030-31	12,075	60.0%	3,509	79.6%

Source: ACIL Allen Consulting, 2014

Table 32 compares DEC growth in the three scenarios against each other and the growth of the economic parameters in the Baseline scenario.

For the NH, the DEC in the Baseline scenario is influenced by both population and real output growth. The growth factor of DEC is bigger than that of output and smaller than population (e.g., 1.60 compared to 1.37 and 1.67 for the NH). The reason is that part of the additional transport task (a result of the increase in population) is absorbed by improved productivity. Therefore, demand for the NH is expected to increase from 2010-11 to 2030-31 (due to growth in the population) but by less than the population growth rate due to increased efficiency of the NH.

For the KFR, its growth factor is not directly comparable with the population and output growth factor. This is because one of the driving parameters underlying the calculations of the KFR DEC - the maintenance costs - were kept constant from 2010-11 to 2030-31 and only the value of travel is projected to grow. As a result, the projected DEC growth factor is larger than both the population and output growth factor. It needs to be noted that this inconsistency is not an error, but is a result of the method used in calculating the KFR maintenance costs given the nature of its roads (not primarily driven by traffic given its lower level of traffic, but more by age related periodical maintenance).

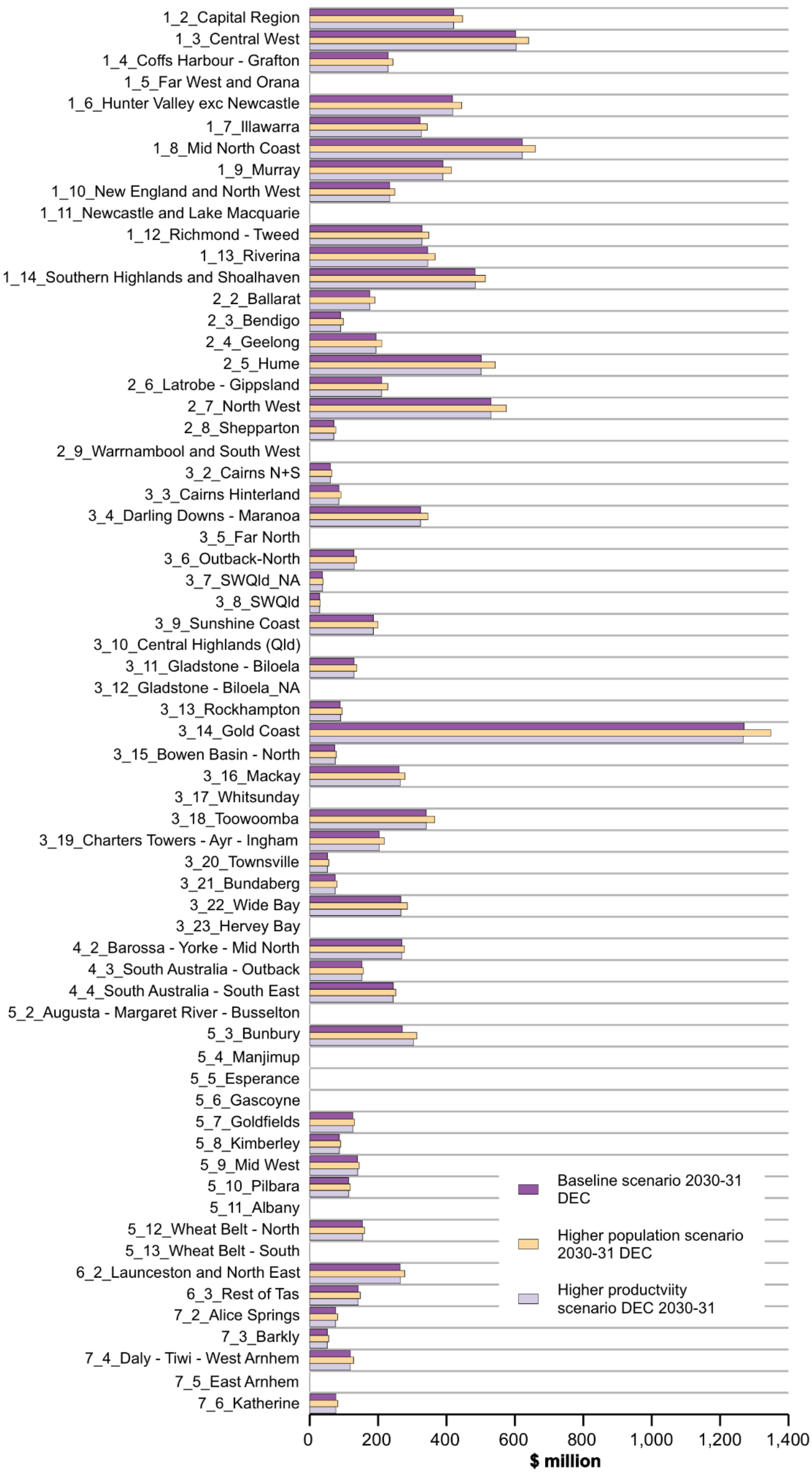
Despite the overall higher level in the growth factor, the 3 scenarios of the KFR follow similar pattern as for the NH. That is, the Baseline scenario and the Higher productivity scenario yield similar DEC while the Higher population scenario gives higher DEC than in other projections. This is for the same reason as for the NH discussed earlier – the additional growth of freight task is absorbed by improved productivity.

Table 32 **Growth factor comparison (between 2010-11 and 2030-31)**

Matrix for comparison	NH growth factor	KFR growth factor
DEC - Baseline scenario	1.60	1.79
DEC - Higher population scenario	1.70	1.92
DEC - Higher productivity scenario	1.60	1.80
Real Output growth - Baseline scenario	1.37	1.37
Population growth - Baseline scenario	1.67	1.67

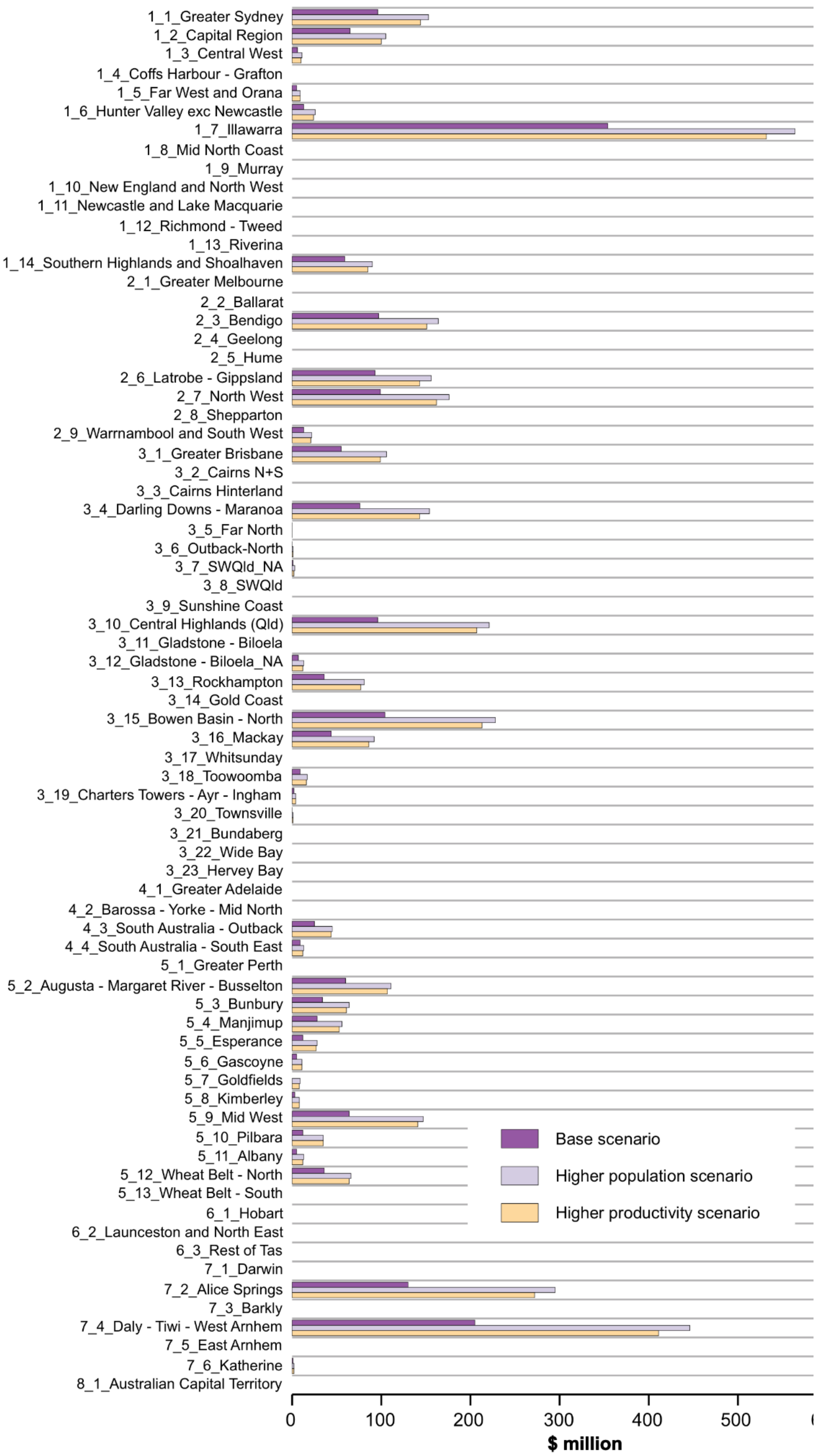
Source: ACIL Allen Consulting, 2014

Figure 113 **National Highway DEC by audit region ($ million in 2010-11 dollars) – scenario comparison**



Source: ACIL Allen Consulting, 2014

Figure 114 **Key Freight Routes DEC by audit region ($ million in 2010-11 dollars) – scenario comparison**



Source: ACIL Allen Consulting, 2014

9 Transport – Ports

KEY FINDINGS

Ports play a key role in the Australia economy as they are a key part of supply chains, linking land and sea transport networks. Ports serve local markets with landside infrastructure being necessary for the efficient movement of goods to and from those ports.

This audit focuses on the economic contribution of the services provided by the port infrastructure, not the value of the goods flowing through the ports (or the costs for constructing the ports).

The port services are provided by 65 ports located across Australia.

Australia's bulk ports are amongst the largest in the world, notably ports supporting Australia's iron ore and coal export trades. The ports across Australia have a capacity for 12 million Twenty Feet Container Equivalent Units (TEU). Victoria has the largest capacity (3.7 million TEUs) followed by New South Wales (3.2 million TEUs).

Analysis of the utilisation to capacity ratio for Australia's 20 largest bulk ports shows that Port Hedland has the highest utilisation to capacity ratio (91 per cent) followed by Port Dampier and Port Newcastle.

The economic contribution of Australia's ports was estimated to be $20.65 billion (1.6 per cent of GDP) in 2010-11. The economic contribution of ports is distributed fairly evenly among the four largest states with New South Wales being the state with the highest economic contribution.

Many ports are expected to reach their current capacity limits before 2030-31.

The demand for port services infrastructure in 2030-31 is projected to be 65 per cent higher than it was in 2010-11 at $41.9 billion (in 2010-11 prices). This is an annualised growth rate of 2.6 per cent per annum.

The projection is highly driven by forecast for growth of Australia's trading partners (especially China) and domestic mining development (transitioning from construction to production). Western Australia (especially in Pilbara audit region), Queensland and Northern Territory are projected to have the largest growth.

The growth gap is expected to be largest in Western Australia followed by Queensland. This reflects the expected growth in Australia's export mining sectors.

Sensitivity analysis was carried out to determine whether the projected economic contribution of ports would change as a result of different economic and demographic projections (the Higher population and Higher productivity scenario). The economic contribution of port services infrastructure is expected to be the highest under the Higher population scenario and only marginally higher under the Higher productivity scenario when measured against the Baseline scenario.

9.1 Port services in scope

Australia is an island nation with more than 80 per cent of its population located within 50 kilometres of the coast. Australia's ports function as components of supply chains, linking land and sea transport networks. Ports also provide passenger services, while others have a key role in national defence.

A distinction must be made between the ports and the facilities built upon the port:

7. A "port" is typically associated with harbours that provide sheltered anchorage, protecting vessels from stormy weather, and offering calmer waters for berthing. The harbours can be natural or man-made (for example with breakwaters and dredged shipping channels).
8. Built upon the port (or within the port) there are many facilities which provide services. These include:

a) Mooring facilities: Wharves, docks or quays. Each of these may have multiple "berths" on them. Also piers and jetties are used to denote mooring facilities which are typically in deeper offshore water.
b) Terminals: Landside terminals offer processing and supply chain activities. These include:
   i) Grain terminals which receive, silo and fumigate the grain, as well as blend and load (or unload) ships at berth
   ii) Container terminals which are managed by stevedores transfer containers from road or rail to a hardstand, then move those containers to a ship at berth
   iii) Fuel terminals which will load or offload a vessel at berth and store fuels in specialised tanks
   iv) Bulk ore/mineral terminals provide stockpiling, blending and shiploading
   v) Roll-on roll-off facilities where machines on wheels are driven off of specialised carriers – these goods include passenger and freight vehicles as well as large mining machinery. Such machinery can sometimes be classified as "high and heavy"
   vi) Some ports offer specialised facilities. For example, the Port of Newcastle has a wharf side rail interface which allows it to unload and place trains on a standard gauge railway which is connected to the national network, making it a destination for many passenger and bulk rail asset shipments
   vii) Other relevant assets, such as container storage, transport services, etc. are typically managed by third party providers.
c) Road and rail connections which support the movement of goods to and from the port and terminals. These can include access roads and rail loops.

For the purposes of this Australian Infrastructure Audit (AIA), port services provided by 65 ports across Australia have been included. The included ports are listed in Table 33.

Table 33 **Ports included in the Australian Infrastructure Audit**

New South Wales	Victoria	South Australia	Tasmania	Northern Territory	Queensland	Western Australian
Eden	Geelong	Adelaide	Burnie	Bing Bong	Abbot Point	Airlie Island
Yamba	Portland	Port Giles	Launceston	Milner Bay	Burketown	Bunbury
Newcastle	Hastings	Thevenard	Stanley	Darwin	Gladstone	Esperance
Port Kembla	Welshpool	Klein Point	Devonport	Gove	Mackay	Kwinana
Port Botany	Melbourne	Port Lincoln	Port Latta		Port Alma	Port Walcott
		Wallaroo	Hobart		Thursday Island	Wyndham
		Port Bonython	Spring Bay		Brisbane	Albany
		Port Pirie			Cairns	Dampier
					Cairns	Fremantle
					Karumba	Onslow
					Maryborough	Thevenard Island
					Quintell Beach	Yampi Sound
					Townsville	Broome
					Bundaberg	Derby Wharf
					Cape Flattery	Geraldton
					Lucinda (Townsville)	Port Hedland
					Mourilyan	Varanus Island
					Rockhampton	
					Weipa	

Source: ACIL Allen Consulting, 2014

This audit of Australia's ports has involved identifying every port in Australia and reported the following metrics by port (where available):

- 2010-11 tonnage handled
- measures of capacity (where these were available)
- the direct economic contribution (DEC).

Australia's ports serve many industries, from the export of bulk ores, minerals, liquefied natural gas and agricultural products, to containerised imports and exports, bulk liquid imports and exports and passenger services.

Key sectors of the economy such as mining, agriculture and manufacturing are dependent on exports to Australia's trading partners. In the 2012-13 financial year the value of Australia's imports was $255.8 billion and the value of its exports was $248.9 billion[45].

The ports which make the highest direct economic contribution are located in the state capitals of Sydney, Melbourne, Brisbane, Perth and Adelaide. These metropolitan ports serve the densely populated cities in which they are located.

Australia's ports can be broadly categorised to two categories: bulk ports and non-bulk ports. Many of Australia's ports are mixed use ports which have elements of both, however the split between bulk and non-bulk activities is useful for contrasting the different infrastructure requirements of the ports.

[45] ABS, Catalogue 5368.0 - International Trade in Goods and Services, Australia, May 2014, Total Goods – Exports and Imports

9.1.1 Bulk ports

Bulk ports are primarily defined by the nature of the commodities that they handle. ACIL Allen Consulting (ACIL Allen)[46] has defined bulk goods as being unpacked cargo which is superficially homogeneous. Such goods include 'dry bulk' such as coal, iron ore and grain as well as 'wet bulk' liquid commodities (such as oil and other petroleum-based products), which we have termed 'bulk liquids'. Finally, there are bulk gas-based commodities including Liquefied Petroleum Gas, ('LPG') and Liquefied Natural Gas ('LNG'), which are shipped in liquid form.

The above definition states "superficially homogeneous" because bulk commodities are not homogeneous goods; each bulk commodity has grades of qualities and attributes and may be conveyed in ways to keep them separate (using containers or separate bunkers in ships) or blended to meet a downstream customer's commodity specification. Such blending is commonly undertaken for commodities such as iron ore and coal; the blending is part of the mining and logistics production process and sometimes occurs at the port.

Another defining characteristic of bulk ports is the high tonnages that they handle. They require high levels of infrastructure and underlying investment, not just in the facilities at the port, but also in the supporting supply chain infrastructure. All of Australia's bulk ports have both road and rail connections which are critical to ensuring a steady and efficient movement of goods.

Bulk ports require infrastructure to unload, store, blend or further process the commodities and to load ships. Volumes exported from many of Australia's bulk ports have increased significantly in the decade to 2010-11 and in the years since. Supporting capacity expansions of these ports has required consideration of the whole supply chain and, in many cases, the augmentation of rail, port and shipping channels.

Despite being fundamental to the success of Australia's $149 billion mining industry[47], bulk ports are also central to Australia's domestic activities such as: handling the importing, exporting and domestic distribution of crude- and refined-oil around the country; for handling cement materials and for moving bauxite-based commodities between mining areas, refineries and smelters.

This audit has defined the following significant ports as bulk ports: Abbot Point, Albany, Bunbury, Esperance, Dampier, Darwin, Geraldton, Gladstone, Mackay, Newcastle, Port Kembla, Portland, Port Lincoln, Port Walcott, Port Hedland, Weipa, Whyalla.

9.1.2 Non-bulk ports

All ports that are not bulk ports have been defined as 'non bulk' ports. Non-bulk ports handle a wide range of goods and most are mixed-use ports which handle some goods which have bulk characteristics (for example, cement, grain, fuel). Typically there will be significant activities related to container handling and handling general cargo but other trades will range from containerised goods, to heavy machinery, steel, timber, and bulk commodities.

Typically non-bulk ports serve as a gateway for domestic and international goods to a local catchment, rather than acting as a link in a supply chain for a specific resource.

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[46] Informed, in part, by Bureau of Infrastructure, Transport and Regional Economics (BITRE), 2013, Australia's Bulk Ports, Report 135, Canberra ACT

[47] ABS, 5206.0 - Australian National Accounts: National Income, Expenditure and Product, Mar 2014, series A3348451J.

However, even this characteristic is blurred, with the Port of Newcastle (a bulk port) being the largest bulk coal port in the world and located next to a substantial local population, and the Port of Brisbane (a non-bulk port) being a significant container port serving the populous south east Queensland (SEQ) region while also being a large exporter of coal, grain and bulk liquids (crude oil imports and refined fuel exports).

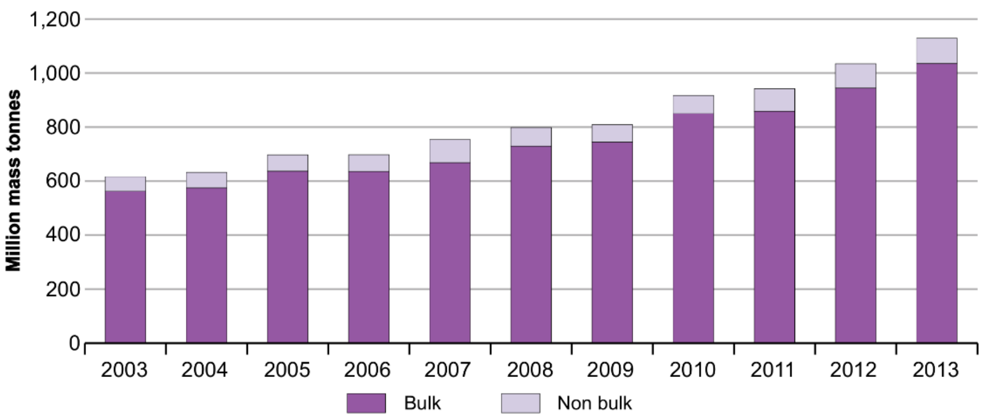
All ports are on a spectrum between being bulk and non-bulk, and any allocation is somewhat arbitrary. However, the allocations to bulk ports has been influenced by a desire to present a grouping of ports where the group members face similar issues and drivers.

9.2 Port services in Australia

9.2.1 The significance of port services to economic activity

Australia is an island nation and its economic welfare is strongly influenced by its trade links with the rest of the world. The total trade measured over the past 10 years at Australia's ports (excluding Port Walcott, which is not included in Ports Australia statistics) is shown in Figure 115.

Figure 115 **Total trade throughput 2003-2013 (million mass tonnes)**

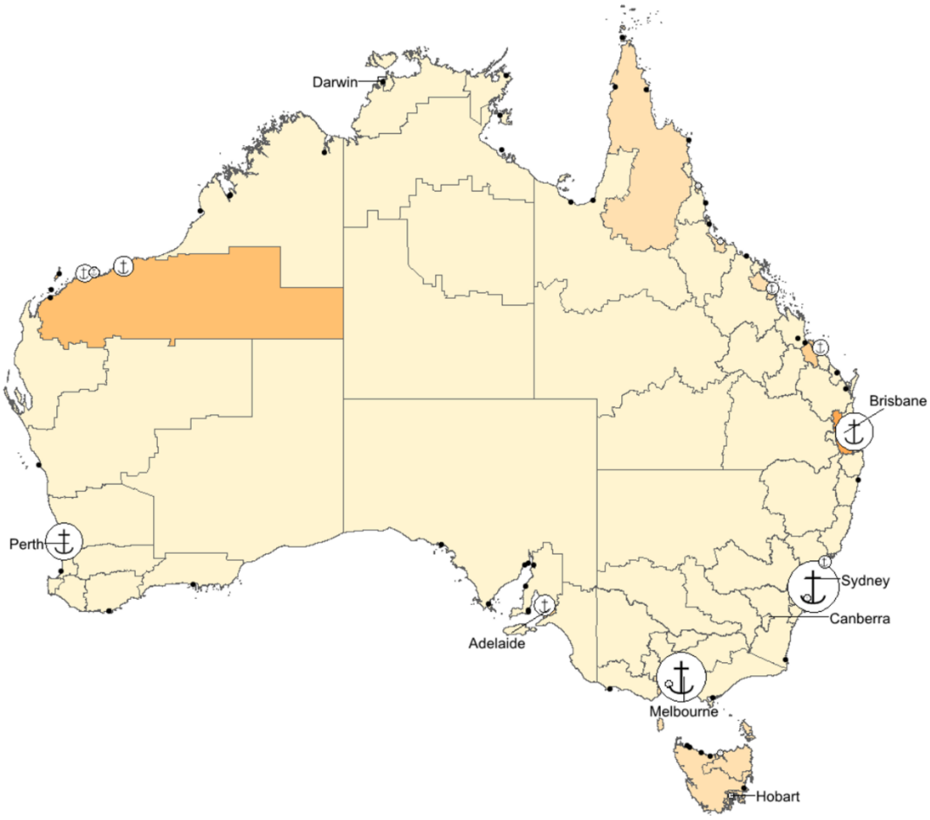


Source: Ports Australia: Trade Statistics, including ACIL Allen's estimate for ports not included in Ports Australia data.

Ports are the gateway through which a significant proportion of Australia's wealth is enabled. In the 2012-13 financial year mining accounted for approximately 10 per cent of Australia's Gross Domestic Product (GDP), agriculture was 2 per cent and manufacturing was 7 per cent.

The economic significance of ports is highlighted by the fact that Australia's ports handled 973 million tonnes of goods in 2010-11, with more than 90 per cent of this volume being exports. The location of Australia's bulk exports, and the scale of the ports are shown Figure 116.

Figure 116 **Map of ports in Australia**

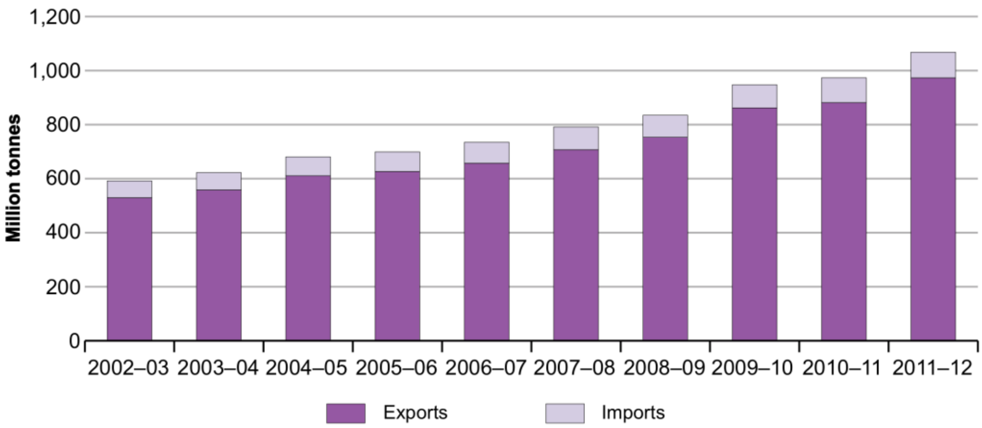


Note: Different shading depicts the different economic contribution of port services across Australia in 2010-11 by audit region, which is discussed later in this chapter.

Source: ACIL Allen Consulting, 2014

Since 2003 this volume has grown at a compound annual growth rate of 6.8 per cent, as shown in Figure 117.

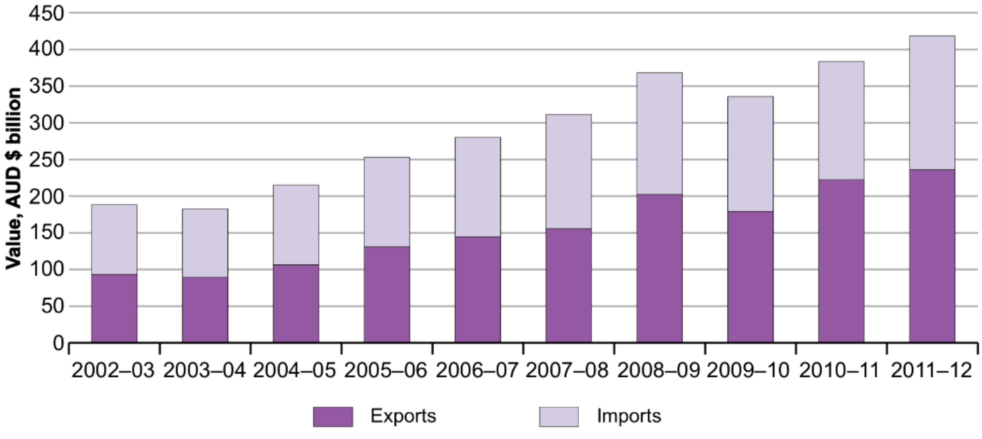
Figure 117 **Volume of Australian trade**



Source: Australian Bureau of Statistics (ABS), 2013. International cargo statistics (unpublished data). Canberra published in Bureau of Infrastructure, Transport and Regional Economics (BITRE) 2013, Australian sea freight 2011–12, Canberra, ACT

The value of trade handled by Australia's ports has increased from $188 billion in 2002-03 to $418 billion in 2012-13[48] as shown in Figure 118.

Figure 118 **Value of Australian trade**



Source: Australian Bureau of Statistics (ABS), 2013. International cargo statistics (unpublished data). Canberra published in Bureau of Infrastructure, Transport and Regional Economics (BITRE) 2013, Australian sea freight 2011–12, Canberra, ACT

In evaluating the direct economic contribution of Australia's ports, consideration must be given to the fact that ports are only one component of the supply chains of exporters and businesses which import components or finished goods. For example, one must also consider that without its ports, Australia would not have a mining industry and would be roughly $149 billion per annum poorer as a result. Similarly its agricultural sector would be much smaller and the Australian manufacturing market would be limited to the domestic population. Without imports or domestic shipping the cost of most goods consumed in Australia would be higher.

Australia's non-bulk ports serve local communities by providing goods which are either unavailable in Australia, or by providing choice of goods in competition with domestic manufactures which creates significant value to consumers and intensifies the effect of competition upon domestic manufacturers.

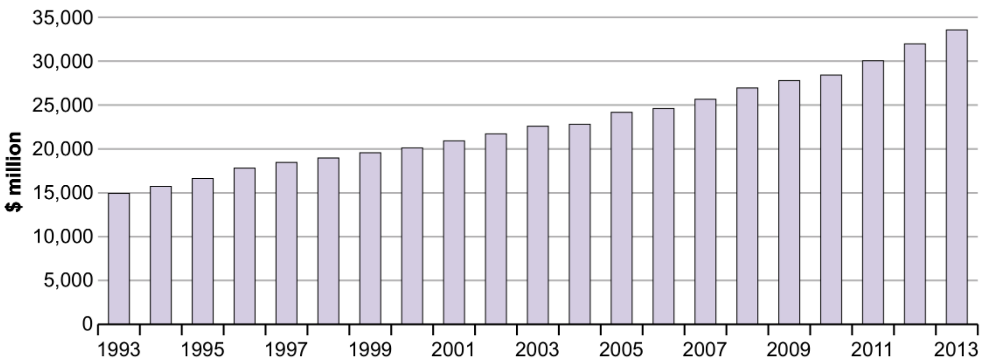
A recent report by ACIL Allen[49] estimated that a 1 per cent decline in the total factor productivity of the logistics sector (including all modes of transport and support activities) would have a $20 billion per annum impact on Australia's economy. As a key component of many logistics chains Australia's ports and their efficiency have a significant impact on the nation's economy.

Australia's ports are accounted for in the national accounts within the Transport Supply Services and Storage account (TSSS). This account includes airports as well, but does not include the port activities in the Pilbara where they are owned and operated by mining companies. Figure 119 depicts the gross value added by the TSSS account to Australia's National Accounts since 1993.

[48] Australian Bureau of Statistics (ABS), 2013. International cargo statistics (unpublished data). Canberra published in Bureau of Infrastructure, Transport and Regional Economics (BITRE) 2013, Australian sea freight 2011–12, Canberra, ACT

[49] ACIL Allen Consulting, 2014. The economic significance of the Australian Logistics Industry.

Figure 119 **Transport Supply Services and Storage (1993-2013, $ millions)**



Source: ABS, Catalogue 5206.0 Australian National Accounts: National Income, Expenditure and Product, Table 33. Industry Gross Value Added, Chain volume measures, Annual. Series A3348472V - Transport Supply Services and Storage

The gross value added by the TSSS industry has increased over the past 20 years to 2013 at a rate 1.15 times faster than the economy, at a compound annual growth rate (CAGR) of 4.14 per cent. This has been buoyed by the growth in aviation as well as growing trade with Asia (especially China).

The growth of exports from the Pilbara is not captured by these figures. Over the past twenty years, the output of the mining industry has grown at a similar rate to TSSS, with a CAGR of 4.18 per cent. This reflects the growth of the mining sector across Australia, supported by bulk export ports.

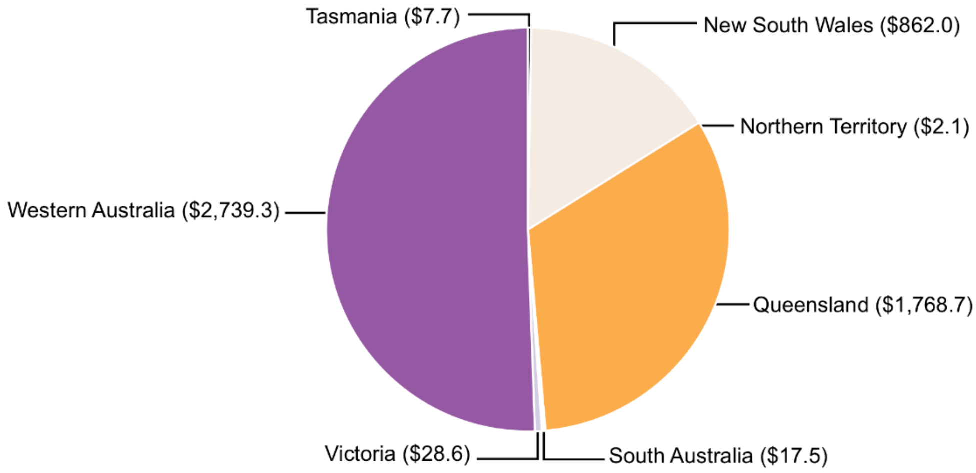
As well as their direct economic contribution, Australia's ports also serve vital community roles, providing a service to local industries and connecting isolated communities with year-round access to domestic supplies.

A review of Australian Bureau of Statistics' (ABS) National Accounts data shows that in the 2010-11 financial year Australian industries spent $29 billion on TSSS. This includes both ports and airports, but does not include port facilities owned by mining companies.

A summary of the industry use of TSSS is shown in Figure 120. It reveals that the industries which are the largest users of TSSS are:

- wholesale trade (which imports a significant amount of food, manufactured and processed goods)
- transport industry (which includes freight forwarding companies who act on behalf of customers across many industries)
- manufacturing, which exports their output and input components
- administrative and support services (which includes travel agencies, security services and agencies as well as defence services).

Figure 120 **Users of Transport Supply and Support Services output, 2010-11 ($ million)**



Source: ABS Catalogue 5209.0.55.001 Australian National Accounts: Input-Output Tables - 2009-10, Table 2. Use table - input by industry and final use category and supply by product group, 20 September 2013.

Many of Australia's ports also play significant roles in national defence and border control. The ports of Townsville and Darwin provide critical infrastructure to Australia's defence interests, and the ports in state capitals as well as Cairns and Gladstone provide ship repair, maintenance, supply and other logistics services to the Royal Australian Navy and allied forces.

9.2.2 Governance, policy and regulatory context

Governance

In Australia all three levels of government are involved in the regulation of ports:

9. The Australian Government regulates the navigation, defence, security, environmental policy, border control, quarantine, and competition policy affecting ports.
10. The State and Territory Governments have planning, development, safety and environmental responsibilities. The states and territories typically control the port precincts, adjacent land uses and in many cases, the connecting road and rail links.

    Ports in Australia are generally operated by corporatized entities (for example, port corporations or port authorities) which are owned by the State/Territory Governments. Some port authorities own and manage more than one port (for example North Queensland Bulk Ports Corporation manages four).

    Port authorities are responsible for assets at and below ground level and are responsible for the contractual relationships with lessees of the port authority's land. They sometimes provide other services, such as pilotage and provision of fuel and water.

    These port authorities balance the need to raise revenue to fund their activities against the economic benefits which arise within the state by facilitating international trade. As a result port authorities typically make a relatively low return on capital, although sustained financial losses are uncommon.

11. Local government makes decisions that affect ports, for example, decisions relating to planning applications and road uses. Local government also represents the views of residents affected by ports, and indeed most ports operate extensive community consultation programmes.

In addition to the three levels of government the ports industry has many other important stakeholders. These include the peak industry body, Ports Australia, and the Maritime Union of Australia.

Policy

In December 2010, Infrastructure Australia (IA) (and the National Transport Council) presented a National Ports Strategy to the Council of Australian Governments (COAG) which sought to deliver a nationally coordinated approach to the future development and planning of Australia's port and freight infrastructure.

The national ports strategy covered both bulk commodity ports and container ports, and identified:

- effective regulatory and governance frameworks
- ways to improve land planning and corridor preservation
- the future infrastructure requirements of Australia's ports, including road and rail links.

Regulation

The regulation of ports is administered by each State/Territory Government. Regulations concerning health and safety and environmental responsibilities apply to all business which operate at the ports.

As a result of being a monopoly, many ports in Australia are regulated by a State economic regulator. Where this is the case, there is generally light-handed regulation of the price for prescribed services.

The prescribed services subject to economic regulation typically include:

- navigation services
- shipping channel access
- berths, buoys or dolphins for the berthing of vessels
- wharfage
- short-term storage or cargo marshalling facilities for the loading or unloading of vessels.

Some ports, including the recently leased Port of Newcastle and the Port of Brisbane, are currently not subject to price regulation. In addition, some providers of services at ports, such as the former monopoly grain exporters and some open-access bulk exporters, are also subject to price regulation. Increasing competition in newly deregulated markets may result in changes to the regulation of these assets.

Planning regulations can lead to significant barriers to expansion of port facilities, and considerable attention is given by ports to planning for future expansion and managing environmental and community risks. Shipping channels in many ports require periodic dredging which requires significant environmental management. Port expansions must also carefully balance the need to increase efficiency with community impacts, particularly road transport and noise impacts, of additional freight during construction and operation of augmented facilities. Many urban ports have faced difficulties as a result of residential encroachment on their operations, leading to difficulties in expanding and reconfiguring operations.

Market

As well as the governance, policy and regulatory framework governing the port authorities, it is also necessary to take into account the diverse interests of the private sector lessees of the port authorities' lands.

There are two dominant stevedoring companies in Australia: DP World and Patricks. Other stevedores include: Hutchinson, ANS Bulk and General, Newcastle Stevedores, Northern Stevedoring Services.

There is an increasing concentration of logistics companies who are serving the ports. Qube Ports is developing a portfolio of end-to-end logistics services including:

- automotive (passenger, agricultural and heavy mining equipment)
- bulk (e.g. iron ore, nickel ore, manganese and copper ore)
- oil and gas (logistics services to major new projects)
- break-bulk (e.g. timber, steel and project cargo)
- rail (port shuttle services)
- grain (through a joint venture with Emerald and Cargill).

Grain terminals are dominated by Graincorp and CBH Group, although there is new entry in this market with the recent construction of the Newcastle Agri Terminal, and an announcement of the Quattro grain facility to be built at Port Kembla.

9.3 Audit of existing port infrastructure

9.3.1 Capacity, utilisation and DEC of port services infrastructure at national level

This section reports the current infrastructure used in the provision of port services, the volume of services supplied/utilised and the DEC of infrastructure services across Australia.

The capacity of Australia's ports is important in order to understand the scale of developments, the regional context for ports and the degree of spare capacity which existed in 2010-11. In some industries, such as iron ore export, this capacity has increased significantly since 2010-11. Since ports exist to serve a local catchment, there is little benefit to discussing ports at a national benefit, beyond introducing some general themes applicable to commodities imported and exported across the nation.

The utilisation of Australia's ports could be measured using many metrics: tonnage, mega litres, container numbers, number of ship calls, value of trade, and many others. Each of these measures reveals a different story about Australia's ports in 2010-11. We discuss the different measures below to identify where significant volumes and volume growth are occurring.

The DEC of Australia's ports is crucial to understanding the annual value that they add to the economy. The DEC for each port has been estimated by reviewing relevant financial accounts of the entity operating the port, supplementing this with an analysis of DEC based on the tonnage moved through the ports (for bulk ports) and further supplementing this where there were no specific data on the economic contribution of port terminals and other facilities by apportioning a share of the gross value added from the port-share of TSSS estimated on a regional level. This means that the estimate is based on a tiered approach involving specific measures, activity levels and regional estimates.

Capacity metrics

Table 34 lists the estimated twenty foot equivalent unit (TEU) capacity and utilisation of ports across Australia.

Table 34 **Estimated container capacity and utilisation by port**

	2010-11 capacity (TEUs)	2010-11 utilisation (TEUs)
New South Wales	**3.24 million**	**2.02 million**
Port Kembla	0.02 [a] million	0.00 million
Newcastle	0.02 [a] million	0.02 million
Port Botany	3.20 million	2.00 million
Northern Territory	**0.15 million**	**0.01 million**
Darwin	0.15 million	0.01 million
Queensland	**2.52 million**	**1.05 million**
Townsville	0.05 million	0.04 million
Cairns	0.02 [a] million	0.02 million
Brisbane	2.45 million	0.98 million
South Australia	**0.63 million**	**0.30 million**
Adelaide	0.63 million	0.30 million
Tasmania	**0.51 million**	**0.38 million**
Burnie/Devonport	0.45 million	0.34 million
Bell Bay	0.06 million	0.05 million
Victoria	**3.70 million**	**2.40 million**
Melbourne	3.70 million	2.40 million
Western Australia	**1.22 million**	**0.61 million**
Esperance	0.02 [a] million	0.01 million
Fremantle	1.20 million	0.60 million
Total (Australia)	**11.97 million**	**6.77 million**

Note: a) For ports moving less than 20,000 TEUs per annum and where there were no statements of capacity, an assumption of 20,000 TEUs capacity was made. This does not materially affect the totals for states.
Source: Container utilisation from Ports Australia trade Statistics, 2010-11. Container capacity from public statements by the ports.

Nationally it is estimated that in 2010-11 there was capacity for 12 million TEUs. This compares to the 6.8 million TEUs which were handled by Australian ports in 2010-11.

This capacity estimate includes a planning cap on Port Botany which was in place in 2010-11. This has subsequently been relaxed, thereby increasing effective capacity by approximately 4-5 million TEUs per annum[50] if landside transport logistics are capable of dealing with the additional freight. The Port of Melbourne is also currently making significant investments in its capacity.

If the utilisation of ports grew at 6 per cent per annum there would only be sufficient national capacity to 2020. However, growth rates differ by port.

In general, it is difficult to assign a tonnage measure of capacity for a mixed-use port. This is because it is determined by identifying the limiting factors in multiple supply chains of diverse commodities. As a result, no measure has been made of the total capacity of mixed-use ports.

[50] ACIL Allen Consulting analysis estimate, 2014

For bulk ports the Audit estimates capacity based on nameplate capacity or public statements of capacity extant at 30 June 2011. Such measures were not always available.

The volumes exported and the estimated capacity of the twenty largest bulk ports in Australia are in Table 35.

Table 35 **Capacity and utilisation of Australia's 20 largest bulk ports (2010-11)**

Port	Capacity (Mtpa)	Utilisation (Mtpa)	Utilisation as % of capacity
Port Hedland	231	210	91%
Dampier	172	153	89%
Newcastle	164	110	67%
Mackay	135	90	67%
Gladstone	93	83	88%
Port Walcott	80	58	72%
Brisbane	60	33	54%
Abbot Point	50	15	30%
Weipa	44	22	51%
Fremantle	40	37	93%
Adelaide	25	22	87%
Port Kembla	23	16	70%
Bunbury	20	14	70%
Esperance	18	13	73%
Townsville	16	11	66%
Geraldton	15	12	77%
Geelong	15	2	11%
Darwin	14	4	27%
Gove	8	8	100%
Albany	8	4	59%
Australian total	**1,230**	**915**	74%

Note: Tonnages for mixed-use ports include tonnes associated with non-bulk commodities.
Source: Capacity from Annual reports and public statements of capacity extant in 2010-11. Utilisation based on Ports Australia statistics, with estimate for Port Walcott volumes based on press statements and Rio Tinto annual report.

Australia's bulk ports in the Pilbara were estimated to have the capacity to export 483 million tonnes of iron ore in 2010-11. Since then there has been substantial investment to nearly double this capacity. Exports from Port Walcott, Port Dampier and Port Hedland were estimated to be in total 420 million tonnes in 2010-11, 87 per cent of estimated capacity at that time.

Coal ports in Queensland and New South Wales also contribute significantly to Australia's export volumes. In 2010-11, Newcastle, Gladstone, Hay Point and Dalrymple Bay, Brisbane, Abbot Point and Port Kembla exported a total of 286.2 million tonnes of coal.

In discussing capacity of Australia's bulk ports it is important to point out that ports are a link in supply chains. For a port to achieve its maximum throughput requires that the mines which produce the ores, the railway networks along which these ores travel, the ports which receive the ore and load the ships, shipping channels and each interface between these links are aligned to complement each other.

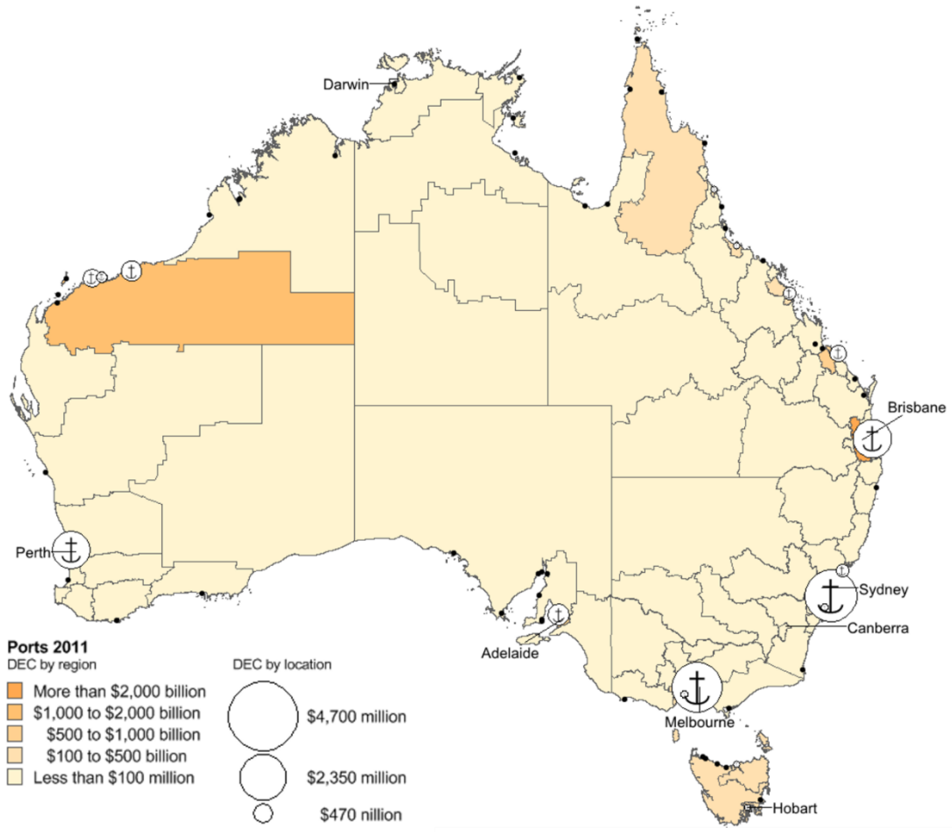
A bottleneck in the landside infrastructure could lead to underperformance of the whole supply chain. For this reason, Australia's best-performing logistics chains in the Pilbara are operated by mining companies which own mines, rail and port facilities. Where ownership of rail and ports is not practical, supply chain coordination is required to ensure that all links in the chain complement each other – a good example of this is the Hunter Valley Coal Chain.

Significant risks are presented where supply chain coordination cannot occur effectively. For example where ports are dependent on land-side infrastructure used for public transport, or where there are multiple port users with different logistics requirements. These risks are managed through the process of drafting port master plans and infrastructure strategies, but there remains uncertainty about whether these plans will lead to actions which could hinder business investment.

DEC metrics

Australian port services are estimated to have contributed $20.7 billion to the economy in 2010-11. This equates to 1.6 per cent of GDP. Figure 121 maps the DEC of port services in 2010-11 by audit region.

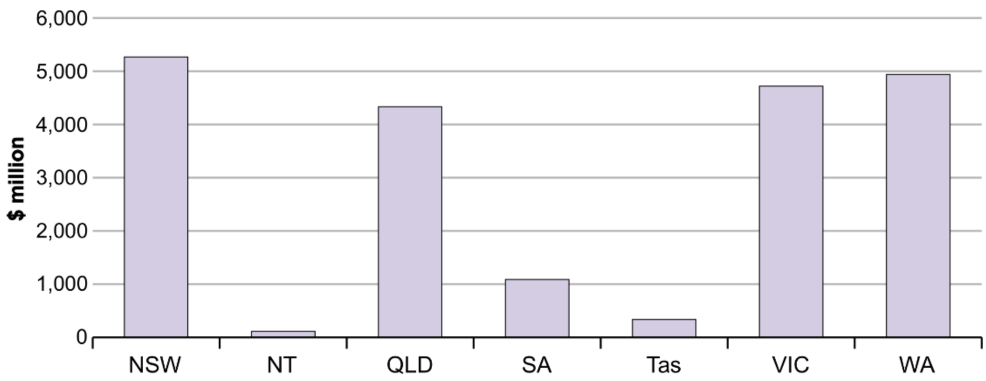
Figure 121 **Map of port DEC by audit region**



Source: ACIL Allen Consulting, 2014

This DEC is distributed fairly evenly amongst the four largest states, as shown by Figure 122.

Figure 122 **DEC of port services by state/territory, 2010-11**



Source: ACIL Allen Consulting, 2014

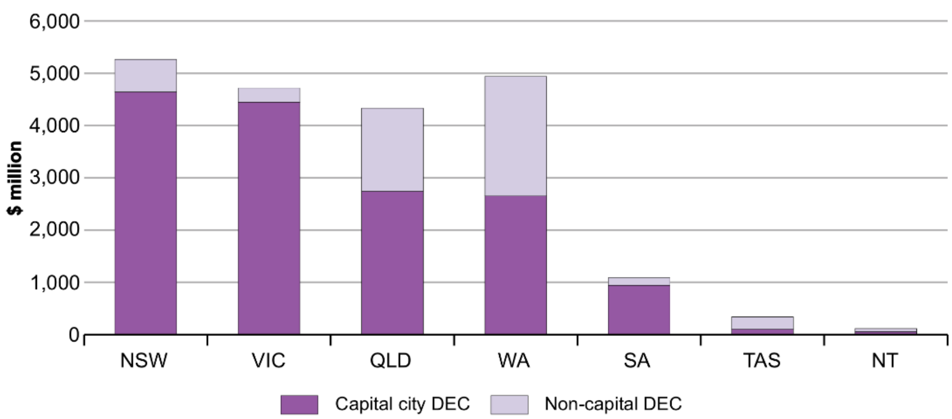
The significant DEC estimated for Western Australia is influenced by the estimated economic contribution of ports in the Pilbara. As the DEC of the iron ore export facilities is recorded in the national accounts within the mining sector, ACIL Allen has estimated the DEC of these ports based on the volume of exports and a calculated average DEC per tonne ($4.62 per tonne) for all bulk ports. This measures the DEC of the Pilbara ports in 2010-11 at $1.9 billion per annum.

9.3.2 Capacity, utilisation and DEC of port services infrastructure by state/territory

This section reports the current infrastructure used in the provision of port services, the volume of services supplied/utilised and the DEC of infrastructure services by state and territory.

Figure 123 depicts DEC by ports serving state capitals and those serving regional communities or commodity supply chains by state and territory.

Figure 123 **Port services DEC by state/territory, split by capital/non-capital cities**



Source: ACIL Allen Consulting, 2014

It highlights that the significant container ports in Sydney, Melbourne and Adelaide generate the majority of port DEC in these respective states, whereas the mixed-use ports of Brisbane and Fremantle are counterbalanced by the significant bulk export ports in their respective states. In Tasmania and the Northern Territory there is a more complex relationship; Tasmania receives the containers destined for Hobart through ports outside of the state capital, and the Port of Darwin has significant bulk export facilities in comparison to a very small container task.

New South Wales

The port services infrastructure operated in New South Wales generated DEC of $5.3 billion in 2010-11. The top five overseas exports (by value) from New South Wales were coal, copper ores and concentrates, aluminium, petroleum oils (excl. crude) and medicaments. The top five overseas imports (by value) into New South Wales were medicaments, telecommunications equipment, petroleum oils (incl. crude), automatic data processing machines, and motor cars.

Table 36 shows the contribution of each port to the state totals for utilisation and DEC.

Table 36 **Utilisation and DEC of NSW port services**

	Utilisation		DEC
	Tpa million	TEUs million	$ million
Eden	1.20	-	46
Newcastle	109.60	0.02	423
Port Botany	29.70	2.00	4,641
Port Kembla	16.00	0.00	150
Yamba	0.01	-	6
Total New South Wales	**156.51**	**2.02**	**5,266**

Source: ACIL Allen Consulting, 2014

New South Wales is dominated by the activity generated by Port Botany, which accounts for 88 per cent of the New South Wales DEC. The port is a major container port, with 29.5 per cent of Australia's containerised imports and exports moving through the port.

Port Botany supports local businesses, with 85 per cent of port Botany's containers originating in, or being delivered to, locations within 40 kilometres of the port[51]. Port Botany also handles bulk fuels and other bulk liquids.

Port Botany is a mixed use port, and so it is difficult to calculate a total capacity figure. Prior to the sale of Port Botany there was a 3.2 million TEU capacity limit imposed upon the port. This reflected perceived negative impacts of container movements on the roads connecting the port. This limit was subsequently annulled.

A major contributor to the non-capital New South Wales DEC is the Port of Newcastle. It accounts for 8 per cent of the New South Wales DEC. The Port of Newcastle is the world's largest coal export port and also provides services to more than 90 other commodities, including significant fuel storage, grain export facilities and general cargo handling facilities.

Port Kembla handles the vast majority of New South Wales automotive imports and is a significant coal and grain export port. The port also services imports of raw materials for BlueScope steel, and provides export facilities to the steelworks.

Victoria

The port services infrastructure operated in Victoria generated DEC of $4.7 billion in 2010-11. The top five overseas exports (by value) from Victoria were wool, motor cars, aluminium,

[51] Sydney Ports – Intermodal Logistics Centre at Enfield Project Overview http://www.sydneyports.com.au/__data/assets/pdf_file/0016/11167/ILC_at_Enfield_Project_Overview.pdf

milk and cream products, and meat (other than beef) and offal. The top five overseas imports (by value) into Victoria were motor cars, petroleum oils (incl. crude), petroleum oils (excl. crude), motor vehicle parts and accessories, and vehicles for transport of goods.

Table 37 shows the contribution of each port to the state totals for utilisation and DEC.

Table 37 **Utilisation and DEC of Victorian port services**

	Utilisation		DEC
	Mtpa	MTEUs	$ million
Geelong	1.65	-	$142
Hastings	2.30	-	$11
Melbourne	56.64	2.40	$4,446
Portland	4.00	-	$55
Welshpool	-	-	$65
Total Victoria	**64.59**	**2.40**	**$4,718**

Source: ACIL Allen Consulting, 2014

The Port of Melbourne dominates the Victorian port DEC contributed by port services in Victoria. More than 95 per cent of the total for Victoria is generated by this port, which serves Victorian manufacturers in Melbourne and Geelong and businesses and consumers throughout Victoria. The Port of Melbourne has significant bulk fuel and other liquids facilities, exports bulk grain through the Emerald terminal located at the port and in 2010-11 it conducted a significant trade in both imported and exported vehicles and parts.

Queensland

The port services infrastructure operated in Queensland generated DEC of $4.3 billion in 2010-11. The top five overseas exports (by value) from Queensland were coal, beef, ores and concentrates of base metals, copper and aluminium. The top five overseas imports into Queensland (by value) were petroleum oils (incl. crude), motor cars, petroleum oils (excl. crude), vehicles for transport of goods, and non-monetary gold.

Table 37 above shows the contribution of each port to the state totals for utilisation and DEC.

Table 38 **Utilisation and DEC of Queensland port services**

	Utilisation		DEC
	Mtpa	MTEUs	$ million
Abbot Point	15.10	-	$70
Brisbane	32.57	0.98	$2,742
Bundaberg	0.31	-	$23
Burketown	-	-	$23
Cairns	1.00	0.02	$121
Cape Flattery	2.00	-	$9
Gladstone	82.50	-	$633
Karumba	0.96	-	$4
Lucinda (Townsville)	0.42	-	$2
Mackay	90.35	-	$417
Maryborough	-		$17
Mourilyan	0.50	-	$15
Port Alma	0.32	-	$1
Quintell Beach	0.00	-	$0
Rockhampton	-	-	$25
Thursday Island	0.01	0.01	$0
Townsville	10.60	0.04	$127
Weipa	22.32	-	$103
Total Queensland	**258.97**	**1.05**	**$4,333**

Source: ACIL Allen Consulting, 2014

With a contribution of $2.7 billion the Port of Brisbane dominates the DEC contributed by port services in Queensland, accounting for 63 per cent of the Queensland DEC for port services. The Port of Brisbane is a mixed-use port which handles 15 per cent of the containers across Australia's wharves, exports bulk coal and grain, imports crude oil and refined fuels, and exports refined oils. The Port of Brisbane also imports a significant number of vehicles.

The Port of Gladstone accounted for $633 million of Queensland DEC for ports (15 per cent of Queensland's total). It is a mixed-use port with 53 million tonnes of coal exports, 19 million tonnes of bauxite imports and 0.6 million tonnes of aluminium exports in 2010-11 Cement and petroleum imports were significant other trades at the port.

Port facilities in the Mackay region also generated 10 per cent of the DEC from port services in Queensland. The coal export facilities at Dalrymple Bay and Hay Point exported 88 million tonnes of coal in 2010-11, with a further 2 million tonnes of bulk imports and exports handled at the port.

The ports of Townsville and Weipa each contributed approximately 3 per cent to the DEC of Queensland's port services. Townsville is a port which exports a significant amount of iron ore, zinc concentrate and other minerals, using the Mt Isa line as a supply chain. It also handles general cargo and livestock. Trade through the port has grown significantly in recent years and significant supply chain augmentation is in progress to ensure that future growth can be accommodated.

Weipa is a bauxite export port which serves a significant local resource on the Western Cape York Peninsula, in 2010-11 it shipped 22.3 million tonnes of bauxite, primarily to Gladstone. The mine is approaching the end of its life, but there are neighbouring deposits of a similar scale which could be developed. Rio Tinto has planned a $1 billion expansion of the Weipa mine, and appears to have obtained the significant approvals required. Rio Tinto is considering the project economics before committing to the South of Emberly extension. The expansion would extend the life of the mine by 40 years, and would involve a staged increase of as much as 50 million tonnes per year from a shallow open-pit mine, using trucks and loaders.

Western Australia

The port services infrastructure operated in Western Australia generated DEC of $4.9 billion in 2010-11. The top five overseas exports (by value) from Western Australia were iron ore and concentrates, non-monetary gold, petroleum oils (incl. crude), natural gas and wheat. The top five overseas imports into Western Australia were non-monetary gold, petroleum oils (including crude), petroleum oils (excluding crude), motor cars, and vehicles for transport of goods. Non-monetary gold, in the form of leaf, foil, bullion and other fabricated gold products (including granules), is imported into Western Australia for processing before being exported in a different form.

Table 39 shows the contribution of each port to the Western Australia totals for utilisation and DEC.

Table 39 **Utilisation and DEC of Western Australian port services**

	Utilisation		DEC
	Mtpa	MTEUs	$ million
Albany	4.41	-	$60
Broome	0.18	-	$41
Bunbury	14.00	-	$45
Dampier	153.10	-	$707
Derby Wharf	0.01	-	$0
Esperance	12.73	0.01	$83
Fremantle	37.27	0.60	$1,787
Geraldton	11.80	-	$100
Kwinana	21.62	-	$866
Onslow	0.01	-	$0
Port Hedland	210.10	-	$957
Port Walcott	57.50	-	$266
Thevenard Island	-	-	$13
Varanus Island	0.80	-	$4
Wyndham	0.31	-	$1
Yampi Sound	2.30	-	$11
Total Western Australia	**526.14**	**0.61**	**$4,940**

Source: ACIL Allen Consulting, 2014

With a DEC of $1.7 billion the Port of Fremantle (including Kwinana) is the largest port in Western Australia. The Port of Fremantle accounts for 78 per cent by value of Western Australia's seaborne imports and 11 per cent by value of Western Australia's seaborne exports. It is a mixed use port which handles the majority of Western Australia's container trade, but also handled approximately 10 million tonnes of bulk liquids (crude oil imports and refined oil imports and exports), 9.3 million tonnes of dry bulk such as grains, bauxite imports and alumina exports, coal exports, cement imports and other commodities including livestock.

The three major ports in the Pilbara (Hedland, Dampier and Walcott) collectively contributed $1.9 billion to Western Australia's economy in 2010-11 as measured by the DEC. This contribution resulted from 420 million tonnes of iron ore exports. These ports also handle other commodities, including manganese from Port Hedland and salt from Dampier. There is also a significant trade in commodities supporting the mining activities – fuel, machinery and general cargo.

The estimated DEC of Port of Esperance is $83 million primarily from its exports of 8.9 million tonnes of iron ore and 1 million tonnes of grain. The port also handles a significant amount of petroleum and fertiliser for use in local industries.

The DEC of Port of Albany is $60 million and is primarily from its exports of 1.4 million tonnes of woodchips and 1.3 million tonnes of grains in 2010-11.

The DEC of Port of Bunbury is $45 million in 2010-11. This is from its exports of 9.4 million tonnes of alumina and 1.5 million tonnes of woodchips, and imports of 1.2 million tonnes of caustic soda. The port also carried out a significant trade in minerals sands and silica sand.

South Australia

The port services infrastructure operated in South Australia generated DEC of $1.1 billion in 2010-11. The top five overseas exports (by value) from South Australia were wheat, copper, alcoholic beverages, copper ores and concentrates, and iron ore and concentrates. The top five overseas imports (by value) into South Australia were petroleum oils (excl. crude), motor cars, motor vehicle parts and accessories, ores and concentrates of base metals, and vehicles for transport of goods.

In 2001 seven of South Australia's ports were leased to Flinders Ports, which has built port infrastructure and manages the ports. These ports are: Klein Point, Port Adelaide, Port Giles, Port Lincoln, Port Pirie, Thevenard and Wallaroo.

Table 40 shows the contribution of each port to the South Australian totals for utilisation and DEC.

Table 40 **Utilisation and DEC of South Australian port services**

	Utilisation		DEC
	Mtpa	MTEUs	$ million
Adelaide	21.73	0.30	$942
Klein Point	1.56	-	$7
Port Bonython	-	-	$16
Port Giles	0.88	-	$4
Port Lincoln	2.93	-	$14
Port Pirie	0.55	-	$60
Thevenard	3.03	-	$14
Wallaroo	0.91	-	$4
Whyalla	6.00	-	$28
Total South Australia	**37.59**	**0.30**	**$1,088**

Source: ACIL Allen Consulting, 2014

The DEC of Port Adelaide ($0.9 billion) dominates the DEC of South Australian port services, accounting for 86 per cent of the total. As well as a significant container port, Port Adelaide is a major exporter of grain, exporting 2.2 million tonnes in 2010-11. It also handled a significant amount of petroleum products and general cargo.

Port Pirie is a significant minerals concentrate and iron ore export port, with commodities sourced by rail from as far away as the Broken Hill region of New South Wales. In 2010-11 the port exported 203,000 tonnes of minerals concentrates. NyrStar operates the world's largest lead smelter and the world's third largest silver refinery, at land adjacent to Port Pirie, exporting large quantities of zinc concentrates and lead (383,000 tonnes in 2010-11). Other exports from Port Pirie include grain and seeds, with principal imports comprising minerals, coal and ores. These activities generated $60 million of DEC.

Whyalla is an iron ore bulk export port and is well placed to capitalise on mining developments to its north and west. The port exported 6 million tonnes in 2010-11 and has a DEC of $28 million.

Port Bonython is a deepwater port in the Upper Spencer Gulf. It is leased to Santos, which operates a hydrocarbon processing plant on the site. The port generated a DEC of $16 million in 2010-11 and adjoining land is being considered as a future minerals export location.

The other ports in South Australia are bulk export ports mainly exporting grain, with the exception of Klein Point, which exports limestone and Thevenard, which exports gypsum.

Tasmania

The port services infrastructure operated in Tasmania generated DEC of $337 million in 2010-11. The Tasmanian DEC has been estimated for individual regions and ports in Tasmania, but caution should be exercised that since the values in Tasmania are an order of magnitude smaller than other states, there is a possibility that allocations of DEC to individual ports may be inaccurate.

A significant proportion of sea trade in Tasmania is with the mainland. In 2010-11 4.9 million tonnes of goods were dispatched from Tasmania to the mainland (mainly primary products such as bulk ores, as well as processed materials and foods). In the same year 4.4 million tonnes of goods were received in Tasmania, these goods were from a wide variety of industry sectors, although commodities and manufactured goods were the largest categories.

The top five overseas exports from Tasmania were zinc, aluminium, wood chips, copper ores and concentrates and iron ore and concentrates. The top five overseas imports into Tasmania were petroleum oils (excl. crude), cocoa, residual petroleum products, feeding stuff for animals, and fertilisers.

Table 41 shows the contribution of each port to the Tasmanian totals for utilisation and DEC.

Table 41 **Utilisation and DEC of Tasmanian port services**

	Utilisation		DEC
	Mtpa	TEUs million	$ million
Burnie	3.98	0.23	$18
Devonport	3.20	0.10	$15
Hobart	2.32	-	$102
Launceston (Bell Bay)	4.03	0.05	$131
Port Latta	2.07	-	$10
Spring Bay	Not known	-	$30
Stanley	Not known	-	$30
Total Tasmania	**15.60**	**0.38**	**$337**

Source: ACIL Allen Consulting, 2014

In 2010-11 Bell Bay was the largest port in Tasmania, handling more than 4 million tonnes of goods. The port is mixed-use, handling containers as well as bulk trades from the surrounding area. In 2010-11 the port operated a direct international container service which has since been abandoned. The estimated DEC for Bell Bay is large relative to the other Tasmanian ports, this may be the result of the estimation process. Launceston generated the largest DEC from port services of all Tasmanian regions, and this is allocated to Bell Bay because it is the only port in the region.

Hobart is the main cruise ship and naval vessel destination for Tasmania, a key base for Australian Antarctic supply vessels and has a fuel supply base located at Self's Point. It made a direct economic contribution of $102 million in 2010-11.

This high estimate in comparison to Burnie and Devonport may have resulted from the method of estimating regional DEC — on the basis of location of employment. It is possible that some employees from all ports work in Hobart and as such the DEC of port services in Hobart may be overstated.

Port Latta is a private port which exports iron ore pellets to Port Kembla. The DEC of this port has been estimated at $10 million based on the volume shipped.

Burnie port services Tasmania's major west coast mines and handles most types of bulk shipping including, minerals, fuels, and woodchips, as well as containerised consumables. The export of forest products is also an important operation of the port. Burnie handled more than half of Tasmania's containers in 2010-11 and made an estimated DEC of $18 million.

The Port of Devonport handles wheat, grain, cement, containerised goods, fertilisers, fuels and consumables inbound. It made an estimated DEC of $15 million. This may be understated because of the algorithm which is used to calculate DEC on a regional basis. Stanley and Spring Bay are in the same audit region as Devonport and Burnie and each of their DECs is estimated to be $30 million – as the balance of regional port services DEC not allocated to Devonport and Port Latta.

Northern Territory

The port services infrastructure operated in the Northern Territory generated DEC of $114 million in 2010-11. Table 42 shows the contribution of each port to the Northern Territory totals for utilisation and DEC.

Table 42 **Utilisation and DEC of Northern Territory port services**

	Utilisation		DEC
	Mtpa	MTEUs	$ million
Bing Bong	-	-	$4
Darwin	3.73	0.01	$54
Gove	8.00	-	$37
Milner Bay	4.10	-	$19
Total NT	**15.83**	**0.01**	**$114**

Source: ACIL Allen Consulting, 2014

Darwin is the key contributor to the port services in the Territory. Its DEC of $54 million reflects its increasing presence as an iron ore and mineral concentrates export port. These trades have been opened up by the Adelaide-Darwin railway, which has a spur line directly to the port. Darwin is also positioned as a marine supply precinct for offshore LNG developments, as well as a centre for live exports of cattle.

Gove is a bauxite export port, located 650 kilometres east of Darwin in north-east Arnhem Land. In 2010-11 Gove exported alumina to Gladstone and abroad, but in November 2013 Rio Tinto decided to close the refinery and instead focus on the export of bauxite. Its DEC was estimated to be $37 million in 2010-11.

The other Northern Territory ports include Milner Bay and Bing Bong. Milner Bay (Groote Eylandt) was estimated to contribute $19 million to the Northern Territory economy. It is a bulk export port exporting manganese. Bing Bong operates a barge facility to export iron ore.

9.3.3 Capacity, utilisation and DEC of port services infrastructure by audit region

This section reports the current infrastructure used in the provision of port services, the volume of services supplied/utilised and the DEC of infrastructure services by audit region across Australia. There are 39 audit regions in which ports are located. Some contain multiple ports within them.

Clearly the Pilbara ore exports and the Queensland and New South Wales coal exports dominate Australia's physical output. Per tonne these exports generate a much lower contribution than the import and export of containerised goods into Australia's state capitals.

The 10 largest regional economic contributions are generated in the regions shown in Table 43.

Table 43 **DEC of port services in the 10 largest regions in 2010-11 ($ million)**

	DEC
	$ million
1_1_Greater Sydney	4,641
1_7_Illawarra	147
1_11_Newcastle and Lake Macquarie	423
2_1_Greater Melbourne	4,457
3_1_Greater Brisbane	2,742
3_12_Gladstone - Biloela_NA	633
3_16_Mackay	417
4_1_Greater Adelaide	942
5_1_Greater Perth	2,653
5_10_Pilbara	1,934

Source: ACIL Allen Consulting, 2014

As discussed in section 9.3.2 the DEC of the ports serving the state capital cities is between $0.9 billion and $4.6 billion per annum. Only the combined contribution of the Pilbara ports rivals this, with the Pilbara generating a DEC of $1.9 billion.

9.4 Projections for port services infrastructure needs

This section details projections of the demand for port service infrastructure, estimates of the required capacity and estimated DEC, as at FY2030-31.

The projections for demand and DEC are based on the economic forecasting work undertaken by ACIL Allen. The underlying economic projections used in this Audit are based on national, state/territory and audit region projections developed using ACIL Allen's Tasman Global model of Australia's economy. These projections cover the period 2010-11 to 2030-31.

9.4.1 National projections

Nationally, the demand for port services infrastructure in 2030-31 is projected to be 65 per cent higher than it was in 2010-11. This is an annualised rate of growth of 2.6 per cent per annum. This is low in the context of the trade growth we have been experiencing over the past 10 years, with total mass tonnages increasing at a rate of 7 per cent per annum.

Two factors explain the difference between history and future projections:

- Within the past 10 years we have seen a dramatic increase in world trade as a result of China's increased focus on trade. This growth is expected to slow down as China's share of global markets stabilises.
- There have also been significant mining developments which are coming to completion. This will see an increase in output within the short term, but the longer growth trend is expected to moderate.

Container growth is projected to follow the trend in GDP with a 1.1 per cent increase in container volumes expected to result from a 1 per cent increase in GDP.

Exports of bulk ores and minerals are expected to continue to increase at an annualised rate that varies by region. For the Pilbara there is a continuation of past growth trends, averaging 6.9 per cent per annum. For the New South Wales coalfields however there is a slowdown in growth compared to the past 10 years, which reflects a step change in volumes followed by a slower rate of growth over time.

Agricultural output is expected to follow historic growth trends. There is considerable annual variability in the export of grains, particularly when looking at specific regions. After the domestic demand for grains is satisfied Australian farmers export all surplus production. In a good harvest this can be substantial. In poor harvests it can be greatly reduced. The long run trend in agricultural exports is expected to reflect a continuation of improving yields and a small increase in the areas planted to grains.

In aggregate the economic projections indicate that the output (as measured by utilisation) of port services infrastructure is expected to increase by more than the increase in output – this reflects improved productivity of assets over time. Nationally, the output of port services is expected to increase by 65 per cent from 2010-11 to 2030-31.

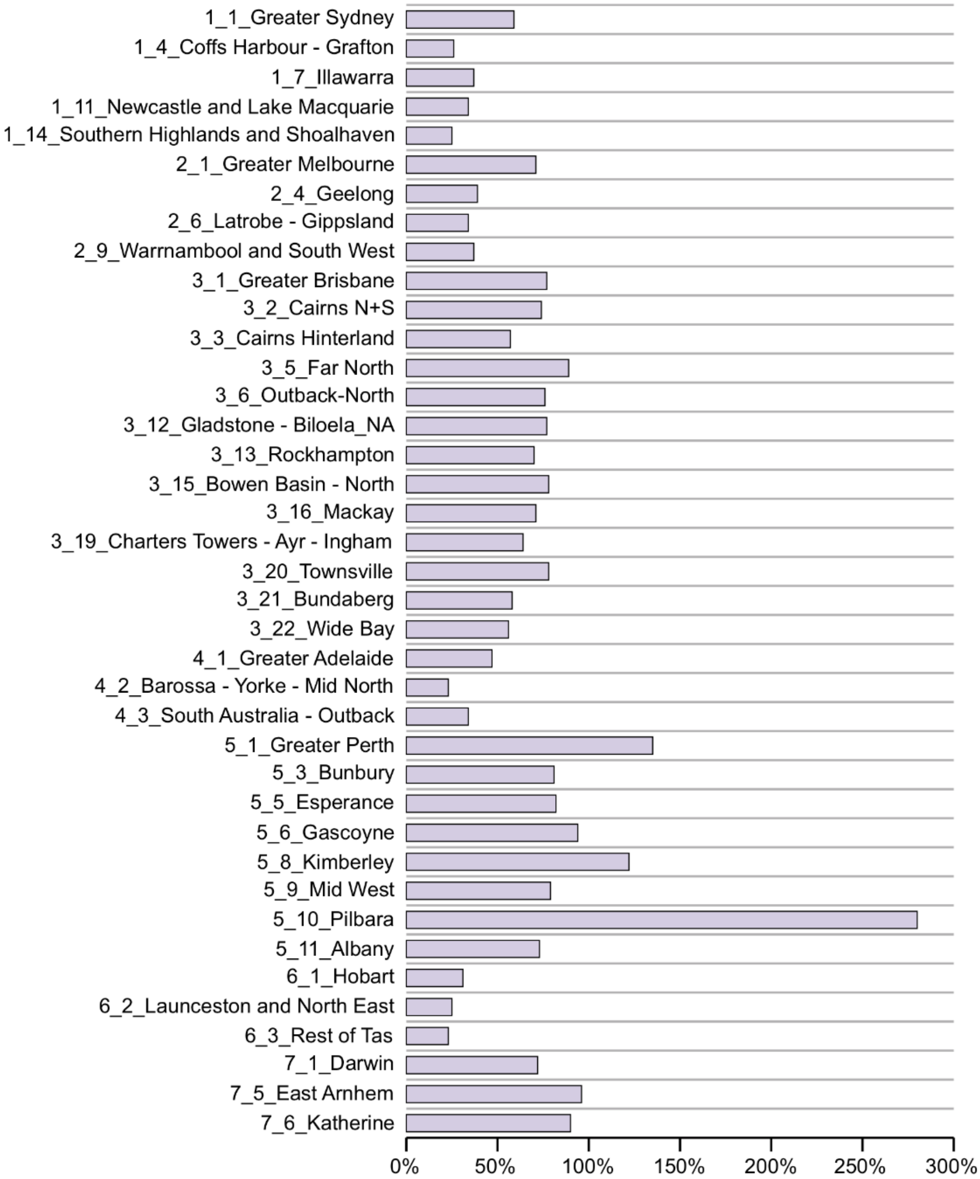
9.4.2 Audit region projections

The analysis of demand and capacity for port service infrastructure is most insightful at the regional level. This is because ports serve local catchments and there is limited substitution between them.

Capacity and utilisation metrics

The projected growth rates in utilisation to 2030-31 is shown in Figure 124.

Figure 124 **Growth in port utilisation by audit region to 2030-31 (per cent)**



ACIL Allen Consulting, 2014

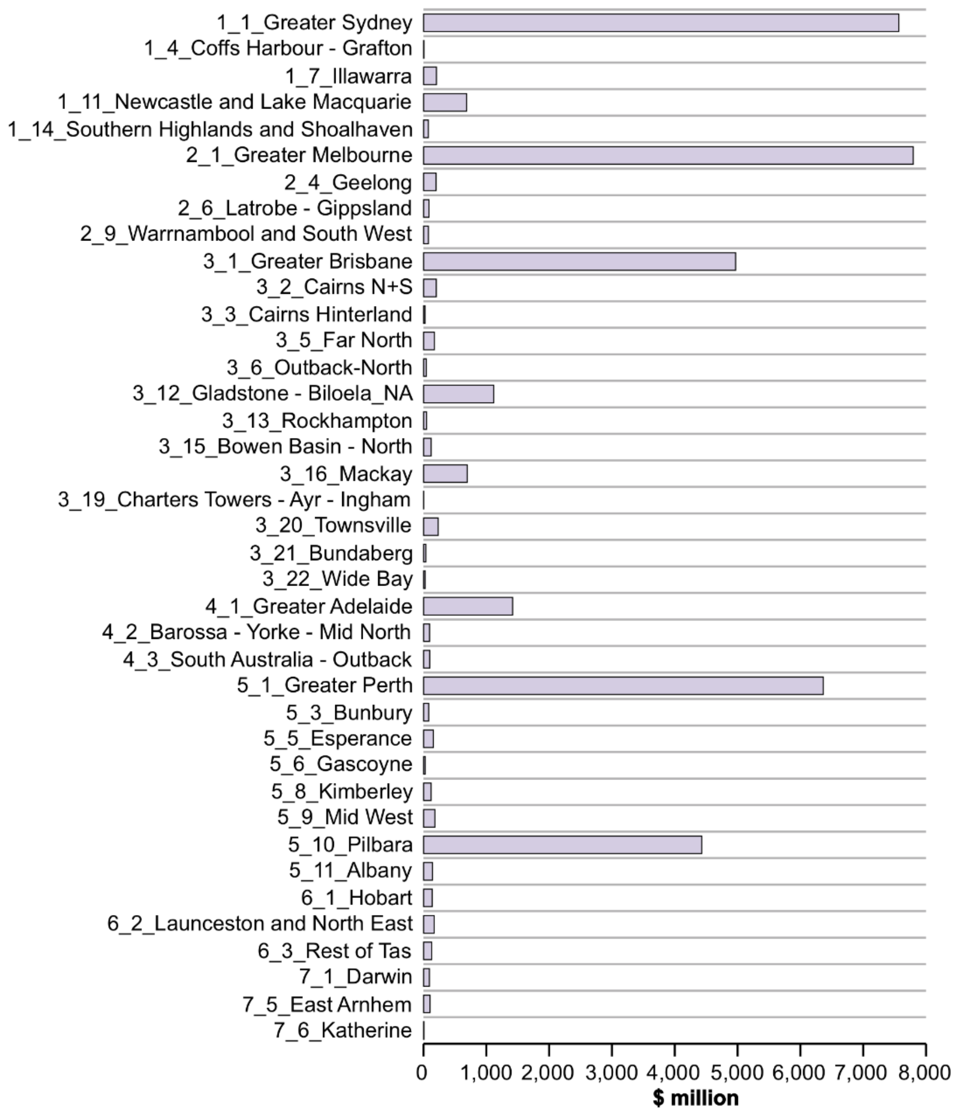
The regions which have intensive mining operations see significant annual growth, with demand for port services in the Pilbara expected to increase by 289 per cent in the years to 2030-31. Perth and the Kimberley see significant growth as new mines come online in the Kimberley and the state's economic growth leads to population growth in Perth.

The estimated capacity of many ports in 2010-11 is insufficient for meeting the expected increase in demand. Some ports, such as the Pilbara have already made investments in recent years to significantly increase capacity, and other are developing plans for the expected growth in volumes. Section 9.5 below discusses this in further detail.

9.5 Projections for ports DEC

The projected DEC of port services by audit region in 2030-31 are shown in Figure 125.

Figure 125 **Projected DEC by region in 2030-31 ($ million in 2010-11 dollars)**



Source: ACIL Allen Consulting, 2014

9.5.1 DEC in ports services infrastructure

The DEC of port services infrastructure is expected to increase from $20.7 billion in 2010-11 to $41.9 billion in 2030-31. While there is some spare capacity at many ports across Australia it is clear that most ports in areas of growth will require investment in port infrastructure to meet this growth of demand and crystallise this potential economic contribution.

Table 11 shows the growth of in port DEC across Australia in the Baseline scenario between 2010-11 and 2030-31.

Table 44 **Ports DEC Growth 2011 - 2031**

	DEC growth 2011 - 2031	
	Projected growth ($million) 2011 - 2031	Projected growth rate (%) 2011 - 2031
NSW	3,155	60.0%
VIC	3,444	73.0%
QLD	3,456	80.6%
SA	523	48.0%
WA	10,463	215.7%
TAS	100	29.7%
NT	93	83.2%
ACT	-	-
Australia average	2,654	102.8%

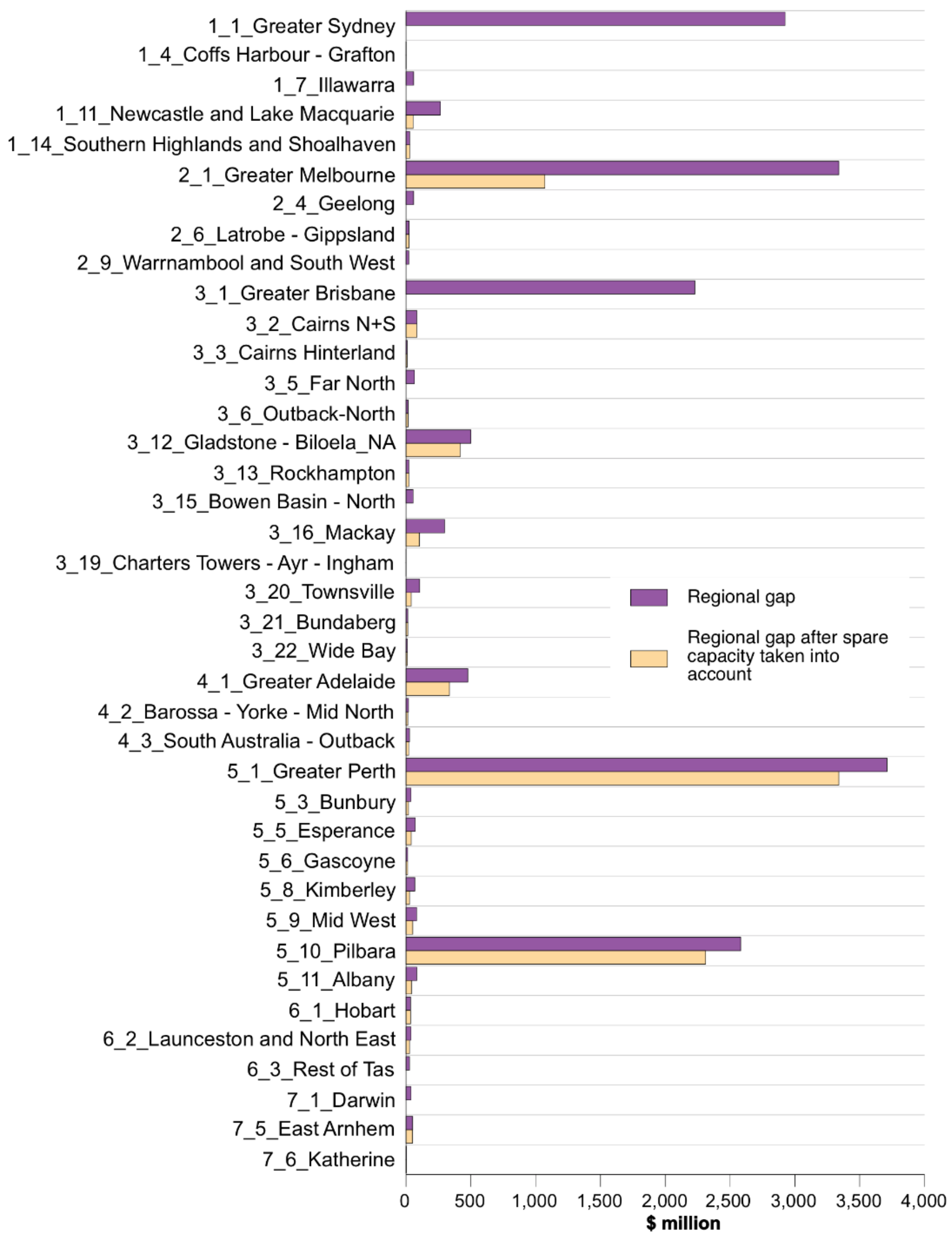
Source: ACIL Allen Consulting, 2014

Some audit regions see significant gaps in the current supply of ports infrastructure and the projected growth in ports demand. The Pilbara in Western Australia is the obvious example. The Greater Perth region is also an area where there is a considerable infrastructure gap. The gap by region is shown in Figure 126.

Infrastructure investments are lumpy in nature and are characterised by initial periods of excess capacity after investment. The 2010-11 infrastructure audit was able to identify the current capacity of some ports, typically Australia's larger bulk ports and container terminals at the state capitals. Using this information, we were able to estimate how much of the infrastructure gap requires new investment and how much could be absorbed by existing infrastructure.

Under this estimation, the DEC addition which requires new capital (compared to the 2010-11 capital base) is also shown in Figure 126.

Figure 126 **DEC gap in port infrastructure services by audit region in 2030-31 ($ million in 2010-11 dollars)**



Source: ACIL Allen Consulting, 2014

Figure 126 is illustrative only in that the difference between the two data series are derived by comparing current spare capacity with the projected demand for the port. This makes the assumption that the future demand can use the spare capacity. For example, the spare capacity estimated for the Port of Melbourne is largely based on spare capacity at the port of Melbourne and an assumption that each TEU weighs 18 tonnes. If the future demand is for dry bulk, or automotive, trades, or even that the actual weight of containers is less than 18 tonnes, then the spare container capacity will be of little use in providing services to those trades.

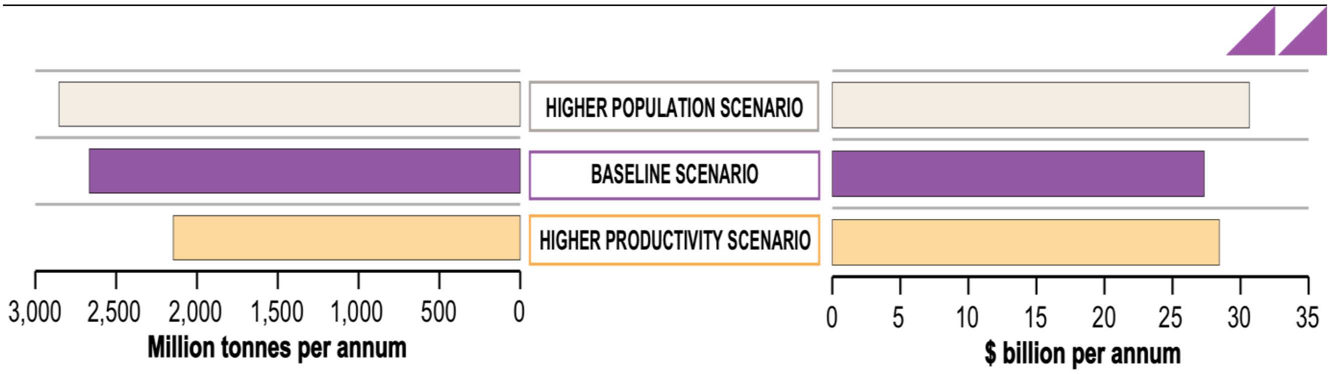
9.6 Sensitivity analysis of projections for port services infrastructure needs and DEC

In order to illustrate how the outlook for infrastructure services could vary given different rates of change in the population and economy, two additional alternative scenarios have been modelled:

- 'Higher population growth scenario' – Scenario 2: which assumes that Australia's population growth is higher (compared with the baseline scenario) and is aligned with ABS Series A projections;
- 'Higher productivity growth scenario' – Scenario 3: which assumes higher factor productivity in the infrastructure sectors in obtaining 1 per cent higher growth in Australian real GDP by 2030-31 (relative to the output growth obtained in the 'baseline scenario').

The impact of the two alternative scenarios on output growth is shown in Figure 127. The Higher population scenario increases the demand for port infrastructure services through increases in both imports and exports due to the growth in the population. Bulk export ports are less affected by this scenario than capital city ports. The Higher productivity scenario reduces the output of ports because of the higher productivity of these ports. This is because domestic manufacturing requires less imported inputs and domestic manufacturing is now more competitive against foreign imports.

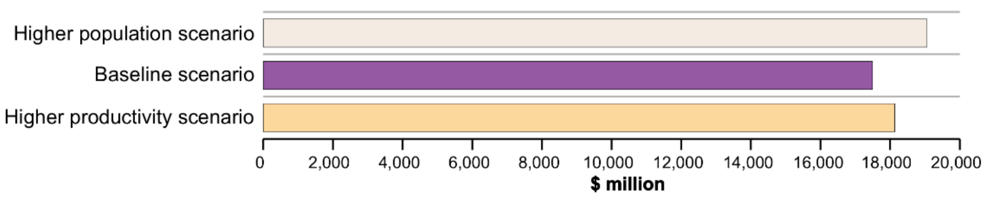
Figure 127 **Output and DEC of port services under 3 scenarios in 2030-31**



Source: ACIL Allen Consulting, 2014

The impact of the two alternative scenarios on DEC is shown in Figure 128. The Higher population scenario increases the return to port infrastructure services through increases in both imports and exports. Bulk export ports are less affected by this scenario than capital city ports. The Higher productivity scenario increases the profitability of the ports.

Figure 128 **Projected increase in DEC of port services in 2030-31 ($ million in 2010-11 dollars) by scenario**



Source: ACIL Allen Consulting, 2014

The national DEC gap under the baseline scenario is estimated at $38.1 billion in the Baseline scenario, is $1.6 billion higher in the Higher population scenario, and $700 million higher in the Higher productivity scenario.

9.7 Issues and implications of findings

Many ports are expected to reach their current capacity limits before 2030-31. The average level of utilisation is estimated to be 74 per cent in 2010-11. In order to ensure that the maximum possible economic contribution is obtained from port services, it is necessary to expedite planning and approvals for port developments.

Capacity is difficult to assess, particularly for mixed use ports. It is being better understood as Port Master Plans are being developed in response to the National Ports Strategy. For bulk goods, whole of supply chain management has proven invaluable in organising sufficient capacity as needed, and in managing risk for the participants.

Ports are parts of supply chains and so integrated land use planning is vital to ensuring the supply chains work effectively. Poor landside links can lead to underperformance at ports. Shipping channels need to be considered as integral to the development of capacity at ports.

Where ports are privately owned, they respond to requests for additional capacity when the market can underwrite them. The least profitable ports are owned and actively managed by government and in locations with declining population.

10 Transport - Rail

KEY FINDINGS

Rail infrastructure services provide a vital link in supply chains for bulk goods supporting the economic activity of mining and agriculture.

Rail offers an alternative to road transport and offers societal benefits in terms of lower emissions, reduced road congestion and increased safety per tonne kilometre, particularly over longer distances or carrying heavy goods.

Australia's rail network is extensive, covering 33,299 operational route-kilometres in 2010-11[52]. Different gauges prevent free movement throughout the rail network.

In 2010-11 year the freight task was 600 billion tonne kilometres. The growth of bulk freight has increased the overall freight task even as other freight markets stagnated after the global financial crisis.

The economic contribution of rail services infrastructure across Australia was $5.4 billion in 2010-11. The economic contribution of rail is dominated by the Pilbara region's contribution ($2.7 billion in 2010-11).

Western Australia, New South Wales and Queensland are expected to experience significant growth in the economic contribution of rail services due to growth in mining. The clear implication is that there may be a significant economic contribution to be realised in investment in rail infrastructure servicing the port supply chains in these states.

The projected growth in GDP between 2010-11 and 2030-31 is 84 per cent. This indicates that the economic contribution of the rail infrastructure services sector is lower in 2030-31 than 2010-11. This reduction in the economic share of the economy is the result of the increased productivity of rail. That is, although the output of the rail industry is growing, its margins are declining which slightly offsets the increase in economic value from increased output.

10.1 Rail infrastructure services in scope

For the purposes of the Australian Infrastructure Audit (AIA), the rail infrastructure services sector includes all Below-the-rail infrastructure services to freight in Australia. Passenger rail services in the cities and major suburbs are separately estimated and included in the audit of urban transport.

Passenger services on the interstate freight network, such as the Ghan and the Indian Pacific, and country network passenger services are included in the estimated economic contribution of railway services. However, they do not materially affect the results, which should be viewed as mostly reflecting freight infrastructure services.

By focussing on Below-the-rail infrastructure services the AIA is not counting the DEC of train operators who use the rail infrastructure services, although the above-rail DEC has been estimated and will be commented on where appropriate. To include the DEC of the users of rail infrastructure services would be analogous to including the DEC of trucking companies in roads, or including the airline's DEC in airports. While the below-rail infrastructure is clearly required for their operation, it is not included in the DEC of the rail infrastructure services for the purposes of this Audit.

52 Where operational and non-operational routes are included, the total rail length for NLTN and other is 45,012 route-kilometres.

In defining which rail services are in scope, there are four distinctive types of rail:

12. Nationally significant rail
13. Nationally significant rail which is part of the port supply chain
14. Strategically significant rail – those railways on the National Land Transport Network
15. Other significant rail

Rail services infrastructure identified as being part of the first group comprise:

- Perth to Adelaide via Kalgoorlie and Tarcoola
- Tarcoola to Darwin
- Adelaide to Melbourne
- Adelaide to Sydney (via Crystal Brook and Parkes)
- Melbourne to Sydney
- Sydney to Brisbane
- Brisbane to Townsville.

Rail services infrastructure identified as being part of the second group comprise:

- The Pilbara railways
- Hunter Valley network
- Aurizon's coal lines (Blackwater, Goonyella, Newlands, and Moura systems)
- Mt Isa to Townsville
- Leonora to Esperance via Kalgoorlie
- Moss Vale to Unanderra (near to Port Kembla).

Rail services infrastructure identified as being part of the third group comprise:

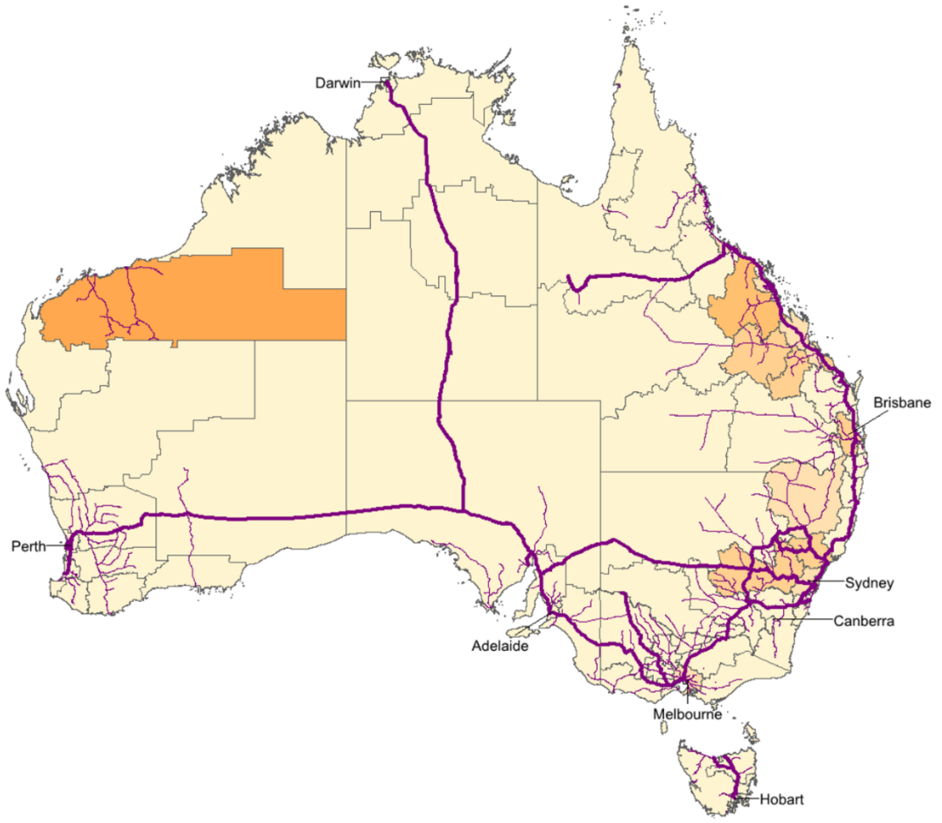
- Perth to Bunbury
- Melbourne to Mildura
- Sydney to Dubbo
- Hobart-Burnie
- Townsville

The final group includes a large number of railway lines and includes regional freight networks and grain supply chains in Western Australia, South Australia, New South Wales, Queensland and Tasmania.

For the first two groups, the AIA was able to gather information on capacity, utilisation and DEC. For the third group the AIA was able to gather information on utilisation and DEC for most of the railways. For the final group, an estimate has been made of utilisation and DEC; capacity for these lines and networks is too difficult to estimate from the data.

The rail network included in the AIA is shown in Figure 129. The AIA has estimated the DEC of rail infrastructure services by audit region. Most audit regions in Australia contain at least one railway line.

Figure 129 **Rail network reported in Australian Infrastructure Audit**



Note: Different shading depict the economic contribution of rail services across Australia in 2010-11 by audit region which is discussed in detail later in this chapter.

Source: ACIL Allen Consulting, 2014

10.2 Railway infrastructure services in Australia

10.2.1 The significance of railway infrastructure services to economic activity

Rail infrastructure is an enabling infrastructure which connects valuable resources to ports for export, businesses to domestic markets, and generates significant indirect benefits as a result.

In 2011–12, the domestic freight task totalled almost 600 billion tonne kilometres[53]. Rail transport accounted for approximately 49 per cent of total domestic freight, with iron ore and coal exports accounting for over 80 per cent of this task.[54]

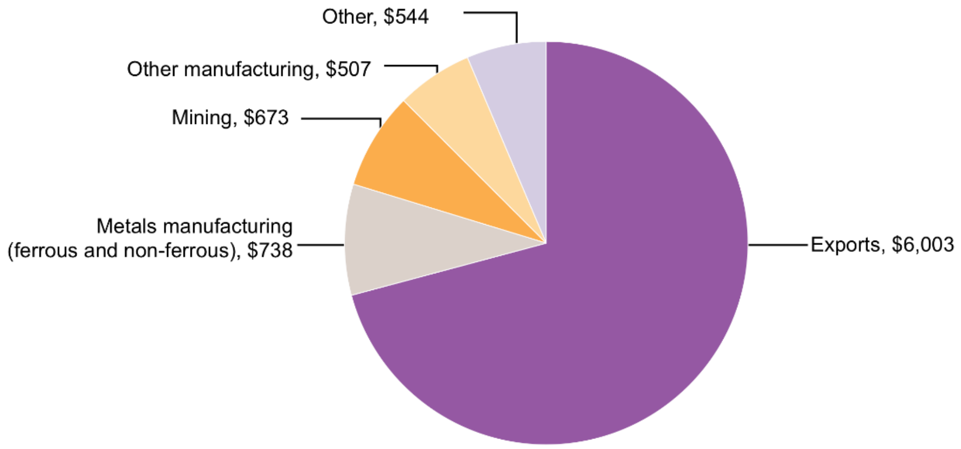
The Gross Value Added (GVA) by the Hire and Reward railway industry (that is, 3rd party provision of rail services for a fee) was estimated to be $6.8 billion in 2011. This industry definition includes both Above-the-rail and Below-the-rail service providers. ACIL Allen Consulting (ACIL Allen) estimates that approximately 20.8 per cent of this amount was attributable to below-rail infrastructure services ($1.4 billion).

53 One tonne kilometre is equivalent to one tonne moved one kilometre.

54 Bureau of Infrastructure, Transport and Regional Economics (BITRE) 2014, Freightline 1 – Australian freight transport overview, BITRE, Canberra.

Rail is a significant input to export industries and supports domestic mining and manufacturing. The expenditure on rail activities by industry is shown in Figure 130:

Figure 130 **Use of rail by industry, 2009-10, $ millions**



Note: The estimates above include expenditure on below and Above-the-rail services, but excludes expenditure on passenger services

Source: Australian Bureau of Statistics (ABS) Catalogue number 5209.0.55.001 Australian National Accounts: Input-Output Tables - 2009-10, Released at 11.30am (Canberra time) 20 September 2013,

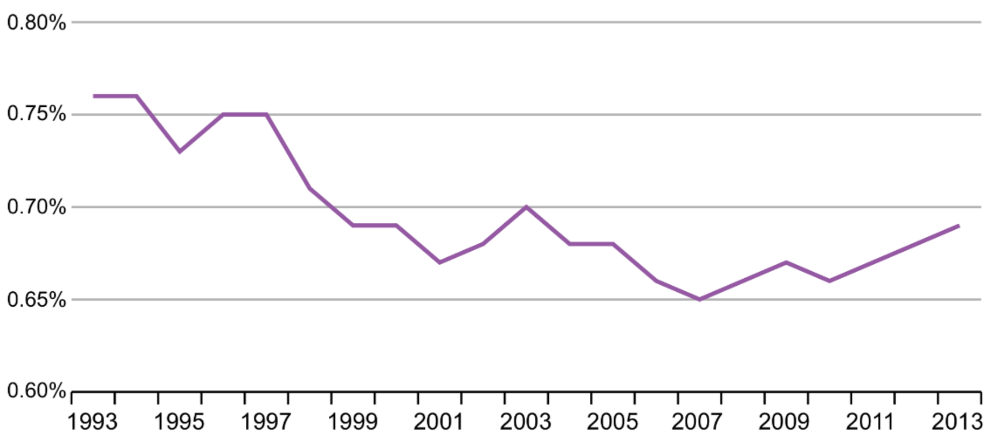
The 2009-10 the Australian Bureau of Statistics (ABS) estimate of the expenditure of other industries on rail, shown in Figure 130, includes Above-the-rail, but excludes expenditure on passenger services. It shows that the $2.9 billion was spent by industries on domestic rail movements in that year, but that rail infrastructure's dominant role was in supporting export industries ($6.9 billion expenditure by export industries).

The domestic rail industry was most heavily used by metals manufacturing (movement of ore and movement of bulk steel between Whyalla, Hastings and Port Kembla/Sydney), mining (movement of coal from mines to electricity generators and to ore smelters) and non-metals manufacturing, for example moving components and finished goods.

The use of rail for the export task was dominated by iron ore (not included in ABS statistics), coal, other bulk ores and concentrates, agricultural goods (especially grain) and containerised manufactured and processed goods making up the balance.

Since 1993, the share of gross value added of rail (above and Below-the-rail), pipeline and other transport industry has declined from 0.76 per cent of Gross Domestic Product (GDP) to 0.69 per cent.

Figure 131 **Rail, pipeline and other transport share of GDP**



Source: ABS Catalogue number 5206.0 - Australian National Accounts: National Income, Expenditure and Product, Mar 2014 Quality Declaration, Issue Released at 11:30 AM (CANBERRA TIME) 4/06/2014

One must bear in mind that the growth of rail freight associated with the transport of iron ore is not included in this metric.

Investment in rail infrastructure has continued, with the majority of activity being located in the Pilbara and Queensland coal networks, For example, the Bureau of Infrastructure, Transport and Regional Economics' (BITRE) Trainline 1 publication identified the railways opened from 2009 to 2011 – see Table 45.

Table 45 **Railways opened from 2009 to 2011**

State	Location	Purpose	Length	Project	Builder
QLD	Goonyella-Newlands	Coal line	69	Northern Missing Link	QR National
	Robina-Varisty Lakes	Interurban passenger line	4	Varsity Lakes	Queensland Rail
	Middlemount Rail Spur	Coal line	16	Middlemount	QR National
	Darra-Richards	Urban passenger line	5	Springfield Line	Queensland Rail
NSW	Epping-Chatswood	Urban passenger line	15	Epping-Chatswood railway	RailCorp
VIC	Epping-South Morang	Urban passenger line	4	South Morang extension	V/Line
WA	Brockman 2 - Brockman 4	Iron ore line	41	Brockman 4	Rio Tinto
	Tilley Siding (Morwa)-Karara	Iron ore line	85	Karara rail spur	Gindalbie Metals
	Cloudbreak-Christmas Creek	Iron ore line	50	Christmas Creek extension	Fortescue Metals Group
	Pannawonica (Mesa J) - Waramboo (Mesa A)	Iron ore line	49	Mesa A	Rio Tinto

Source: BITRE rail database, published in Bureau of Infrastructure, Transport and Regional Economics (BITRE), 2012, TrainLine 1, Statistical Report, BITRE, Canberra ACT.

10.2.2 Regulatory, policy and governance context

Regulatory context

Below-rail infrastructure – track and terminals – typically has natural-monopoly characteristics. In most Australian jurisdictions rail infrastructure is regulated to ensure that access to the infrastructure is provided to users on terms do not allow infrastructure providers to abuse their market power.

In line with the National Access Regime, the predominant regulatory approach is the negotiate/arbitrate model. Under this model, the regulator approves a broad framework for negotiation between the infrastructure provider and access seekers – typically articulated in an Access Undertaking (AU). The AU may include pricing principles, which relate access charges to the efficient costs of access provision. The regulator then stands ready to arbitrate disputes between the infrastructure provider and access seekers in the event that they are unable to reach agreement about detailed terms of access within the broad access framework.

The Australian Competition and Consumer Commission (ACCC) is the regulator for the Australian Rail Track Corporation (ARTC), which is the below-rail infrastructure provider for the Interstate Rail Network (IRN) and the Hunter Valley Rail Network (HVRN). AUs are in place for both these networks. ARTC is vertically separated from the Above-the-rail freight and passenger service providers that use the networks.

Western Australia, South Australia and Queensland all assign the regulation of intra-state freight and passenger rail networks to their independent economic regulators – the WA Economic Regulation Authority (ERA), the Essential Service Commission of South Australia (ESCOSA) and the Queensland Competition Authority (QCA). The rail access regimes of all three of these states have been certified by the National Competition Council (NCC).

This makes the networks covered by the state regimes immune from declaration for access under Part IIIA of the Competition and Consumer Act.

Most passenger networks, especially metropolitan commuter networks, are subsidised heavily. The ability of network operators to exercise market power in general freight markets is often circumscribed by modal competition, particularly by competition from road freight operators. Hence, the most interesting regulatory issues arise with respect to networks specialised in the servicing of bulk-commodity transport. The main examples are the networks constructed and operated by mining companies (BHP, Rio Tinto and Fortescue Metals Group) to transport iron ore from the Pilbara in WA, the HVRN operated by ARTC in NSW and the Central Queensland Coal Network (CQCN) operated by Aurizon in Queensland. Aurizon was formerly part of the government-owned Queensland Rail but was privatised by the Queensland state government in 2010.

As noted above, ARTC is vertically separated from above-rail operators. The Pilbara networks and the Aurizon CQCN are all run as part of vertically integrated businesses that combine network operation with the provision of above-rail services. The main economic argument for allowing vertical integration is that it allows for operational efficiencies in the coordination of below-rail and above-rail operations. The main counter-argument is that it makes it more difficult for the regulator to ensure that third-party operators or end-use customers are not disadvantaged by the market power available to the below-rail operator.

In 2013, access declarations for the Pilbara networks were set aside following the 2012 High Court decision that a network was not subject to declaration for third party access if it could be privately profitable for a network operator to duplicate the network.

Policy context

Rail is an integral part of Infrastructure Australia's (IA) ongoing work on a National Land Freight Strategy. IA proposed that a national land freight strategy would work towards:

- standardised track on general freight railways
- separate management of specific railways
- unified governance of general freight railway
- freight corridors to unlock productivity potential currently unknown
- commercially operated high productivity road networks within cities and to ports.

The Australian Department of Infrastructure and Regional Development assists government to manage its rail investments and to oversee the ARTC and the Moorebank Intermodal Company Limited. The Department also assists government, working collaboratively with states and territories on an agreed national model for rail safety legislation and associated regulations.

The Australian Government has committed $300 million to enable Inland Rail (a freight railway between Melbourne and Brisbane) to commence in 2014 starting with pre-construction activities such as detailed corridor planning, environmental assessments, community consultation as well as commencing land acquisition.

In past years there have been conflicting policy influence on the rail industry.

While government maintained a desire to see more freight on rail, the initial scope of the Carbon Pollution Reduction Scheme (CPRS) would see the carbon tax impact on fuel prices mitigated through a reduction in excise duty – negating its impact on truck costs, while the tax would apply fully to train operators. The carbon pricing legislation has now been repealed.

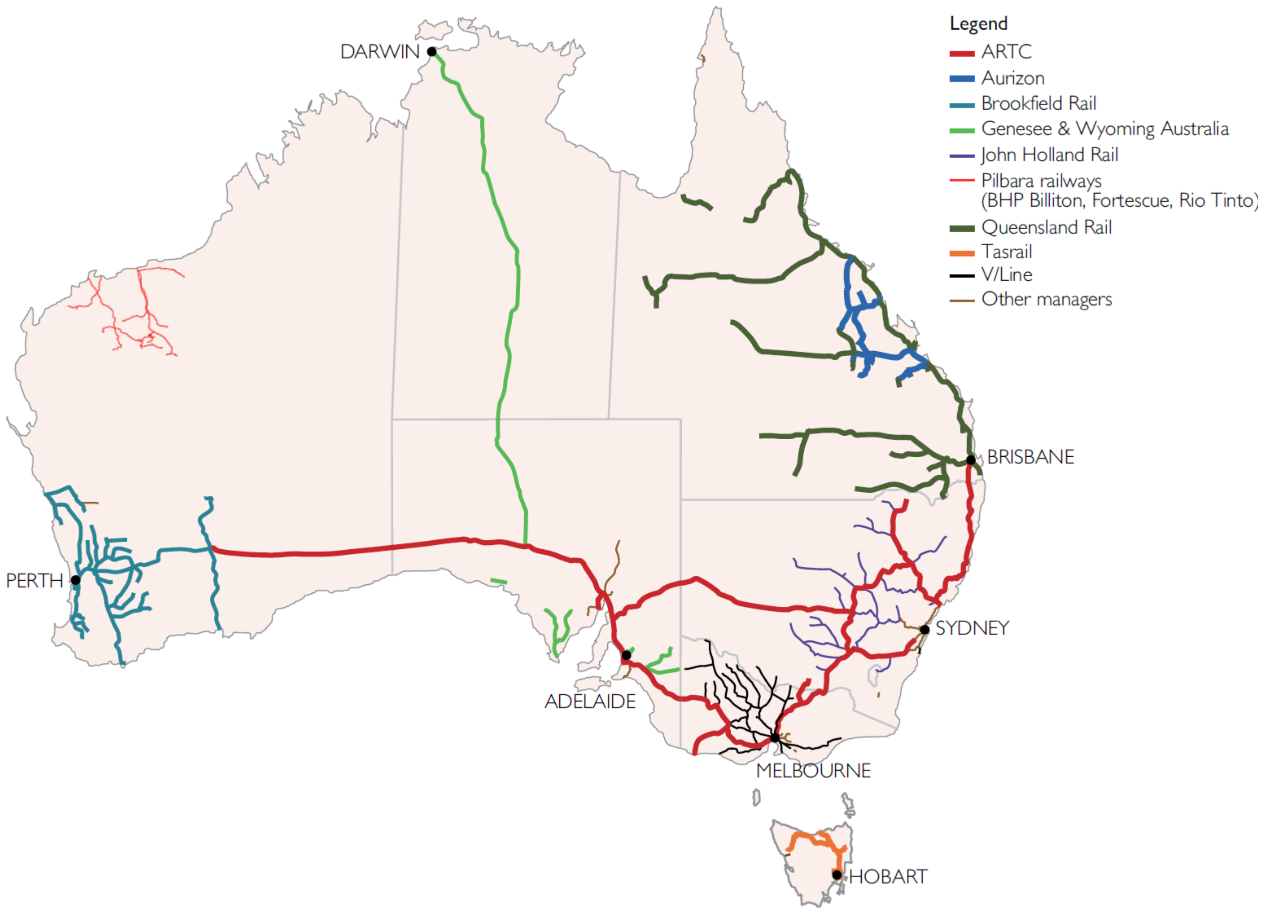
The Productivity Commission's Inquiry report on Public Infrastructure was released on 14 July 2014. It recommended that greater use be made of pricing to manage demand and provide funds for investment and signals for where investment is needed. The privatised providers of rail infrastructure services have long argued that they seek to recover their cost of capital, but in many markets their price is constrained by competing road services which do not adequately recover road user costs. Ongoing road price reform is a policy area which will have a direct impact on the competitiveness and profitability of intermodal rail services and the below-rail infrastructure.

A key threat to intermodal rail services is the adoption of high productivity vehicles (HPVs) on Australian freight networks. The use of HPVs such as B-Triples will further erode rail market share in short and medium distance markets.

Governance arrangements

The rail network is managed by a number of track managers, these are shown in Figure 132.

Figure 132 **Australian railways by network manager, 2012**



Note: From 2012 CityRail has been split into Sydney Trains and NSW Trains, providing urban passenger and Newcastle/interurban/country passenger services, respectively.

Source: Bureau of Infrastructure, Transport and Regional Economics (BITRE), 2013, Yearbook 2013, Statistical Report, BITRE, Canberra ACT.

10.3 Audit of existing rail infrastructure

This section audits the existing rail infrastructure services across Australia.

10.3.1 Capacity, utilisation and DEC of rail infrastructure at the national level

This section reports the current infrastructure used in the provision of rail infrastructure services, the volume of services supplied/utilised and the DEC of rail infrastructure services across Australia.

Trends in the utilisation of rail infrastructure are important because they highlight the areas where future investment may be necessary and they also highlight areas where policy or market outcomes may be hindering the most efficient outcomes.

Capacity metrics

It is difficult to determine a capacity metric for the rail network at a national level. Each track and network carries a variety of freight and the characteristics of the track (single or multiple tracks, double stacked, rail grade and tonne axle load, speed limits, etc.) meaning that the value of a train path in terms of the weight which can be moved or the value of the freight carried can vary enormously.

Capacity on a railway can be variable. When a customer approaches a track manager to seek access, a preferred time (or window) of access is stated. There may be times when the track manager already has these times scheduled to other customers. If the customer is unwilling or unable to change the time that they require access then there is a capacity constraint even if there is capacity at an alternative time. However, it is inefficient for a track manager to maintain sufficient spare capacity so that all access requests can be accommodated at the preferred time.

Similar issues are faced with seasonal demands for track access. For example grain exporters seek access to train paths mostly during the harvesting period. Unless a track manager can secure an off-peak freight customer to occupy the track outside of harvest season, ensuring sufficient capacity for an average grain harvest would entail significant surplus capacity for the remaining eight to nine months of the year. A balance is therefore required between the track manager maintaining sufficient capacity that new or seasonal requests for access can be met, and making a sufficient return on capital.

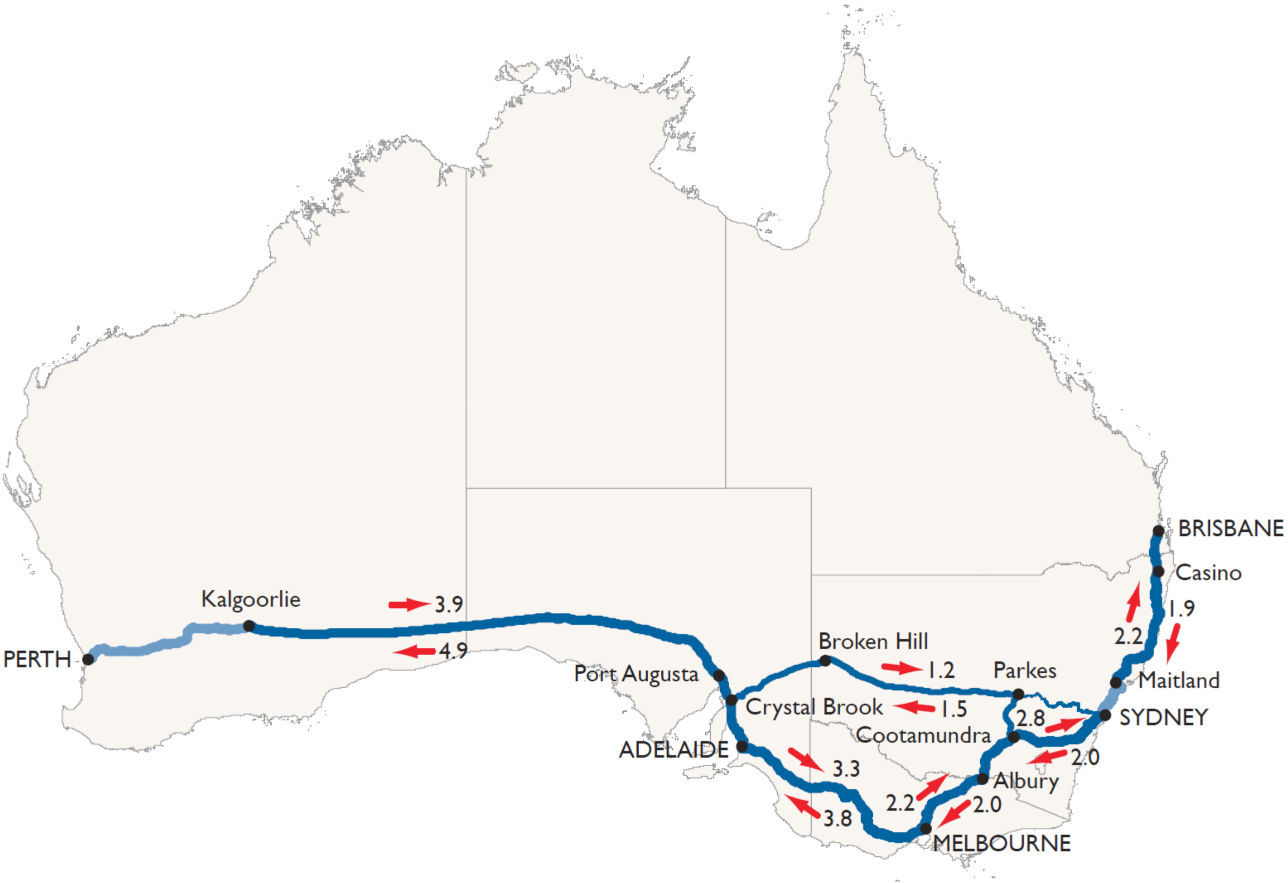
Since capacity can be variable, in some respects it is easier to look for evidence of capacity constraints than it is to measure capacity. Such evidence might include long waits, unscheduled waits and a lack of reliability on arrival times. A review of BITRE's Trainline 1 indicated no evidence of significant capacity constraints on the interstate route.

Utilisation metrics

At a national level the movement of gross tonnes has been recorded and reported by BITRE in Trainline 1. A map showing the distance weighted gross tonnes[55] of intermodal freight on the interstate network is shown in Figure 133.

[55] Gross tonnes means that the tare weight of the train is included as well as the weight of the payload.

Figure 133 **Intermodal freight on the interstate network (excluding Tasmania), 2009-10**



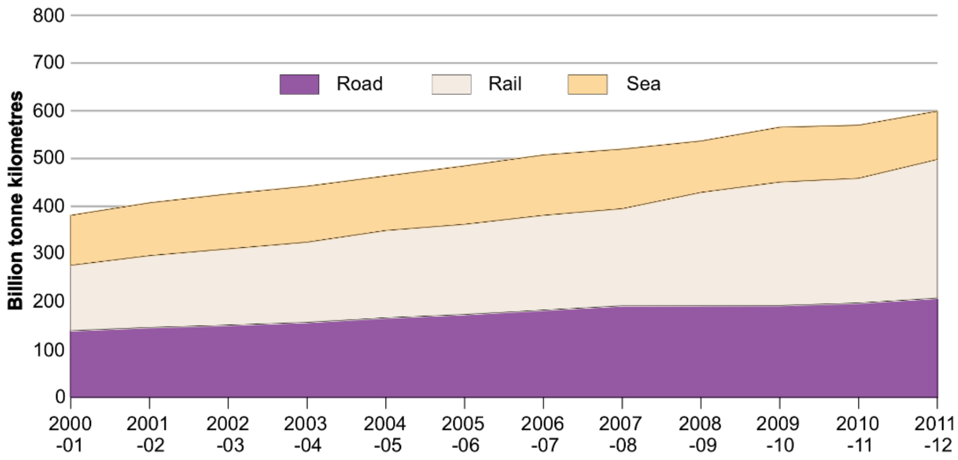
Note: Numbers listed on train lines are millions of gross tonnes by direction

Source: Rail track managers (ARTC, Brookfield Rail) reported in Bureau of Infrastructure, Transport and Regional Economics (BITRE), 2012, TrainLine 1, Statistical Report, BITRE, Canberra ACT.

In addition to this, six intermodal services per week (round trips) run between Adelaide and Darwin on track managed by Genesee and Wyoming Australia. ACIL Allen estimates that these trains carry an annual payload of approximately 870,000 tonnes per annum (800,000 tonnes of intermodal freight and 70,000 tonnes of bulk liquids. There are also container services between Brisbane and Cairns.

Trainline 1 also publishes distance weighted tonnes by line segment for the interstate network in tabular form. ACIL Allen has obtained this information for 2010-11 and has presented it on the map in Figure 134. The North-South corridor (Melbourne to Brisbane via Sydney) has seen a decline in total tonnes and decline in market share since 2007-08, and the East West corridor (Sydney/Melbourne to Perth via Adelaide) has seen little volume growth. This reflects both stagnation in intermodal freight volumes since the global financial crisis and a loss of market share on the North-South corridor.

Figure 134 **Australian freight volumes by transport mode, 2000-1 to 2011-12**



Source: Bureau of Infrastructure, Transport and Regional Economics (BITRE) 2014, Freightline 1 – Australian freight transport overview, BITRE, Canberra.

DEC metrics

ACIL Allen's estimate of the DEC of rail services, including both Above-the-rail and Below-the-rail service providers was $5.4 billion in 2010-11 comprising:

- $392 million based on ABS estimates after removing passenger and Above-the-rail service providers, plus
- $2.7 billion from estimates of the contribution of the Pilbara infrastructure plus
- $2.3 billion from estimates of the contribution of the below-rail-infrastructure to coal exports.

To do this, ACIL Allen removed an estimate of passenger rail in the following key audit regions:

- 1_1_Greater Sydney
- 1_10_New England and North West
- 1_2_Capital Region
- 1_7_Illawarra
- 1_8_Mid North Coast
- 2_1_Greater Melbourne
- 2_2_Ballarat
- 2_3_Bendigo
- 2_4_Geelong
- 3_1_Greater Brisbane
- 3_14_Gold Coast
- 4_1_Greater Adelaide
- 5_1_Greater Perth
- 5_2_Augusta - Margaret River - Busselton
- 8_1_Australian Capital Territory.

For each of these audit regions, ACIL Allen removed 90 per cent of the rail services DEC as being attributable to passenger rail. This adjustment was informed by estimates of the DEC of passenger rail calculated elsewhere.

From comparing the accounts of Asciano's rail division[56] it was possible to estimate the GVA of a train operator, and the proportion of the GVA which represented access charges to ARTC. Using ARTC's annual report it was possible to calculate the gross value added per dollar of revenue which ARTC earned in 2010-11. This allowed an estimate to be made of the share of total rail GVA which accrued to the Below-the-rail infrastructure service provider. This share was estimated to be 20.8 per cent. Applying this share to the freight rail DEC generated a Below-the-rail DEC of $392 million.

The ABS data do not adequately capture the economic value created by 'ancillary rail' operations, whereby Rio Tinto, BHP Billiton and Fortescue Metals Group own and operate their own rail infrastructure. The AIA estimates that these rail services added a further $2.7 billion of value to the nation's economy. The method used for this allocation is detailed in the following Box.

[56] Asciano, Annual Report 2010-11.

Box 7 **Estimating the DEC of 'ancillary rail' for operations in the Pilbara**

ABS National Accounts do not separately capture the economic value created by 'ancillary rail' operations, whereby Rio Tinto, BHP Billiton and Fortescue Metals Group (FMG) own and operate their own rail infrastructure. The economic contribution of these railways is allocated within the mining sector rather than the rail sector.

The AIA estimates that these rail services added a further $2.7 billion of economic contribution to Australia.

This estimate was calculated by estimating the capital value of the railway and applying a weighted average cost of capital to determine the returns to capital. A return to labour was then estimated based on relationships identified from other Below-the-rail infrastructure providers and the return to labour and capital were summed to obtain the DEC.

The estimate of the capital value of the Pilbara network was calculated by estimating the capital cost of existing Pilbara rail operations based on information released about FMG's recent investment in the Pilbara infrastructure. FMG has spent $2.2 billion to obtain capacity of 155 million tonnes per annum over 280 kilometres. This equates to $0.05 per tonne kilometre of capacity. FMG investment information was used as the benchmark as it was recent and publicly available.

The three lines owned by Rio Tinto, BHP Billiton and FMG offer 820 million tonnes capacity over 2,010 kilometres, equivalent to 1.65 trillion tonne kilometres of capacity. Using the rate of $0.05 per tonne kilometre previously identified, the capital cost of the Pilbara network is estimated to be $31.2 billion.

The Western Australian Economic Regulation Authority has issued a regulatory determination that the Weighted Average Cost of Capital for The Pilbara Infrastructure, owned by FMG, is 9.64 per cent. ACIL Allen has assumed that the average return on capital for the whole Pilbara network over the 20 years to 2031 is 9.64 per cent, or $3 billion per annum, taking into account the growth of volumes on those lines (estimated to be 3.5 per cent per annum). Back-solving for the return on capital in 2011 calculates generates an estimated return on capital of $2.1 billion.

The return to labour is not easily identified for the Pilbara since the assets in the Pilbara are probably the most capital-intensive rail assets in the world. ACIL Allen undertook a review of rail infrastructure accounts and estimated that the returns to labour are typically 35-50 per cent of the size of the gross value added. Taking into account the capital nature of the Pilbara network ACIL Allen assumed the return to labour was 23 per cent of the estimated gross value added.

This determined the estimate of the DEC for rail infrastructure services in the Pilbara of $2.7 billion per annum, growing in line with the increasing output of the Pilbara, estimated at 3.5 per cent per annum.

Table 46 **Estimate of DEC for Pilbara rail infrastructure**

	Capacity	Distance	Capital value	2011 Return on capital	Return to labour	GVA
	Tonnes	Km	$ million	$ million	$ million	$ million
Hammersley & Robe	346	1,300	$22,528	$1,504	$451	$1,956
Newman and Goldsworthy	300	430	$6,461	$431	$129	$561
TPI	156	280	$2,188	$146	$44	$190
Total Pilbara	**802**	**2,010**	**$31,177**	**$2,082**	**$625**	**$2,706**

Source: ACIL Allen Consulting, 2014

Finally, it became apparent (see Box 8 below) that the ABS estimate for GVA generated by railways involved in the coal supply chain was too low, partly evidenced by the bottom-up estimate of the return to rail infrastructure services in the Pilbara railways. To counter this underestimate, ACIL Allen apportioned 7.5 per cent of the DEC of the coal industry to the below-rail infrastructure services. This added $2.3 billion to the AIA estimate of below rail infrastructure.

Box 8 **DEC in coal mining regions**

The calculated DEC per tonne for the Pilbara below-rail infrastructure services is $11.1 and this DEC represents 8.6 per cent of the mining DEC in the Pilbara.

The DEC per tonne estimated for the Hunter Valley below-rail operations ($0.09 per tonne) represents only 0.2 per cent of the mining DEC in the Hunter Valley. This indicates that the DEC of rail infrastructure serving the coal export industries is undervalued. Similar low results were obtained for the Queensland coal networks. To address this, the AIA has allocated 7.5 per cent of regional coal mining DEC to railways which serve the coalfields. The combination of the DEC already estimated and the additional allocation brings DEC in the audit regions with coalfields closer to the proportions seen in the Pilbara.

Source: ACIL Allen Consulting

10.3.2 Capacity, utilisation and DEC of rail infrastructure by state/territory

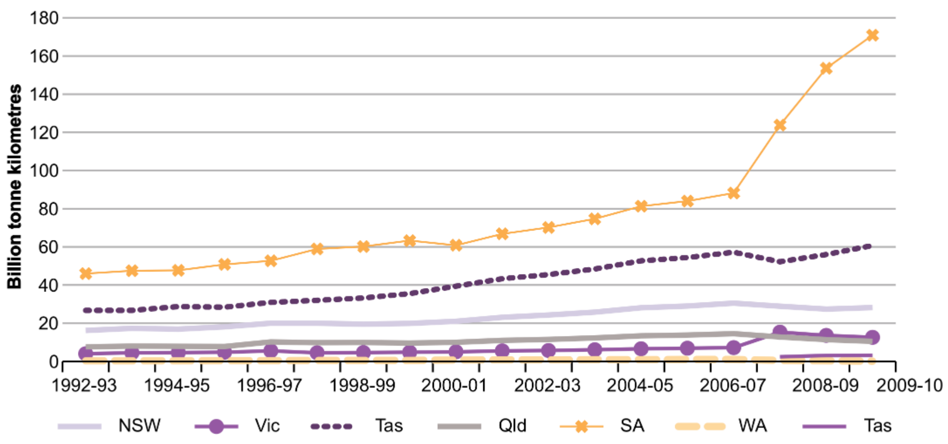
This section reports the current infrastructure used in the provision of rail infrastructure services, the volume of services supplied/utilised and the DEC of infrastructure services by state and territory.

The railways in each state respond to different drivers and the trade carried on them can be quite different. Western Australia is dominated by its iron ore and grain networks, Queensland and New South Wales by their coal networks. Victoria has an extensive broad gauge regional freight network and is well connected for standard gauge freight from the Riverina in NSW as well as intermodal freight to all state capitals.

Utilisation metrics

The freight task in each state between 1992-93 and 2009-10 is depicted in Figure 135.

Figure 135 **Total domestic freight by state/territory, by rail**



Source: Bureau of Infrastructure, Transport and Regional Economics (BITRE), 2013, Yearbook 2013, Statistical Report, BITRE, Canberra ACT.

Western Australia is dominated by its iron ore freight task with a task in 2009-10 of 171 billion net tonne kilometres. This doubled in within the three years to 2009-10 and ACIL Allen estimates that it has increased by more than 50 per cent between 2010 and 2014.

Queensland's task took a dip in 2008 after the global financial crisis caused demand to stall, and Queensland also suffered a reduction in volumes in 2011 as the network was severely affected by the floods in that year.

The New South Wales task has not yet recovered to its level of 2006-07 and there is uncertainty related to future coal output. The ARTC 2014-2023 Hunter Valley Corridor Capacity Strategy released in July 2014 indicates possible future growth to 280 million tonnes by 2020-21 if supported by sufficiently high coal prices.

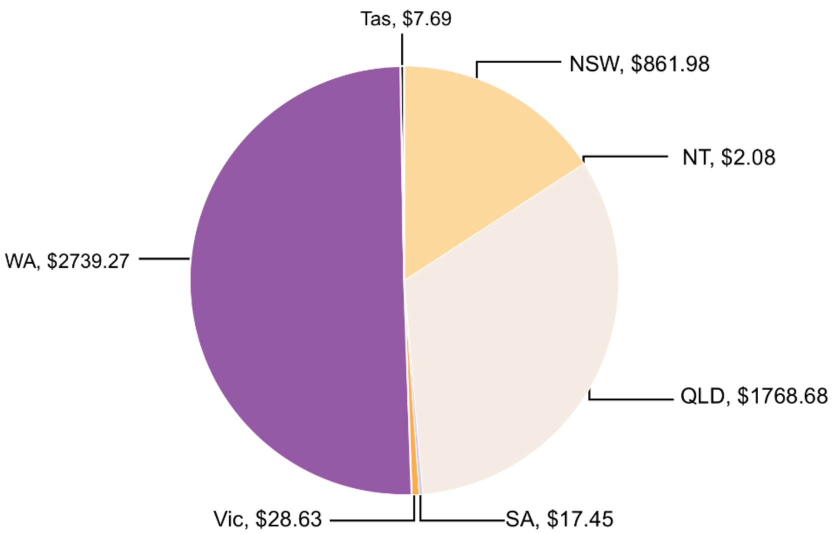
Victoria and South Australia are influenced by intermodal tonnes and the grain freight task.

The Northern Territory has seen an increase in tonnes through mining exports induced by the construction of the Adelaide-Darwin railway line.

DEC metrics

The DEC for rail infrastructure services by state and territory is shown in Figure 136.

Figure 136 **DEC of rail infrastructure services by state/territory, $ million (in 2010-11 dollars)**



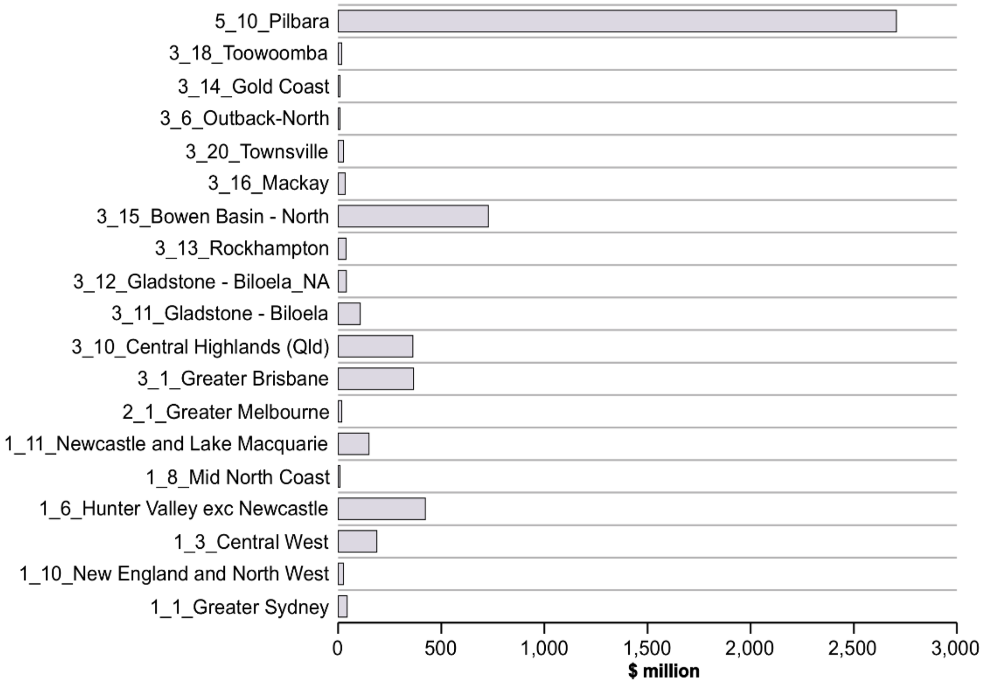
Source: ACIL Allen Consulting, 2014

The DEC for rail services is dominated by the effects of the Pilbara's rail task, with Western Australia generating $2.7 billion. Queensland and New South Wales have a large DEC due to their coal networks.

10.3.3 Capacity, utilisation and DEC of rail infrastructure by audit region

The AIA has identified the DEC of rail infrastructure services by audit region – see Figure 137 for the top 20 audit regions for regional Australia.

Figure 137 **Rail DEC by region – 20 largest audit regions, 2010-11**



Source: ACIL Allen Consulting, 2014

Figure 137 shows quite clearly that DEC is linked to mining activity with every significant mining operation being represented within the 20 largest regional DEC for rails services. The Pilbara's DEC for rail dwarfs all other regional DECs.

10.4 Baseline scenario: projections for rail infrastructure services

The demand for infrastructure services between 2010-11 and 2030-31 has been projected. The Baseline scenario forecasts for rail infrastructure services assumes that there is Australian population growth in line with the Australian Bureau of Statistics' (ABS) Series B projections at the national, state and capital city levels.

The underlying economic projections used in this report are based on national, state/territory and audit region projections developed using ACIL Allen's in-house CGE model *Tasman Global*. These projections cover the period 2010 - 11 to 2030-31 (see Appendices in Part C for more detail on the 'baseline scenario' forecast assumptions and parameters).

10.4.1 National projections for rail infrastructure services

The AIA's Baseline scenario projections for rail infrastructure services is shown in Table 47.

Table 47 **Estimates of capacity, utilisation, output growth and DEC growth by state**

	Minimum Capacity[a] (Mtpa)	Maximum of Percentage of available minutes utilised (2013)	Average Output Growth to 2030-31	2010-11 DEC	Average DEC Growth to 2030-31[b]
NSW	n.a.	81.0%	1.34	$862.0	1.48
NT	n.a.	n.a.	1.37	$2.1	1.43
QLD	6.59	82.9%	1.48	$1,768.70	1.48
SA	10.87	80.0%	1.18	$13.0	1.20
VIC	1.61	54.8%	1.22	$28.60	1.36
WA	7.22	95.0%	1.59	$2,739.30	2.01
TAS	n.a.	n.a.	1.06	$7.70	1.09
ACT	n.a.	n.a.	0.83	-	-
National total	**n.a.**	**95.0%**	**1.35**	**$5,425.90**	**1.74**

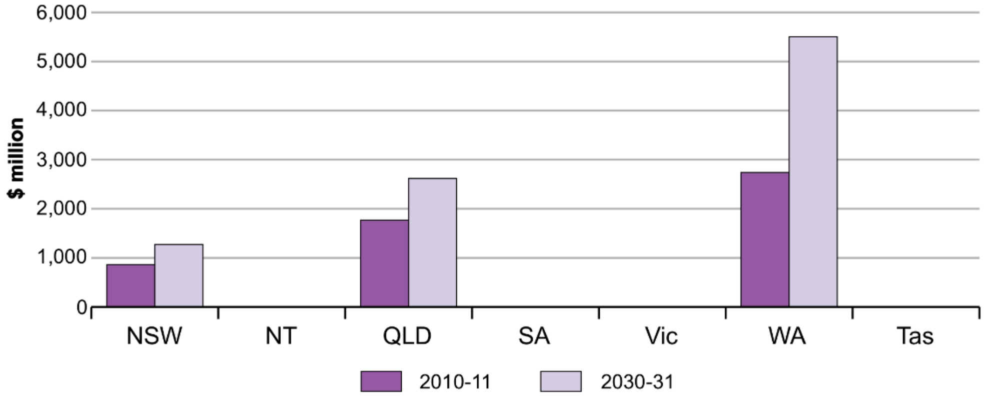
Note: n.a. –Not available, a) Does not include regional freight network or branch lines b) The average is not weighted by the regional DEC
Source: ACIL Allen Consulting, 2014

The rail infrastructure services DEC is estimated to increase by 74 per cent nationally to $9.4 billion in 2030-31. This is an increase of $4 billion.

The projected growth in GDP over the same period is 84 per cent. This indicates that the economic contribution of the rail infrastructure services sector is lower in 2030-31 than 2010-11. This reduction in share is the result of the increased productivity of rail – the output of the rail industry is growing but its margins are declining.

10.4.2 Projection for rail infrastructure services by state/territory

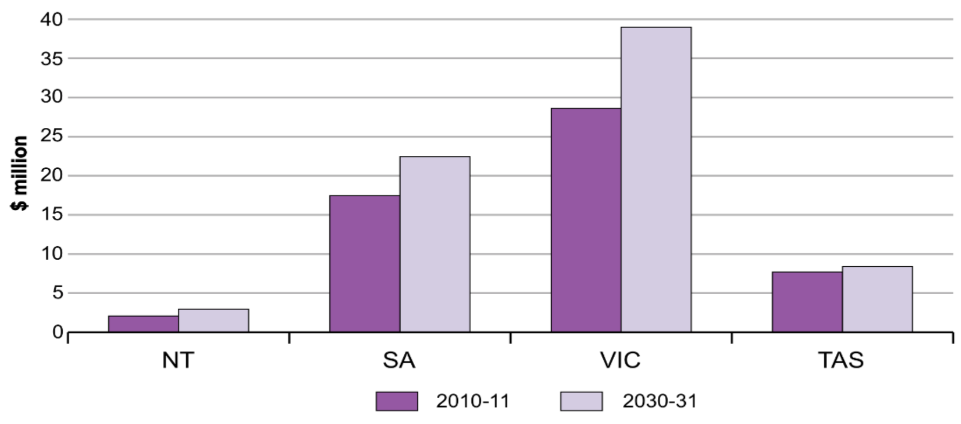
Figure 138 **Projected DEC of rail infrastructure services by state/territory in 2030-31 ($ million, 2010-11 dollars)**



Source: ACIL Allen Consulting, 2014

New South Wales and Queensland are projected to experience DEC growth in rail infrastructure services over time as a result of continued growth in coal export volumes. Western Australia sees significant growth in the next 10 years, which is expected to level off after 2021. These DEC of rail infrastructure services in other states are shown in more detail in Figure 139.

Figure 139 **DEC Projected DEC of rail infrastructure services for NT, SA, Tasmania and Victoria**



Source: ACIL Allen Consulting, 2014

10.4.3 Implications of projections for services

The clear implication of the analysis is that there is significant economic contribution to be had from investment in rail infrastructure services servicing the port supply chains in Western Australia, Queensland and New South Wales. A key focus should therefore be on ensuring that supply chain coordination occurs, either through state bureaucracies or through a specific coordinating entity.

The Tasmanian economic contribution is not projected to increase materially.

Victoria and South Australia both see robust growth, albeit from a much lower base than the resource states of Western Australia, Queensland and New South Wales.

10.5 Baseline projection of DEC and additional needs for rail infrastructure

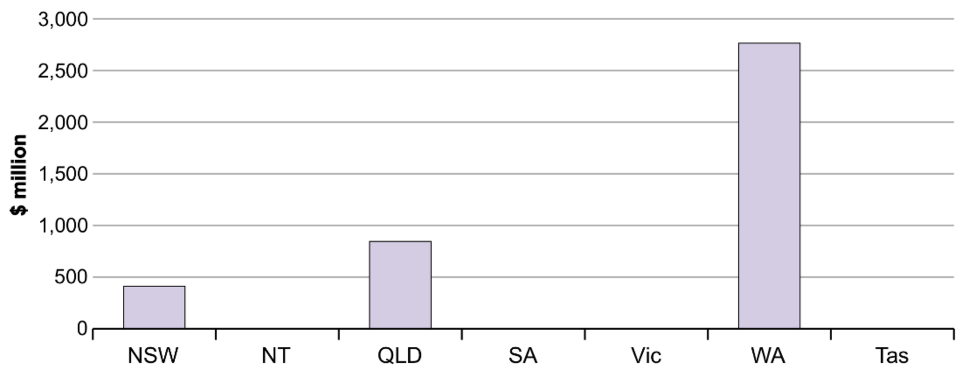
The infrastructure 'gap' is the difference between current and projected DEC of the rail infrastructure services. The gap indicates where value could be captured from ensuring there is sufficient capacity to deliver the projected demand for services.

10.5.1 DEC gaps

The baseline projection for rail infrastructure DEC in 2030-31 is expected to increase by $4 billion over 20 years. 68 per cent of that increase comes from Western Australia and is driven by growth in the Pilbara.

Figure 140 depicts the expected gap in DEC of rail services by state/territory in 2030-31.

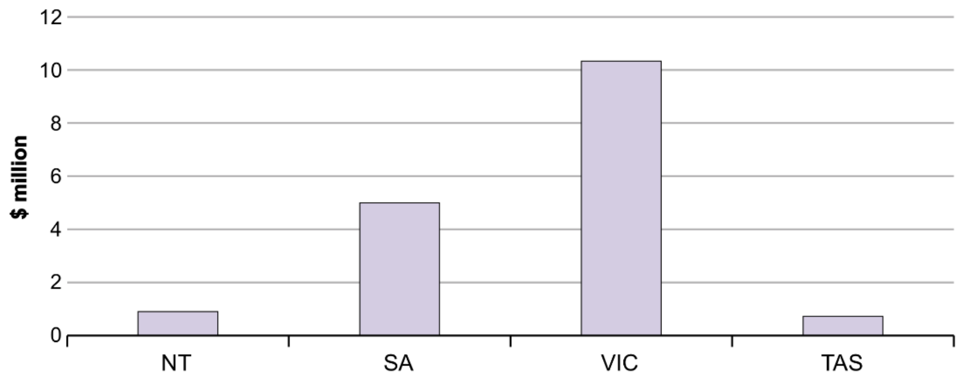
Figure 140 **Projected DEC in rail services by state, 2030-31 ($ million, 2010-11 dollars)**



Source: ACIL Allen Consulting, 2014

The scale of the gap in resource states dwarfs the less resource dependent states. These are shown in Figure 141.

Figure 141 **Projected DEC in rail services, NT, SA, Tasmania and Victoria, 2030-31 ($ million, 2010-11 dollars)**



Source: ACIL Allen Consulting, 2014

The rail services infrastructure gap for 5 regions which exhibit the biggest increase in DEC of rail services infrastructure between 2010-11 and 2030-31 include:

- 5_10_Pilbara - $2,750 million
- 3_15_Bowen Basin – North - $319 million
- 1_6_Hunter Valley exc Newcastle - $217 million
- 3_10_Greater Brisbane - $194 million

10.6 Projections for rail infrastructure services needs and DEC

In order to illustrate how the outlook for infrastructure services could vary given different rates of change in the economy, two additional alternative scenarios have been modelled:

- Higher population growth scenario which assumes that Australia's population growth is higher (compared with the Baseline scenario) and is aligned with ABS Series A projections

— Higher productivity scenario which assumes that there is higher factor productivity in the infrastructure sectors to obtain a 1 per cent higher growth in Australian real GDP by 2030-31 (relative to the output growth obtained in the Baseline scenario)

These additional two scenarios indicate how future demand for rail infrastructure services may vary under different economic scenarios.

10.6.1 Projected national impacts in 2030-31

The per annum growth in rail infrastructure services DEC in 2030-31 is higher under all three projections – see Table 48.

Table 48 **National impact of projections**

	2010-11	2030-31	2030-31
	DEC $ millions	DEC growth index	DEC $ millions
Scenario 1: Baseline projection	$5,426	1.74	$9,466
Scenario 2: Higher population projection	$5,426	1.78	$9,668
Scenario 3: Higher productivity projection	$5,426	1.74	$9,442

Source: ACIL Allen Consulting, 2014

In the Higher population scenario Australia's domestic economy is larger, prices will be moderately higher, and the nation's demand for resources will be higher. Importantly for Australia's export industries, the exchange rate is likely to be higher in the Higher population scenario. This is sees a reduction in export volume compared to the Baseline scenario, but DEC increases due to the higher prices, greater availability of workers and greater domestic demand for both resources and manufactured goods.

The increase in DEC, however, for the Higher productivity scenario is not as large (relative to the other two scenarios). This is explained by the increase in factor productivity within the rail sector. The higher levels of productivity imply higher output from Australian mines as they are able to capture a greater share of world markets. However, in competitive markets this productivity will be reflected in lower rail margins. The loss from the rail infrastructure sector is a gain to society as it is able to spend this increased disposable income on other goods.

10.6.2 Projected state/territory impacts

The projected change in DEC of rail infrastructure services in 2030-31 for all three projections is in Table 49.

Table 49 **Projected increase in DEC of rail in 2030-31 by scenario**

	2030-31 DEC Baseline scenario	2030-31 DEC Higher population scenario	2030-31 DEC Higher productivity scenario
	$ million	$ million	$ million
NSW	412.06	442.05	404.58
Victoria	10.33	12.06	9.66
Queensland	846.42	976.27	832.19
SA	2.55	2.86	2.25
WA	2,767.57	2,806.90	2,766.16
Tasmania	0.72	1.13	0.50
Northern Territory	0.90	0.93	0.86

Source: ACIL Allen Consulting, 2014

10.7 Issues and implications of findings

The implications of the AIA for rail infrastructure services are that the increase in rail services is projected for resource states and related to infrastructure that is privately owned and in many cases, vertically integrated. As such, there are clear private incentives for future increases investment by the market. Government therefore has a key role in ensuring that they markets in this area of the economy are well functioning.

The rail infrastructure services is likely to be more difficult to address where there is little growth in railway infrastructure services demand nor DEC. Many railways across Australia clearly operate to provide societal benefits to society than being pure commercial ventures, and the need to invest when there is no commercial imperative for it will make it difficult to fund these infrastructure gaps.

11 Energy — Electricity

KEY FINDINGS

The potential service capability of electricity infrastructure on the ground across Australia in 2010-11 was:

- 54 GW of installed capacity for generation
- the sum of the peak demands on the transmission networks was 41 GW
- the sum of the peak demands on the distribution networks was 37 GW

The areas with the largest generation capacities in 2010-11 were Latrobe-Gippsland, the Hunter Valley and Newcastle, Darling Downs-Maranoa, and Riverina. The areas with the highest peak demands on the transmission network were the large capital cities (Sydney, Melbourne, Brisbane, Perth, and Adelaide) and the Hunter Valley. The areas with the highest peak demands on the distribution network were the large urban areas (Sydney, Melbourne, Brisbane, Perth, Adelaide, and the Gold Coast).

The demands for electricity infrastructure services in 2010-11 comprised:

- a total of 228,195 GWh of electricity energy generated by generators connected to bulk supply systems across Australia
- a total of 216,050 GWh of electricity transferred through transmission networks
- a total of 183,992 GWh of electricity transferred through distribution networks

The economic contribution of electricity infrastructure in 2010-11 was $16.1 billion, comprising $4.8 billion for generation, $3.6 billion for transmission, and $7.6 billion for distribution.

The areas with the highest direct economic contribution from electricity infrastructure in 2010-11 were Sydney ($2.4 billion), Perth ($1.3 billion), Latrobe-Gippsland ($1.2 billion), Brisbane ($1.0 billion), Melbourne ($0.9 billion), the Hunter Valley (excluding Newcastle) ($0.7 billion), Adelaide ($0.7 billion), Bunbury ($0.5 billion), and Newcastle-Lake Macquarie ($0.4 billion).

The total installed capacity for generation is projected to reach 79 GW in 2030-31. This is 25 GW more than in 2010-11 – an increase of 46 per cent. Most of this will occur in NSW, Queensland and Victoria. The areas with the greatest absolute increases in generation capacity are Latrobe-Gippsland, the urban Gladstone area, Hunter Valley, Newcastle and Lake Macquarie, and Greater Sydney (including the Central Coast).

The sum of the peak demands on the nationally significant transmission networks is projected to be 60 GW in 2030-31. This is 19 GW more than in 2010-11 – an increase of 47 per cent. Most of this is focussed in NSW, Queensland and Victoria. The areas with the greatest absolute increases in peak demand are Sydney, Melbourne, the urban Gladstone area, Brisbane and Perth.

The sum of the peak demands on the nationally significant distribution networks is projected to be 53 GW in 2030-31. This is 16 GW more than in 2010-11 – an increase of 43 per cent. Most of this is focussed in NSW, Victoria and Queensland. The areas with the greatest absolute increases in distribution peak demand are Sydney, Melbourne, Brisbane, Adelaide, and Perth.

The gap between the 2010-11 and 2030-31 economic contribution of the electricity sector is projected to be $10 billion, comprising $3 billion for generation, $3 billion for transmission and $4 billion for distribution. Areas with the projected greatest absolute increases in the economic contribution from electricity infrastructure are Greater Perth ($1.7 billion), Greater Sydney ($1.3 billion), Latrobe—Gippsland ($0.7 billion), Bunbury ($0.6 billion), and Greater Brisbane ($0.5 billion).

Areas with the highest percentage increase in DEC from electricity infrastructure are the urban Gladstone area (220 per cent), Greater Perth (137 per cent), Bunbury (129 per cent), Goldfields (WA) (128 per cent) and the WA Mid West (126 per cent).

Investment in the electricity infrastructure sector is generally subject to market (for generation) and economic regulation (for network) factors across most of Australia (by population). These factors will drive investment instead of government decisions. The analysis therefore indicates the potential outworking of the policy and regulatory framework for investment in the electricity infrastructure sector rather than the types of investments governments across most of Australia may need to decide to make over the period 2010-11 to 2030-31.

11.1 Electricity services in scope

For the purposes of the Australian Infrastructure Audit (AIA), the electricity sector covers supply chain components that generate electricity from other resources and deliver that electricity to end users. This includes generation, transmission and distribution facilities.

Most of the electricity generated in Australia is generated through centralised power plants that transform fossil fuels (coal, gas or liquid fuel) or renewable resources (wind, solar radiation, biomass or waste) into electrical energy. Most of this electricity is traded in wholesale markets with a smaller proportion either provided at a regulated price, through bilateral contracts or consumed directly by the end consumer.

Generated electrical energy is transported to end users through high-voltage bulk power lines (the transmission system) and low-voltage power lines (the distribution system). In some cases, electricity is generated close to the point of consumption and does not need to be transported through a transmission system – this is referred to as 'distributed generation'. The only generation facilities included in the audit are those connected to the major national transmission systems. The retail segment of the supply chain, which on-sells wholesale energy to end users, has not been included in the audit as it does not depend on substantial infrastructure facilities in addition to those included in the generation, transmission and distribution segments.

The National Electricity Market (NEM) accounts for most electricity production and use within Australia. It covers New South Wales, the Australian Capital Territory, Victoria, Queensland, South Australia and Tasmania. Other major electricity networks include the South-West Interconnected System (SWIS) and North-West Interconnected System (NWIS) of Western Australia and three separate systems in the Northern Territory operated by the Power and Water Commission (PWC). There are also remote areas with no interconnected systems in parts of Australia, notably large parts of Western Australia.

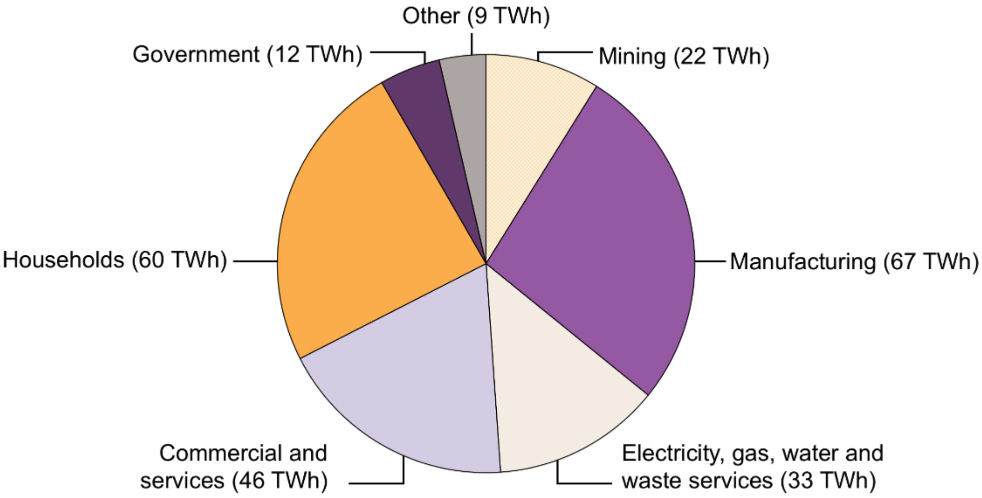
11.2 Electricity services in Australia

11.2.1 The significance of electricity services to economic activity

The generation and transport of electricity makes a significant direct and indirect contribution to the economy. Electricity's direct contribution (DEC) is measured by its value added, i.e., its contribution to Gross Domestic Product (GDP). The estimated DEC for electricity generation and transport is the third largest of the subsectors included in the audit.

Electricity consumption by sector is shown in Figure 142.

Figure 142 **Electricity consumption by sector, 2010-11**

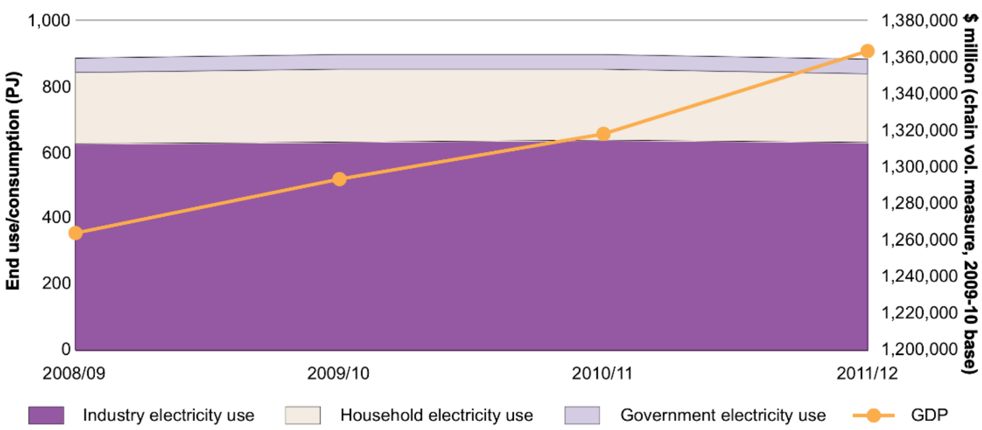


Note: Excludes energy losses; “Other” category includes Agriculture, forestry & fishing, construction and transport
Source: ABS Catalogue 4604.0 Energy Account, Australia

Electricity is consumed by all major sectors of the economy and is therefore likely to remain a key sector in influencing economic growth and productivity, notwithstanding any structural changes which may occur.

Due to its significance, the electricity sector plays a key role in influencing economic growth and productivity. Figure 143 below shows electricity consumption and GDP over the period 2008-09 to 2011-12. Electricity consumption has been relatively flat despite growth in GDP, suggesting that the economy is becoming less electricity intensive. This is due in part to increasing energy efficiency, which has been impacted by a wide range of federal and jurisdictional energy efficiency initiatives such as the National Framework for Energy Efficiency (NFEE).

Figure 143 **Electricity consumption and growth**



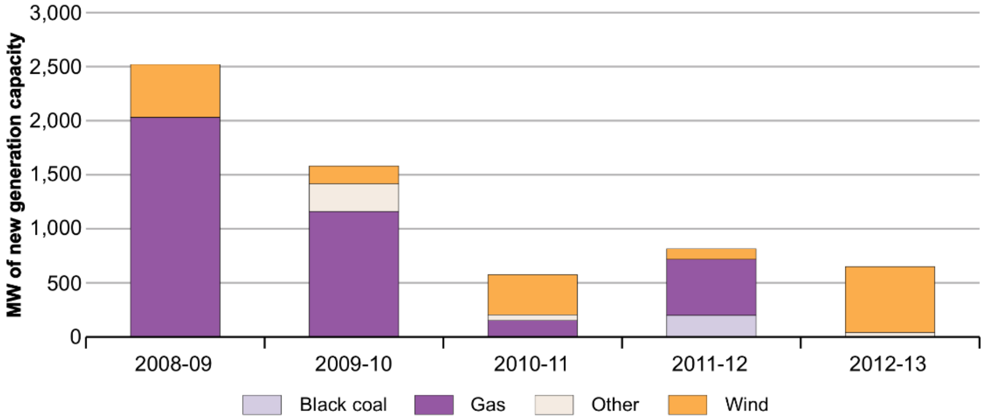
Sources: ABS 4604.0 (Energy Account Australia), ABS 5206.0 (Australian National Accounts)

The electricity sector’s role in contributing to economic growth and productivity may be examined through the DEC. However, the DEC contributes to costs incurred by downstream consumers and thus a high DEC should not necessarily be interpreted as a positive or negative indicator.

In Australia’s largest market, the NEM, adequate supply and stagnant demand has led to declining investment in new generation capacity, as shown in Figure 144.

Much recent generation has been driven primarily by the Renewable Energy Target (RET) – almost all investment in 2012-13 was in wind.

Figure 144 **Annual investment in NEM registered generation capacity**



Source: AER, State of the Energy Market, 2013

New investment in the future will be driven by a combination of demand, policy settings and technological change factors. Major factors influencing future investment include the RET, major projects (such as liquefied natural gas), Smart Metering Infrastructure (SMI) and the cost of distributed generation (such as solar photovoltaic).

11.2.2 Regulatory, policy and governance context

History of reform in the electricity sector

The electricity sector in Australia has been dramatically restructured since the 1980s with the aim of enhancing the efficiency of investment in electricity infrastructure and use of electricity services to better meet the needs of electricity service consumers.

In the 1980s, electricity sectors across Australia were generally vertically integrated industries owned by State Governments. In the late 1980s and early 1990s, some State Governments started to restructure their electricity industries by vertically disaggregating the supply chain, with the aim of strengthening commercial decision-making and making internal cross-subsidies transparent.

Under National Competition Policy (NCP), the NEM was established and commenced operation on 13 December 1998 in southern and eastern Australia. The aim of the establishment of the NEM was to enhance incentives for the efficient operation of, investment in, and use of, electricity services. In particular, a wholesale market for generators was established under which generators would compete in a spot market to supply electricity to retailers. While not part of the NEM, Western Australia and the Northern Territory committed to apply electricity sector reforms to their electricity sectors.

Transmission and distribution networks in the NEM, the SWIS and the Northern Territory are subject to economic regulation by the Australian Energy Regulator, the Economic Regulation Authority (for Western Australia), and the Utilities Commission (for the Northern Territory).

There is a mixture of public and private ownership of electricity businesses, with a trend of declining government ownership of assets.

Major players in the electricity supply sector include Origin Energy, Energy Australia, AGL, Stanwell Corporation and Snowy Hydro and all but one of these (Stanwell Corporation) are vertically integrated generation/retail businesses.

Current issues in electricity sector policy and regulation

The electricity sector is currently facing two major areas of reform, including:

- carbon and renewable energy policy
- regulation of networks and retail electricity prices.

Carbon and renewable energy policy

The Clean Energy Legislation, which legislated a price on carbon emissions produced by electricity generators from 1 July 2012, was repealed by the Australian Parliament on 17 July 2014. In the period the Clean Energy Legislation was in force, electricity generators incurred a cost (a fixed price per tonne of carbon emissions) for each unit of electricity produced. The Direct Action Policy proposed as an alternative by the current government has not yet been considered in Parliament. Additionally, the RET policy is currently being reviewed. Current policy mandates that a certain amount of renewable energy be produced each year, with obligations placed on electricity retailers to purchase renewable energy certificates or pay a shortfall penalty. The policy target of an additional 41,850 GWh of large scale renewable generation over a baseline by 2020 (the Large-scale Renewable Energy Target or LRET) and a financial incentive for the uptake of small-scale installations (the Small-scale Renewable Energy Scheme or SRES). The target, operation and timeframe of the policy are subject to review.

The final form of carbon and renewable energy policy will directly influence the nature of investment in the generation sector. There are also likely to be effects in other parts of the supply chain. Most notably, the rapid uptake of small-scale renewable systems and particularly solar photovoltaic (PV) have impacted on distribution networks by increasing the variability of residential demand.

Regulation of network businesses and retail electricity prices

There have been a number of recent policy and regulation reviews relating to electricity prices, at both the national and jurisdictional levels, in response to a rapid increase in end user prices over the last five years. In 2013, the Australian Energy Market Commission (AEMC) found that network costs were the key driver of price increases (Australian Energy Market Commission, 2013). Key reviews include:

- the AEMC 2012 Power of Choice review and subsequent ongoing reforms including changes to distribution network pricing, expanding competition in metering, customer access to information and improving demand side participation information
- a 'Better Regulation' program launched by the Australian Energy Regulator (AER)
- the Productivity Commission (PC) finding that benchmarking could be used to test network business proposals
- the Queensland Competition Authority (QCA) rebalancing retail electricity prices, increasing the proportion of fixed charges to better reflect the structure of the cost of supplying electricity
- State regulators paring back the feed-in tariffs provided to rooftop solar PV operators to better reflect the social benefit of their production
- a Senate inquiry into electricity prices.

Tied to the issue of electricity prices is the impact of rapid uptake of small scale distributed generation (such as PV) on distribution networks. Penetration of distributed generation and in some cases consumers disconnecting completely from the electricity grid lowers utilisation of the distribution network infrastructure, leading to higher charges for consumers that remain on the grid. It is possible that this could create a feedback loop of higher charges incentivising greater adoption of distributed generation in turn leading to even higher charges and potentially stranding network assets. To some extent, these risks have eventuated due to historical tariff settings that did not appropriately reflect the cost (or benefit in the case of feed-in tariffs) of producing electricity.

As electricity is a widely used input, the impact of these reforms will be experienced broadly throughout the economy.

The future of investment in the electricity sector

Despite the current trend of stagnant demand, there are likely to be major future developments and investment in parts of the electricity supply sector in response to policy, technology and consumption changes and replacement of existing equipment.

The audit provides a view of the current economic contribution of electricity and potential growth areas in the future. The next stage of the project will involve developing a project pipeline for each sector that considers current infrastructure, future requirements and the gap between the two.

For the electricity sector, where the vast majority of investment is expected to occur in market and economically regulated sectors (both with mixed public/private ownership), the next stage will focus on initiatives that facilitate efficient investment in infrastructure and efficient use of that infrastructure.

11.3 Audit of existing electricity infrastructure

This section audits the existing electricity services across Australia.

11.3.1 Capacity, utilisation and DEC of electricity services infrastructure at national level

This section reports the current infrastructure used in the provision of electricity services, the volume of services supplied/utilised and the DEC of electricity infrastructure services across Australia.

The supply chain in the electricity infrastructure sector consists of generation, transmission and distribution infrastructure. In general all three parts of the chain will be relevant. However in the case of remote regions not connected to a major transmission system, supply will be by means of small-scale local generators and connecting wires.

The audit of electricity infrastructure makes use of a top down approach. Every state has a transmission network that connects generators to bulk supply points. In the case of Eastern Australia and Southern Australia these transmission networks form an interconnected power grid and exports and imports can occur between states.

For the purpose of the audit we account for electricity at the state level as follows:

> Electricity generated +/(-) electricity imported (exported) = electricity distributed + electricity directly transmitted (to large end users).

Information relating to electricity generated is available from various publications. In the case of the NEM jurisdictions, detailed information for each scheduled generator is available from AEMO as is information on interstate transfers. The quantities of electricity distributed is published in the annual reports of the various electricity distribution businesses. Each state has one or more electricity distribution businesses which function as regional monopolies and are regulated by the AER.

The bulk supply of electricity within each state is largely provided by generation facilities located within the state in some cases with a relatively smaller component of imported electricity from other states. This electricity is transmitted from generation facilities and inter-regional interconnection points to bulk supply points supplying a number of distribution systems or in the case of some large industrial customers directly to these facilities. Transmission services within each state are provided (generally) by a single electricity transmission business operating in each state. The distribution systems are operated by distribution network service businesses which function as regional monopolies.

The revenues of transmission and distribution network businesses in the NEM are regulated by the AER; the Economic Regulation Authority regulates pricing methodologies for Western Power in Western Australia; and the Northern Territory Utilities Commission regulates revenues for the Power and Water Corporation.

In the following we discuss how audit data relating to the generation, transmission and distribution parts of the electricity supply chain were obtained.

Generation

Generation facilities connected to the national major transmission systems were identified. Each generator's installed capacity (in MW) and quantity of electricity energy generated (in GWh) for the audit year (2010-11) was identified.

The DEC of a generator facility was calculated to be the facility's estimated revenue less its operating cost plus its estimated labour value added. It was assumed that labour costs comprised 70 per cent of a generation facility's fixed operations and maintenance cost (i.e. operating cost less fuel cost).

A generation facility's revenue was estimated by multiplying the annual generation (MWh) by the average annual NEM regional reference price for the year ($/MWh) and an uplift factor which took into account the generator's operating regime. The generation facility's operating cost was estimated from generation cost data prepared by ACIL Tasman and published by AEMO. The generation DEC we show for each audit region is the sum of the DECs of the generation facilities located in that region. We also show the total of installed capacity energy generated for all generation facilities within an audit region.

Transmission

The total electrical energy transmitted through the transmission system was taken to be the sum of the electrical energy transferred through transmission networks to distribution networks and the electrical energy transferred from generators to users connected directly to the transmission network. These end users are generally large energy-intensive industrial users.

The quantity of electricity energy directly transmitted to end users connected directly to the transmission network was allocated to audit regions by identifying as far as possible the identity and location of these end-users.

Total electricity use (distribution and direct transmission) was calculated for each audit region. The DEC of each transmission business was calculated as its annual revenue less operating expenditure plus estimated labour value added from information published in the appropriate revenue determination. The DEC of the transmission system was allocated to the audit regions served by the transmission business on a pro-rata basis according to the energy transmitted to the region. For electricity transmission and distribution systems it was assumed that labour costs comprised 70 per cent of operating expenditure.

Distribution

The DEC of the distribution businesses was calculated in the same way as transmission businesses. The DEC of each distribution business was allocated to the audit regions served by the business' distribution network on a pro-rata basis according to the energy distributed within the audit region.

It should be noted that distribution network geographic areas are not aligned with audit regions. One distribution business usually supplied a number of audit regions. Some audit regions with relatively high population densities were supplied by more than one distribution network. Distribution energy was allocated on a pro-rata basis according to population.

Below we discuss the capacity, utilisation and DEC metrics used in the audit for the electricity infrastructure sector.

Capacity metrics

The capacity measures for electricity infrastructure are:

- Installed capacity, for generating facilities
- Peak demand, for transmission networks
- Peak demand, for distribution networks.

The sum of the *installed capacities* of generation facilities was estimated to be 54 GW (1 GW = 1000 MW) in 2010-11. This refers to the instantaneous generating capacity across Australia or the total amount of electricity that could flow through all generators across Australia at a given moment. By way of explanation, if all of the generators were producing electricity *at full capacity* for one hour, they would collectively generate 54,000 Megawatt hours of electricity energy.

This metric on its own demonstrates the overall capacity of a system, but it should be noted that generation capacity can be variable depending on the fuel source used – for example in the case of solar or wind energy where fuel supply is not constant.

To provide some concrete examples of capacity versus peak demand, the NEM had 49,110 MW of registered capacity in 2010-11 with peak summer demand of 34,933 MW and peak winter demand of 31,240 MW (AER, 2011).

Western Australia's Wholesale Energy Market (WEM: encompassing the SWIS covering Perth and surrounding areas) had a peak demand of 3,879 MW and reserve capacity of 5,191 MW[57] (Economic Regulation Authority, 2013) in 2010-11.

The *peak demands* in 2010-11 for transmission networks and distribution networks have been used as the capacity measures for those networks. These are described in more detail later in this chapter.

The metrics used as capacity indicators are set out in Table 50.

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[57] Reserve Capacity Requirement.

Table 50 **Electricity capacity metrics**

Metric	Units	Note
Installed capacity - maximum generation capacity of one or more generation facilities measured in megawatts	MW[58]	Used to describe capacity of generation facilities
Peak demand - maximum instantaneous power (rate of transfer of energy) measured within one or more transmission or distribution network	MW	Used to describe capacity of transmission and distribution networks.

Source: ACIL Allen Consulting, 2014

Electricity distribution businesses are not aligned to audit regions and in some cases a distributor will service multiple audit regions, or where population is very dense, more than one distributor will service an audit region. As such, the allocation of electricity capacity to audit regions has been done on a pro-rata basis according to population.

Utilisation metrics

The utilisation metrics for electricity are:

- Energy generated, for generating facilities
- Total energy transmitted to distribution networks and transmission-connected end users, for transmission businesses
- Energy distributed to end-users, for distribution businesses.

The amount of electricity generated by generators connected to bulk supply systems across Australia in 2010-11 was 228 TWh.

Electricity consumption across Australia has been steadily declining since 2010; there has been a steady decline in the quantity of electricity sold through the NEM since 2008. This is partly in response to the economic pressures of the Global Financial Crisis and rising electricity prices which have led to a slowdown in emissions intensive sectors such as manufacturing (Vivid Economics, 2013).

Table 51 **Electricity utilisation metrics**

Metric	Units
Total Gigawatt-hours (GWh) of energy generated by one or more generation facilities or transported by one or more transmission or distribution networks.	GWh[59]

Source: ACIL Allen Consulting, 2014

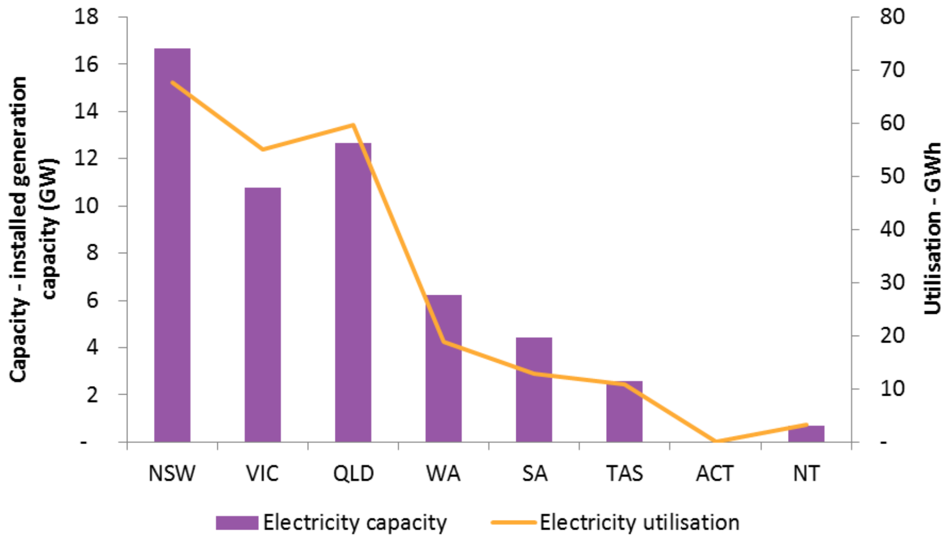
In 2010-11, 216 TWh of electricity was estimated to be transmitted (either directly to transmission-connected customers or delivered through the distribution system) and 184 TWh was estimated to be transferred through distribution networks to customers connected to those distribution networks. The difference in quantities between categories is explained by losses (losses are incurred in electricity transmission and distribution) and the fact that electricity consumed by large transmission connected consumers does not require distribution services.

Figure 145 shows the correlation between capacity and utilisation of electricity generation infrastructure across Australia.

[58] Megawatt (MW): a unit of power equal to 10^6 Watts (where a Watt is a Joule per second).

[59] Gigawatt-hour (GWh) : a unit of energy measurement equal to 10^9 Watt-hours.

Figure 145 **Capacity and utilisation of electricity generation infrastructure**



Source: ACIL Allen Consulting, 2014

The utilisation of electricity and electricity infrastructure in a state or territory will be influenced by a number of factors. The utilisation of electricity is influenced by the size and composition of industry in that state or territory, and the relationship between capacity and utilisation of electricity networks will be impacted by the demand load factor in that state or territory. The demand load factor can vary across states and territories due to weather conditions among other factors – for example, South Australia has a 'peaky' load due to its climate which may impact the average use of the network relative to networks in other states and territories.

DEC metrics

The DEC of electricity infrastructure in 2010-11 was $16,064 million, comprising:

- $4,837 million for generation
- $3,608 million for transmission
- $7,619 million for distribution.

(Note that electricity retail is not included in this analysis.)

The DEC of transmission and distribution businesses is calculated as annual revenue less operating expenses plus labour value added. The first two items were obtained for required years from relevant revenue determinations (e.g. as published by the AER). The labour value added was estimated.

Below we describe how electrical energy, peak demand, and DEC were allocated to audit regions for the audit.

Allocation of physical product and DEC to audit regions

Electrical energy and peak demand were allocated to audit regions in the following way.

Annual energy

$ED_j = ED \times P_j / DP$

$EDT_j = EDT \times q_j$

Where ED_j is the electricity distributed in audit region *j*, P_j is the population of audit region *j*, DP is the population of the distribution system area, and q_j is the proportion of the EDT identified as being located in audit region *j*.

Total energy delivered to the audit region (E_j) was then calculated as:

$ET_j = ED_j + EDT_j$.

Peak demand

In the case of electricity distributed, peak demand was estimated using the average distribution system load factors implied by the annual energy and peak distribution system demand published by the distribution businesses in their annual and annual performance reports. In the case of direct transmission electricity, a relatively higher load factor was assumed to calculate peak demand from annual energy.

DEC was allocated on the basis of physical product as follows –

Distribution DEC_j = Distribution DEC x ED_j / ED

Transmission DEC_j = Transmission DEC x ET_j / ET and

Generation DEC_j was the sum of the DECs of the generation facilities located in audit region *j*.

11.3.2 Capacity, utilisation and DEC of electricity infrastructure by state/territory

This section reports the current infrastructure used in the provision of electricity services, the volume of services supplied/utilised and the DEC of infrastructure services by state and territory.

Capacity results

Table 52 **Capacity results by state/territory, 2010-11**

State	Generation installed capacity	Transmission peak demand	Distribution peak demand
	(MW)	(MW)	(MW)
NSW	16,654	13,563	12,291
VIC	10,765	9,982	8,836
QLD	12,644	8,109	6,993
SA	4,438	3,477	3,031
WA	6,224	3,581	3,696
TAS	2,601	1,771	1,055
NT	686	–	577
ACT	–	620	620

Source: ACIL Allen Consulting, 2014

Electricity capacity results for the various jurisdictions are presented in Table 52. NSW has the largest generation, transmission and distribution capacity. The ACT does not generate power and the NT electricity network is separated from the other networks and does not have any transmission value. As would be expected, population is a major driver of the results.

Utilisation results

Table 53 **Utilisation results by state/territory, 2010-11**

State	Generation	Transmission	Distribution
	(GWh)	(GWh)	(GWh)
NSW	67,611	71,827	61,797
VIC	55,050	52,352	43,319
QLD	59,603	47,341	38,540
SA	12,960	13,045	11,093
WA	18,814	17,838	18,270
TAS	10,863	10,585	4,619
NT	3,293	–	3,293
ACT	–	3,062	3,062

Source: ACIL Allen Consulting, 2014

Note that the quantities for electricity transmitted and distributed should not be added to obtain a total utilisation figure for electricity networks. Doing this would result in double counting. Most of the electricity in the table that was distributed was also transmitted.

Electricity generation was highest in NSW, Queensland and Victoria in 2010-11 with these states making up 80 per cent of electricity generated across Australia. Electricity generation was least in the ACT (in which there was no electricity generated) and the Northern Territory. The Northern Territory's generation facilities serve only a relatively small proportion of the population of Australia.

The average capacity factor for generation across Australia can be readily calculated using the information in Table 52 and Table 53. The average capacity factor across Australia in 2010-11 was 48.23 per cent.

DEC results

The results of the direct economic contribution analysis by jurisdiction are presented in Table 54. The value of generation and transmission in WA appears disproportionately high with respect to its population. This is probably due to different prices applying in the network — note that even one or two instances of extreme weather can impact on the average cost of energy.

Table 54 **Electricity generation, transmission and distribution DEC results by state/territory, 2010-11 (2010-11 prices)**

State	Generation DEC	Transmission DEC	Distribution DEC
	$ million	$ million	$ million
NSW	1,254	835	3,190
VIC	1,240	434	1,400
QLD	560	684	2,026
SA	194	246	550
WA	1,163	1,178	–
TAS	393	204	227
NT	34	–	85
ACT	–	28	140

Source: ACIL Allen Consulting, 2014

11.3.3 Capacity, utilisation and DEC of electricity infrastructure by audit region

The breakdown of electricity services by audit region provides some insights into how electricity is distributed and where the value of electricity services is highest across different jurisdictions. From the results by audit region, the structure of the electricity network plays a significant role in how the capacity, utilisation and DEC measures are allocated.

It is interesting to note that generation capacity may not necessarily be located in close proximity to major population centres, and that population is also not necessarily the only determinant in terms of the value of electricity services.

Capacity metrics

Within NSW, while Sydney is the primary consumer of electricity, the largest generation capacity by a significant margin is found in the Hunter Valley. There is also significant generation capacity in the areas of Newcastle, the Riverina and in Greater Sydney (which includes the Central Coast).

In Queensland there is significant generation capacity in the Darling Downs-Maranoa area. Gladstone and Rockhampton have significantly higher generation capacity compared to the audit region of greater Brisbane.

Victoria has a very high concentration of energy generation capacity in the Latrobe-Gippsland audit region with generation in the audit region of Greater Melbourne being relatively low (compared to other major capital cities).

Tasmania is similar to Victoria although more extreme in that greater Hobart contains no generation facilities at all and is serviced via transmission and distribution.

When comparing capital cities across Australia, not all of them have generation capacity within the audit region. Melbourne and Brisbane appear to have limited generation capacity within their own audit region while Canberra and Hobart do not have any generation capacity and rely on transmission or other distribution.

Utilisation metrics

The utilisation results strongly reflect the capacity results outlined above. A total of 49 TWh was generated in the Latrobe-Gippsland audit region in 2010-11 and the Hunter Valley generated 24 TWh. These were by some margin the audit regions with the highest production of electricity.

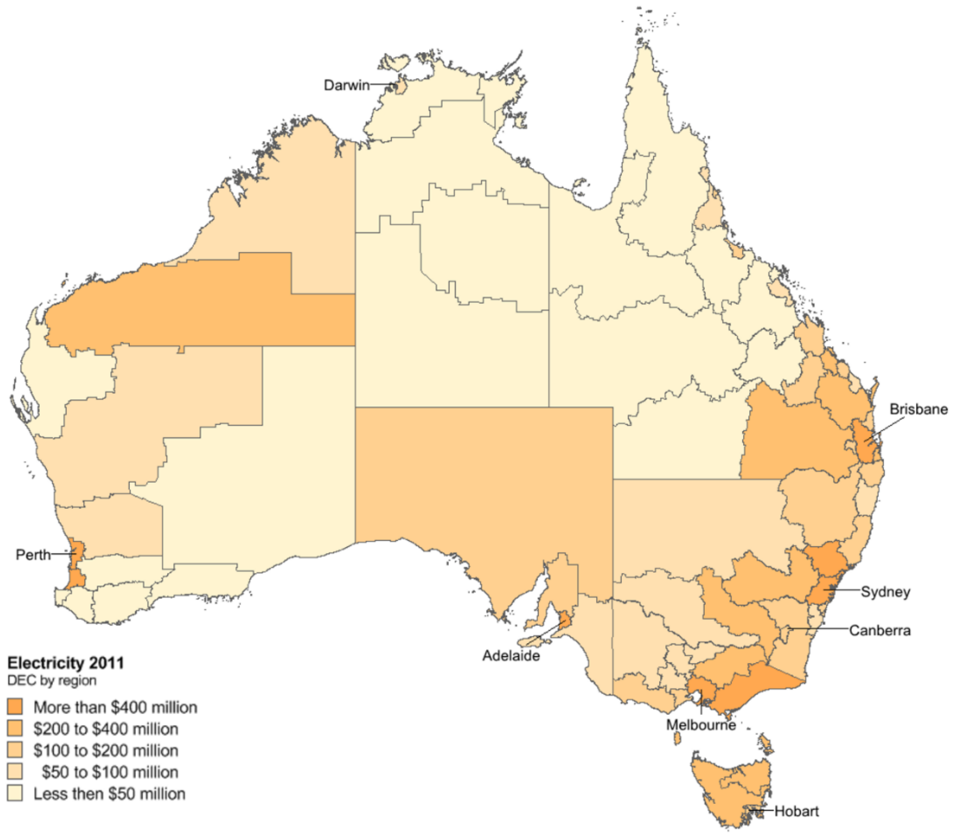
Utilisation of transmission is more clearly linked to population with the major urban centres of Greater Sydney and Greater Melbourne accounting for a much higher share than their generation capacities. Brisbane, Perth and Adelaide also account for the majority of transmission and other distribution utilisation in their respective jurisdictions.

In terms of smaller audit regions, the Pilbara is an interesting case because the level of transmission is zero indicating that that region is self-sufficient in terms of energy generation. This is true for many more remote areas such as Esperance, Gascoyne, and for every audit region in the Northern Territory.

DEC metrics

The total DEC for electricity infrastructure services across Australia was $16,064 million in 2010-11. Figure 146 maps the DEC for electricity infrastructure services by audit region in 2010-11.

Figure 146 **DEC for electricity infrastructure services by audit region in 2010-11**



Source: ACIL Allen Consulting, 2014

The audit region with the greatest DEC from electricity infrastructure services was Greater Sydney (combined DEC of $2,416 million). The audit region with the next highest DEC from electricity infrastructure services was Greater Perth ($1,268 million). The DEC for these services in Greater Perth was greater than for Greater Melbourne (at $927 million). Distribution makes up the majority of Sydney's DEC, at $1,772 million. This means that distribution companies have a significant amount of their business in the Sydney region.

Sample calculation – Electricity DEC calculation for 4_3_South_Australia – Outback

A sample calculation of the DEC for the 4_3_South_Australia-Outback audit region is provided below, with the text below the table describing how the numbers in the table were determined.

Table 55 **Sample Calculation – Electricity DEC calculation for 4_3_South_Australia-Outback, 2010-11**

Item	Units	Value
Population	No.	87,362
Electricity distributed	GWh	585
Electricity directly transmitted	GWh	1,659
Total electricity delivered	**GWh**	**2,244**
Estimated peak load	MW	539
Generation installed capacity	MW	820
Energy generated	GWh	4,261
Generation DEC	$M	74
Transmission DEC	$M	42
Distribution DEC	$M	29
Total Electricity DEC	**$M**	**145**

Source: ACIL Allen Consulting, 2014

Electricity distributed

11,093 GWh of electricity was delivered in South Australia in 2010-11, with a distribution system peak of 3,031 MW (ETSA Utilities Annual Report 2011). The population of the audit region was 87,362 and the population of South Australia was 1,656,299. ETSA served the whole of South Australia.

The estimate of electricity delivered to the audit region in 2010-11 is 11,093 GWh x 87,362 / 1,656,299 = 585 GWh.

Electricity directly transmitted

Electranet (the transmission network service provider in South Australia) transmitted 13,045 GWh of electricity in 2010-11 (AER, State of the Energy Market 2012). Subtracting the electricity distributed (see calculation above), the electricity directly transmitted across South Australia was estimated to be 13,045 GWh-11,093 GWh = 1,952 GWh. It is estimated that 85 per cent of the electricity directly transmitted (amounting to 1,659 GWh) was consumed in the 4_3_South_Australia-Outback audit region.

Total electricity delivered

The total electricity delivered in the 4_3_South_Australia-Outback audit region was equal to the sum of electricity distributed (585 GWh) and electricity directly transmitted (1,659 GWh).

Estimated peak load

The estimated peak load was calculated as follows.

(585,000 MWh / 8,760 hours) / 41.78 per cent + (1,659,000 MWh / 8,760 hours) / 50 per cent = 539 MW.

The ETSA Utilities distribution load factor of 41.78 per cent was calculated as follows: 11,093,000 MWh / (3,031 MW x 8,760 hours) = 41.78 per cent. The 50 per cent load factor assumed for electricity directly transmitted appears to be low. However the choice of this value results in an aggregate peak for electricity delivered to all audit regions which is reasonably consistent with the transmission peak demand of 3,570 MW cited by the AER.

Generation

The following generation facilities were identified in the 4_3_South_Australia-Outback audit region: Port Lincoln, Northern and Playford power stations. Adding their installed capacities and electricity generated gives 820 MW and 4,261 GWh respectively.

Transmission DEC

For 2010-11, the AER allowed Electranet revenue of $265.12 million and operating expenditure of $64.36 million. Labour value added was estimated to be 0.7 x $64.36 million = $45.05 million. The DEC was calculated as follows:

$265 million – $64 million + $45 million = $246 million.

The transmission DEC allocated to this audit region as calculated as follows:

$246 million x 2,244 GWh / 13,045 GWh = $42 million.

Note that the 2,244 GWh was the total electricity transmitted and distributed in this audit region in 2010-11, and that the 13,045 GWh was the total electricity transmitted and distributed in South Australia in 2010-11.

Distribution DEC

For 2010-11, AER allowed ETSA Utilities revenue of $609.6 million and operating expenditure of $197.9 million. Labour value added was estimated to be 0.7 x 197.9 = $138.53 million. The DEC was calculated as follows:

$610 million – $198 million + $138 million = $550 million.

Distribution DEC allocated to this audit region is calculated as;

$550 million x 585 GWh / 11,093 GWh = $29 million.

Note that 585 GWh was the total electricity distributed in this audit region in 2010-11, and that the 11,093 GWh was the total electricity distributed in South Australia in 2010-11.

Total electricity DEC

This is calculated as the sum of the DEC for generation, transmission and distribution for this audit region:

$74 million + $42 million + $29 million = $145 million.

Sample Calculation – Generation Facility DEC

Northern Power Station is a coal-fired power station of 530 MW installed capacity. In 2010-11 it generated 3,943 GWh (around 30 per cent of South Australia's total generation in that year). The station had a capacity factor of 85.8 per cent which is typical of a base load station. We assume a price adjustment factor of 1.1 which we multiply by the average regional reference price for South Australia in that year of $32.58/MWh to obtain $35.84/MWh. We estimate the power station's revenue as follows (note that we have rounded to a couple of significant figures to show the calculation):

$35.48/MWh x 3,943 GWh = $141 million .

In 2010-11, the components of the operating costs of Northern Power Station were estimated to comprise: FOM = $56,650/MW, VOM = $1.23/MWh, and FC = $17.41/MWh.

The total operating costs were:

$56,650/MW x 530 MW + ($1.23/MWh + $17.41/MWh) x 3,943 GWh = $103 million.

We estimate the labour value added as 0.7 x FOM x installed capacity or 0.7 x $56,650/MW x 530 MW = $21 million. The DEC of the facility is calculated as:

$141 million – $103 million + $21 million = $59 million.

Cost structure of electricity generation

Basic information on the cost structure of electricity generation in the NEM for Queensland, NSW and Victoria in 2010-11 is presented in Table 56.

There are differences between the DECs for Queensland, Victoria and New South Wales. While New South Wales has the highest costs it also has by far the highest revenue and the highest revenue per megawatt hour.

The Victorian market has noticeably lower costs – in particular variable costs – compared to New South Wales and Queensland, while Queensland has both lower revenue and high costs, making the DEC per unit of energy much lower than the two other states in spite of the fact that they are part of the same interconnected network.

Table 56 **Cost structure of electricity services by jurisdictions (NEM only*) – 2010-11**

State	Units	QLD	NSW	VIC
Generation	(GWh)	58,021	67,611	55,050
Revenue	$M	1,876	2,821	1,753
Revenue	$/MWh	32.33	41.72	31.84
Fixed costs (less labour)	$M	159	229	206
Variable Costs	$M	1,104	1,338	307
Total Costs	$M	1,263	1,567	513
Total Costs	$/MWh	21.77	23.18	9.32
DEC	$M	613	1,254	1,240
DEC	**$/MWh**	**10.57**	**18.55**	**22.52**

Note:*QLD figures for DEC are slightly different to those reported above because the information contained in the table only includes QLD audit regions part of the NEM. Other remote audit regions in QLD have negative DEC.

Source: ACIL Allen Consulting, 2014

11.4 Projections for electricity services infrastructure needs

This section details projections for the demand for infrastructure service demand, capacity and utilisation and DEC (as appropriate), as at 2030-31.

The increase in energy prices seen since 2007 has contributed to slowing growth in energy consumption in Australia. As pointed out above, energy use in the NEM has declined since 2008 although this may be due to structural reasons rather than trends in energy use. It is clear that energy use is becoming more efficient and this trend is likely to continue. Therefore, while energy consumption is expected to grow between 2010-11 and 2030-31, the magnitude of the increase is lower than what might have predicted five or ten years ago.

11.4.1 National forecasts

Capacity

National installed generation capacity is forecast to reach 79 GW by 2030-31, with peak national demands for transmission and distribution networks forecast to reach 60 GW and 53 GW respectively. These are increases of 46 per cent, 47 per cent, and 43 per cent from 2010-11, respectively.

Utilisation

The total electricity generated in 2030-31 is projected to be 333 TWh; the total electricity is transmitted to be 321 TWh; and the total electricity distributed is projected to be 262 TWh. These are increases of 46 per cent, 48 per cent, and 43 per cent from 2010-11, respectively.

There are a variety of projections for electricity generation and care must be taken in comparing them. In 2012, the Bureau of Resources and Energy Economics (BREE) published projections on a national and state/territory basis out to 2034-35 (BREE 2012) and AEMO published annual projections of electricity consumption out to 2023-24 for the NEM as a whole and for each NEM region (Australian Energy Market Operator 2014).

Caution must be taken in comparing the ACIL Allen projections in this report to the BREE and AEMO projections. The BREE projections incorporate a carbon price path different to that the one used in the ACIL Allen projection, while the AEMO projections do not extend past 2023-24 and they exclude Western Australia, the Northern Territory, and part of Queensland.

Notwithstanding these caveats, we compare the ACIL Allen projections with the BREE projections in the table below. Note that BREE published the projections of electricity generated as at 2034-35 and not 2030-31.

Table 57 **Bureau of Resources and Energy Economics projected electricity generated 2012-13 and 2034-35, (TWh)**

	BREE 2012-13	BREE 2034-35	ACIL Allen 2010-11	ACIL Allen 2030-31
Australia	253	324	228	333

Source: Arif Syed 2012, Australian energy projections to 2049-50, Canberra, December; ACIL Allen Consulting, 2014

For interest, the table below details the AEMO-published projections of electricity consumption for the NEM. Note that these projections are not directly comparable to ACIL Allen's projections - ACIL Allen projects annual electricity generated only a national basis out to 2030-31 (and not a state/territory basis) while state/territory projections are only made as at 2030-31.

Table 58 **AEMO annual energy forecasts for the NEM (TWh)**

Year	Actual	High	Medium	Low	ACIL Allen NEM jurisdictions (electricity generated)
2013-14 (estimate)	181				
2014-15		180	176	170	
2015-16		186	180	167	
2016-17		191	183	162	
2017-18		193	184	164	
2018-19		196	184	163	
2019-20		199	184	161	
2020-21		202	185	160	
2021-22		204	185	158	
2022-23		206	185	156	
2023-24		208	186	154	
Average		1.40%	0.30%	-1.60%	
2024-25					
2025-26					
2026-27					
2027-28					
2028-29					
2029-30					
2030-31					304

Source: Table 3, 2014 National Electricity Forecast Report , ACIL Allen, 2014

Our modelled electricity utilisation incorporates assumed improvements in energy efficiency including the impact of energy efficiency policies of 1.5 per cent per year between 2010-11 and 2020-21 and then 1.0 per cent per year between 2020-21 and 2030-31. Our modelling does not output specific projections of capacity nor, volumes of energy produced by distributed generation – the impacts of these are incorporated through the projected capacity and utilisation of grid-connected generation.

DEC metrics

DEC is set to rise from $16 billion in 2010-11 for the electricity infrastructure services sector to $26 billion in 2030-31.

11.4.2 State/territory forecasts

The growth in capacity, utilisation and DEC shows marked differences between the different States and Territories. The greatest gaps lie in the states of Queensland and Western Australia. The lowest predicted growth is in Tasmania.

Capacity metrics

The breakdown of generation, transmission and distribution capacity forecasts is presented in Table 59 below.

Table 59 **Capacity projections by state/territory 2030-31**

State	Generation installed capacity	Transmission peak demand	Distribution peak demand
	(MW)	(MW)	(MW)
NSW	24,498	20,121	18,218
VIC	16,176	14,698	13,024
QLD	19,698	12,925	9,711
SA	6,290	4,930	4,274
WA	8,104	4,694	4,882
TAS	2,971	2,004	1,203
NT	883	0	736
ACT	0	857	857

Note: All network in the Northern Territory has been classified as distribution.
Source: ACIL Allen Consulting, 2014

From the table, NSW is projected to continue having the largest generation, transmission and distribution capacities of all state and territories.

The results of the projected capacity growth between 2010-11 and 2030-31 are presented in Table 60. The highest growth in generation installed capacity is projected to occur in Queensland and Victoria. Queensland is also projected to have the highest growth in transmission peak demand, while NSW and Victoria are projected to have the highest growth in distribution peak demand. Population growth will also drive a strong change in the Australian Capital Territory.

Table 60 **Projected proportional change in capacity by state/territory 2010-11 to 2030-31**

State	Generation installed capacity	Transmission peak demand	Distribution peak demand
NSW	47%	48%	48%
VIC	50%	47%	47%
QLD	56%	59%	39%
SA	42%	42%	41%
WA	30%	31%	32%
TAS	14%	13%	14%
NT	29%	Not applicable	28%
ACT	Not applicable	38%	38%

Note: All network in the Northern Territory has been classified as distribution.
Source: ACIL Allen Consulting, 2014

Utilisation metrics

Reflecting the increase in generation capacity, NSW, Queensland and Victoria are projected to have the greatest increases in electricity generation. They also make up the majority of energy utilised in the other categories as well. The results are provided in detail in Table 61.

Table 61 **Utilisation projections by state/territory 2030-31**

State	Energy generated (GWh)	Energy transmitted (GWh)	Energy distributed (GWh)
NSW	100,016	106,559	91,554
VIC	82,911	77,042	63,847
QLD	90,401	78,861	53,520
SA	18,564	18,517	15,642
WA	24,469	23,374	24,132
TAS	12,379	11,933	5,271
NT	4,149	0	4,150
ACT	0	4,231	4,231

Source: ACIL Allen Consulting, 2014

Similarly to capacity, the greatest proportional increases in utilisation for generation and transmission are projected to occur in Queensland. We project an increase of 67 per cent increase for transmission in Queensland. The lowest proportional growth is projected to occur in Tasmania across all three sectors.

Table 62 **Projected proportional change in utilisation by state/territory 2010-11 to 2030-31**

State	Energy generated	Energy transmitted	Energy distributed
NSW	48%	48%	48%
VIC	51%	47%	47%
QLD	52%	67%	39%
SA	43%	42%	41%
WA	30%	31%	32%
TAS	14%	13%	14%
NT	26%	Not applicable	26%
ACT	Not applicable	38%	38%

Note: All network in the Northern Territory has been classified as distribution.
Source: ACIL Allen Consulting, 2014

Our projections of electricity generated by state and territory can be compared to the projections of the BREE as shown in the following table. Note that the projections for Victoria are different because BREE's modelling incorporated carbon price assumptions based on Commonwealth Treasury modelling (published in 2011).[60]

[60] BREE's assumed carbon price path (in real 2009-10 dollars) included the following prices: $21 in 2012-13; $29.4 in 2019-20; $52.6 in 2029-30; and $69.9 in 2034-35. ACIL Allen assumed a substantially lower carbon price path – see Appendix in Part C for details.

Table 63 **Bureau of Resources and Energy Economics projections of electricity generated to 2034-35**

State	BREE 2012-13	BREE 2034-35	ACIL Allen 2010-11	ACIL Allen 2030-31
	(TWh)	(TWh)	(TWh)	(TWh)
NSW[a]	72	110	68	100
VIC	49	40	55	83
QLD	67	82	60	90
SA	18	26	13	19
WA	30	41	19	24
TAS	14	22	11	12
NT	3	4	3	4
ACT	-	-	0	0
TOTAL	253	324	228	333

[a] Includes ACT for BREE information.

Source: Arif Syed 2012, Australian energy projections to 2049-50, Canberra, December; ACIL Allen Consulting, 2014

DEC metrics

DEC is projected to rise to $26 billion for the electricity infrastructure services sector by 2030-31. NSW is the jurisdiction with the highest level of DEC.

Table 64 **Projected DEC by state/territory 2031**

State	DEC generation	DEC transmission	DEC distribution	DEC total
	$ million	$ million	$ million	$ million
NSW	1,944	1,301	4,956	8,201
VIC	1,920	657	2,133	4,709
QLD	837	1,237	3,072	5,147
SA	311	391	869	1,571
WA	2,419	2,747	0	5,165
TAS	451	229	259	939
NT	47	0	123	171
ACT	0	41	204	246

Note: All network in the Northern Territory has been classified as distribution.

Source: ACIL Allen Consulting, 2014

Trends in the forecast increases in DEC are slightly different to those for generation and utilisation due to the fact that DEC involves an estimation of electricity prices which are dependent on the observed prices in the base year 2011. There are marked differences in the way prices change over time between jurisdictions — possibly due to highly variable levels of competition between jurisdictions. In the NEM there is a much higher level of competition in the sector compared to the WEM. Costs are also very important – for example, NSW and Victoria benefit from the lower hydroelectricity fuel costs of the Snowy Mountain Hydroelectric scheme which has an installed capacity of 3.8 GW (note that this does not mean that generating electricity is not costless for this generator).

Table 65 **Projected proportional change in DEC by state/territory 2010-11 to 2030-31**

State	DEC generation	DEC transmission	DEC distribution	DEC total
NSW	55%	56%	55%	55%
VIC	55%	51%	52%	53%
QLD	50%	81%	52%	57%
SA	61%	59%	58%	59%
WA	108%	133%	Not applicable	121%
TAS	15%	13%	14%	14%
NT	41%	Not applicable	45%	44%
ACT	Not applicable	47%	47%	47%

Note: All network in the Northern Territory has been classified as distribution.
Source: ACIL Allen Consulting, 2014

11.4.3 Regional forecasts

There is significant variance in capacity growth across the audit regions with some outliers set to growth by more than 50 per cent in generation capacity between 2010-11 and 2030-31 while other regions are set grow by as little as 6 per cent.

The greatest increases in DEC are found in the Gladstone Biloela NA[61] audit region, the Kimberley, and Gascoyne. Western Australia has a mixture of high capacity growth regions and low capacity growth regions.

Capacity growth

Table 66 below shows the top five and bottom five audit regions in terms of growth in capacity between 2010-11 and 2030-31.

Table 66 **Top 5 and bottom 5 audit regions in terms of projected growth in capacity, 2010-11 to 2030-31**

Audit region	Generation capacity growth	Transmission capacity growth	Distribution capacity growth
Top 5 audit regions			
3_12_Gladstone - Biloela_NA	195%	195%	195%
5_8_Kimberley	76%	Not applicable	76%
5_6_Gascoyne	70%	Not applicable	70%
3_5_Far North	54%	54%	54%
1_14_Southern Highlands and Shoalhaven	52%	52%	52%
Bottom 5 audit regions			
5_12_Wheat Belt - North	15%	15%	15%
7_5_East Arnhem	14%	Not applicable	14%
6_2_Launceston and North East	9%	9%	9%
5_5_Esperance	8%	Not applicable	8%
5_13_Wheat Belt - South	6%	6%	6%

Note: All network in the Northern Territory has been classified as distribution. 'Not applicable' indicates that the transmission peak demand was 0 GWh in 2010-11 and that there is no projected change in this to 2030-31.
Source: ACIL Allen Consulting, 2014

[61] This audit region contains the Gladstone urban area.

The strong growth forecast in the Gladstone-Biloela_NA audit region is due mainly to growth in LNG production.

The fastest growing audit regions in NSW in terms of capacity are in the Southern Highlands/Shoalhaven (52 per cent) and Newcastle/Lake Macquarie (51 per cent). Greater Sydney is scheduled to grow capacity by 48 per cent while the lowest growth in NSW is predicted for Murray (39 per cent).

Among the capital cities, Greater Melbourne has the second-highest growth (47 per cent) after Greater Sydney, followed by Greater Adelaide (41 per cent), Greater Brisbane (37 per cent), Greater Perth (33 per cent) and Darwin (32 per cent).

Utilisation growth

Proportional growth in utilisation of electricity infrastructure is projected to essentially follow the percentage growth in capacity. Table 67 below shows the top five and bottom five audit regions in terms of proportional increases in utilisation of the transmission network.

Table 67 **Top 5 and bottom 5 audit regions in terms of projected growth in transmission, 2010-11 to 2030-31**

Audit region	Generation capacity growth	Transmission capacity growth	Distribution capacity growth
Top 5 audit regions			
3_12_Gladstone - Biloela_NA	195%	195%	195%
3_6_Outback-North	Not applicable	78%	78%
1_4_Coffs Harbour - Grafton	Not applicable	55%	55%
3_5_Far North	54%	54%	54%
1_8_Mid North Coast	Not applicable	54%	54%
Bottom 5 audit regions			
5_12_Wheat Belt - North	16%	16%	16%
7_5_East Arnhem	Not applicable	16%	16%
6_2_Launceston and North East	15%	15%	15%
5_5_Esperance	9%	9%	9%
5_13_Wheat Belt - South	6%	6%	6%

Note: 'Not applicable' indicates that no electricity was generated in that audit region in 2010-11 and that there is no projected change in this to 2030-31.
Source: ACIL Allen Consulting, 2014

DEC growth

In line with the findings above, the top 5 audit regions in terms of growth in DEC between 2010-11 and 2030-31 are found in audit regions in Western Australia and Queensland. It is likely that this growth is mainly associated with spending on large industrial and mining projects. The growth in DEC for Greater Perth reflects the large increase in value add in the electricity sector in that region arising from our economic modelling. By contrast, lower growth in DEC in seen for Tasmania.

Table 68 **Top 5 and bottom 5 audit regions in term of projected proportional DEC growth, 2010-11 to 2030-31**

Audit region	DEC 2010-11	DEC 2030-31	Growth
	$ million	$ million	
Top 5 audit regions			
3_12_Gladstone - Biloela_NA	204	654	220%
5_1_Greater Perth	1,268	3,001	137%
5_3_Bunbury	457	1,049	129%
5_7_Goldfields	44	101	128%
5_9_Mid West	66	151	126%
Bottom 5 audit regions			
7_5_East Arnhem	14	18	25%
6_3_Rest of Tas	393	458	17%
5_10_Pilbara	206	240	16%
6_1_Hobart	172	198	15%
6_2_Launceston and North East	259	283	9%

Source: ACIL Allen Consulting, 2014

11.5 Projections of DEC and additional needs for electricity services infrastructure

This section discusses the gaps between the DEC at 2010-11 and the projected DEC as at 2030-31 in the Baseline scenario.

11.5.1 National gaps

The table below details the national projected gaps in DEC, capacity and utilisation metrics for the electricity sector between 2010-11 and 2030-31. It should be noted that the gap in DEC is *not* a projected measure of the capex that will be required. The DEC includes both the returns to capital (including return on and of capital) and returns to labour.

Table 69 **National gap in DEC, capacity and utilisation metrics, 2010-11 to 2030-31, Baseline scenario**

	Generation	Transmission	Distribution
Capacity (MW)	24,607	19,124	15,806
Utilisation (GWh)	104,694	104,465	78,353
DEC ($ million)	3,092	2,995	3,998

Source: ACIL Allen Consulting, 2014

11.5.2 State and territory gaps

The table below details the projected state and territory gaps in capacity metrics for the electricity sector between 2010-11 and 2030-31.

Table 70 **State and territory gap in capacity metrics, 2010-11 to 2031-31, Baseline scenario**

	Generation	Transmission	Distribution
	MW	MW	MW
NSW	7,844	6,558	5,927
VIC	5,411	4,715	4,187
QLD	7,054	4,816	2,718
SA	1,853	1,454	1,243
WA	1,880	1,113	1,186
TAS	370	232	149
NT	196	0	159
ACT	0	237	237
TOTAL	**24,607**	**19,124**	**15,806**

Source: ACIL Allen Consulting, 2014

The table below details the projected state and territory gaps in utilisation metrics for the electricity sector between 2010-11 and 2030-31.

Table 71 **State and territory gap in utilisation metrics, 2010-11 to 2031-31, Baseline scenario**

	Generation	Transmission	Distribution
	GWh	GWh	GWh
NSW	32,405	34,732	29,757
VIC	27,861	24,690	20,528
QLD	30,798	31,520	14,980
SA	5,604	5,472	4,549
WA	5,655	5,536	5,862
TAS	1,516	1,348	652
NT	856	0	857
ACT	0	1,169	1,169
TOTAL	**104,694**	**104,465**	**78,353**

Source: ACIL Allen Consulting, 2014

The table below details the projected state and territory gaps in DEC for the electricity sector between 2010-11 and 2030-31.

Table 72 **State and territory gap in DEC, 2010-11 to 2031-31, Baseline scenario**

	Generation	Transmission	Distribution	Total
	$ million	$ million	$ million	$ million
NSW	690	466	1,766	2,922
VIC	680	223	732	1,636
QLD	278	553	1,046	1,877
SA	117	145	319	581
WA	1,256	1,569	0	2,825
TAS	58	26	32	115
NT	14	0	38	52
ACT	0	13	65	78
TOTAL	**3,092**	**2,995**	**3,998**	**10,086**

Source: ACIL Allen Consulting, 2014

11.5.3 Audit region gaps

Of particular interest in the electricity sector are the projected gaps in capacity – as areas of large projected capacity gaps may indicate where investment may be needed. In our analysis, we have allocated generation to the particular audit region in which the generation occurs.

The five audit regions with the greatest projected gaps in generation capacity between 2010-11 and 2030-31 are:

- 2_6_Latrobe-Gippsland: 3,789 MW
- 3_12_Gladstone-Biloela_NA: 3,608 MW
- 1_6_Hunter Valley exc Newcastle: 2,490 MW
- 1_11_Newcastle and Lake Macquarie: 1,474 MW
- 1_1_Greater Sydney: 1,331 MW.

The table below indicates the five audit regions with the greatest projected gaps in transmission capacity between 2010-11 and 2030-31 and the five regions with the smallest projected gaps. The top five regions are comprised of the four largest capital cities together with the audit region containing the Gladstone urban area.

Table 73 **Top 5 and bottom 5 audit regions in terms of transmission capacity gap, 2010-11 to 2031-31**

Audit region	Generation capacity growth	Transmission capacity growth	Distribution capacity growth
	MW	MW	MW
Top 5 audit regions			
1_1_Greater Sydney	1,331	3,952	3,952
2_1_Greater Melbourne	458	3,137	3,137
3_12_Gladstone - Biloela_NA	3,608	2,241	166
3_1_Greater Brisbane	347	1,233	1,233
5_1_Greater Perth	872	968	952
Bottom 5 audit regions			
3_11_Gladstone - Biloela	361	8	8
5_4_Manjimup	0	7	7
3_7_SWQld_NA	16	5	5
3_8_SWQld	0	4	4
5_13_Wheat Belt - South	7	3	2

Source: ACIL Allen Consulting, 2014

The table below indicates the five audit regions with the greatest projected gaps in distribution capacity between 2010-11 and 2030-31 and the five audit regions with the smallest projected gaps. The major capital cities are projected to have the greatest gaps.

Table 74 **Top 5 and bottom 5 audit regions in terms of distribution capacity gap, 2010-11 to 2031-31**

Audit region	Generation capacity growth	Transmission capacity growth	Distribution capacity growth
	MW	MW	MW
Top 5 audit regions			
1_1_Greater Sydney	1,331	3,952	3,952
2_1_Greater Melbourne	458	3,137	3,137
3_1_Greater Brisbane	347	1,233	1,233
4_1_Greater Adelaide	955	968	968
5_1_Greater Perth	872	968	952
Bottom 5 audit regions			
3_7_SWQld_NA	16	5	5
3_8_SWQld	0	4	4
7_3_Barkly	8	0	3
5_13_Wheat Belt - South	7	3	2
5_5_Esperance	2	0	1

Source: ACIL Allen Consulting, 2014

11.6 Sensitivity analysis of projections for electricity services needs and DEC

Two scenarios were used to undertake a sensitivity analysis of the results for the electricity infrastructure sector:

- Higher population scenario
- Higher productivity scenario.

While the national DEC for the electricity infrastructure sector was higher under each sensitivity scenario relative to the Baseline scenario, there were material differences in the projected growth of capacity and utilisation metrics relative to the Baseline scenario.

11.6.1 National and state/territory capacity projections

Capacity metrics for generation, transmission and distribution were projected to be:

- *higher* in the Higher population scenario relative to the Baseline scenario – both nationally and across most states and territories
- *lower* in the Higher productivity scenario relative to the Baseline scenario – both nationally and across most states and territories.

The table below shows how projections for capacity metrics in the sensitivity scenarios vary from the Baseline scenario. Note that a negative percentage indicates that the projection is less than that of the projected value in the Baseline scenario as at 2030-31 – *not* that it is less than the relevant value in 2010-11.

Table 75 **Sensitivity analysis relative to Baseline scenario – capacity projections, 2030-31**

	Higher population scenario			Higher productivity scenario		
2030-31	Generation	Transmission	Distribution	Generation	Transmission	Distribution
NSW	1.79%	1.70%	1.68%	-1.01%	-0.97%	-0.97%
VIC	4.41%	4.71%	4.73%	-1.81%	-1.83%	-1.84%
QLD	3.96%	4.32%	4.94%	-3.24%	-3.02%	-2.97%
SA	2.59%	2.61%	2.62%	-3.69%	-3.69%	-3.65%
WA	-0.83%	-0.84%	-0.68%	-3.78%	-3.77%	-3.66%
TAS	5.05%	5.46%	5.35%	0.41%	0.46%	0.45%
NT	-1.10%	Not applicable	-1.09%	-6.01%	Not applicable	-5.96%
ACT	Not applicable	5.01%	5.01%	Not applicable	-1.10%	-1.10%
TOTAL	**2.76%**	**3.04%**	**2.98%**	**-2.24%**	**-2.02%**	**-2.06%**

Note: 'Not applicable' indicates a zero value in both 2010-11 and 2030-31.
Source: ACIL Allen Consulting, 2014

It is of interest to note that capacity metrics in all jurisdictions except Tasmania are lower in the Higher productivity scenario relative to the Baseline scenario.

11.6.2 National and state/territory utilisation projections

The sensitivity analysis for utilisation metrics at 2030-31 appears similar to that of capacity metrics. Relative to the results in the Baseline scenario, the utilisation of electricity infrastructure is projected to be:

- higher in the Higher population scenario
- lower in the Higher productivity scenario.

These results hold both nationally and in most states and territories, as shown in the table below.

Table 76 **Sensitivity analysis relative to Baseline scenario – utilisation projections, 2030-31**

	Higher population scenario			Higher productivity scenario		
	Generation	Transmission	Distribution	Generation	Transmission	Distribution
NSW	1.83%	1.71%	1.68%	-1.03%	-0.96%	-0.97%
VIC	4.37%	4.70%	4.73%	-1.82%	-1.83%	-1.84%
QLD	4.02%	4.14%	4.94%	-3.24%	-3.04%	-2.97%
SA	2.58%	2.60%	2.62%	-3.75%	-3.70%	-3.65%
WA	-0.84%	-0.85%	-0.68%	-3.78%	-3.77%	-3.66%
TAS	5.08%	5.51%	5.35%	0.42%	0.47%	0.45%
NT	-1.14%	Not applicable	-1.11%	-5.96%	Not applicable	-5.93%
ACT	Not applicable	5.01%	5.01%	Not applicable	-1.10%	-1.10%
TOTAL	**2.99%**	**3.08%**	**3.01%**	**-2.19%**	**-1.99%**	**-2.05%**

Note: 'Not applicable' indicates a zero value in both 2010-11 and 2030-31.
Source: ACIL Allen Consulting, 2014

11.6.3 National and state/territory DEC projections

By comparison with the capacity and utilisation projections, the national DEC for electricity infrastructure in 2030-31 is projected to be higher under both sensitivity scenarios relative to the Baseline scenario:

- the national DEC in the Higher population scenario is projected to be $26,809 million (2.5 per cent higher than in the Baseline scenario)
- the national DEC in the Higher productivity scenario is projected to be $26,885 million (2.8 per cent higher than in the Baseline scenario).

There is variation by state and territory in the DEC growth in the two sensitivity scenarios relative to the Baseline scenario, as shown in the table below.

Table 77 **Sensitivity analysis relative to Baseline scenario – total projected DEC, 2030-31**

	Higher population scenario	Higher productivity scenario
NSW	0.49%	4.65%
VIC	4.18%	0.67%
QLD	4.87%	0.73%
SA	1.90%	0.77%
WA	1.66%	4.58%
TAS	5.20%	4.63%
NT	-3.46%	-1.30%
ACT	5.80%	-1.92%
TOTAL	**2.52%**	**2.81%**

Source: ACIL Allen Consulting, 2014

While NSW and Western Australia have materially higher DECs in the Higher productivity scenario than in the Higher population scenario, the converse is true for Victoria, Queensland and the ACT. Tasmania has a materially higher DEC in both sensitivity scenarios while the Northern Territory has a lower DEC in both sensitivity scenarios.

The table below shows that there is little variation by supply chain element in each state or territory in terms of how its DEC for a sensitivity scenario varies relative to the Baseline scenario.

Table 78 **Sensitivity analysis relative to Baseline scenario – DEC projections, 2030-31**

	Higher population scenario			Higher productivity scenario		
	Generation	Transmission	Distribution	Generation	Transmission	Distribution
NSW	0.60%	0.47%	0.45%	4.61%	4.66%	4.67%
VIC	4.03%	4.34%	4.26%	0.67%	0.65%	0.67%
QLD	4.70%	4.41%	5.10%	0.50%	0.78%	0.77%
SA	1.86%	1.90%	1.92%	0.69%	0.76%	0.80%
WA	2.09%	1.29%	Not applicable	3.84%	5.24%	Not applicable
TAS	4.96%	5.50%	5.34%	4.60%	4.68%	4.65%
NT	-3.45%	Not applicable	-3.46%	-1.27%	Not applicable	-1.31%
ACT	Not applicable	5.80%	5.80%	Not applicable	-1.92%	-1.92%
TOTAL	2.59%	2.23%	2.65%	2.80%	3.50%	2.44%

Note: 'Not applicable' indicates zero values in both the Baseline scenario and the sensitivity scenario.
Source: ACIL Allen Consulting, 2014

11.6.4 Regional projections

It is interesting to identify regions in which the projected capacity measures vary the most from the Baseline scenario.

The table below shows the top ten audit regions in each of the two sensitivity scenarios in which the capacity of installed generation varies the most (proportionally) from the Baseline scenario.

Table 79 **Top ten audit regions, sensitivity analysis relative to Baseline scenario – generation capacity, 2030-31**

Higher population scenario		Higher productivity scenario	
6_2_Launceston and North East	5.76%	6_2_Launceston and North East	0.52%
5_6_Gascoyne	5.56%	6_3_Rest of Tas	0.36%
5_8_Kimberley	5.41%	5_10_Pilbara	-0.07%
3_1_Greater Brisbane	5.13%	1_14_Southern Highlands and Shoalhaven	-0.60%
3_20_Townsville	5.10%	1_2_Capital Region	-0.79%
3_11_Gladstone - Biloela	5.03%	1_6_Hunter Valley exc Newcastle	-0.91%
3_22_Wide Bay	4.82%	1_7_Illawarra	-1.00%
2_1_Greater Melbourne	4.81%	1_1_Greater Sydney	-1.00%
2_4_Geelong	4.77%	1_9_Murray	-1.02%
6_3_Rest of Tas	4.72%	1_13_Riverina	-1.03%

Source: ACIL Allen Consulting, 2014

The table below shows the top ten audit regions in each of the two sensitivity scenarios in which the capacity of transmission varies the most (proportionally) from the Baseline scenario.

Table 80 **Top ten audit regions, sensitivity analysis relative to Baseline scenario – transmission capacity, 2030-31**

Higher population scenario	Variation from Baseline projection scenario (%)	Higher productivity scenario	Variation from Baseline projection scenario (%)
6_2_Launceston and North East	5.76%	6_2_Launceston and North East	0.52%
6_1_Hobart	5.55%	6_1_Hobart	0.46%
3_14_Gold Coast	5.38%	6_3_Rest of Tas	0.36%
3_1_Greater Brisbane	5.13%	1_12_Richmond - Tweed	-0.59%
3_20_Townsville	5.10%	1_14_Southern Highlands and Shoalhaven	-0.60%
3_9_Sunshine Coast	5.08%	1_4_Coffs Harbour - Grafton	-0.62%
3_2_Cairns N+S	5.05%	1_8_Mid North Coast	-0.71%
3_19_Charters Towers - Ayr - Ingham	5.03%	1_2_Capital Region	-0.79%
3_11_Gladstone - Biloela	5.03%	1_6_Hunter Valley exc Newcastle	-0.91%
8_1_Australian Capital Territory	5.01%	1_7_Illawarra	-1.00%

Source: ACIL Allen Consulting, 2014

The table below shows the top ten audit regions in each of the two sensitivity scenarios in which the capacity of distribution varies the most (proportionally) from the Baseline scenario.

Table 81 **Top ten audit regions, sensitivity analysis relative to Baseline scenario – distribution capacity, 2030-31**

Higher population scenario	Variation from Baseline projection scenario (%)	Higher productivity scenario	Variation from Baseline projection scenario (%)
6_2_Launceston and North East	5.76%	6_2_Launceston and North East	0.52%
5_6_Gascoyne	5.56%	6_1_Hobart	0.46%
6_1_Hobart	5.55%	6_3_Rest of Tas	0.36%
5_8_Kimberley	5.41%	5_10_Pilbara	-0.07%
3_14_Gold Coast	5.38%	1_12_Richmond - Tweed	-0.59%
3_1_Greater Brisbane	5.13%	1_14_Southern Highlands and Shoalhaven	-0.60%
3_20_Townsville	5.10%	1_4_Coffs Harbour - Grafton	-0.62%
3_9_Sunshine Coast	5.08%	1_8_Mid North Coast	-0.71%
3_2_Cairns N+S	5.05%	1_2_Capital Region	-0.79%
3_19_Charters Towers - Ayr - Ingham	5.03%	1_6_Hunter Valley exc Newcastle	-0.91%

Source: ACIL Allen Consulting, 2014

11.7 Issues and implications of findings

A significant factor in the level of investment in the electricity infrastructure sector is investment in new capacity (together with replacement of existing capacity) in the generation, transmission and distribution elements of the supply chain.

11.7.1 National gaps

We project large national capacity gaps in the Baseline scenario between 2010-11 and 2030-31:

- a gap of 24.6 GW in installed generation capacity
- a gap of 19.1 GW of peak demand in the transmission network
- a gap of 15.8 GW of peak demand in the distribution network.

A sensitivity analysis indicates that there are large capacity gaps in both the Higher population scenario and the Higher productivity scenario – larger gaps in the former scenario but smaller gaps in the latter (noting that this can vary by state/territory).

These capacity gaps indicate a potential need to invest.

We also project large national gaps in DEC between 2010-11 and 2030-31:

- a gap of $3.1 billion in relation to generation
- a gap of $3.0 billion in relation to transmission
- a gap of $4.0 billion in relation to distribution.

11.7.2 Regional gaps

We project large regional capacity gaps between 2010-11 and 2030-31:

- for generation capacity – in the Latrobe/Gippsland, Gladstone urban, Hunter Valley, Newcastle and Lake Macquarie, and Greater Sydney areas
- for transmission capacity – in the large capital cities and the Gladstone urban area
- for distribution capacity – in the large capital cities.

These gaps may indicate where investment might need to be concentrated.

11.7.3 Investment environment

Investment in the electricity infrastructure sector is generally subject to market (for generation) and economic regulation (for network) factors across most of Australia (by population). Consequently, it would be expected that these factors would drive investment instead of government decisions. The analysis in this chapter, then, indicates potential outworkings of the policy and regulatory framework for investment in the electricity infrastructure sector rather than the types of investments governments may need to decide to make over the period 2010-11 to 2030-31. It is also important to note that the DEC gap is not a projection of the level of capex required between 2010-11 and 2030-31. The DEC is a measure of the combined returns to capital (including returns on and of capital) and returns to labour.

12 Energy - Gas

KEY FINDINGS

Gas infrastructure services in scope for this audit are natural gas transmission pipelines and distribution networks.

The total throughput of Australian natural gas transmission pipelines was 1,334 petajoules in 2010-11. By comparison, the total annual throughput capacity of Australian natural gas transmission pipelines in 2010-11 was 1,918 petajoules per annum.

Total throughput capacity in the gas distribution networks was 344 petajoules in 2010-11. This is lower than the total throughput of gas transmission pipelines because it represents gas supplied only to residential and commercial customers and small industrial consumers.

The economic contribution of gas transmission and distribution infrastructure in 2010-11 was $2,345 million. Victoria accounted for the largest share of the economic contribution of the gas sector, followed by Western Australia and New South Wales.

Large increases in gas throughput between 2010-11 and 2030-31 are projected due to the development of LNG projects in Queensland. The most marked aspect of this outlook is the relatively stable domestic demand for gas which has been affected by rising gas prices and lower electricity demand compared with the dramatic increase in supply of LNG to international markets.

It is projected that the national economic contribution of gas transmission infrastructure across Australia in 2030-31 will be $3,178 million (in 2010-11 dollars). The economic contribution of distribution pipelines in 2030-31 is projected to be $1,509 million.

The greatest increases in the economic contribution of gas transmission infrastructure across Australia occur in Queensland. This is attributable to the investment in pipelines to service LNG projects in Gladstone.

Increases in other audit regions, other than in Gladstone-Biloela region, are generally modest reflecting relatively low growth in projected domestic demand for natural gas.

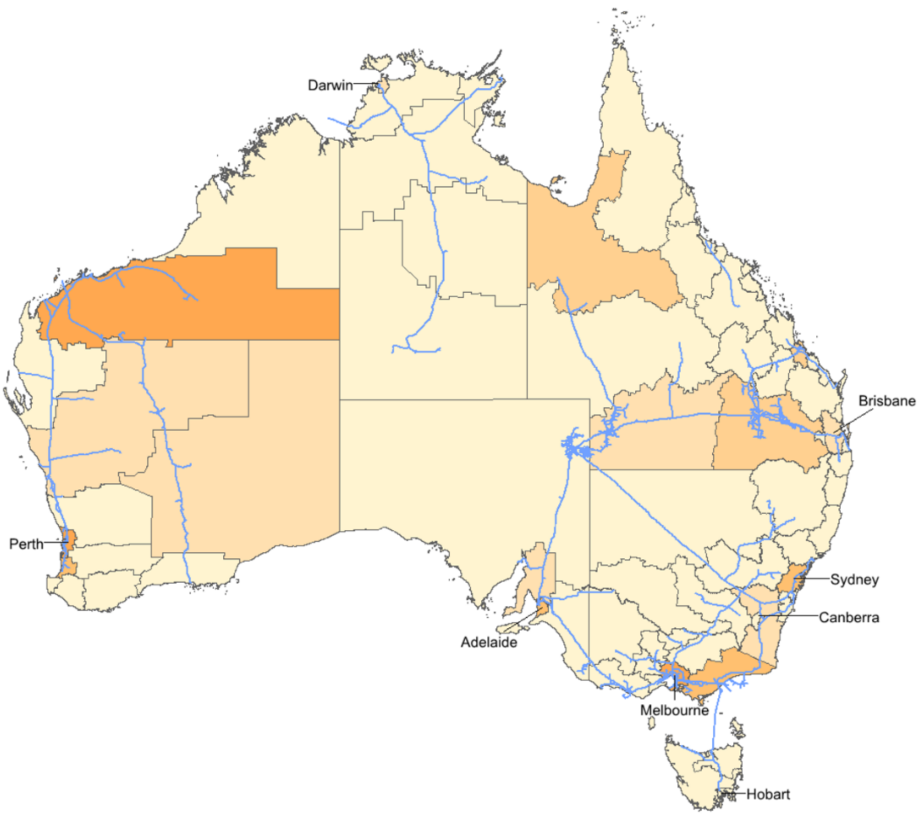
Economic modelling in this report indicates there will be an ongoing, if modest, need for further investment in the natural gas transmission pipeline system to meet domestic demand. The function of this investment will be to connect new gas fields to markets and to meet changing patterns of supply and demand.

There will be an increased demand for transmission capacity for large LNG projects in Queensland increasing pressures on the development of new transmission capacity (notably from the Gippsland Basin in Bass Strait to New South Wales). There may also be an ongoing need for investment in gas storage to meet emerging peak loads.

12.1 Gas services infrastructure in scope

The gas supply chain comprises producing fields, gas processing plants, high pressure gas transmission systems, low pressure distribution systems and various meter and valve stations to control pressures and line pack. In addition, transmission and distribution systems include trading hubs and in some areas gas storage systems to manage peak demands. Australia’s main natural gas transmission pipelines are shown in Figure 147.

Figure 147 **Natural gas transmission pipelines**



Note: Natural gas transmission pipelines are shown in blue.
Source: ACIL Allen Consulting, 2014

From an infrastructure perspective the most important components of the natural gas supply chain are the natural gas transmission pipelines and gas distribution networks. Transmission pipelines transport gas at high pressure from producing fields to major demand centres such as cities, large industrial customers and gas fired power generators. Distribution networks operate at lower pressure than transmission pipelines and deliver gas from the transmission delivery point to residential, commercial and industrial customers. Gas infrastructure services in scope for this audit are transmission pipelines and the distribution networks.

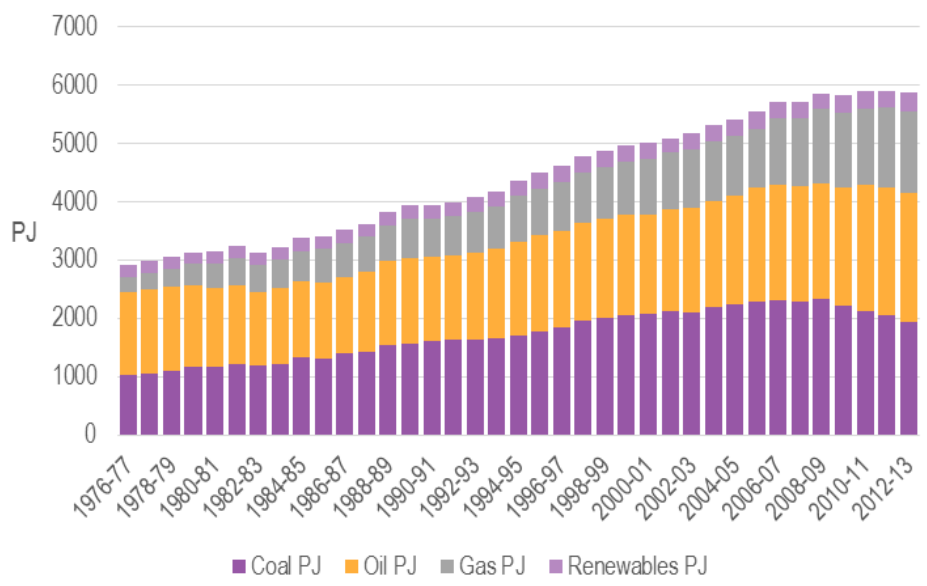
12.2 Gas services in Australia

12.2.1 The significance of gas transmission and distribution services in Australia

Natural gas in Australia

Australia is endowed with significant gas resources with around 3.8 trillion cubic metres of economic demonstrated gas resources. Gas has grown in importance over the last decade, with gas representing the majority of new electricity generation investment. As such, gas demand growth has been faster than other fossil fuels (see Figure 148). The emergence of an LNG industry on Australia's west coast and more recent developments on the east coast have brought renewed attention to the importance of gas to the Australian economy.

Figure 148 **Primary energy demand in Australia**



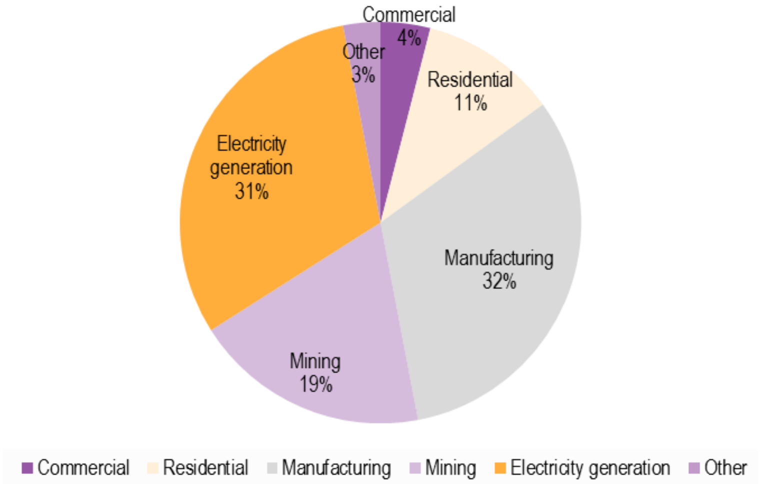
Source: (BREE, 2014)

Gas is an important fuel in both domestic and industrial applications, and makes up around 21 per cent of Australia's energy supply. Total gas production in 2011-12 was around 59 billion cubic metres. More than one third of this was exported from offshore LNG projects in the Northern Territory and in Western Australia.

Australia has three gas market areas (Eastern, Western and Northern) which although physically and economically separate from each other, are becoming increasingly integrated with global gas markets through the expansion of LNG exports. The vast majority of trade in the three market areas is through long term bilateral contracts although short term trading markets have been established on the East Coast and one is proposed for Western Australia.

Gas consumption in 2011-12 accounted for around 23 per cent of total primary energy consumption in Australia. The manufacturing sector was Australia's largest consumer of gas, followed by the electricity generation, mining, residential and commercial sectors (Figure 149).

Figure 149 **Gas consumption by load 2011-12**



Source: **Invalid source specified.**

Gas is used widely in the manufacturing sector but it is of particular importance to a relatively small number of large consumers in the metal product industries (mainly smelting and refining activities) and the chemical industry (fertilisers and plastics) where gas is a major energy source and/or production input.

The relatively large share of gas consumption in the electricity generation sector is a result of the large increase in gas-fired generation capacity since 2005-06. This increase was driven by state based policies encouraging the use of gas for power generation and the expectation that gas would provide a transition fuel in a carbon constrained economy. With the onset of an LNG export industry on Australia's east coast gas prices are rising to be closer in line with international prices. With the decline in the rate of growth in electricity consumption and rising gas prices the consumption of gas for electricity generation has declined.

Transmission

Australia's gas pipelines are privately owned. APA Group is the principal owner in both gas transmission and distribution, through both direct ownership and its interest in Envestra. State Grid Corporation of China and Singapore Power International own a number of pipelines through Jemena and SP AusNet. DND owns the Dampier to Bunbury Pipeline.

The written down capital value of natural gas transmission pipelines is in excess of $8.3 billion in 2014. The distribution of asset ownership in each State and the approximate written down capital value of these pipelines is summarised in Table 82.

Table 82 **Capital value of transmission pipelines**

	Owners	Written down capital value (approximate)
		$ million
Queensland	Victorian Funds Management Corporation, Jemena, Singapore Power International, APA Group,Westised, Mitsui, Origin Energy	911
New South Wales	APA Group, Jemena	1,366
Victoria	APAO Group, Jemena Asset Management, AEMO	668
South Australia	QIC Global Infrastructure, APA Group, Retail Employers Superannuation Trust	870
Western Australia	DBP, APA Group, Goldfields Pipelines Ltd, Alinta Energy	4,049
Tasmania	Palisade Investment Partners, Tasgas	440
Northern Territory	APA Group	n/a
Total		**8,304**

Note: Data taken from access arrangement approvals and are not all in $ of the same year. Some non-regulated pipelines are not included in this estimate.
Source: Australian Energy Regulator, Economic Regulation Authority (WA)

Distribution

The major gas distribution networks in Australia are privately owned. The owners are:

- Envestra
- Jemena
- DUET Group (Multinet)
- APA Group
- ATCO Group
- TasGas.

The written down capital value of natural gas distribution networks in Australia is in excess of $8.9 billion (see Table 83).

Table 83 **Gas distribution networks asset value**

	Owners	Written down capital value (approximate)
		$ million
Queensland	Allgas Energy, Envestra	755
New South Wales	Jemena, ACTEW/AGL, Envestra, APA Group	2,779
Victoria	SP Austnet, Multinet, Envestra	3,393
South Australia	Envestra	1,036
Western Australia	ATCO Group	805
Tasmania	TasGas Networks	122
Northern Territory	Envestra, APA Group	n/a
Total		**8,890**

Note: Data taken from access arrangement approvals and are not all in $ of the same year. Some non-regulated pipelines are not included in this estimate.
Source: Australian Energy Regulator, Economic Regulation Authority (WA)

12.2.2 Regulatory, policy and governance context

Prior to regulatory reform in the 1990s the gas supply chain in Australia was highly integrated with government ownership of transmission and distribution assets. A strategy for regulatory reform of the gas industry was canvassed in the National Strategy for the Natural Gas Industry in 1991 (Department of Primary Industries and Energy, 1991). This strategy was further developed by COAG through the early 1990s and culminated in the 1994 COAG agreement on free and fair trade in gas. The agreement included removing legislative and regulatory barriers to inter- and intra-jurisdictional trade and the implementation of vertical separation of gas and distribution businesses. Several jurisdictions introduced regulation to implement the agreement. Following the report of the Hilmer committee in 1993 (Hilmer, 1993) the focus of regulatory reform shifted to promote a nationally consistent legal regime under which businesses can be given access to essential facilities such as gas transmission and distribution networks. In 1997 COAG approved the Gas Code (Council of Australian Governments, 1997) with objectives to:

- facilitate the development and operation of a national market for natural gas
- prevent abuse of monopoly power
- promote a competitive market for natural gas in which customers may choose suppliers, including producers, retailers and traders
- provide rights of access to natural gas pipelines on conditions that are fair and reasonable for both service providers and users
- provide for resolution of disputes.

The reform process sought to achieve free trade and competition in gas by removing regulatory impediments to trading gas, applying third party access regime to transmission and distribution gas infrastructure, and facilitating the construction of new transmission links between gas fields and markets. Access arrangements set out the conditions under which third parties may seek access to pipelines.

In the late 1990s the Victorian Government set up a wholesale market for gas within Victoria. Pipeline investment between various states has led to an interconnected gas transmission network across Queensland, New South Wales, South Australia, Victoria, Tasmania and the Australian Capital Territory.

Wholesale markets in the form of Short-Term Trading Market hubs have been established in Sydney, Adelaide and Brisbane since September 2010 with the aim of introducing greater transparency into wholesale gas prices.

National Gas Law and Rules set out the regulatory framework for the gas pipeline sector. In Western Australia the Economic Regulation Authority regulates pipelines. The Australian Energy Regulator (AER) is the regulator in all jurisdictions other than Western Australia.

Gas transmission pipelines may be covered (subject to full economic regulation), lightly covered (subject to some economic regulation) or uncovered (not subject to economic regulation). Owners of covered pipelines are required to submit an access arrangement to the AER for each regulatory period.

Most gas distribution networks are covered apart from those in the Northern Territory and Tasmania.

12.3 Audit of existing gas services infrastructure

12.3.1 Capacity, utilisation and DEC of gas transmission services infrastructure at national level

This section reports the current infrastructure used in the provision of gas transmission services, the volume of services supplied/utilised and the DEC of infrastructure services across Australia.

For this audit we have included onshore natural gas transmission pipelines and natural gas distribution networks. We have not included pipelines delivering natural gas to processing plants from offshore LNG facilities off the Western Australian or Northern Territory coastlines. We have included potential pipelines delivering coal seam gas to LNG plants on Curtis Island near Gladstone.

The operation of high pressure natural gas transmission pipelines and lower pressure natural gas distribution networks differs in an important way. Gas transmission pipelines can store gas in the pipeline through compression (referred to as line pack). This allows the pipeline to balance differences in inflows at injection points and outflows.at extraction points.

Low pressure gas distribution pipelines and networks are generally not able to store gas.

These differences have implications for assessing levels of utilisation as explained below.

Capacity and utilisation metrics

Gas transmission pipelines

The total throughput of Australian natural gas transmission pipelines was 1,334 PJ (petajoules) in 2010-11. By comparison the total annual throughput capacity of Australian natural gas transmission pipelines in 2010-11 was 1,918 PJ per annum.

Table 84 **Annual capacity and throughput for natural gas transmission pipelines (2010-11)**

	Throughput capacity	Annual throughput
	petajoules	petajoules
Queensland	493	265
New South Wales	228	196
Victoria	467	310
South Australia	197	117
Western Australia	403	387
Tasmania	47	16
Northern Territory	82	43
Total	**1,918**	**1,334**

Note: Pipeline capacity is defined by Maximum Daily Capacity for pipelines with load factors less than 1.
Source: ACIL Allen Consulting, 2014

While this suggests that there is spare capacity in all states, annual throughput capacity is not a sufficient indicator of the level of utilisation. The capacity of a transmission pipeline is dependent in part on the load factor under which the pipeline operates.

Load factor is the ratio of the average annual throughput to the peak throughput. Most natural gas transmission pipelines do not operate at 100 per cent load factor because of seasonal variations in demand. For example the Victorian transmission system experiences demand peaks during winter months due to higher demand for gas for heating in winter.

Peak throughput, generally expressed in terms of Maximum Daily Quantity (MDQ), is a key determinant of a pipeline's capacity utilisation. A table of the capacity of selected gas transmission pipelines and the MDQ as estimated for 2010-11 is provided in Table 85. The table shows that a number of gas transmission pipelines were operating at or close to their peak day capacity in 2010-11. These include the Dampier to Bunbury and Goldfields pipelines in Western Australia, the Bonaparte Pipeline linking production from the offshore Blacktip field to the Amadeus Pipeline in the Northern Territory, the Moomba to Adelaide Pipeline in South Australia, the Eastern Gas pipeline in New South Wales and the Carpentaria, Roma to Wallumbilla and the Roma to Brisbane pipelines in Queensland.

On the other hand the Moomba to Sydney Pipeline in New South Wales, the Longford to Melbourne and the Tasmanian Gas pipeline linking Tasmania to the Victorian gas transmission system were operating at below full capacity.

Table 85 **Estimate of Peak Daily Capacity and Quantity**

Pipeline	Peak day capacity	Peak day throughput	MDQ Utilisation factor in 2010-11
	TJ per day	TJ per day	
Queensland			
North Queensland gas pipeline	108	na	Understood to be below full capacity
Queensland Gas Pipeline (Wallumbilla to Gladstone)	145	128	88%
Carpentaria Pipeline (Ballera to Mount Isa)	119	107	90%
Berwyndale to Wallumbilla Pipeline	140	110	79%
Roma (Wallumbilla) to Brisbane Pipeline	219	208	95%
South West Queensland Pipeline (Ballera to Wallumbilla)	400	222	56%
New South Wales			
Moomba to Sydney Pipeline	420	350	83%
Central West Pipeline (Marsden to Dubbo)	10	8	80%
Central Ranges Pipeline (Dubbo to Tamworth)	7	7	100%
Eastern Gas Pipeline (Longford to Sydney)	291	258	88%
Victoria			
Longford to Melbourne	1,030	432	41%
South West Pipeline	414	132	32%
Victoria NSW Interconnect	68	55	81%
South Australia			
Moomba to Adelaide Pipeline	253	262	104%
SEA Gas Pipeline (Port Campbell to Adelaide)	314	250	80%
Tasmania			
Tasmanian Gas Pipeline	129	87	68%
Northern Territory			
Bonaparte Pipeline	80	80	100%
Darwin to Amadeus Basin	104	82	79%(a)
Daly Waters to McArthur River Pipeline	16	8	50%
Palm Valley to Alice Springs Pipeline	27	16	60%
Western Australia			
Dampier to Bunbury Pipeline	869	851	98%
Goldfields Pipeline	109	105	96%

Note [a] Utilisation of the Amadeus Pipeline south of Ban where the Bonaparte Pipeline connects is lower than 78 per cent.
Source: (AER, 2011),

The capacity of existing natural gas transmission pipelines can be increased by either looping (duplicating part or all of the pipeline) or adding compression (compressors are used to pressurise the pipeline allowing more throughput). Pipeline operators will either loop or add compression when MDQ constraints arise. These are commercial decisions based on demand growth and the cost of capacity expansion. Recently for example, APA expanded the interconnector form Wagga to Albury to facilitate more flow to New South Wales from

Victoria to supply more gas from the Bass Strait gas fields. Expansion of the capacity of the Dampier to Bunbury Pipeline commenced in 2010[62].

The gas pipeline system on Australia's East Coast is a network connecting multiple supply sources with multiple customers. Markets evolve as demand and supply conditions change and contracts are rolled over. The utilisation of gas transmission pipelines can therefore change over time. For example the Ballera to Roma pipeline in Queensland originally flowed from west to east supplying natural gas from the Cooper Basin fields to east coast markets. With the discovery of coal seam gas in south east Queensland, decline in Cooper Basin production and growth in demand in New South Wales and South Australia, it now flows east to west.

Gas distribution pipelines

Total throughput capacity in gas distribution networks was 344 PJ in 2010-11. This is lower than the total throughput of gas transmission pipelines because it represents gas supplied to residential and commercial customers and smaller industrial customers. Large industrial customers and gas fired power stations are generally supplied directly from gas transmission pipelines.

Table 86 **Annual throughput for gas distribution networks (2010-11)**

	Annual throughput
	PJ
Queensland	18
New South Wales	105
Victoria	162
South Australia	22
Western Australia	28
Tasmania	2
Northern Territory	0
Australian Capital Territory	7
Total	**344**

Source: ACIL Allen Consulting, 2014, Australian Economic Regulator, Economic Regulatory Authority WA

There is not sufficient information in the public domain to estimate the maximum daily capacity of gas distribution pipelines by region. The load factor on gas distribution pipelines can vary widely in Australia depending on seasonal variation and on load composition.

DEC metrics

The total DEC of gas transmission services in 2010-11 was $1,138 million (2010-11 dollars). The estimated DEC of gas distribution services was $1,208 million. The breakdown of these amounts by state is shown in Table 87.

While the throughput through distribution networks is lower than that for transmission pipelines, the DEC is higher because volume based charges (dollars per GJ) are significantly higher for distribution networks. In general terms the volumes that can be put through a pipeline are proportional to the square of the diameter. Transmission pipelines are in most cases of much higher diameter than distribution pipelines. As a result transmission

[62] http://www.dbp.net.au/the-pipeline/expansion.aspx accessed on 15 October 2014

pipelines enjoy higher economies of scale, charge lower tariffs on a volume basis and have a lower DEC per volume.

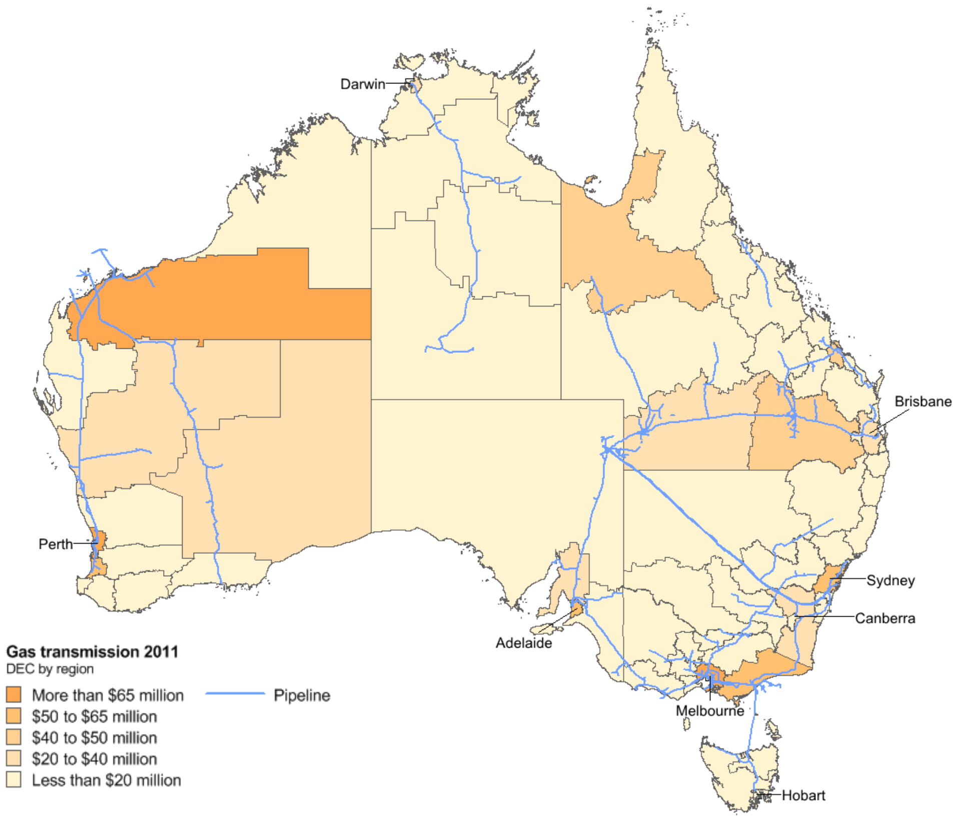
Table 87 **DEC of transmission pipelines and distribution networks by state/territory in 2010-11**

	Transmission	Distribution
	$m	$m
Queensland	214	69
New South Wales	123	353
Victoria	144	483
South Australia	86	151
Western Australia	528	94
Tasmania	15	13
Northern Territory	28	4
Australian Capital Territory	-	39
Total	**1,138**	**1,208**

Source: ACIL Allen Consulting, 2014

The economic contribution of the gas transmission services by audit region in 2010-11 is mapped in Figure 150.

Figure 150 **DEC of gas services by audit region in 2010-11**



Source: ACIL Allen Consulting, 2014

12.4 Projections for gas services

ACIL Allen Consulting has projected forecast demand for infrastructure services between 2010-11 and 2030-31. The Baseline scenario forecasts gas transmission services assuming that the Australian population grows in line with the Australian Bureau of Statistics' (ABS) Series B projections at the national, state and capital city levels.

The underlying economic projections used in this report are based on national, state/territory and audit region projections developed using ACIL Allen's in-house CGE model *Tasman Global*. These projections cover the period 2010-11 to 2030-31 (see Appendix in Part C for more detail on the Baseline scenario forecast assumptions and parameters).

12.4.1 National projections for gas services

The projected increases in throughput for both transmission and distribution are shown in Table 88.

Table 88 **Throughput projections (Australia)**

	2010-11	2020-21	2030-31
	PJ	PJ	PJ
Gas transmission	1,334	2,939	3,178
Gas distribution	344	388	429

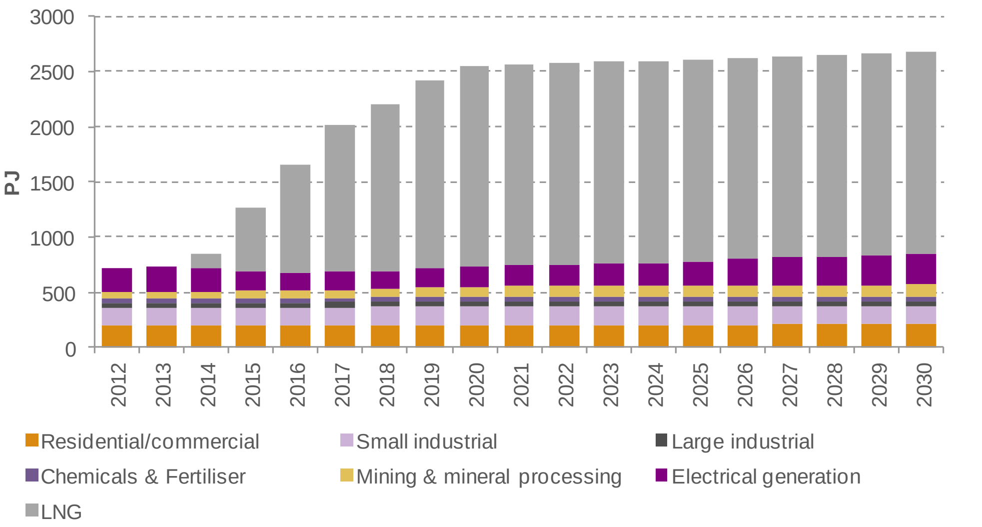
Note: Throughputs for transmission and distribution are not additive. Projections of throughput for gas distribution are based on the output of the economic modelling discussed in Chapter 5.
Source: ACIL Allen Consulting, 2014

The large projected increases in throughput in gas transmission pipelines between 2010-11 and 2020-21 are primarily due to the development of LNG projects in Queensland. The projections for gas distribution pipelines reflect the output of the economic modelling discussed in Chapter 5[63].

The natural gas market in Australia is undergoing a dramatic transition with the development of LNG projects in Queensland and Western Australia proceeding. Figure 151 shows ACIL Allen's projections of gas demand in the Eastern Australian Gas Market.

[63] The projections for gas distribution pipelines are based on the output from the economic modelling undertaken for this project. Some industry commentators have commented that they are more pessimistic about the outlook for gas distribution pipelines.

Figure 151 **Gas demand potential in the Eastern Australian Gas Market**

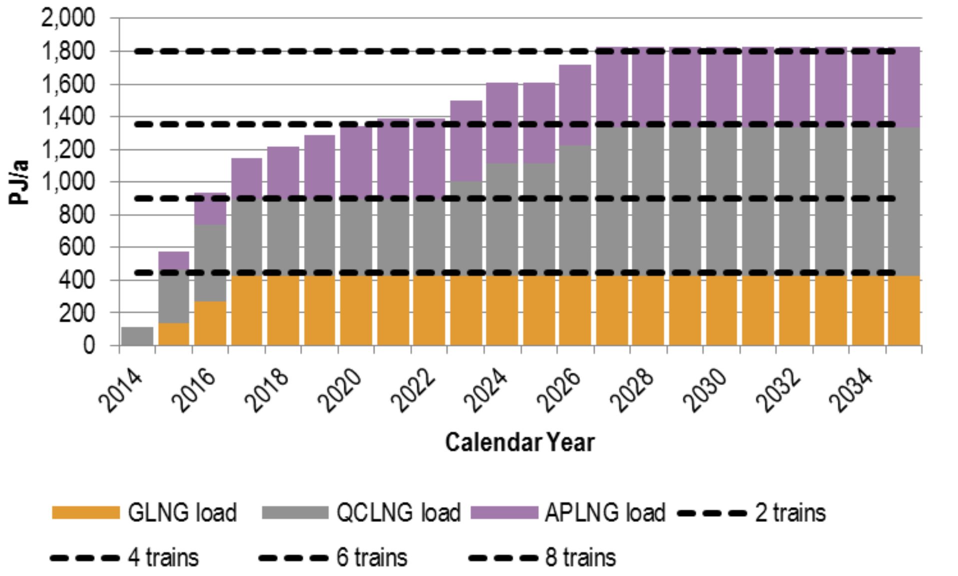


Note: This figure does not include export demand for gas from offshore platforms in WA or the NT
Source: ACIL Allen Consulting, 2014

An important aspect of this outlook is the relatively stable domestic demand which has been affected by rising gas prices and lower electricity demand compared with the dramatic increase in supply of LNG to international markets.

The demand shown in Figure 151 above includes gas demand by LNG projects in Queensland but does not include LNG in the Northern Territory. The LNG projects in the Northern Territory source their gas requirements from dedicated offshore gas fields and are not connected to the domestic market except for an emergency pipeline connecting Weddell power station in Darwin with Conoco Philips Darwin LNG project. The LNG projects which are currently under development in Gladstone source their gas from onshore fields and have a major impact on pricing in the East Coast market. The assumed demand from LNG projects ex-Gladstone is shown in Figure 152.

Figure 152 **Assumed gas demand from East Coast LNG developments**



Source: ACIL Allen Consulting, 2014

The DEC for gas transmission and distribution services across Australia in the Baseline scenario is projected to increase from $2,345 million in 2010-11 to $4,686 million in 2030-31 (in 2010-11 dollars), equivalent to 0.19 per cent of 2030-31 GDP (see Table 86) -an increase of $2,341 million or 100 per cent. This is the largest relative increase in DEC of any infrastructure sector studied in this report.

Table 89 **DEC of infrastructure sectors, Australia, 2010-11 and 2030-31, Baseline scenario**

	DEC 2010-11	2030-31 DEC	2010-11 DEC	2030-31 DEC	2030-31 DEC
	$m	$m	% of GDP	% of GDP	Index (2010-11= 1.00)
Transmission	1,138	3,178	0.08%	0.13%	2.79
Distribution	1,208	1,509	0.09%	0.06%	1.25
Total	2,345	4,686	0.18%	0.19%	2.00

Source: ACIL Allen Consulting, 2014

12.4.2 State and Territory projections for gas transmission and distribution services

The table below shows in the increase in DEC for gas transmission between 2010-11 and 2030-31 by state and territory (in 2010-11 dollars). The largest increase in the DEC occurs in Queensland. This is attributable to the investment in pipelines to service the LNG projects in Gladstone.

Table 90 **Increase in DEC for gas services by state and territory, 2010-11 and 2030-31, Baseline scenario**

	Gas transmission	Gas distribution	Total
	$m	$m	$m
Queensland	1,659	17	1,676
New South Wales	49	142	191
Victoria	14	48	63
South Australia	19	34	54
Western Australia	247	63	309
Tasmania	9	8	16
Northern Territory	43	7	49
Australian Capital Territory	-	- 17	17
Australia	**2,040**	**301**	**2,341**

Source: ACIL Allen Consulting, 2014

12.4.3 Audit regions projections for gas transmission and distribution services

The DEC in the Baseline scenario increases from $2,345 million in 2010-11 to $4,686 million by 2030-31. The top ten regions for growth in the DEC are shown in Table 91.

Table 91 **Change in DEC in the top ten regions between 2010-11 and 2030-31 under the Baseline scenario**

Region	Transmission change in DEC	Distribution Change in DEC	Total change in DEC
	$m	$m	$m
3_12_Gladstone - Biloela	1,618	-	1,618
5_1_Greater Perth	198	63	260
1_1_Greater Sydney	27	114	140
2_1_Greater Melbourne	9	45	53
4_1_Greater Adelaide	13	32	45
5_3_Bunbury	44	-	44
7_1_Darwin	33	4	37
5_9_Mid West	27	-	27
3_1_Greater Brisbane	5	15	20
5_7_Goldfields	14	-	14

Source: ACIL Allen Consulting, 2014

The largest projected increase in DEC for gas transmission and distribution between 2010-11 and 2030-31 is in the Gladstone-Biloela region ($1.618 billion) which is driven by the gas transmission pipelines to service the LNG plants at Curtis Island and Gladstone. The next largest increase (albeit significantly lower) is Greater Perth ($260 million), followed by greater Sydney ($140 million), Greater Melbourne ($53 million), Adelaide West ($45 million) and Bunbury ($44 million).

Increases other than in the Gladstone-Biloela region are generally modest reflecting relatively low growth in projected domestic demand for natural gas.

12.4.4 Implications of service projections

Economic modelling undertaken for this report shows that there will be an ongoing, if modest, need for further investment in the natural gas transmission pipeline system to meet domestic demand. The function of this investment will be to connect new gas fields to markets, and to meet changing patterns of supply and demand. However there will be an increased demand for transmission capacity for large LNG projects in Queensland and increasing pressures on the development of new transmission capacity (notably from the Gippsland Basin in Bass Strait to New South Wales). There will also be a need for ongoing investment in gas storage to meet emerging peak loads.

The largest investment required will nevertheless be in major pipelines to deliver gas from the Surat Basin in South East Queensland (the Darling Downs-Maranoa region) to Gladstone (the Gladstone-Biloela region).

12.5 Sensitivity analysis for gas services needs

12.5.1 National impacts

The changes in the DEC for the scenarios shown in Table 93 reveal only small differences in the outcomes by 2030-31 for the three scenarios. The DECs for gas infrastructure in the Higher population scenario and the Higher productivity scenario are each around 100 per cent of that in the Baseline scenario. The Higher population scenario results in the highest outcome by a small margin. The main driver of the increase in all scenarios is the investment in supply pipelines for the Queensland LNG projects.

Table 92 **Comparison of results for the three scenarios**

	2010-11 DEC	2030-31 DEC Baseline scenario	2030-31 DEC Higher population scenario	2030-31 DEC Higher productivity scenario
	$m	$m	$m	$m
Gas transmission	1,138	3,178	3,218	3,188
Gas distribution	1,209	1,509	1,549	1,514
Total	2,345	4,686	4,766	4,702
Difference in DEC to Baseline scenario (%)		100%	102%	100%
Index		2.00	2.02	2.00

Source: ACIL Allen Consulting, 2014

Table 93 shows the DEC for 2010-11 and the Baseline Scenario for 2030-31 and compares these to the two scenarios. The DEC as a percentage of GDP increases marginally from 0.18 per cent to 0.19 per cent for each Scenario.

Table 93 **Sensitivity analysis by state and territory**

	2010-11	2030-31 DEC Baseline scenario	2030-31 DEC Higher population	2030-31 DEC Higher productivity scenario
	($m)	($m)	($m)	($m)
Queensland	283	1,959	1,970	1,970
New South Wales	477	668	677	652
Victoria	628	690	717	708
South Australia	237	291	298	295
Western Australia	622	931	956	932
Tasmania	27	44	47	42
Northern Territory	32	81	81	83
Australian Capital Territory	39	22	22	21
Australia	**2,345**	**4,686**	**4,766**	**4,702**
Percentage of GDP	0.18%	0.19%	0.19%	0.19%

Source: ACIL Allen Consulting, 2014

The index changes in Table 94 show that the increase in the DEC in Queensland is an important driver of the growth in DEC in all scenarios tested. The DEC in other States either declines or remains the same in the period from 2010-11 to 2030-31. This reflects the importance of the Queensland LNG projects and the low to declining growth in domestic demand for gas which is a result of higher gas prices and lower than expected growth in demand for gas fired generation.

Table 94 **Index by state and territory**

State/territory	2030-31 Baseline scenario	2030-31 Higher population scenario	2030-31 Higher productivity scenario
	Index (2010-11= 1.00)	Index (2010-11= 1.00)	Index (2010-11= 1.00)
Queensland	6.92	6.96	6.96
New South Wales	1.40	1.42	1.37
Victoria	1.10	1.14	1.13
South Australia	1.23	1.25	1.24
Western Australia	1.50	1.50	1.50
Tasmania	1.60	1.65	1.53
Northern Territory	2.53	2.53	2.57
Australian Capital Territory	0.56	0.55	0.53
Australia	**2.00**	**2.01**	**2.00**

Source: ACIL Allen Consulting, 2014

The rankings by region do not change for the three scenarios. Table 95 shows the ranking of the top ten regions. This reinforces the importance of the LNG pipelines in Queensland to the results in 2030-31. The greater metropolitan areas of Perth, Sydney, Melbourne and Adelaide are the next highest ranking in all of the scenarios.

Table 95 **Ranking of DEC of gas services increases by scenario in 2030-31**

Region	Increase Baseline Scenario	Increase Higher population scenario	Increase Higher productivity scenario
	$m	$m	$m
3_12_Gladstone - Biloela	1,618	1,619	1,619
5_1_Greater Perth	260	277	261
1_1_Greater Sydney	140	147	129
2_1_Greater Melbourne	53	76	68
4_1_Adelaide-West	45	51	49
5_3_Bunbury	44	46	44
7_1_Darwin	37	37	38
5_9_Mid West	27	29	27
3_1_Greater Brisbane	20	23	24
5_7_Goldfields	14	15	14

Source: ACIL Allen Consulting, 2014

12.5.2 Implications of sensitivity analysis

The projected DEC of gas transmission and distribution services in the Higher population scenario is $4.77 billion. Of the $2.42 billion projected increase in DEC between 2010-11 and 2030-31, $1.61 billion is attributable to the LNG pipelines.

The critical impacts will be in Queensland where the LNG pipelines will deliver more in terms of DEC than the current DEC for the Australian gas transmission pipeline sector.

Other expansions in pipeline capacity over the period are likely to include:

— Increasing the capacity of the New South Wales to Victoria interconnector between Albury and Wagga and the Eastern Gas Pipeline from Longford to Sydney to deliver gas from the Gippsland Basin to Sydney and other New South Wales markets.

- Possible investment in pipelines to connect Wallumbilla in Queensland to Newcastle in New South Wales or alternatively connecting coal seam gas fields in the Narrabri region with the gas pipeline network near Newcastle, and
- Possible interconnection of the Northern Territory and Eastern Gas Pipeline Transmission System to meet demand for LNG and domestic growth.
- Increase in capacity of the Dampier to Bunbury Pipeline which is currently underway.

Expansions may be subject to the outcome of policy considerations with respect to development of coal seam gas in New South Wales. If the restrictions on development of Coal Seam Gas (CSG) in New South Wales are removed or reduced there could be further investment in gas transmission pipelines to deliver gas to loads in New South Wales and possible Queensland. If the restrictions are not reduced it is more likely that the investment will be in expansion of pipeline capacity from Victoria to New South Wales.

12.6 Issues and implications of findings

Gas will continue to be an important energy source in Australia for retail and commercial, industrial and power markets. The 100 per cent DEC increase is the highest percentage rise for all of the infrastructure projects.

Rising prices for gas driven both by demand from LNG projects as well as increasing costs of production as more marginal fields are developed, can be expected to have a downward impact on gas demand from domestic markets. A key domestic market is the power sector where demand is currently subdued. Growth in demand for natural gas from domestic consumers is likely to moderate over the forecast period

This is not expected to reduce the demand for new investment in transmission pipelines as the portfolios of supply change over time. Development of LNG projects in Queensland will however continue to require significant investment in pipeline capacity as projects are developed and expanded over the forecast period.

13 Energy - Petroleum product terminals

KEY FINDINGS

Petroleum product distribution infrastructure includes refineries, pipelines and fuel terminals. Australia currently has six operating refineries and terminals at 28 locations around the coast.

Australia's refineries produce around 644,300 barrels per day of petroleum products (37,368 megalitres (ML) per year).

The utilisation of petroleum product terminals in 2010-11 in Australia was 79,199 ML. Of this amount 34,104 ML of throughput was attributable to terminals at refineries some of which is conveyed by pipeline to other terminals. Total net consumption of petroleum in 2010-11 was 52,095 ML.

The economic contribution for petroleum product terminals across Australia in 2010-11 was $1,077 million. The highest economic contribution arises in Queensland followed by New South Wales, Victoria and Western Australia reflecting the throughputs from refineries in those States at the time.

It can be expected that while the capital cities will continue to exhibit the highest economic contribution in the future, the economic contribution in regional areas such as Gladstone, Mackay and Newcastle will increase at a higher rate relative to the metropolitan centres, as regional demand grows and the impact of refinery closures work through the system.

It is projected that the national economic contribution for petroleum product terminals in 2030-31 will be $1,722 million (in 2010-11 dollars), equal to 0.07 per cent of projected GDP in 2030-31. This is an increase of $644 million when compared to the $1,077 million in 2010-11 (in 2010-11 dollars).

The largest projected increases in economic contribution for petroleum product terminals between 2010-11 and 2030-31 are in Greater Brisbane (105 million), Greater Perth ($100 million), Greater Melbourne ($75 million, Greater Sydney ($65 million) and Geelong ($33 million). These increases occur in areas adjacent to the metropolitan centres and major ports. Other important areas where the economic contribution is projected to increase include Newcastle and Lake Macquarie ($12 million) and Adelaide ($10 million). These increases are driven by growth in diesel demand to service the mining and agricultural industries.

Major areas for new investment are likely to include:

- the Gladstone to Mackay region in Queensland to meet demands for diesel from the mining and agricultural industries
- Brisbane in following the closure of the BP refinery at Bulwer Island
- Newcastle Port in New South Wales to meet growth in demand for diesel in the mining sector
- a jet fuel pipeline to the proposed Badgerys Creek airport to convert crude storage to fuel storage with the closure of the Shell and Caltex refineries
- Melbourne or Geelong to meet growing demand for diesel in particular
- Port of Adelaide to overcome capacity constraints in the Inner Harbour and meet growth in demand for diesel and jet fuel
- Western Australian regional ports to meet growth in demand for diesel for the mining sector.

Petroleum fuels are an important input into economic activity in Australia particularly in mining, transport and manufacturing and agriculture. Demand is forecast to continue to grow as growth in demand for diesel and jet fuel offsets a flattening in growth in petrol demand.

Two trends are important to the need for investment in petroleum terminals in Australia in the future. The first is the prospective decline in indigenous production of crude oil (suitable for Australian refineries) that will increase the future requirement for imports of crude oil. The second is closure of three refineries which will require investment in petroleum product import terminals to meet demand.

The current outlook is that further investment is expected by the private sector and importantly new entrants into the market such as Puma Energy and Idemitsu Kosan, which will provide further competition in the market for new terminal capacity.

13.1 Petroleum product terminal services in scope

The petroleum industry is a global industry. It is owned and operated in Australia entirely by the private sector.

The petroleum wholesale supply chain in Australia comprises refineries, storage terminals, pipelines, import terminals and load out facilities for road transport. Key components of this supply chain are the refineries, which were largely based on the east coast of Australia, and the terminals that are almost exclusively located at ports to import crude oil and petroleum products. Details of the supply chain are provided in the Appendix in Part C.

In 2011-12 around 85 per cent of crude oil for use in Australian refineries was imported. Domestic refineries account for around 68 per cent of Australia's refined product consumption.

Import terminals are located throughout Australia. Around 50 per cent of imported petroleum fuels come from refiners and regional traders in Singapore. The location of Australia's petroleum product infrastructure is shown in Figure 153.

Figure 153 **Australia's petroleum product infrastructure**

Source: Australian Institute of Petroleum

Petroleum product distribution infrastructure includes refineries, pipelines and fuel terminals. In 2011-12, Australia had seven operating refineries and terminals at 28 locations around the coast. The majority of the fuel terminals handle imported petroleum products.

In 2011-12, Australia's refineries produced around 42,720 megalitres (ML) of petroleum products as shown in Table 96 below. Fuel storage at refineries are included in the audit.

Table 96 **Australian refineries as at 2010-11**

Refinery	Status	Throughput (ML per annum)
Caltex Lytton Brisbane		5,110
BP Bulwer Island Brisbane	Scheduled to close in 2015	6,270
Caltex Kurnell Sydney	Closed in June 2014	7,540
Shell Clyde Sydney	Closed in November 2013	4,930
Mobil Altona Melbourne		4,530
Shell Geelong		6,380
BP Kwinana		7,960
Total throughput		**42,720**

Source: ACIL Allen Consulting, 2014

Shell closed its refinery at Clyde NSW in 2013. The Caltex refinery ceased refining operations in June 2014 and BP has announced that it will close its Bulwer Island refinery in 2015 once these refineries close, the total throughput of Australian refineries will fall to around 25,140 ML per annum. Closure of refineries will create the need for greater import capacity for petroleum products.

Fuel terminals are the key infrastructure in the petroleum supply chain and are the point where fuels are transferred from wholesalers to retailers. Fuel terminals are fuel storage facilities where petroleum products are stored, sometimes blended and loaded onto road tankers for shipping to service stations, fuel depots or direct to large customers.

Some terminals are connected by pipelines. Important product pipelines are those linking refineries to other terminals such as those linking the Sydney refineries to terminals in Sydney and Newcastle[64]. There is little information in the public domain on the capacity of these pipelines. Some airports are also supplied by jet fuel lines. A crude oil pipeline ships crude oil from the Moomba production fields in North East South Australia to Port Bonython. This pipeline has not been included in the audit as it is mainly an export facility.

The petroleum infrastructure reported in this audit comprises petroleum fuel storage terminals linked to ports plus storage terminals at refineries. With closure of the refineries, import terminals are becoming increasingly important to meeting the demand for petroleum products in Australia.

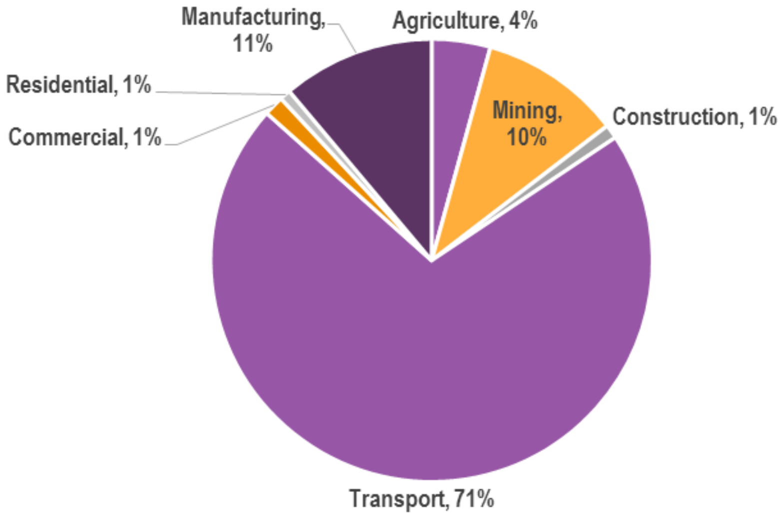
13.2 Petroleum product terminal services in Australia

13.2.1 The significance of petroleum product terminal services to economic activity

Liquid fuels play a key role in the Australian economy and underpin the economic performance of the transport, mining and agriculture sectors. Transport and mining are the largest proportionate consumers of petroleum fuels (see Figure 154).

[64] These pipelines will continue to operate after the refineries close. However they will then link import terminals to other inland terminals.

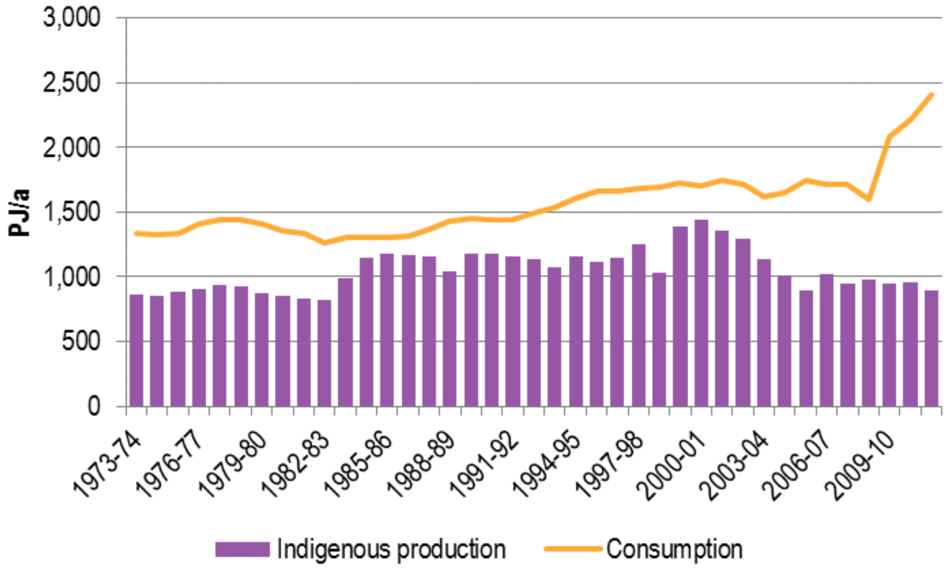
Figure 154 **Consumption of petroleum fuels by industry – 2012-13**



Source: (BREE, July 2014)

While in the past Australia has enjoyed relatively high levels of liquid fuels self-sufficiency, this has declined in recent years (see Figure 155). Unless further discoveries of petroleum resources are made in Australia it is likely that it will continue to decline.

Figure 155 **Consumption and domestic production of petroleum fuels in Australia**



Source: (BREE, 2013

The recent closure of three refineries in Australia has increased Australia's reliance on imported petroleum products. This has created the need for significant new investment in petroleum import terminals particularly in Queensland, New South Wales and South Australia where demand for diesel is growing and likely to continue to grow to meet the needs of the mining industry.

The consumption of petroleum products in Australia for selected states and for Australia as a whole is shown in Table 97.

Table 97 **Consumption of petroleum products in Australia**

	Queensland	NSW	Victoria	South Australia	Western Australia	Australia
	ML	ML	ML	ML	ML	ML
1991-92	7,166	11,137	9,975	2,939	4,638	37,823
1992-93	7,552	11,326	10,380	2,970	4,835	39,055
1993-94	8,061	11,624	10,444	3,015	5,026	40,208
1994-95	8,575	12,221	10,816	3,152	5,402	42,295
1995-96	8,687	12,529	10,716	3,240	5,715	43,060
1996-97	8,963	12,674	10,479	3,045	5,817	43,184
1997-98	8,988	12,701	10,709	3,090	5,772	43,482
1998-99	8,932	12,780	10,682	3,168	5,734	43,560
1999-00	9,660	13,211	10,885	3,211	5,759	45,055
2000-01	9,533	13,213	10,854	3,195	5,610	44,581
2001-02	9,730	13,095	11,151	3,157	5,995	45,313
2002-03	9,687	12,623	10,959	3,199	6,054	44,718
2003-04	10,306	13,023	11,516	2,965	6,185	46,276
2004-05	10,653	13,198	11,543	2,944	6,569	47,145
2005-06	11,064	13,810	11,522	3,076	6,549	48,234
2006-07	11,655	14,155	11,158	3,151	7,264	49,746
2007-08	12,138	14,638	10,903	3,247	7,404	50,788
2008-09	11,989	14,677	10,572	3,255	7,655	50,614
2009-10	12,116	15,290	10,509	3,309	7,608	50,928
2010-11	12,241	15,655	10,988	3,440	7,952	52,095
2011-12	13,178	15,768	11,120	3,467	8,453	53,797
CAGR 1991-23 to 1996-97	4.6%	2.6%	1.0%	0.7%	4.6%	2.7%
CAGR 1996-97 to 2001-02	1.7%	0.7%	1.3%	0.7%	0.6%	1.0%
CAGR 2001-02 to 2006-07	3.7%	1.6%	0.0%	0.0%	3.9%	1.9%
CAGR 2006-07 to 2011-12	2.5%	2.2%	-0.1%	1.9%	3.1%	1.6%

Note: Includes all petroleum products including bitumen and LPG
Source: (BREE, 2013)

The table shows that growth in demand has been relatively strong in Queensland and NSW with a five-year compound annual growth rate (CAGR) to 2011-12 of 2.5 per cent and 2.2 per cent respectively. The corresponding 5 year CAGR was 1.9 per cent for South Australia and minus 0.1 per cent for Victoria. While the Victorian result was fairly flat, demand for petrol and diesel was positive.

Projections prepared by the Bureau of Resources and Energy Economics (BREE) suggest that overall growth in petroleum demand is likely to continue to 2031 *albeit* more modest than in recent years Table 98 illustrates this point.

Table 98 **Projections of petroleum consumption**

	2012-13	2034-35	2049-50	Average annual growth 2012-13 to 2034-35	Average annual growth 2012-13 to 2049-50
	PJ	PJ	PJ	%	%
Primary consumption	2,359	2,888	3,391	0.9%	1.0%
Petroleum products consumption	2,180	2,709	3,241	1.0%	1.1%

Source: (BREE, 2013)

Table 98 shows that over the next 25 years, primary consumption of petroleum in Australia (crude oil plus product) is expected to grow at around 0.9 per cent per annum while consumption of petroleum products is expected to grow at around 1 per cent per annum. More importantly net imports are likely to increase by 2.4 per cent per annum over the period to 2034-35. This reflects the increasing need to import petroleum products to replace those formerly produced by refineries and the decline in domestic production of crude oil for Australian refineries (crude oil from the North West Shelf is exported).Increased imports of petroleum fuels will require expansion of import infrastructure. Petroleum import terminals are the key infrastructure supporting this process. They can be expected to play a key role in the supply chain and are important both in supporting the ongoing supply of petroleum fuels to Australian consumers and industry and in underpinning the security of Australia's petroleum supplies.

13.2.2 Regulatory, policy and governance context

The petroleum industry in Australia is privately owned and operated. Historically the downstream industry (refineries, terminals, wholesalers and retailers) has been dominated by the oil majors (Shell, BP, ExxonMobil and Caltex). More recently however there have been significant ownership changes in the downstream sector. Shell has sold its refinery in Geelong and its downstream operations to Vitol, BP is selling its service stations in South Australia to Peregrine Fuels, Idemitsu Kosan has acquired Freedom Fuels and Puma Energy has acquired Neumann Petroleum and Gull Petroleum. In addition, Stolthaven has acquired Marstel Terminals and is planning new terminal expansions in the Port of Newcastle and Puma Energy is investing in a new import terminal in Mackay. More investment in new terminals by independent market participants has been foreshadowed.

The petroleum terminal industry is not subject to industry specific regulation. Petroleum terminals are not subject to specific price control. However the ACCC exercises some oversight of fuel prices in Australia. In 2003 the ACCC authorised an industry code of practice "the Oil Code" that requires wholesalers to post the wholesale prices of petrol and diesel at the terminal gate. The terminal gate price (TGP) is an important indicator of petrol and diesel prices in Australia.

13.3 Audit of existing petroleum product terminal infrastructure

13.3.1 Capacity, utilisation and DEC of petroleum product terminal services infrastructure at national level

In 2012-13, Australia consumed 55,100 ML of petroleum products (or around 151 ML per day) – an 8.9 per cent increase since 2008-09. Australian refineries produced 36,900 ML of petroleum products, of which around 9 per cent was exported (excluding LPG). Net imports from over 20 countries accounted for 40 per cent (or 22,500 ML) of total consumption. A proportion of this imported volume was supplied to northern and north western areas of Australia where it is more economical to supply directly from Asia.

Capacity metrics

This audit does not report the storage capacity of petroleum product terminals at the national level. Storage capacity is not a good indicator of utilisation of petroleum terminals as discussed in the box below.

Box 9 **Key considerations relating to capacity, utilisation and investment for petroleum product terminals**

The economics of petroleum terminals is driven by the cost of storage and related facilities and the economics of shipping and distribution. In many cases it is shipping economics that determines the appropriate capacity requirements for a given level of throughput.

For an import terminal, the optimal refill time is around 10 to 12 refills per year. When terminal capacity is expanded, the tank turns per year can fall to around 5 to 7 refills per year. As the market grows and throughput increases, tank turns per year increase. When the tank turns reach around 15 per year, the cost of shipping rises to the point where the marginal cost of adding capacity is less than the marginal cost of increasing the shipping cycles - further investment in capacity is then warranted.

Petroleum terminals are operated by private companies and capacity is optimised to commercial considerations. While there have been cases of speculative investment in capacity (Vopak made speculative investment in tank capacity at Botany) most new terminal investment is based on term contracts with customers to manage the investment risk.

For these reasons it is difficult to use concepts of capacity utilisation for petroleum terminals as an indicator of infrastructure capacity or shortfall. By definition, a tank that is operating at optimal capacity is half full on average over a year. This does not mean that there is spare capacity as it is throughput not volume capacity that determines utilisation.

Source: ACIL Allen Consulting, 2014

Utilisation metrics

The utilisation of petroleum product terminals in 2010-11 in Australia was 79,199 ML. Of this, 34,104 ML of throughput is attributable to terminals at refineries some of which is conveyed by pipeline to other terminals. Total net consumption of petroleum in 2010-11 was 52,095 ML.

The breakdown of throughput by state is shown in Table 99.

Table 99 **Throughput in petroleum terminals in Australia 2010-11**

State/Territory	Stand-alone terminals	Terminals at refineries	Total throughput
	ML	ML	ML
QLD	10,867	103,44	21,211
NSW	11,661	5,930	17,591
VIC	10,197	10,530	20,727
SA	2,928	0	2,928
WA	7,013	7,300	14,313
TAS	1,042	0	1,042
NT	1,388	0	1,388
Total	**45,095**	**34,104**	**79,199**

Note: Total throughput includes some double handling of petroleum fuels from refinery terminals and non-refinery terminals.
Source: ACIL Allen Consulting, 2014

DEC metrics

The DEC in 2010-11 for petroleum product terminals across Australia was $1,077 million. The breakdown of this by state is shown in Table 100. This represents the value added by petroleum terminals in the petroleum supply chain.

It does not represent the value of the products shipped through the terminals which would be of the order of some $35 billion in final end use (not including fuel excise paid to the government)[65].

Table 100 **DEC of petroleum product terminal services by state/territory, 2010-11 ($ million)**

State/Territory	2010-11 DEC
	($m)
QLD	288
NSW	239
VIC	282
SA	40
WA	195
TAS	14
NT	19
Total	**1,077**

Source: ACIL Allen Consulting, 2014

The highest DEC arises in Queensland, New South Wales, Victoria and Western Australia reflecting the throughputs from refineries in those States at the time. Closures of refineries in these states may result in some readjustment of the distribution of the DEC between States/Territories.

13.3.2 Capacity, utilisation and DEC of petroleum infrastructure by audit region

Petroleum terminals at major ports are important components of a supply chain that extends well beyond the immediate region of the port. For example much of New South Wales is supplied from terminals in Sydney and Newcastle. Mining projects in central Queensland are supplied by truck from terminals in Gladstone, Mackay and Port Alma. For these reasons the DEC tends to be largest in the regions around where major ports are located as shown in Table 101.

The ranking by regions is shown in Table 101. It can be expected that while the capital cities will continue to exhibit the highest DEC in the future, regional areas such as Gladstone, Mackay and Newcastle will experience higher growth than the metropolitan centres as regional demand grows and the impact of refinery closures works its way through the system.

65 Based on total consumption in 2011 FY or 53,095 ML and an average price of 70 cents per litre.

Table 101 **DEC of petroleum terminal services in 2010-11 by region**

Audit region	2010-11 DEC
	$m
3_1_Greater Brisbane	236
5_1_Greater Perth	164
2_1_Greater Melbourne	196
1_1_Greater Sydney	202
2_4_Geelong	86
1_11_Newcastle and Lake Macquarie	37
4_1_Adelaide_West	38
5_10_Pilbara	16
3_20_Townsville	16
3_12_Gladstone - Biloela_NA	14
3_16_Mackay	13
7_1_Darwin	11
3_2_Cairns N+S	9
5_5_Esperance	7
7_5_East Arnhem	8
6_3_Rest of Tas.	8
5_9_Mid West	3
6_1_Hobart	6
5_8_Kimberley	2
4_3_South Australia - Outback	2
3_5_Far North	1
5_11_Albany	1
6_2_Launceston and North East	1
3_13_Rockhampton	0
Total	**1,077**

Source: ACIL Allen Consulting, 2014

13.4 Projections for petroleum product terminal services

ACIL Allen has projected forecast demand for infrastructure services between 2010-11 and 2030-31. The 'Baseline scenario' projections for petroleum product terminal services assumes that there is Australian population growth in line with the Australian Bureau of Statistics' (ABS) Series B projections at the national, state and capital city levels.

The underlying economic projections used in this report are based on national, state/territory and audit region projections developed using ACIL Allen's in-house CGE model *Tasman Global*. These projections cover the period 2010-11 to 2030-31 (see Appendix in Part C for more detail on the 'Baseline scenario' forecast assumptions and parameters).

13.4.1 National projections of throughput for petroleum product terminal services

There are no published projections of demand for petroleum products by state and territory available in Australia. ACIL Allen's projections have been based on the projections of growth in Gross State Product (GSP) from the CGE modelling for each scenario and an assumption of an income elasticity of demand for petroleum fuels drawn from published studies and internal ACIL Tasman research[66].

The projections of throughput by state and territory for the Baseline Scenario are shown in Table 102.

Table 102 **Projections of growth in throughput by state/territory (Baseline scenario)**

State/Territory	2010-11	2020-21	2030-31	CAGR 2010-11-2021	CAGR 2010-11-2031
	ML/a	ML/a	ML/a	%	%
QLD	21,211	25,687	35,156	1.9	2.6
NSW	17,591	19,180	24,863	0.9	1.7
VIC	20,727	23,057	30,975	1.1	2.0
SA	2,928	3,045	3,851	0.4	1.4
WA	14,313	19,380	28,133	3.1	3.4
TAS	1,042	1,046	1,255	0.0	0.9
NT	1,388	1,771	2,355	2.5	2.7
Total	**79,199**	**93,167**	**126,588**	**1.6**	**2.4**

Note: CAGR stands for Compound Annual Growth Rate
Source: ACIL Allen Consulting, 2014

The CAGR is projected to be 1.6 per cent for 10 years to 2020-21 and 2.4 per cent for 20 years to 2030-31. These are lower than the BREE projections in the early years and higher in the later years. In its energy forecasts released in 2013, the Bureau of Agricultural and Resource Economics projected that final energy consumption of petroleum products would grow at the rate of around 1.1 per cent per annum over the coming 30 years (BREE, Dec 2012).

The higher growth rates are projected to occur in states with strong mining activity and lower growth rates are associated with other states with less mining and or agricultural activity such as Tasmania or with declining manufacturing (as well as a subdued mining sector) such as in South Australia. Future growth rates will be sensitive to regional economic growth and in particular to the prospects for mining and agriculture.

13.4.2 Projections of DEC

ACIL Allen projects the national DEC for petroleum product terminals in 2030-31 to be $1,722 million (in 2010-11 dollars), equal to 0.07 per cent of projected GDP in 2030-31 (see Table 103). This is an increase of $644 million from the $1,077 million in 2010-11 (in 2010-11 dollars), which was equal to 0.08 per cent of GDP in 2010-11.

The DEC for petroleum product terminals are projected by grow by 60 per cent in real terms between 2010-11 and 2030-31. This is a smaller proportional increase than the increase in real GDP of 86 per cent.

[66] A recent study of elasticities (Dahl, 2012) suggested income elasticities of between 0.5 and 0.7. Other research undertaken in house suggested income elasticities could be as high as 1.2. For the purpose of this project an income elasticity of demand of 0.8 was assumed.

Table 103 **Forecasts of DEC for the Baseline scenario**

State/Territory	DEC 2010-11	DEC 2020-21	DEC 2030-31
	$m	$m	$m
QLD	288	349	478
NSW	239	261	338
VIC	282	314	421
SA	40	41	52
WA	195	264	383
TAS	14	14	17
NT	19	24	32
Australia	**1,077**	**1,267**	**1,722**

Source: ACIL Allen Consulting, 2014

Table 104 shows the growth in DEC for petroleum product terminals between 2010-11 and 2030-31 by state and territory for the Baseline scenario. The largest growth occur in Queensland, Western Australia and Victoria. New South Wales has a slightly lower growth rate than these but still significant. Coal and minerals mining is a significant driver for petroleum demand in New South Wales.

Table 104 **DEC gap by state/territory in 2030-2031, Baseline scenario**

Jurisdiction	Petroleum product terminals
	($m)
QLD	190
NSW	99
VIC	139
SA	13
WA	188
TAS	3
NT	13
Australia	**644**

Source: ACIL Allen Consulting, 2014

A breakdown of the DEC for 2010-11 and 2030-31 is shown in Table 105. The greatest increases in DEC for petroleum product terminals between 2010-11 and 2030-2031 are located in Greater Brisbane ($105 million), Greater Perth ($100 million), Greater Melbourne ($75 million), Greater Sydney ($65 million) and Geelong ($ 33 million). These increases occur in areas with wholesale distribution services adjacent to the metropolitan centres and major ports.

Other important areas where DEC will increase include Newcastle and Lake Macquarie ($12 million) and Adelaide ($10 million). These increases are driven by growth in demand for diesel in particular to service the mining and agricultural industries.

Table 105 **Projected DEC of petroleum product services terminals by region, Baseline scenario**

Audit region	2010-11 DEC Baseline scenario	2030-31 DEC Baseline scenario	Change 2010-11 to 2030-31
	$m	$m	$m
3_1_Greater Brisbane	236	391	155
5_1_Greater Perth	202	286	84
2_1_Greater Melbourne	196	293	97
1_1_Greater Sydney	164	323	159
2_4_Geelong	86	128	42
1_11_Newcastle and Lake Macquarie	38	50	12
4_1_Greater Adelaide	37	52	15
5_10_Pilbara	17	33	16
3_20_Townsville	15	24	10
3_12_Gladstone - Biloela_NA	14	23	9
3_16_Mackay	13	22	9
7_1_Darwin	11	19	8
3_2_Cairns N+S	9	15	6
5_5_Esperance	8	10	2
7_5_East Arnhem	8	13	5
6_3_Rest of Tas.	7	15	7
5_9_Mid West	6	7	1
6_1_Hobart	3	7	3
5_8_Kimberley	2	4	2
4_3_South Australia - Outback	2	3	1
3_5_Far North	1	2	1
5_11_Albany	1	1	1
6_2_Launceston and North East	1	1	0
3_13_Rockhampton	0	1	0

Source: ACIL Allen Consulting, 2014

Major areas for new investment are likely to include:

- the Gladstone to Mackay region in Queensland to meet demands for diesel from the mining and agricultural industries
- Brisbane in the follow up to the closure of the BP refinery at Bulwer Island
- Newcastle Port in New South Wales to meet growth in demand for diesel in the mining sector
- a jet fuel pipeline to the Badgerys Creek airport and to convert crude storage to fuel storage with the closure of the Shell and Caltex refineries
- Melbourne or Geelong to meet growing demand for diesel in particular
- Port of Adelaide to overcome capacity constraints in the Inner Harbour and meet growth in demand for diesel and jet fuel, and
- Western Australian regional ports to meet growth in demand for diesel for the mining sector.

13.5 Sensitivity analysis of economic projections

In order to illustrate how the outlook for infrastructure services could vary given different rates of change in the economy, two additional alternative scenarios have been modelled:

- Higher population scenario : which assumes that Australia's population growth is higher (compared with the baseline scenario) and is aligned with ABS Series A projections
- Higher productivity scenario: which assumes that there is higher factor productivity in the infrastructure sectors to obtain a 1 per cent higher growth in Australian real GDP by 2030-31 (relative to the output growth obtained in the 'baseline scenario')

These additional two scenarios indicate how future demand for services may vary under different economic scenarios.

13.5.1 National impacts

The DEC increases from $1,077 million in 2010-11 to $1,722 million in the Baseline scenario in 2030-31, $1,783 million in the Higher population scenario in 2030-31and $1,740 million in the Higher productivity scenario in 2030-31.

The increase in DEC is highest for the Higher population scenario with an index of 1.63 compared to an index of 1.60 for the Baseline scenario and 1.62 for the Higher productivity scenario (see Table 106).

For comparison, the index for total infrastructure included in this report is 1.86, 1.02 and 1.89 for the Baseline scenario, Higher population scenario and Higher productivity scenario, respectively.

Table 106 **DEC for petroleum product terminals, 2030-2031, sensitivity analysis**

	DEC 2010-11	DEC 2030-2031 Baseline scenario	DEC 2030-2031 Higher population scenario	DEC 2030-2031 Higher productivity scenario	Index growth 2010-11 to 2030-2031 Baseline scenario	Index growth 2010-11 to 2030-2031 Higher population scenario	Index growth 2010-11 to 2030-2031 High productivity scenario
	$m	$m	$m)	$m	(2010-11=1.00)	(2010-11=1.00)	(2010-11=1.00)
Petroleum product terminals	1,077	1,722	1,783	1,740	1.60	1.66	1.62
Total for infrastructure sectors	104,375	193,762	200,204	197,241	1.86	1.92	1.89

Source: ACIL Allen Consulting, 2014

13.5.2 State/territory impacts

The DEC outcomes for each scenario are shown by state and territory in Table 107. The highest DEC occurs in the High population scenario for Australia as a whole ($1,783 million).

Table 107 **Scenarios by State/Territory**

State/Territory	DEC 2010-11 Baseline scenario	DEC 2030-31 Baseline scenario	DEC 2030-31 Higher population scenario	DEC 2030-31 Higher productivity scenario
	($m)	($m)	($m)	($m)
QLD	288	478	500	483
NSW	239	338	339	342
VIC	282	421	436	426
SA	40	52	53	53
WA	195	383	405	386
TAS	14	17	18	17
NT	19	32	31	32
Australia	**1,077**	**1,722**	**1,783**	**1,740**
Percent of GDP	**0.05%**	**0.07%**	**0.08%**	**0.07%**

Source: ACIL Allen Consulting, 2014

The increases in DEC and percentage increases over 2010-11 are shown in Table 108. The highest increase for Australia as a whole is 66 per cent for the Higher population scenario compared to 62 per cent for the Higher productivity scenario and 60 per cent for the Baseline scenario.

The largest increase occurs in Western Australia (108 per cent) under the Higher population scenario and the lowest occurs in Tasmania (21 per cent) under the Baseline scenario.

Table 108 **Comparison of DEC increases by scenario**

State/Territory	DEC 2030-31 Baseline scenario	Baseline scenario - percentage increase over 2011	DEC 2030-31 High population scenario	High population scenario - percentage increase over 2011	DEC 2030-31 High productivity Scenario	High productivity scenario - percentage increase over 2011
	($m)	%	($m)	%	($m)	%
QLD	190	66	212	73	195	67
NSW	99	41	100	42	103	43
VIC	139	49	154	55	144	51
SA	13	32	13	34	13	33
WA	188	97	211	108	191	98
TAS	3	21	4	27	3	22
NT	13	70	12	63	13	71
Australia	**644**	**60**	**706**	**66**	**662**	**62**

Source: ACIL Allen Consulting, 2014

13.5.3 Audit region impacts

The regions with the greatest projected increases in DEC for petroleum product terminals between in the Higher population scenario between 2010-11 and 2030-31 are Greater Brisbane ($409 million), Greater Perth ($342 million), Greater Melbourne ($304 million) and Greater Sydney ($287 million) (Table 109).

Table 109 **Comparison of regions by scenario**

Audit region	DEC 2030-31 - Baseline scenario	DEC 2030-31 - Higher population scenario	DEC FY 20131 - Higher productivity scenario
	($m)	($m)	($m)
3_1_Greater Brisbane	391	409	395
5_1_Greater Perth	323	342	326
2_1_Greater Melbourne	293	304	297
1_1_Greater Sydney	286	287	289
2_4_Geelong	128	132	129
1_11_Newcastle and Lake Macquarie	52	52	53
4_1_Adelaide_West	50	51	50
5_10_Pilbara	31	33	31
3_20_Townsville	26	27	26
3_12_Gladstone - Biloela_NA	23	24	23
3_16_Mackay	22	23	22
7_1_Darwin	19	18	19
3_2_Cairns N+S	15	16	16
5_5_Esperance	15	16	15
7_5_East Arnhem	13	13	13
6_3_Rest of Tas.	10	10	10
5_9_Mid West	7	7	7
6_1_Hobart	7	7	7
5_8_Kimberley	4	5	4
4_3_South Australia - Outback	3	3	3
3_5_Far North	2	2	2
5_11_Albany	1	2	1
6_2_Launceston and North East	1	1	1
3_13_Rockhampton	1	1	1

Source: ACIL Allen Consulting, 2014

13.6 Issues and implications of findings

Petroleum fuels are an important input into economic activity in Australia, particularly in mining, transport and manufacturing and agriculture. Demand is forecast to continue to grow as growth in demand for diesel and jet fuel offsets a flattening in growth in petrol demand.

Two trends are important for future investment in petroleum terminals in Australia. The first is the decline in indigenous production of crude oil (suitable for Australian refineries) that will lead to increased imports of crude oil in the future. The second is closure of three Australian refineries which will require further investment in petroleum product import terminals to meet growth in demand.

The DEC ($1,077 million in 2010-11) is likely to increase by 60 per cent by 2030-31 under the Baseline scenario. This represents the value that terminals add into the supply chain. The ultimate value of petroleum products delivered to the market in 2010-11 is of the order of $35 billion in final end use.

The current outlook is that further investment by the private sector is expected to occur as demand for imports increases. New entrants into the market such as Puma Energy and Idemitsu Kosan, which will provide further competition in the market for new terminal capacity.

There are no major regulatory constraints on further investment in terminals. Access to land at ports and willingness of port authorities to facilitate new developments will be an issue. While the industry has pointed to delays in getting approvals for more capacity at some port precincts (notably in Sydney in the past) this is not expected to be an insurmountable problem as port operations are privatised.

The need to supply new demand in the larger mining states is seen as the most critical. There will also be a need for related infrastructure (such as a jet fuel line to the foreshadowed Badgery's Creek airport) and road access as new terminal capacity is commissioned.

Policy makers will need to be alert to any unnecessary administrative or regulatory delays in approving new terminal or loading facilities. Equally, management of road transport in the vicinity of terminals at port precincts, such as at Port Botany and the Port of Newcastle, will also be important issues to monitor.

14 Water and sewerage services infrastructure

KEY FINDINGS

The water and sewerage audit is concerned with the infrastructure used to provide water supplies and collect and treat wastewater and stormwater, to/from third party customers.

It covers urban and rural water, but not the management of natural resources, or direct abstractions form natural resources used for self-provision (such as hydro-electricity generation). It does not measure the volume of water.

Indicators of the capacity of existing (2013) infrastructure include total dam capacity of 84,111 GL, total water in storage of 58,488 GL, 539 GL of desalination capacity, 213,500 km of water mains (in 2011) and 113,500 km of sewer mains (in 2011).

Water supplied in 2010-11 through the water infrastructure included in the audit totalled 7,641 GL. This is significantly greater than the volume of sewerage collected (1,931 GL) due to the supply of irrigation water. Water was supplied to 8.5 million properties and sewerage collected from 7.8 million properties.

Large urban areas and irrigation districts had the greatest lengths of water mains, while urban areas had the greatest lengths of sewerage mains. The Rest of Tasmania region, Hume, Kimberley and NSW Capital regions had the greatest dam storage capacities and the largest volumes of water in storage. The regions with the greatest volumes of water supplied were the Hunter Valley (excluding Newcastle), Riverina, Murray, Greater Sydney and Hume. The regions with the greatest volumes of sewerage collected were the large urban areas: Greater Sydney, Greater Melbourne, Greater Brisbane, Greater Perth and Greater Adelaide.

The direct economic contribution (DEC) of water infrastructure services was $5.79 billion and $4.8 billion for sewerage services infrastructure in 2010-11 (in total $10.6 billion of water infrastructure services).

The regions with the largest economic contributions from water and sewerage infrastructure services were the large urban areas: Greater Sydney ($1.8 billion), Greater Melbourne ($1.4 billion), Greater Perth ($1.2 billion), Greater Brisbane ($1.2 billion) and Greater Adelaide ($700 million).

However we note that the under-pricing of water and sewerage services means that these measures understate the true economic contribution of the infrastructure, and concomitantly the remuneration required for capital and labour to maintain the industry in steady state.

We project that the total volume of water supplied will increase from 7,641 GL in 2010-11 to 15,285 GL in 2030-31 and that the total volume of sewerage collected will increase from 1,931 GL to 2,405 GL. The regions with the greatest increases in volumes of water supplied will be the Hunter Valley (excluding Newcastle), Murray, Riverina and the Hume; the large urban areas will have the greatest increase in volumes of sewerage collected.

We also project that the number of properties served in relation to water will increase from 8.5 million to 11.6 million and that the number of properties served in relation to sewerage will increase from 7.8 million to 10.6 million.

The economic contribution of water and sewerage infrastructure services is projected to grow by 50 percent or $5.9 billion between 2010-11 and 2030-31. The largest gaps by state/territory will be: Queensland ($1.8 billion), Western Australia ($1.7 billion), and Victoria ($1.2 billion).

The largest regional increases in DEC are projected to occur in: Greater Perth ($1,278 billion), Greater Melbourne ($826 million), Greater Brisbane ($624 million), the Gold Coast ($286 million) and Greater Adelaide ($358 million).

Rectifying the current under-pricing of services would add a further increase in DEC of some $3 billion or 25 percentage points in the growth of DEC. Concerns about affordability, and current price setting arrangements will constrain the actual likely growth in DEC below this level. However such constraints will add to funding pressures on the industry, especially where current prices do not provide sufficiently for renewals and replacement expenditures.

14.1 Water and sewerage infrastructure in scope

In water, key activities comprise the provision of raw water resources, treatment to potable standard, transmission through trunk water mains, transmission through smaller more local water distribution mains, and retail services. Sewerage involves the collection of wastewater from domestic and commercial/industrial premises, collection of stormwater, transmission through local distribution sewer mains and large transmission mains, treatment at a sewerage treatment plant, and disposal of wastewater volumes into the ocean or water courses.

Water and sewerage services are provided via integrated networks, rather than discrete pieces of infrastructure. Moreover, while water and sewerage services have several elements in their supply chains, the services are by and large supplied by integrated utilities undertaking all activities in the chain. This means that it is possible to identify revenue and output, the volume of service supplied and the economic contribution only for the service as whole[67]. At the same time, as discussed further below, there are a number of different dimensions of infrastructure utilisation and capacity, corresponding to the different activities involved, such as water resources, water distribution and sewerage collection.

This audit covers water and sewerage infrastructure which is used to provide priced services to customers (and hence contributes to Gross Domestic Product (GDP)). It does not include natural resources, such as rivers, aquifers or oceans, as these do not constitute infrastructure which is constructed for the purpose of serving customers. Nor does it cover assets which have been built to manage natural resources, such as dams and weirs that regulate river flows.

The audit includes private infrastructure, provided the main purpose of the business providing the services is water, sewerage or drainage services. The audit does not cover business or individuals who “self-serve” to support a different main activity, such as farm abstractions from rivers or aquifers, on-farm dams, hydro-electric producers who do not distribute water to other customers, or mining companies that access water from aquifers for their mining activities. The economic contribution of such infrastructure is included within each of those sectors.

The audit covers both urban and rural infrastructure. However, as described later in this chapter, the National Water Commission (NWC) data set does not cover water utilities serving less than 10,000 properties. This means that utilisation and some capacity information is not complete for rural and some regional urban areas. In particular, not all irrigation water suppliers passed the reporting threshold requirements. For example, irrigation suppliers in Tasmania were just below the threshold, with no irrigation suppliers included in the NWC reporting datasets for any of the reporting years 2010-11 to 2012-13. Accordingly, the volume of water supplied and length of mains information for Tasmania does not cover rural water supplies.

In addition to the supplies provided by the above rural water suppliers, the NWC data includes several bulk water suppliers, such as Fish River Water, Goldenfields Water (Bulk Water Supply), Rous Water, Sydney Catchment Authority, Melbourne Water and Gladstone Area Water Board. Also included are state-wide suppliers such as SA Water and Water Corporation.

[67] In a few locations there is a split between resources/treatment and treatment/distribution – for example Melbourne provides what is termed “wholesale” services and the three water retailers provide distribution and retail services.

To estimate the economic contribution of water and sewerage services infrastructure, we have been able to supplement the NWC information with that contained within a computable general equilibrium (CGE) model of the Australian economy. Thus, as discussed further below, the economic contribution of businesses whose main function is water supply, sewerage or drainage have been added to the data set where missing from the NWC data.

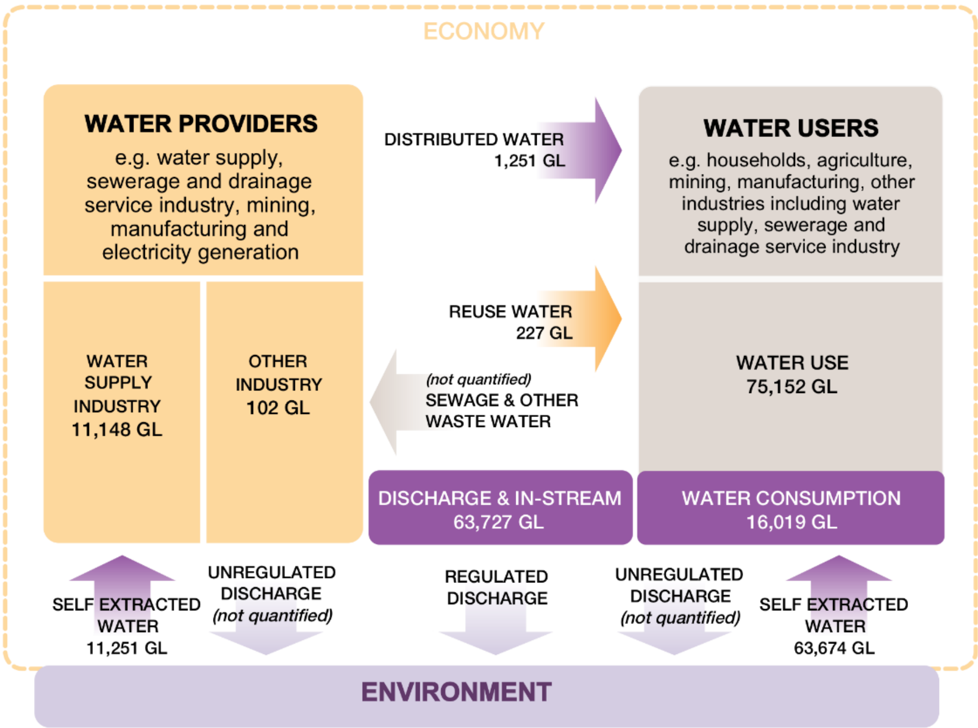
14.2 Water and sewerage services in Australia

14.2.1 The significance of water and sewerage services to economic activity

Water and sewerage services play a key role in the national economy. They are important inputs into many sectors as diverse as agriculture, electricity generation and mining, as well as providing essential services to households and businesses.

Figure 156 shows the flow of water within the economy and to/from the environment.

Figure 156 **Water Supply in the Australian Economy**



Source: ABS, 2013 (Australian Bureau of Statistics, 2013)

Figure 156 shows that water business provide some 11,251 GL of water to their customers (with the volume of returning wastewater flows not quantified)[68]. There is a small volume (102 GL) of recycled water supplied by other businesses to customers.

In addition, water users such as electricity generators and farmers extract large volumes of water directly from the environment (some 63,674 GL in 2011-12).

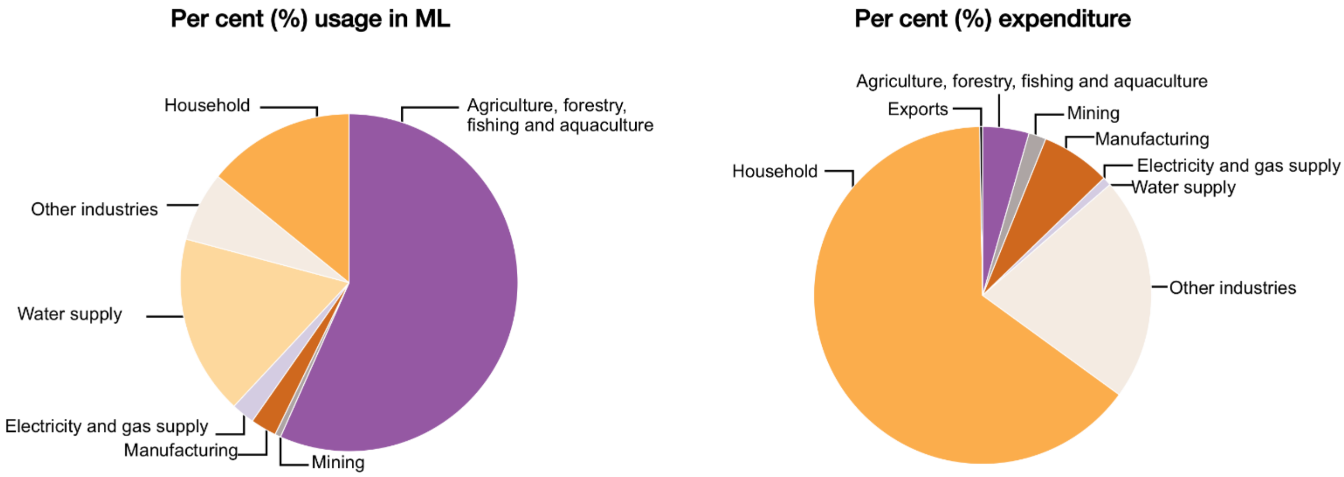
Much of this water is used for hydroelectric power generation and then returned to the

[68] Note the difference between volumes supplied by water providers from the ABS data and the volumes reported in our audit set reflect bulk supplies between water providers (which is included in the ABS data) and the incomplete coverage of the NWC data set in terms of smaller water providers.

environment. As such, it is “used” but not “consumed”. Water that is directly extracted by agriculture, by contrast, is not returned to the environment and so is regarded as being “consumed” in the same way as supplies to households and businesses.

Figure 157 shows that of water distributed by providers, agriculture consumes 54 per cent of volumes, with households consuming just 14 per cent. The water industry itself consumes some 17 per cent due to leakage and treatment requirements. However the pattern of expenditure on services is very different. Households spend some 55 per cent of total expenditure on water services, with agriculture, forestry and fishing spending some 4 per cent[69].

Figure 157 **Supply of water to consumptive uses**



Source: ABS, 2013a, Table 2 and Table 4 (Australian Bureau of Statistics, 2013)

This difference in sectoral usage as measured by volumes versus expenditure in part reflects differences in the extent of infrastructure required to deliver services to the different sectors, with supplies of potable water in densely populated regions requiring more infrastructure in terms of treatment and distribution. However it also reflects the lower prices charged for the use of rural infrastructure, as a result of past government contributions. The implications for the audit conclusions of this under-pricing of water infrastructure – which exists generally and not only for rural infrastructure – are addressed further below.

14.2.2 Regulatory, policy and governance context

Governance and water resource planning

The water and sewerage businesses are owned by the state and territory governments. As owner, these governments are responsible for monitoring the operational and financial performance of the businesses, as well as playing a substantial role in terms of policy and planning (including water supply planning).

State and territory governments are responsible for managing water resources sustainably: to ensure adequate security of supply for consumptive uses of water, while ensuring that sufficient water is made available to the environment to protect basin ecosystems and optimise environmental outcomes for rivers and wetlands. To this end, state and territory

69 Adjusting to remove intermediate bulk water sales to other water providers.

governments have developed Water Plans, which set out the frameworks for managing water within their jurisdictions.

Progress is being made towards securing additional environmental water requirements by buying back water entitlements where these have been over-allocated and managing environmental water allocations.

The Murray-Darling Basin Authority is the body responsible for planning the management of the Murray-Darling basin's resources, one of Australia's most important river basins.

Regulation

The water businesses are subject to a range of regulatory requirements concerning drinking water quality and the quality of wastewater discharges, with regulatory responsibility lying with the Department of Health and the state/territory based Environment Protection Agencies.

A number of the businesses are also subject to independent economic regulation, particularly those in major urban centres. Price regulation was introduced as part of a set of wider reforms implemented following the realisation, in the early 1990s, that the water industry was not sustainable.

The industry was fragmented and faced challenges in regard to required future capital investment. There was also growing community concern about the industry's environmental impact. The problems included:

- Water charges that did not reflect the cost of supply, with an absence of consumption related charges that led to excessive water use and costly augmentations of capacity.
- Low tariffs which meant that charges failed to recover the costs of service provision, particularly in regional and rural areas. Many of the water businesses were in a fragile financial state with assets not being maintained adequately.
- Water businesses set their own tariffs and were responsible for their service delivery and environmental performance. There were no incentives to provide appropriate levels of service at efficient levels of cost.
- Resource allocation and wastewater management practices that were resulting in increasing competition for scarce supplies and environmental degradation.

Nation-wide reforms began with the Council of Australian Governments (COAG) Water Reform Framework in 1994. The 1994 COAG reforms sought the separation of policy setting, service delivery and regulatory enforcement and reforms to pricing and resource allocation. However they lacked firm commitments for action, and in 2004 COAG instituted the National Water Initiative (NWI).

The NWI set a more ambitious reform agenda, aimed at achieving efficient water use and investment and improved environmental outcomes. The specific objectives that the NWI sought to achieve included transparent water planning, improved environmental management outcomes, secure water entitlements, conjunctive management of surface water and groundwater resources, resolution of water over-allocation and overuse, the clear assignment of risks associated with changes in future water availability, effective water accounting, open water markets and effective structural adjustment, water use efficiency and innovation in service delivery.

In the urban context the NWI also sought pricing that was more transparent and cost reflective. Thus the urban water reforms aimed to ensure reliable water supplies, efficient water use, recycling of wastewater where cost effective, water trading between and within the urban and rural sectors, innovation in water activities and improved pricing for metropolitan water.

These early reforms are viewed as having been successful. Greater commercialisation and outsourcing has increased efficiency. Pricing has a substantial volumetric element; many jurisdictions have moved towards upper bounds pricing as defined by the NWI. Independent regulation has contributed towards improved transparency and more efficient pricing.

According to the NWC (National Water Commission, 2011):

> "By the early 2000s, the urban water sector was demonstrably more efficient, sustainable, accountable and transparent than it had been 20 years before. The early reforms therefore were extremely valuable".

However the prolonged drought and government and industry's response demonstrated that a number of deficiencies in arrangements remained. The planning framework proved unable to manage climate variability effectively. While no cities ran out of water, the decision processes involved excessive use of restrictions, bans on various supply options and inadequate application of real option techniques to manage the uncertainties involved in the drought. The resultant investment in large and costly infrastructure schemes could have been avoided if better processes had been employed, and the ad hoc nature of government intervention undermined the separation of roles established previously (Productivity Commission, 2011).

In response, COAG put forward an enhanced national urban water reform framework in 2008 to improve the security of supply for urban water and further the urban reforms contained in the 2004 NWI, which were in hindsight regarded as inadequate. The 2008 reforms included agreement to adopt urban planning guidelines, best practice scenario planning for climate variability, adoption of NWI pricing principles, enhancements to pricing reform (including consideration of scarcity values and recovery of environmental externalities), establishing entitlements for recycling, stormwater and managed aquifer recharge and promoting competition through a nationally consistent access regime.

The jurisdictions are working towards achieving these objectives, with considerable effort going to ensure that water supply planning processes are adaptive and undertaken on a "whole of system" basis, incorporating real options principles. Despite the breaking of the drought, emphasis continues to be placed on demand management as a significant element of the forward supply-demand balance. Greater emphasis is being placed on whole-of-water-cycle planning: in Victoria for example further regulatory reforms are aimed at delivering improved efficiency and planning processes which recognise the wider community value of water.

14.3 Audit of existing water and sewerage infrastructure

The section audits the existing water and sewerage services across Australia.

The audit reports on the current infrastructure used in the provision of water and sewerage services to customers, the volume of services supplied/utilised and the DEC of infrastructure services. This covers the infrastructure used in the provision water storage facilities, water and sewerage treatment and distribution/collection to/from customers. Specifically, the following infrastructure is covered:

- dams
- transmission pipelines for water transfers between dams

- water treatment facilities including water, sewerage (including water recycling) and desalination
- pumping stations and pumping equipment, and
- pipe distribution systems for water and sewerage collection and drainage.

The audit does *not* cover:

- infrastructure not used to serve third party customers[70]
- natural resources such as rivers and aquifers, and
- drainage infrastructure operated by local councils.

The extent of infrastructure required for each stage of service provision varies according to the nature of the water source and the geography of the area. Thus water sourced from a major river system or from an underground aquifer requires less infrastructure than water sourced from surface water storages (dams) or from the ocean (desalination). Water supply systems that are able to rely on gravity require less pumping infrastructure than systems where the customers are located on higher ground than the water source (typically the case for desalinated water). Regional and rural water supply systems generally serve customers that are more dispersed that urban systems, with the result that the length and cost of mains is higher per property served.

Our approach for water and sewerage necessarily considers the capacity, utilisation and DEC of the supply systems as a whole, for example in terms of total volume of water supplied and total volume of sewerage collected. However some individual metrics provide an indication of the capacity/utilisation of particular segments of the supply chain, such as the length of water or sewerage mains (which refers to the distribution and transmission elements of the supply chain) and the volume of water in storage (which refers to resources part of the chain).

14.3.1 Capacity, utilisation and DEC of water and sewerage services infrastructure at national level

This section reports the current infrastructure used in the provision of water and sewerage services, the volume of services supplied/utilised and the DEC of infrastructure services across Australia.

Capacity metrics

Table 110 below shows some key capacity metrics for water and sewerage infrastructure across Australia.

[70] The BOM data on dam storage does include information on all major dams, including hydro-electric water storages. These have been adjusted to exclude dams which primarily serve hydro-electric generation, to make the storage data consistent with the utilisation and DEC information used in the audit, which does not include hydro-electric infrastructure.

Table 110 **National capacities of existing water and sewerage infrastructure**

Capacity metrics	
Dam capacity, 2013	84,111 GL
Dam water in storage, 2013	58,487 GL
Desalination capacity, 2013	539 GL
Length water mains, 2011	213,518 km
Length sewer mains, 2011	133,508 km

Source: Bureau of Meteorology, 2014, NWC Water Utilities Performance Reporting Reports 2012-13 and supporting databases

Table 110 above shows the total storage capacity for dams and the volumes held in 2013 (data for 2011 not being available). Also reported is the capacity to supply desalinated water.

Dam storages plus desalination plant represent the major infrastructure used in water resource services. Although river extractions and extractions from underground aquifers provide further water resources available for consumptive purposes, these are not included in the audit as they are not infrastructure per se.

Note that both desalination capacity and dam storage capacity provide two different functions within the water supply system. Both can be used to provide volumes of water supply, but in addition both are important in ensuring adequate security of supplies given the possibility of drought. The characteristics of these two types of capacity are very different, however. Dam storages provide relative inexpensive volumes of water for supply, and economies of scale mean that it is sensible to build these with spare capacity. By contrast, desalinated water is expensive to produce, but provides a “climate independent” source of water. Thus in several states, including Victoria and NSW, desalination was installed to ensure that water supplies remained secure under drought conditions, rather than provide additional volumes of water per se. In other regions, such as Perth, desalination provides capacity which is essential in meeting projected levels of demand for water supplies.

Also reported is the length of water mains and the length of sewers, which form the major element of the water and sewerage distribution systems. No information was available regarding the treatment capacity of water supply and sewerage systems.

Utilisation metrics

The table below shows the total volume of water supplied, volume of sewerage collected, and number of properties served by water and sewerage services across Australia. The audit does not report the volumes of stormwater collected or recycled water delivered, although the infrastructure used by water and sewerage businesses in providing these services is included in the measurement of direct economic contribution (DEC).

Table 111 **National utilisation of existing water and sewerage infrastructure, 2010-11**

Utilisation metrics	
Water supplied	7,641 GL
Number of properties served - water	8.5 millions
Sewerage collected	1,931 GL
Number of properties served - sewerage	7.8 millions

Source: NWC Water Utilities Performance Reporting Reports 2012-13 and supporting databases

DEC metrics

The DEC of water and sewerage infrastructure services in 2010-11 was $10,610 million (in 2010-11 dollars).

Table 112 sets out the total DEC for water and sewerage infrastructure services for Australia as a whole. The table shows that sewerage services account for a little over half of total DEC for the sector, while capital accounts for some two-thirds of the contribution.

Table 112 **DEC of water and sewerage services infrastructure in 2010-11 ($ million)**

	Capital	Labour	Total
	$m	$m	$m
Water infrastructure services	3,944	1,847	5,791
Sewerage infrastructure services	3,360	1,459	4,819
Total water and sewerage infrastructure services	7,304	3,306	10,610

Source: ACIL Allen Consulting, 2014

The DEC provides a useful summary measure of the contribution of the sector to the economy. It provides a measure of the value contributed by the sector, through capital investment and through the efforts of the labour force as measured by wages. It does not include the inputs used, which have an opportunity cost in terms of being able to be used elsewhere. In the case of water and sewerage, inputs include the cost of electricity used for pumping and treatment, professional services such as engineering or financial advice, and the value of natural resources.

The NWC National Performance Reports include revenue and operating cost information, which allows the calculation of the value added of capital. Revenue less operating cost will equal depreciation plus operating profit before interest. This provides a measure of capital value added from infrastructure (including taxation transfers). To this we add the value added of labour, to derive total value added which is used as the indicator of Direct Economic Contribution or DEC.

Example calculation of DEC

The table below illustrates the calculation of DEC for a particular region: 2_1_Greater Melbourne.

The water and sewerage businesses operating in the Greater Melbourne region are listed in column 1 of Table 113. Column 2 shows the percentage of each business that is allocated to the Greater Melbourne region.

Column 3 shows revenue for each business and column 4 shows operating costs (both of which are given separately for water and sewerage within the NWC data). Subtracting operating costs from revenue gives capital value added (column 5), which is then summed across all businesses and across water and sewerage.

The NWC does not include information on labour value added, so the total labour value added for water and sewerage has been derived from the CGE analysis which reflects detailed information about employment by sector by region. The value used in the example is the value derived for the Greater Melbourne region. Adding together capital value added and labour value added provides our estimate of the total DEC of water and sewerage infrastructure in 2010-11.

Table 113 **Calculation of DEC of water and sewerage services for Greater Melbourne 2010-11**

Water				
Utility businesses	Percentage of activities in region (per cent)	Revenue ($m)	Operating cost ($m)	Capital value added ($m)
City West Water	100	219.73	155.98	63.75
Goulburn Valley Water	5	27.26	18.70	0.41
South East Water Ltd	100	245.75	201.63	44.03
Western Water	95	32.82	30.31	2.40
Yarra Valley Water	100	275.96	200.02	75.58
Melbourne Water	100	349.37	94.40	253.88
Total water capital value for region				**440.05**
Sewerage				
Utility businesses	Percentage of activities in region (per cent)	Revenue ($m)	Operating cost ($m)	Capital value added ($m)
City West Water	100	182.93	115.75	67.18
Goulburn Valley Water	5	26.10	17.41	0.41
South East Water Ltd	100	316.94	187.18	129.50
Western Water	95	32.31	19.86	11.86
Yarra Valley Water	100	348.53	174.45	173.26
Melbourne Water	100	300.85	78.32	221.58
Total sewerage capital value for region				**603.80**
Totals				
Total water and sewerage capital value added				1,043.85
Labour value added				322.83
Total value added				**1,366.69**

Source: ACIL Allen Consulting, 2014

14.3.2 Capacity, utilisation and DEC of water and sewerage infrastructure by state/territory

This section reports the current infrastructure used in the provision of water and sewerage infrastructure services, the volume of services supplied/utilised and the DEC of infrastructure services by state and territory.

Capacity metrics

Table 114 presents some key metrics regarding the capacity of existing infrastructure by state and territory.

Table 114 **Capacity of existing water and sewerage infrastructure**

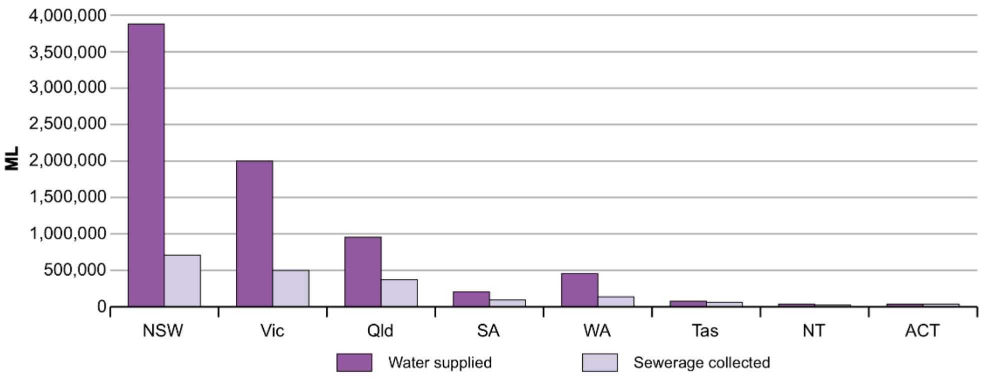
	Dam capacity, 2013	Dam water in storage, 2013	Desalination capacity, 2013	Length water mains, 2011	Length sewer mains, 2011
	GL	GL	GL	(km)	(km)
NSW	22,929	13,630	90	63,529	42,254
Vic	14,441	9,703	150	75,269	35,623
Qld	10,429	9,726	49	36,090	26,055
SA	2,257	2,002	100	10,357	7,700
WA	11,470	8,861	150	17,248	13,253
Tas	22,141	14,283	0	6,186	4,535
NT	285	228	0	1,706	954
ACT	158	56	0	3,134	3,134
Australia	**84,111**	**58,488**	**539**	**213,518**	**133,508**

Source: Bureau of Meteorology, 2014, NWC Water Utilities Performance Reporting Reports 2012-13 and supporting databases

Utilisation metrics

The following graphs show the distribution of volumes of water supplied/sewerage collected and the number of properties served by water and sewerage services by state and territory.

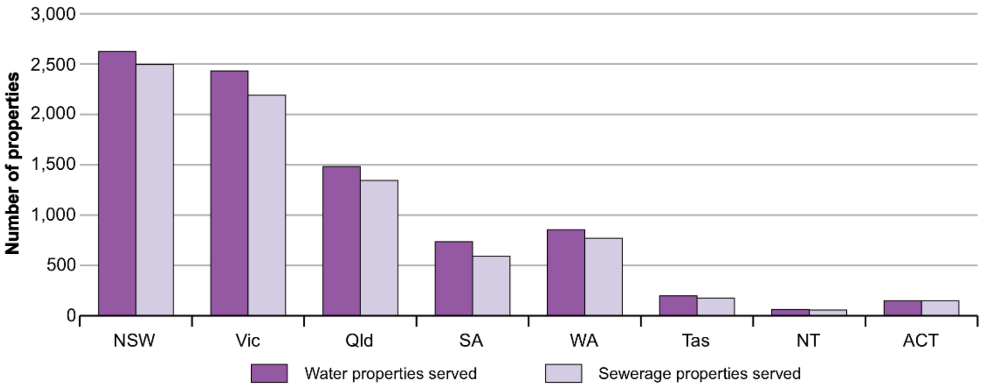
Figure 158 **Utilisation 2010-11 – water supplied and sewerage collected**



Source: NWC Water Utilities Performance Reporting Reports 2012-13 and supporting databases

In Figure 158 above the significantly greater volumes of water supplied (relative to sewerage collected) provides some indication of the relative importance of irrigation water, although as noted above, the NWC reporting threshold means that not all irrigation supplies have been captured. Figure 159 below shows a relatively close correlation between the number of properties served by water and sewerage services.

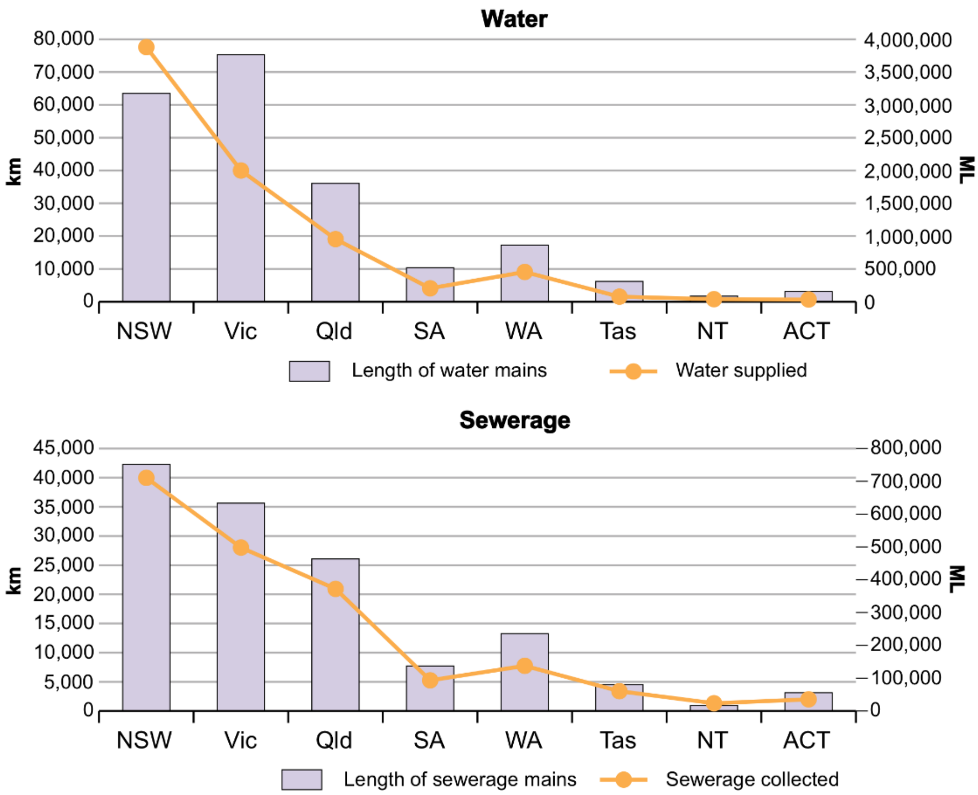
Figure 159 **Number of properties served 2010-11 – water and sewerage**



Source: NWC Water Utilities Performance Reporting Reports 2012-13 and supporting databases

Figure 160 below compares capacity and utilisation information for both water and sewerage infrastructure by state and territory.

Figure 160 **Capacity and utilisation of water and sewerage infrastructure, 2010-11**



Source: ACIL Allen Consulting, 2014

The figure shows a broad relationship between capacity (measured in terms of km of mains) and utilisation measured in volumes supplied/collected. As above, the relationship is closer for sewerage, given the relatively large volumes of irrigation water supplied.

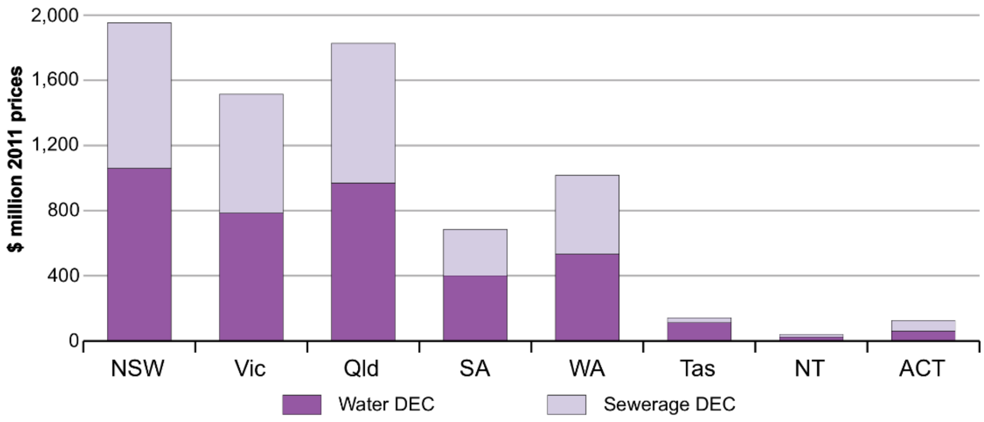
The length of water mains in a region depends on the population density of centres in that region, water infrastructure to support agricultural operations as well as other specific factors (such as the significant lengths of water mains used to supply the La Trobe Gippsland power generation region in Victoria).

Utilisation (ML of water supply) reflects similar factors (resulting in the high degree of correlation between capacity and utilisation shown in Figure 160. However, it is also linked to factors such as water efficiency initiatives, drought restrictions and the effect of drought on the allocation of irrigation water.

DEC metrics

Figure 161 below shows the distribution of DEC for water and sewerage services across the states and territories. In 2010-11, total DEC contributions were greatest in NSW, followed by Queensland and then Victoria. Total DEC in Tasmania, NT and ACT is relatively low.

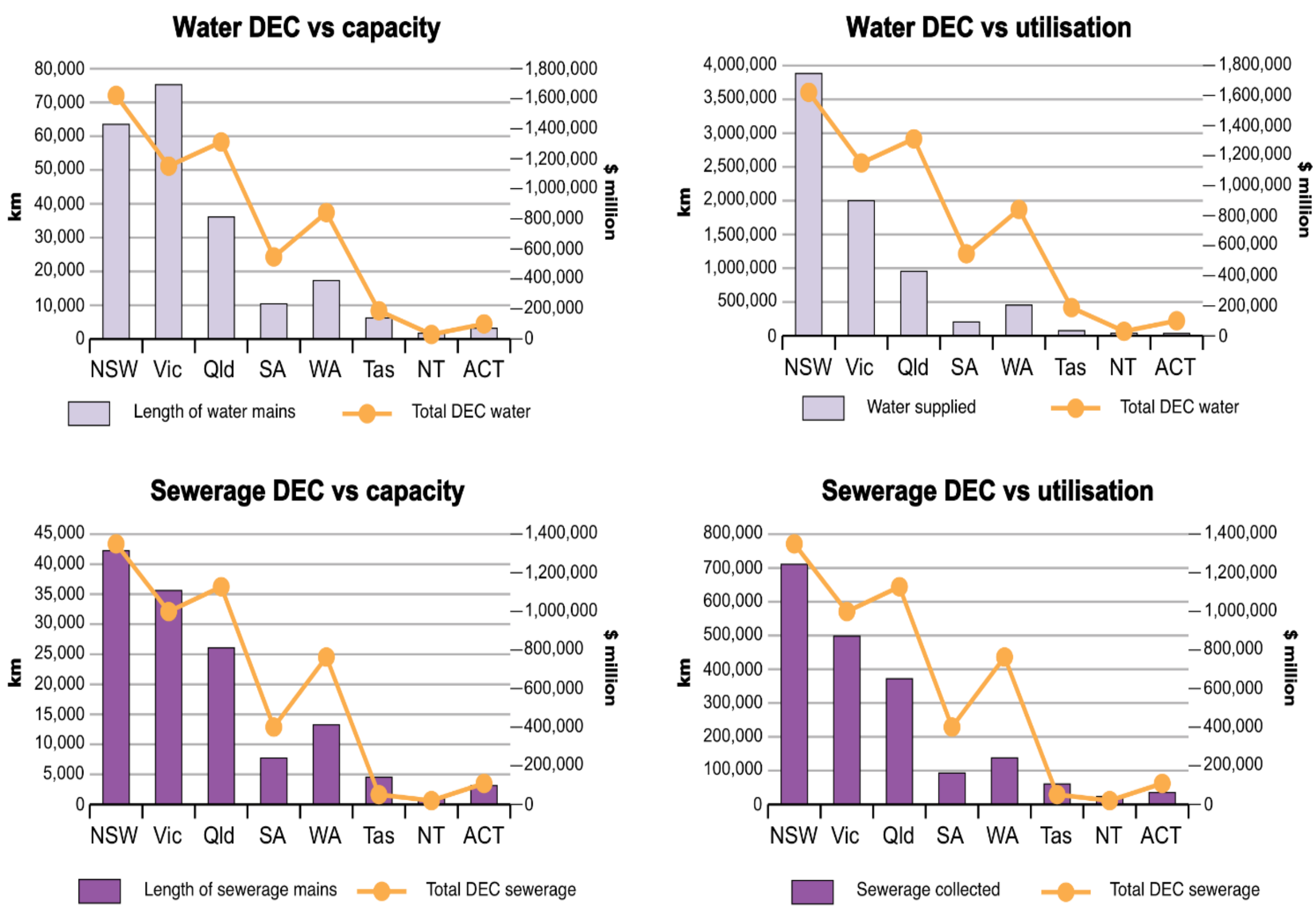
Figure 161 **DEC for water and sewerage services in 2010-11, $m (2010-11 prices)**



Source: ACIL Allen Consulting, 2014

Figure 162 examines the relationship between 2010-11 DEC and 2011 capacity and utilisation metrics by state and territory.

Figure 162 **DEC vs capacity and utilisation by state and territory – water and sewerage, 2010-11**



Source: ACIL Allen Consulting, 2014

Figure 162 above shows that in very broad terms the relationship between DEC and capacity is similar to the relationship between DEC and utilisation, although some differences can be seen. In particular, DEC appears to be low relative to both capacity and utilisation in NSW (in comparison to Vic, Qld, SA and WA), for both water and sewerage.

Similarly, DEC seems to be low relative to capacity and utilisation in Tasmania and the NT, particularly for sewerage services. It is also noticeable that DEC in Victoria seems to be low relative to the capacity for water, but not relative to utilisation.

Under pricing and implicit government subsidies

It is important to recognise that water and sewerage services have traditionally been under-priced, and that this will have resulted in an under-statement of DEC as measured by the NWC data (and as incorporated into the national accounts and GDP numbers). The under-pricing of water and sewerage services has arisen because the return on the capital base is a long way below the level needed to remunerate the full replacement cost of assets.

In 1994 the Council of Australian Governments (COAG) recognised that water services were not being provided on a sustainable basis, and through the National Water Initiative governments committed to best practice in water pricing to:

- promote efficient and sustainable use of resources and assets
- ensure sufficient revenue streams to allow efficient delivery of services

— achieve user pays and pricing transparency in irrigation systems.[71]

In urban areas Governments agreed to move from lower bound pricing towards upper bound pricing. Upper bound pricing involves prices recovering the full cost of operating, maintenance and administration costs, tax equivalents, provision for asset consumption (depreciation) and a return on capital as measured by the weighted average cost of capital. Lower bound pricing involves the recovery of operating, maintenance and administrative costs, the cost of renewals/replacement, tax if paid, and interest and dividend payments (to the extent that any dividend payments are made).

The 2010 NWI Pricing Principles made clear that this commitment to upper bound pricing applied only to "new" assets, i.e. new capital expenditure. Thus the NWI Pricing Principles allow the under-valuation of existing (termed legacy) assets, for which a renewals annuity on future replacement expenditures was required as a minimum. As a consequence, the movement towards upper bound pricing for all assets, with a return on and depreciation being recovered in prices, occurs only as assets are replaced.

Under the pricing arrangements introduced by independent regulators, these pricing commitments have been incorporated into the regulatory pricing regimes through the setting of regulatory asset values (RAVs) which are depreciated and earn a full cost of capital. In particular, the rolling forward of the RAV by adding in all new capital expenditure ensures that the NWI requirement for upper bound pricing on new assets is met.

For regional and rural water businesses, COAG recognised that it might not be practical to move towards upper bound pricing[72]. Instead governments committed to achieving lower bound pricing, and moving towards upper bound pricing for new assets where this was possible given affordability concerns.

Thus, the DEC observed from the NWC data, and contributing towards GDP, will reflect the pricing constraints previously imposed on the industry. In the cases where an independent regulator sets or approves prices, the mechanisms used to "roll forward" the regulated asset value (RAV) of the businesses means that the value of the capital value increases over time as existing (low value) assets are replaced by new (full value) assets. However the upward movement in asset value is slow given the long asset lives involved.

The fact that prices are insufficient to remunerate the full depreciated replacement cost of all assets implies an ongoing subsidy from government (and taxpayers) to water and sewerage customers. To provide an indication of the scale of the implicit subsidy, we have examined the written down asset values reported by businesses and estimated an associated capital value added (using a cost of capital and a depreciation period consistent with recent regulatory decisions). Of course, written down asset value is not a perfect measure of the replacement value of the assets. The financial reporting requirements for businesses in the sector differ according to whether they are "for profit" or "not for profit", and where fair value is used it can be on an income basis or cost basis, with the income basis of valuation being subject to the same problem.

The Victorian regulator, the Essential Services Commission (ESC), recently examined statutory assets values for the Victorian water businesses, and found that as at 2011-12, statutory asset values (the written down value or WDV) were approximately equal to regulatory values (which underpin current estimates of DEC) for the metropolitan businesses. For regional urban businesses, regulatory asset values are around 40 per cent

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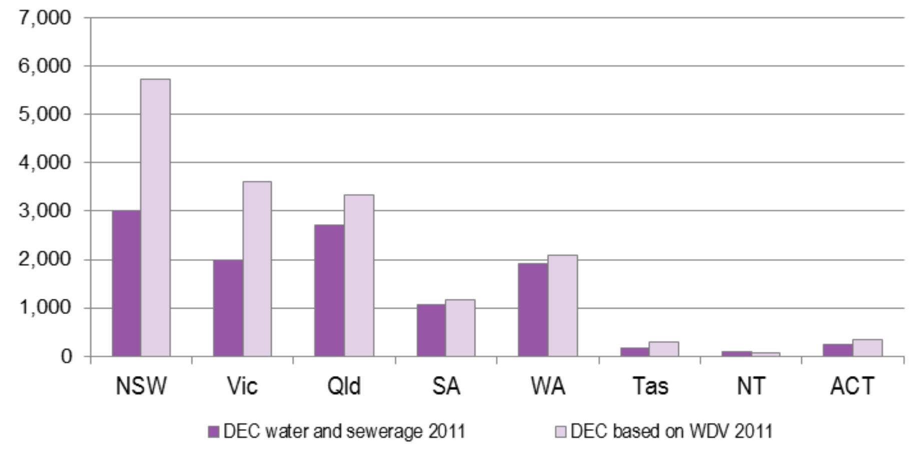
[71] COAG, 2010, National Water Initiative Pricing Principles,p2, following COAG, 2004, Intergovernmental Agreement on a National Water Initiative, s66.

[72] COAG, 2010, National Water Initiative Pricing Principles, p6.

of statutory WDV, while for rural businesses regulatory asset values were around 5 per cent of WDV.

Figure 163 provides an indication of the potential scale of the implicit subsidy and under-estimation of economic contribution, for the states and territories in 2013. The figure suggests that there is no such subsidy problem in the Northern Territory. However this may reflect the methodology used to assess fair value rather than the absence of an implicit subsidy (for example if impairment tests have been applied when valuing assets). The fact that the implicit subsidy appears to be greatest in NSW explains the low DEC relative to capacity and utilisation seen for that state in Figure 162.

Figure 163 **Comparison of value added: audit DEC vs WDV DEC in 2012/13**



Source: NWC National reporting database, consultations, regulatory decisions

The implications of this subsidy and its interaction with the regulatory regime, is explored further in Section 14.7.

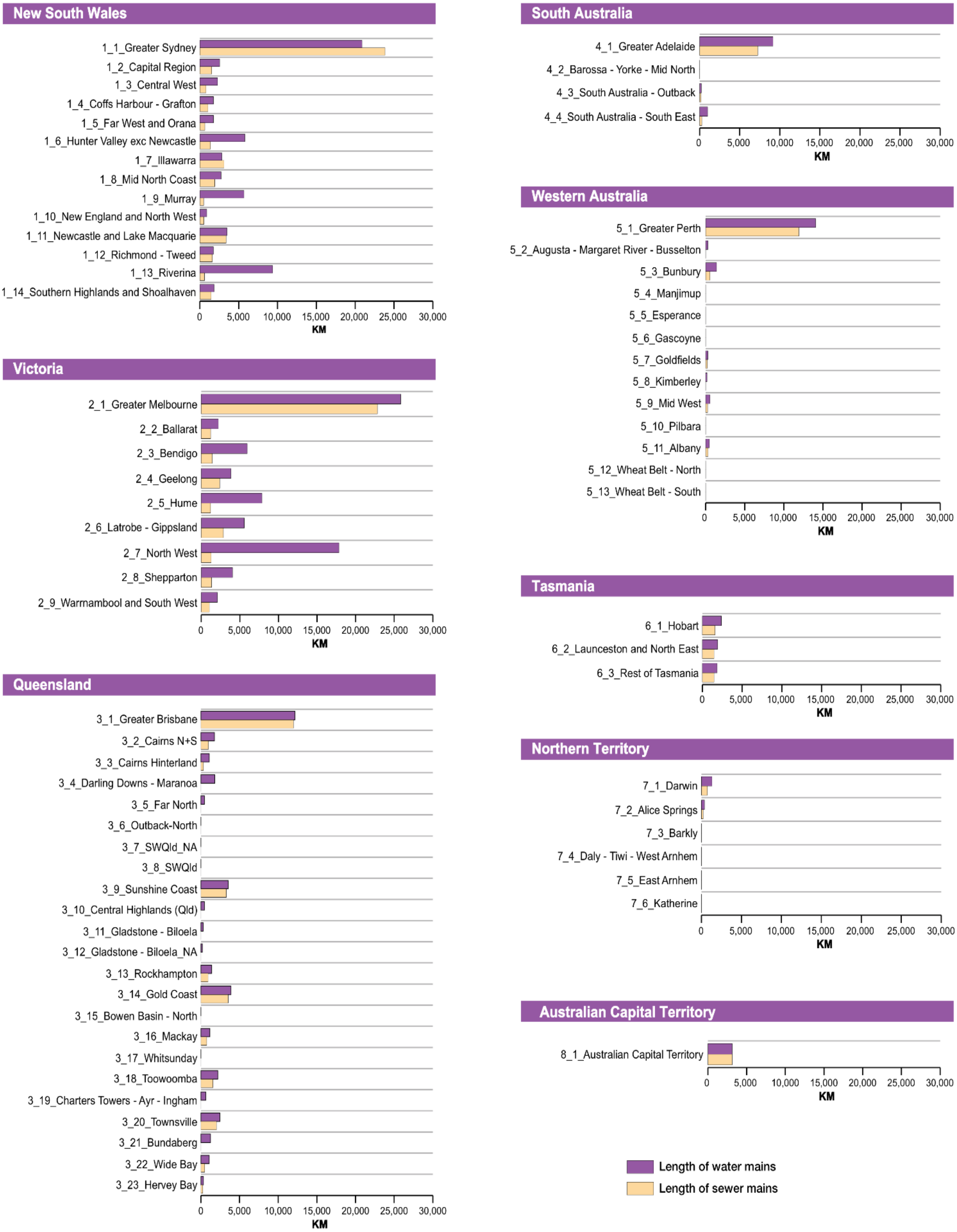
14.3.3 Capacity, utilisation and DEC of water and sewerage infrastructure by audit region

Capacity metrics

At the regional level, the extent of water and sewerage infrastructure tends to reflect the distribution of major population centres, although some major agricultural areas have significant amounts of water infrastructure.

Figure 164 shows the distribution of water and sewerage mains across the audit regions. The major “spikes” are for the capital cities, although sizeable population regions such as the Gold Coast, Sunshine Coast and Townsville can be identified. The country areas with significant lengths of water mains include the Murray region, Riverina, Bendigo, the Victorian North West and Shepparton. The La Trobe Gippsland power generation region in Victoria also has significant lengths of water mains.

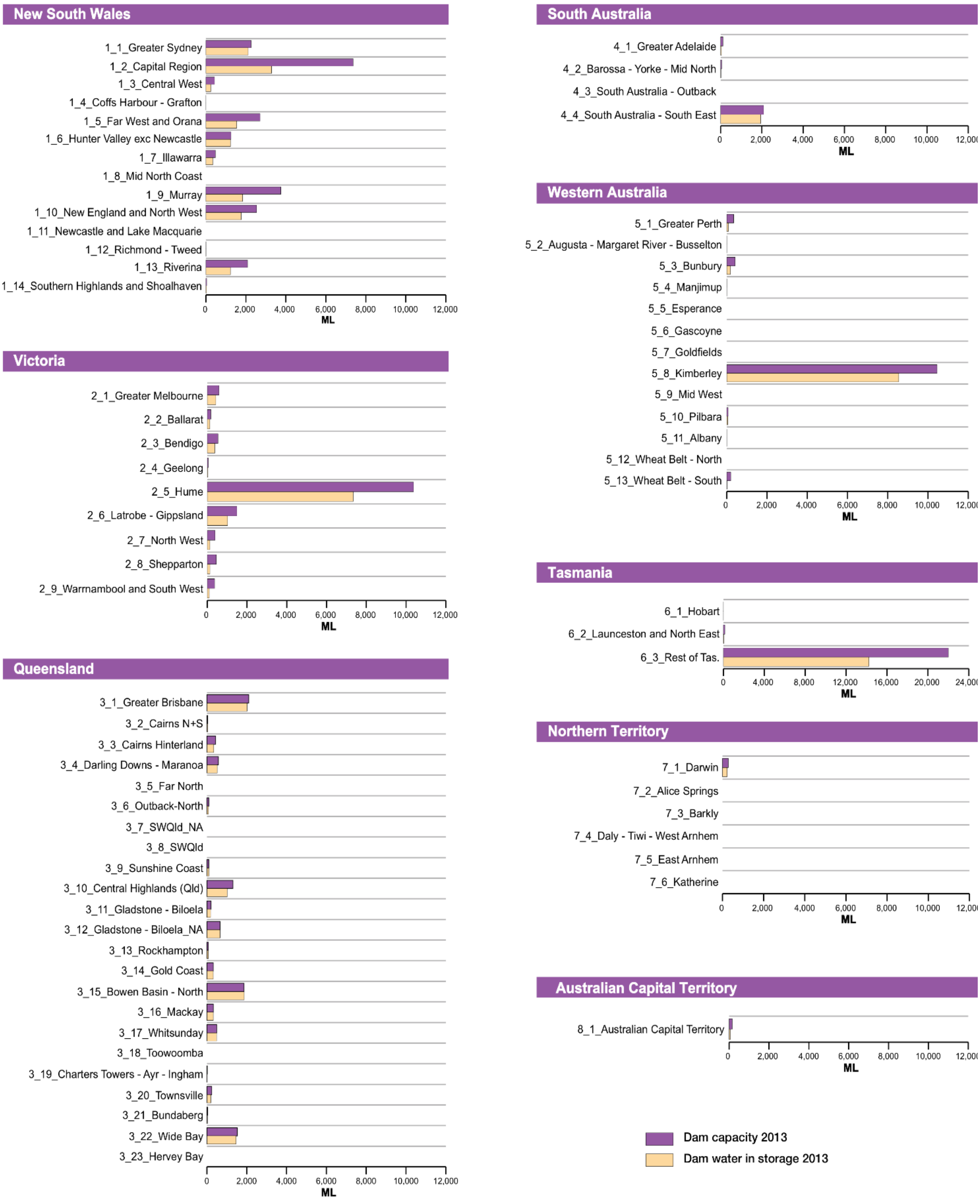
Figure 164 **Length of water and sewerage mains, 2010-11**



Note: Mains for rural suppliers include all carriers including pipes, lined and unlined channels and natural waterways
Source: NWC Water Utilities Performance Reporting Reports 2012-13 and supporting databases

Figure 165 shows the distribution of water storage capacity and volumes held in storage by region. In this case, however, the greatest capacity is evident in regions with significant irrigation, such as the Kimberley's Ord River, the Murray and Capital regions in NSW and Hume in Victoria. The many and large storages in Tasmania contribute towards its hydroelectric generation.

Figure 165 **Water storage by region, 2010-11**



Source: Bureau of Meteorology, 2014

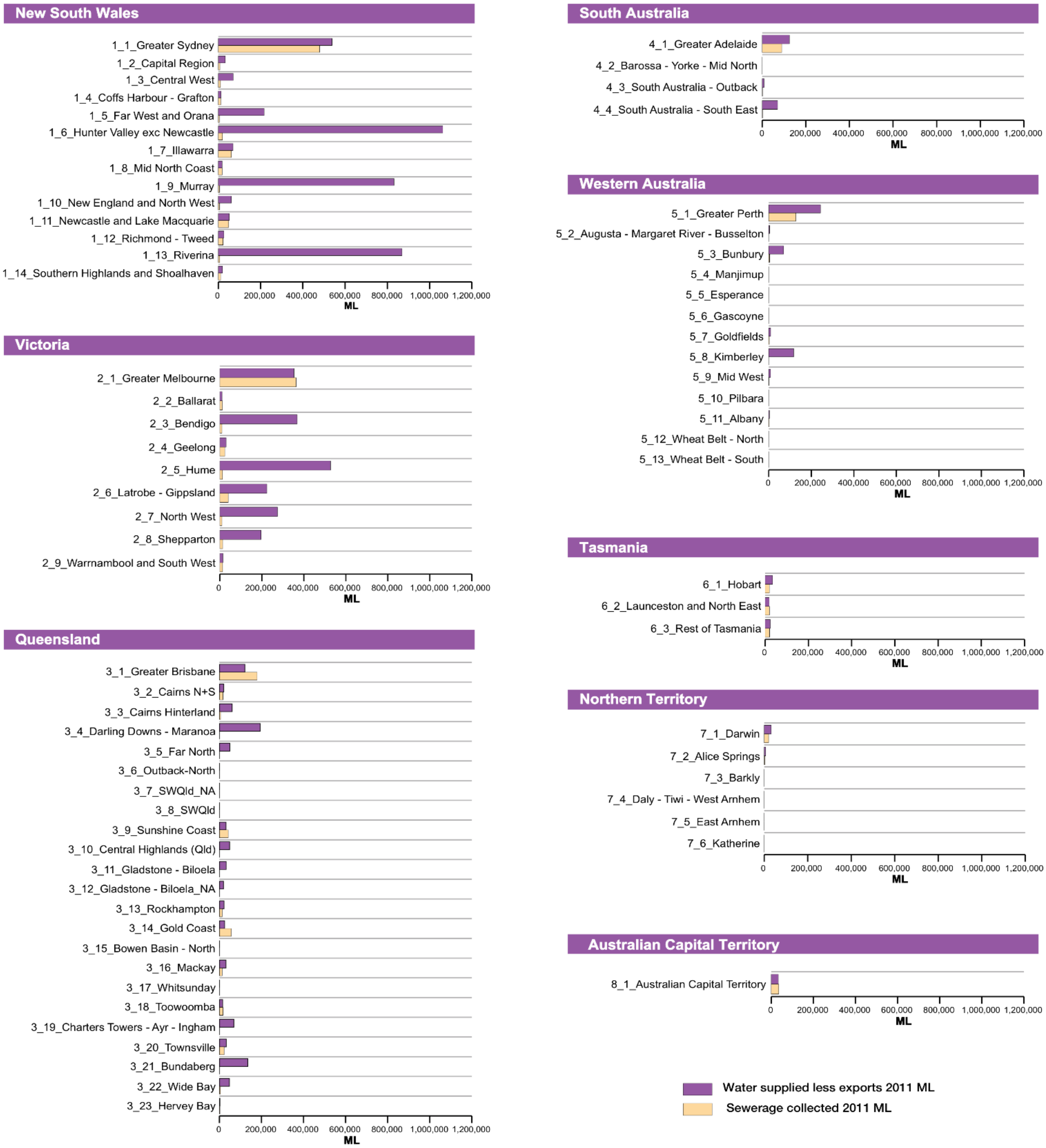
Lastly we note that desalination capacity is confined to the major metropolitan regions.

Utilisation metrics

Figure 166 shows the volume of water supplied and sewerage collected for each of the audit regions. The metropolitan regions show significant volumes of both water and sewerage delivered/collected.

The regions with sizeable irrigation activities are also evident, being the regions with large volumes of water delivered but only small or no volumes of sewerage collected. Examples of the latter include the Hunter Valley excluding Newcastle, Riverina, and the Murray region.

Figure 166 **Water supplied and sewerage collected by region, 2011**



Source: ACIL Allen Consulting, 2014

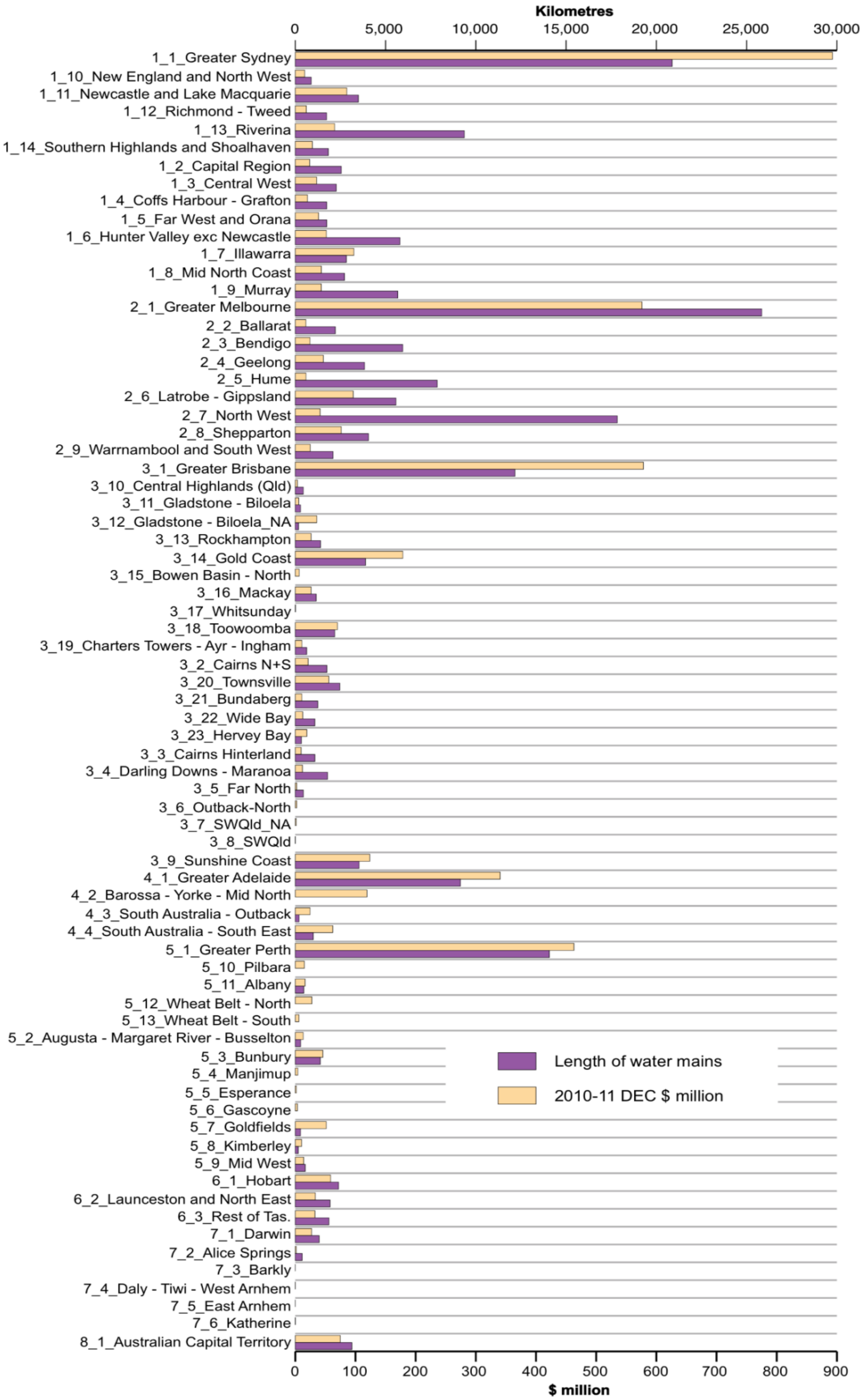
DEC metrics

Figure 167 and Figure 168 compares DEC by region with capacity as measured by length of mains, for both water and sewerage.[73] The DEC is relatively high for the main metropolitan regions, and this is true for both water and sewerage. (This is shown by the fact that the blue DEC line is relatively longer than the red line (length of mains) for metropolitan regions – particularly for Sydney, Brisbane, Perth and Adelaide, and for Melbourne for sewerage).

It is also apparent that in other regions the DEC for sewerage is low compared to the capacity measure, but the relationship between the DEC for water and length of mains is particularly low for the irrigation areas (as shown by the water side of the graph). This is consistent with the traditionally lower prices (and hence relatively greater subsidy) given to customers in rural regions).

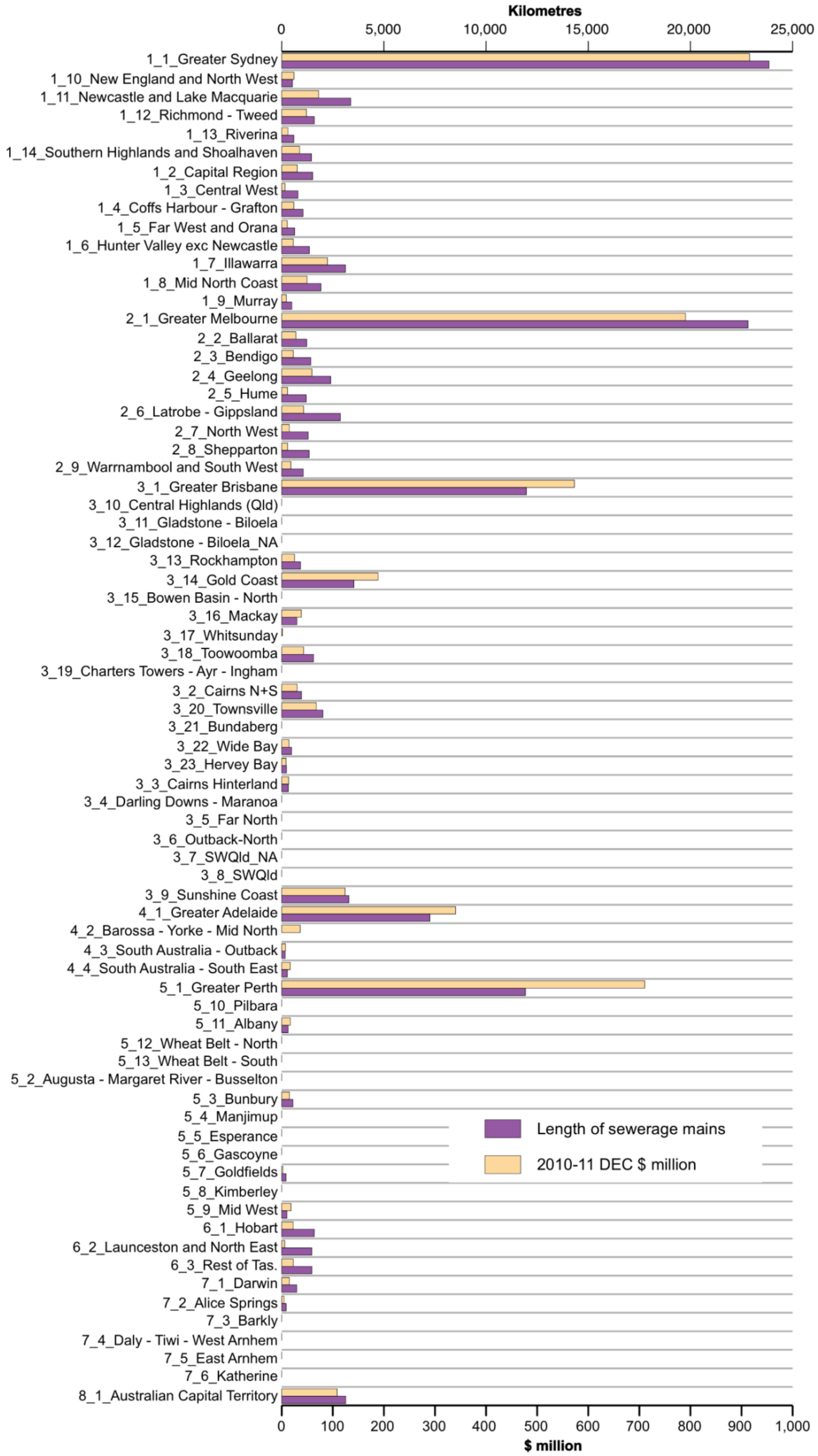
[73] To ensure comparability with the capacity information, we have used DEC as measured by the NWC data.

Figure 167 **Comparison of DEC ($ million) and capacity for water (length of water mains, kilometres)**



Source: ACIL Allen Consulting, 2014 calculations

Figure 168 **Comparison of DEC ($ million) and capacity for sewerage (length of sewerage lines, kilometres)**



Source: ACIL Allen Consulting, 2014 calculations

14.4 Projections for water and sewerage services infrastructure needs

This section presents the projections of demand for water and sewerage infrastructure and the corresponding projections of DEC which follow from our Baseline scenario.

As discussed above, infrastructure services in the water and sewerage sectors are necessarily delivered by the entire network. Thus projections of demand need to consider the key dimensions of services delivered, which concern the volumes delivered/collected and the number of properties served. Thus the key metrics that show projected demand are:

- Volume of water supplied to customers (ML)[74]
- Sewerage collected from customers (ML), and
- Number of properties served – water and sewerage ('000).

14.4.1 National projections

Utilisation metrics

Table 115 summarises the projections of demand for Australia as a whole. Projected demand for services will reflect both growth in population and growth in economic activity. In addition, the growth of water supplied to 2021 reflects the lifting of drought conditions in many regions, with the restoration of water entitlements to irrigators.

Table 115 **National projection of utilisation measures**

	2010-11	2030-31	Growth between 2010-11 and 2030-31 (%)
Volumes of water supplied (GL)	7,641	15,285	100
Volumes of sewerage collected (GL)	1,931	2,405	25
Number of properties served - water (million)	8.5	11.6	36
Number of properties served - sewerage (million)	7.8	10.6	37

Source: ACIL Allen Consulting, 2014

The volume utilisations of infrastructure services are assumed to grow in line with the projections for sector output derived from the CGE model, which will reflect population growth and sectoral adjustments. This means that the implications of changes in activity in one part of the economy will flow through to other sectors. For example, increased industrial activity will flow through into increased water usage. Similarly, the large-scale production of LNG that is forecast to come on-stream over the next couple of years results in exchange rate movements which serve to decrease projected output and DEC in 2016 and 2017 across many sectors and regions, including water.

In addition, consultations in several jurisdictions revealed that demand management activities were expected to dampen the effect of population growth on future demand for services.

[74] Net of exports to other water businesses to avoid double-counting

Where this was the case, the projections were adjusted to take into account the demand projections for individual utilities/regions. Demand management activities in the Greater Sydney, Darwin and Alice Springs regions serve to dampen future growth in demand.

Growth in the number of properties served is assumed to grow in line with regional population growth. The steps involved in developing projected usage were as follows:

— Review actual volumes supplied in 2010-11 to 2012-13 to determine appropriate forecasting base for each utility
— Adjust CGE growth projection as necessary
— Apply adjusted CGE output growth projection to base volumes, and
— Aggregate growth projection for each utility into region projections.

DEC metrics

The national economic contribution for water and sewerage infrastructure services in 2030-31 is projected to be $15,939 million in 2010-11 prices. This is a projected growth of 50 per cent from 2010-11 ($10,610 million).

The growth in DEC in the water and sewerage infrastructure sectors is somewhat lower than the projected growth in GDP over the same period, suggesting that water and sewerage infrastructure services will be declining in relative importance as a share of GDP.

Box 10 details aspects of the process for projecting DEC.

Box 10 **Approach to projecting economic contribution of water and sewerage infrastructure services**

Labour value added for 2010-11 and for the projection period is derived from CGE modelling of the Australia economy. Capital value added is derived from revenue less operating costs from the NWC data for 2011 to 2013, supplemented by the CGE model's information on capital value, where there are gaps in the NWC data.

The projections assume that capital DEC for the sector grows in line with the growth in sector capital value added as projected by the CGE model. The main driver of this growth is a combination of population growth and industrial/agricultural/commercial activities projected by the model, although it also assumes a low level of real price increases in the latter part of the period. In addition, as discussed above, the projections also take account of demand management activities which are expected to reduce the volume of water demanded in particular urban areas. Labour DEC grows in line with the CGE model projections for labour value added.

The steps involved in projecting the capital component of DEC are similar to the steps for projecting utilisation, although projecting DEC involves additional steps:

- Review actual volumes supplied in 2010-11 to 2012-13 to determine appropriate projecting base
- Adjust CGE growth projection as necessary for individual utilities
- Apply adjusted CGE growth projection to base volumes
- Apply to projected capital DEC any regulatory adjustment to future allowed returns to and of capital
- Aggregate DEC for all utilities operating in the region
- Add projected labour DEC for region from the CGE model.

Source: ACIL Allen Consulting, 2014

Table 116 provides a worked example of the projected volume of water supplied for Sydney Water Corporation under the Baseline scenario projections.

Table 116 **Calculation of projected DEC for water and sewerage in Greater Sydney region ($ million)**

Step		Description	2011	2012	2013	2014	2019	2024	2031
1	Review actual DEC		2011	2012	2013	choice of projection base 2013			
		Capital DEC water supply for SWC from NWC	557	531	461	461			
2	Adjust CGE projected growth as necessary					2014	2019	2024	2031
	Calculate CGE rate of growth for utility as weighted average of growth of water output in the regions it is located in	CGE projected rate of growth for SWC				2.12 per cent	1.05 per cent	1.56 per cent	1.46 per cent
	Adjust for planned demand management etc	Adjusted growth for SWC				0.35 per cent	0.84 per cent	0.65 per cent	0.16 per cent
3	Apply adjusted projected growth	Projected capital DEC water SWC				462	480	496	508
4	Apply regulatory adjustment if appropriate	Not applicable for SWC, decision incorporated in 2013							
		Revised projected capital DEC SWC				462	480	496	508
5	Allocate to region	100per cent allocation to Greater Sydney 1_1				462	480	496	508
	Add capital DEC for all water utilities in region	Total water capital DEC in region				490	509	526	538
5	Add projected labour DEC for water	Projected water labour DEC				288	319	327	333
6	Derive total DEC water supply	Total DEC water supply				778	828	853	872
7	Calculate total DEC sewerage	Total DEC sewerage				1,026	1,091	1,123	1,090
		Total DEC water and sewerage				1,804	1,919	1,976	2,019

Source: ACIL Allen Consulting, 2014 calculations

14.4.2 State/territory projections

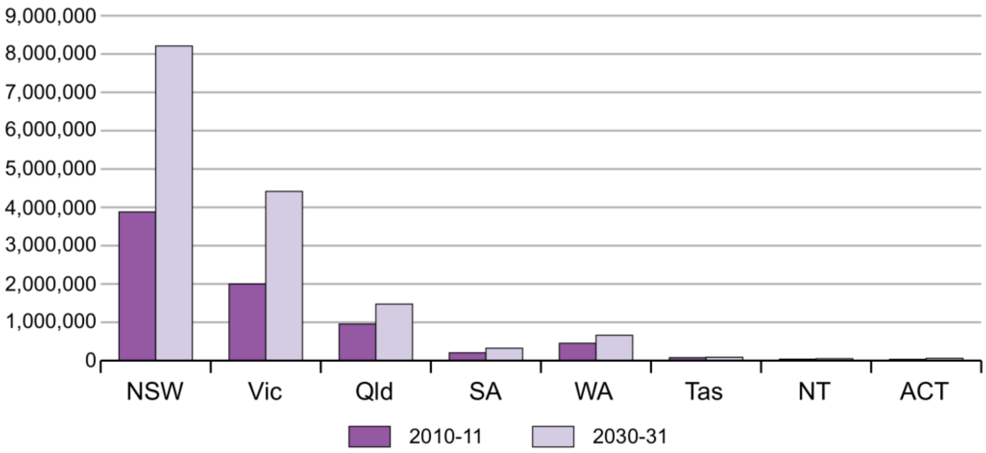
Utilisation metrics

The following figures show the projected pattern of growth in utilisation by state and territory over the period 2011 to 2031.

Figure 169 shows how the growth in water supplied varies by state and territory.

The rapid increase in water supplied in NSW and Victoria to 2021 reflects the restoration of allocations following the breaking of the drought, and in the case of Victoria, 2011 being a low volume year for many businesses because of flooding. As can be seen from the regional analysis below, large increases in the volumes supplied occurred in 2012 and 2013 in irrigation regions.

Figure 169 **Projected volume of water supplied, ML**



Source: NWC National reporting database, consultations, CGE projections

Figure 170 shows that growth in the number of properties served by water connections has been growing steadily, and is assumed to continue to grow in line with population.

Figure 170 **Projected number of properties served, water '000**

Source: NWC National reporting database, consultations, CGE projections

Figure 171 shows the projections for sewerage collected to 2030-31, which largely follows population growth and industrial activity.

Figure 171 **Projected volume of sewerage collected, ML**

Source: NWC National reporting database, consultations, CGE projections

DEC metrics

The table below shows the projected DEC for the water and sewerage infrastructure sector in 2030-31 by state and territory. The Northern Territory has the greatest proportional increase in DEC (132 per cent) while NSW has the smallest proportional increase (15 per cent).

Table 117 **Projected DEC of water and sewerage infrastructure in 2030-31 by state/territory**

Jurisdiction	2010-11	2030-31	Percentage growth
	$ m	$ m	%
NSW	2,971	3,403	15
VIC	2,150	3,252	51
QLD	2,439	4,062	67
WA	1,605	3,143	96
SA	947	1,364	44
TAS	239	282	18
ACT	209	316	51
NT	50	115	132
Australia	**10,610**	**15,939**	**50**

Source: ACIL Allen Consulting, 2014

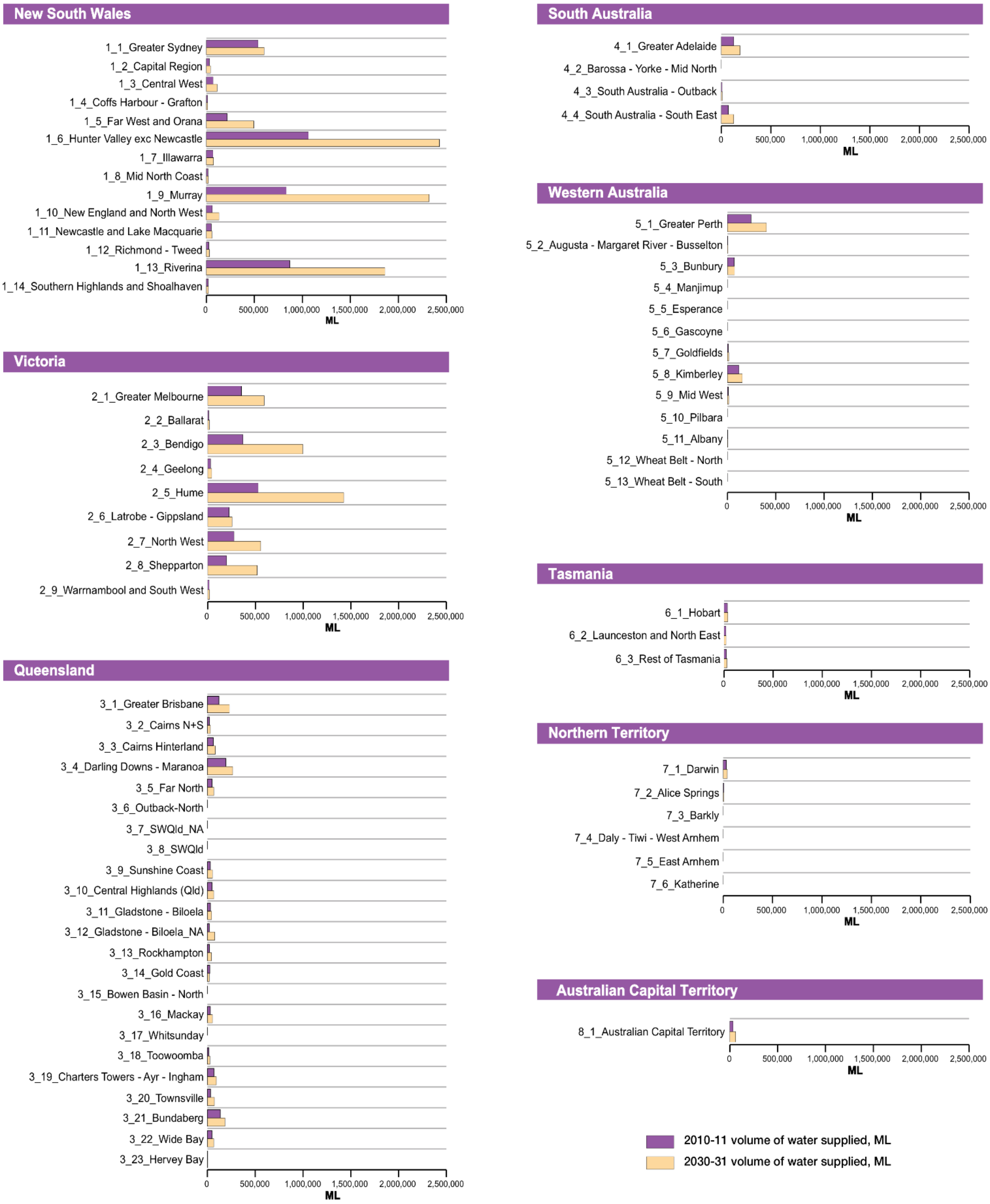
14.4.3 Regional projections

Utilisation metrics

The figure below shows the regions with the greatest projected volumes of water supplied are those containing significant irrigation districts, such as the Riverina, Murray and Hunter excluding Newcastle in New South Wales, and Bendigo, Hume and Shepparton in Victoria. These regions also show the greatest increases in volumes supplied, which are largely driven by the restoration of water allocations in the 2011-12 and 2012-13, following the breaking of the drought.

Note that the forecasts do not allow for the impact of variations in weather or climate, in effect assuming a central case. The forecasts will therefore be overstated to the extent that another drought arises and impacts allocations, and/or to the extent that there are significant allocation buy-backs in regions such as the Murray Darling basin.

Figure 172 **Projected volume of water supplied, 2010-11 to 2030-31**



Source: NWC National reporting database, consultations, CGE projections

By contrast, the regions with the greatest growth in the number of properties connected are the more densely populated urban areas, headed by Sydney and Melbourne, followed by Perth, Brisbane and Adelaide. This is shown in Figure 173 below.

Figure 173 **Projected number of properties connected – water**

Source: NWC National reporting database, CGE projections

It should be noted that the relatively rapid rise in the population and hence number of connections in some regions does not translate into proportionate growth in water delivered. In Greater Sydney, Darwin and Alice Springs, active demand management in being undertaken, which is expected to dampen the growth in demand for water and sewerage services.

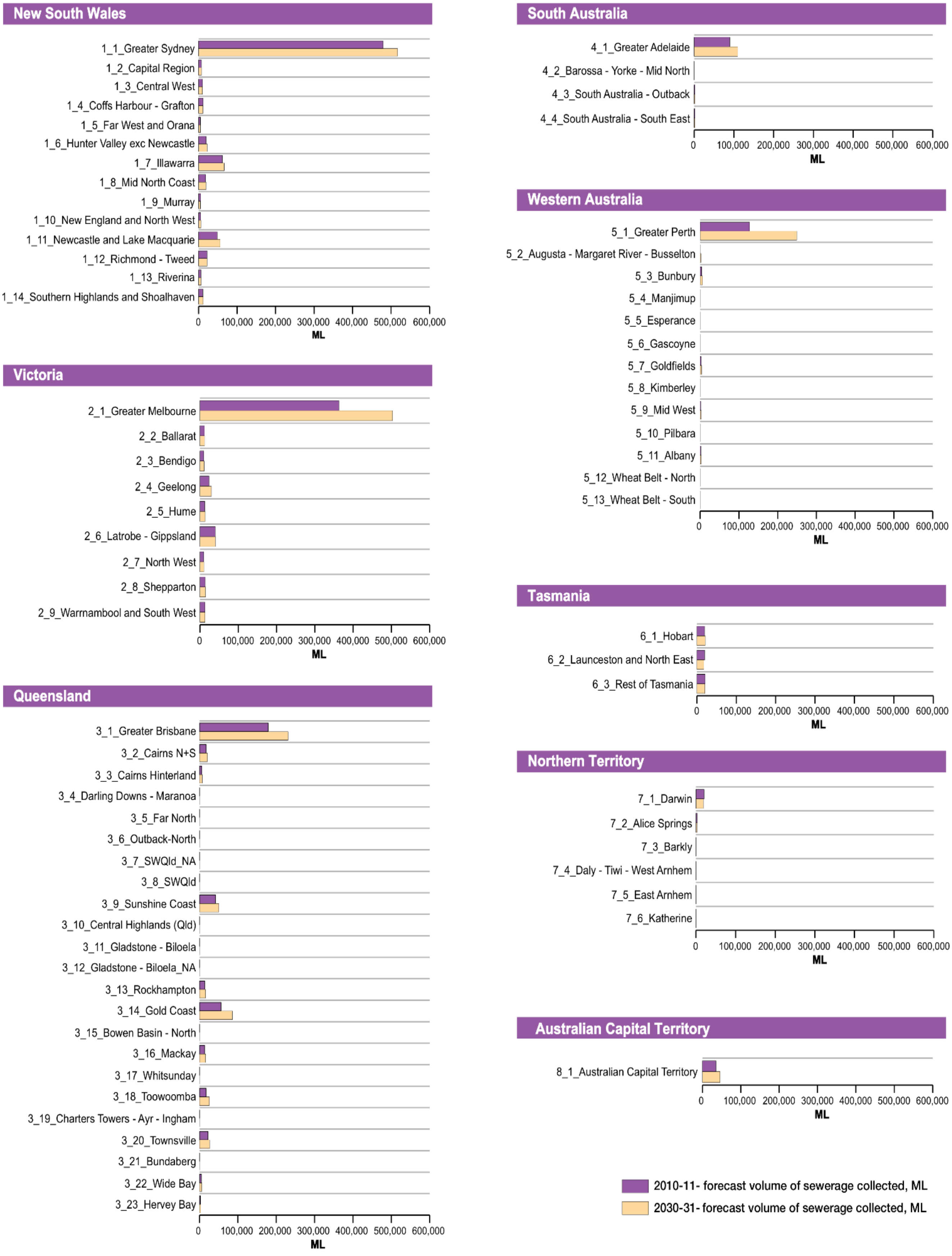
In the Sydney region, growth in demand is also dampened by the fact that the majority of new connections (around 80 per cent) are apartments, unlike other cities such as Melbourne where apartments form a lower proportion of the total additions to housing.

In Melbourne, the emphasis being given by the Office of Living Victoria (OLV) on whole of water cycling planning will also carry ramifications on the extent to which demand for water and sewerage services grows in line with population. OLV's earlier advice to the Ministerial Advisory Committee contained targets for reduced demand for potable water supply and sewerage collection. OLV is currently undertaking work to assess to what extent these targets might be met, however within the time frame for this study the Office was unable to provide any guidance on the extent of moderation they expect to be achieved. In the absence of firm forecasts from OLV, our projections for the Melbourne region are based on projections consistent with the water plans recently approved by the Essential Services Commission during the 2013 water price review.

Figure 174 shows projected growth in sewerage collected. The volume of sewerage is greatest in heavily populated areas, unlike the volume of water supplied which is dominated by irrigation areas. Accordingly, projected growth in sewerage collected largely follows population growth/industrial activity. The figure shows the volumes in Greater Melbourne growing rapidly, to catch up with Greater Sydney by the end of the period.[75]

[75] The increase in 2012 volumes for Sydney reflects NWC data.

Figure 174 **Projected volume of sewerage collected**



Source: NWC National reporting database, CGE projections

14.5 Projected DEC and infrastructure gaps

In this section, we project the economic contribution that accompanies the projected growth in demand for water and sewerage infrastructure services. By comparing the projected DECs in 2030-31 with those of 2011, we can identify the areas where there are 'gaps', and hence additions to be made to infrastructure.

Broadly speaking, larger gaps indicate where investment may need to take place to meet the future demand for infrastructure services.

A higher DEC in 2030-31 than in 2010-11 may be due to one or more of the following:

- delivery of a greater 'quantity' of service by 2031
- a higher price for the delivery of the service by 2031
- a reduction in the cost of provision of services by 2031 (increased efficiency).

The identification of a DEC gap is just one factor potentially pointing to a need for infrastructure investment. In particular, it does not imply that any particular project should proceed.

14.5.1 National gaps

There is a $5,329 million gap between the projected DEC in 2030-31 and the DEC in 2010-11 for the water and sewerage infrastructure sector across Australia. This gap results from a projected increase in DEC to $15,939 million in 2030-31 from $10,610 million in 2010-11.

14.5.2 State and territory gaps

Table 118 shows the gaps in DEC between 2010-11 and 2030-31 by state and territory.

Table 118 **DEC gap for water and sewerage: 2010-11 and 2030-31**

Jurisdiction	2010-11	2030-31	Gap	Percentage growth
	$ m	$ m	$ m	%
NSW	2,971	3,403	432	15
VIC	2,150	3,252	1,102	51
QLD	2,439	4,062	1,623	67
WA	1,605	3,143	1,538	96
SA	947	1,364	417	44
TAS	239	282	43	18
ACT	209	316	107	51
NT	50	115	65	132
Australia	**10,610**	**15,939**	**5,329**	**50**

Source: ACIL Allen Consulting, 2014

From the table it can be seen that the largest "gaps" in DEC arise for the larger states with the fastest rate of growth, namely WA, Queensland and Victoria. As we would expect, the rate of growth in sector DEC broadly follows the pattern of Gross State Product (GSP), as shown in Table 119.

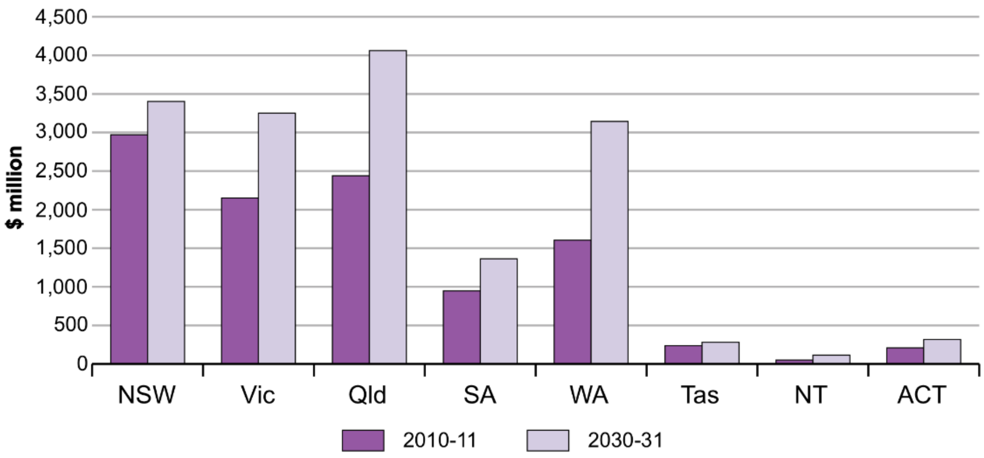
Table 119 **Growth in Gross State Product versus DEC water and sewerage sector, 2010-11 to 2030-31**

	Growth in real GSP	Growth in total DEC
	%	%
NSW	66	15
VIC	76	51
QLD	95	67
WA	131	96
SA	55	44
TAS	42	18
ACT	79	51
NT	100	132
Australia	**84**	**50**

Source: ACIL Allen Consulting, 2014

Figure 175 shows the growth in water and sewerage DEC by state/territory. The figure shows that the rapid growth of DEC in Queensland means that it overtakes NSW by 2030-31. Similarly, rapid growth in WA will see it catching up with Victoria and NSW in terms of infrastructure needs.

Figure 175 **Projected DEC in water and sewerage services in 2030-31 by state/territory**

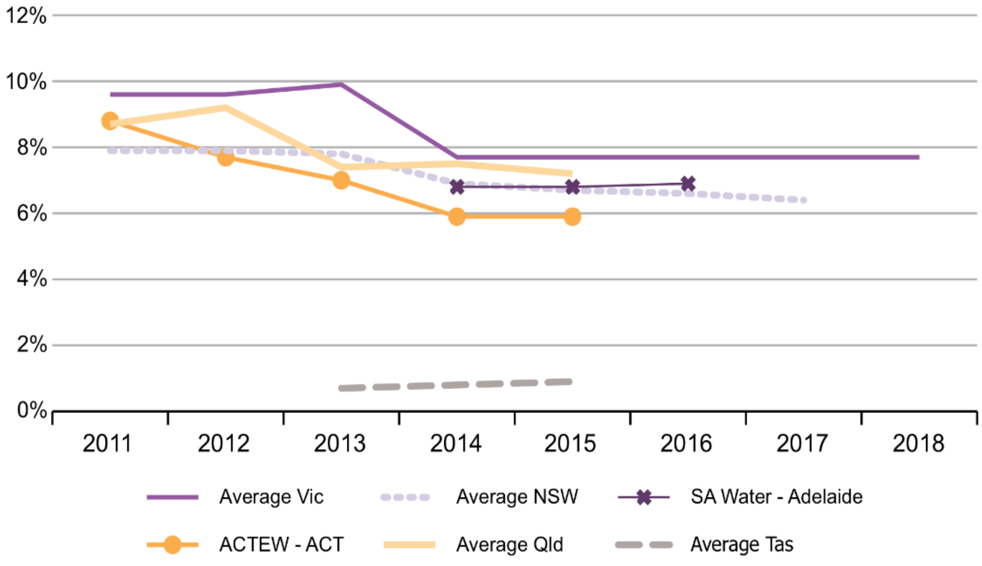


Source: NWC National reporting database, consultations, CGE projections

Capital value reflects the return on (i.e. cost of capital earned by the assets base) and the return of capital (i.e. depreciation). However recent regulatory decisions in a number of states have served to reduce the cost of capital earned by the regulatory asset base as well as increasing the depreciation life of assets in some cases. As a result, the DEC for a number of the regulated urban and regional water and sewerage businesses is expected to decline in 2014 or 2015. Where regulatory information is available, this has been incorporated into the DEC projections for the relevant years.

Figure 176 shows the pattern of capital value added as allowed by regulators in recent regulatory decisions. The figure shows capital value added as a percentage of the regulatory asset base (RAB).

Figure 176 **Forecast regulatory capital value added per RAB**

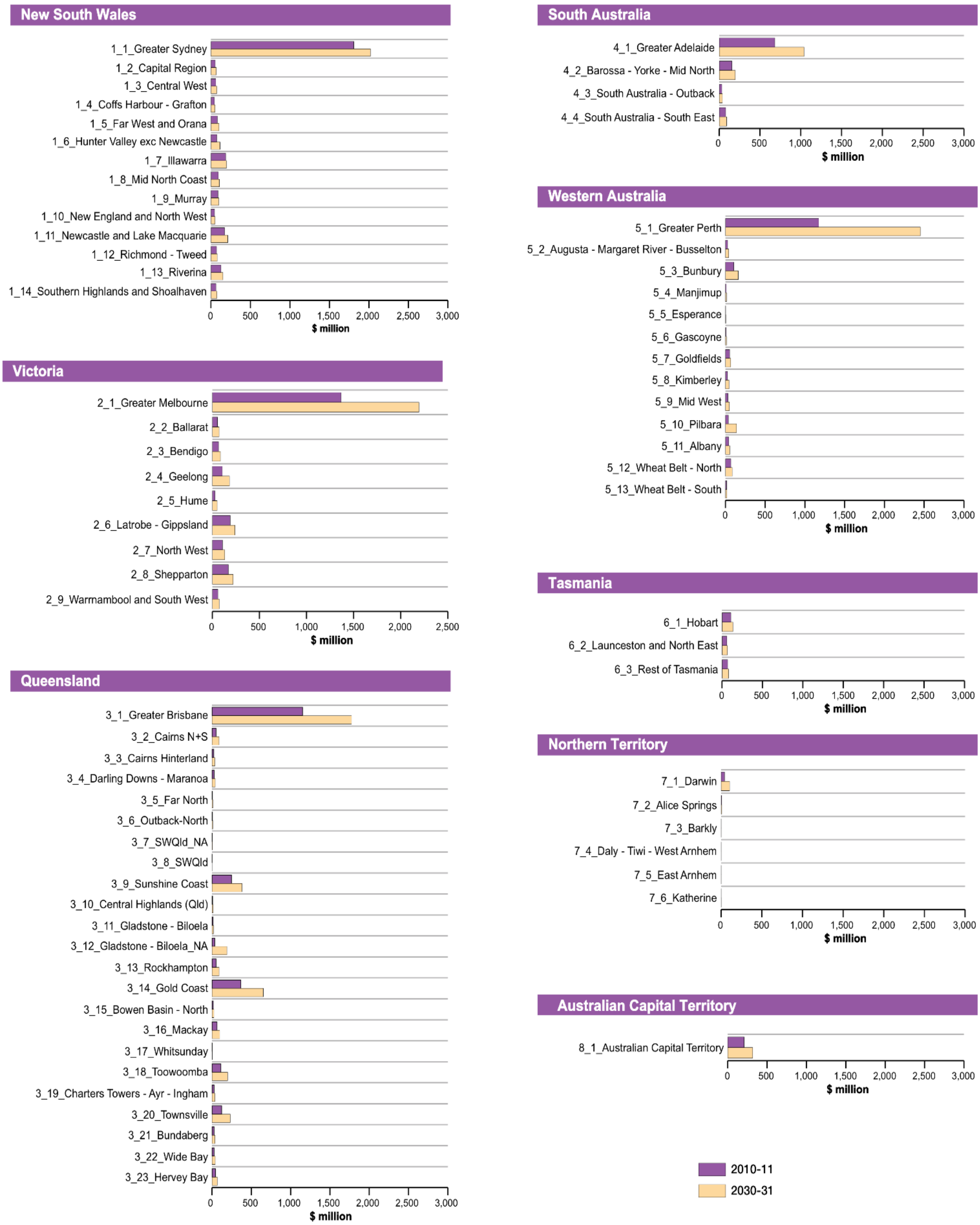


Source: Regulatory pricing decisions

14.5.3 Audit region gaps

DEC for water and sewerage in 2010-11 and projected 2030-31 DEC is shown for the regions in Figure 177. As expected, the greatest economic contribution is made in the capital cities. The Greater Sydney region makes the highest contribution in 2010-11, but its relatively slower growth means that by 2030-31 it is overtaken by Perth and Melbourne, with Brisbane also catching up.

Figure 177 **Projected DEC for water and sewerage services by region, 2010-11 and 2030-31 ($ million in 2010-11 dollars)**



Source: NWC National reporting database, CGE projections

14.6 Sensitivity analysis

This section examines how the future gap in water and sewerage infrastructure services varies under two alternative growth scenarios.

- the Higher population scenario, which incorporates the ABS Series A population projections
- the Higher productivity scenario, which assumes higher factor productivity in order obtain a 1 per cent higher growth in real GDP by 2031 (relative to the Baseline scenario).

The purpose of the sensitivity analysis is to test the extent to which the projected growth in demand for infrastructure services is sensitive to the assumptions used in the Baseline scenario.

Note that the sensitivity analyses consider only the base DEC calculations: they do not consider the alternative WDV DEC estimates for the sector.

14.6.1 National and state/territory impacts

The Higher population scenario was designed to test how high population and economic growth may affect the projected gap in infrastructure services.

Under the Higher population scenario, growth in output and DEC in the sector is higher than under the Baseline scenario on a national basis. Thus Australia-wide, DEC for the water sector reaches $16.6 billion in 2031 under the Higher population scenario, compared to $15.9 billion under the Baseline scenario, a 6 per cent increase in growth.

Under the Higher productivity scenario, the growth in DEC is again higher than under the Baseline scenario, but lower than under the Higher population scenario. Thus DEC for the water sector reaches $16.1 billion in 2031 under the Higher productivity scenario, implying a DEC growth of 52 per cent, compared to growth of 50 per cent under the Baseline scenario and growth of 56 per cent under the Higher population scenario.

Table 120 **DEC projections for sensitivity scenarios**

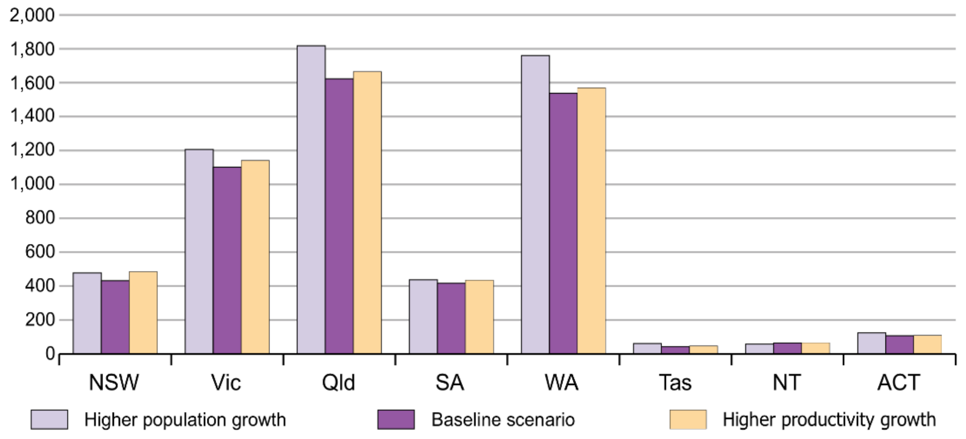
	DEC ($ million)				Growth in DEC		
	2010-11	Baseline scenario, 2030-31	Higher population scenario, 2030-31	Higher productivity scenario, 2030-31	Baseline scenario, 2030-31	Higher population scenario, 2030-31	Higher productivity scenario, 2030-31
NSW	2,971	3,403	3,449	3,456	15%	16%	16%
VIC	2,150	3,252	3,355	3,291	51%	56%	53%
QLD	2,439	4,062	4,257	4,105	67%	75%	68%
WA	1,605	3,143	3,365	3,175	96%	110%	98%
SA	947	1,364	1,384	1,382	44%	46%	46%
TAS	239	282	299	285	18%	25%	20%
ACT	209	316	333	318	51%	59%	52%
NT	50	115	108	116	132%	117%	133%
Australia	**10,610**	**15,939**	**16,551**	**16,128**	**50%**	**56%**	**52%**

Source: ACIL Allen Consulting, 2014 calculations

Table 120 shows projected DEC by state/territory, and the results are shown graphically in Figure 178. The figure shows the results for Baseline scenario as the central case, alongside the Higher population scenario and the Higher productivity scenario.

Growth in output and DEC in the sector in the Higher population scenario is higher than in the Baseline scenario for all jurisdictions other than the Northern Territory, which experiences reduced population growth due to migration to other states and territories. Under the Higher productivity scenario, growth in DEC is higher than under the Baseline scenario for all states/territories, including the Northern Territory. Moreover, the increase (relative to the Baseline scenario) is relative evenly spread – more so than under the Higher population scenario which shows relatively faster growth in states such as WA and Queensland.

Figure 178 **Projected increase in DEC of water and sewerage services to 2030-31, by scenario ($ millions in 2010-11 dollars)**



Source: ACIL Allen Consulting, 2014

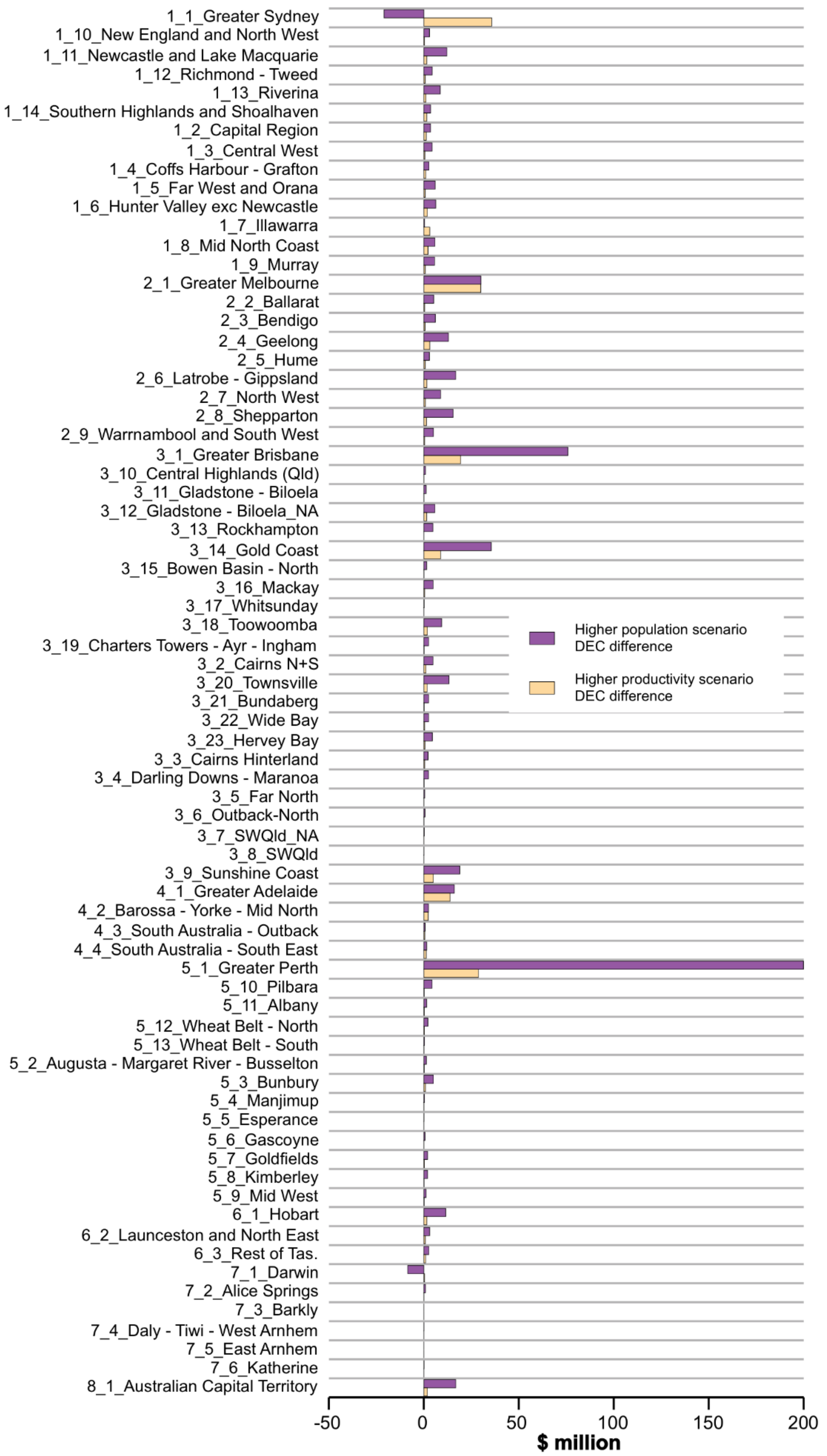
From Figure 178 it is apparent that the differences between the scenarios do not change the broad conclusions of the analysis regarding the states/territories where growth in demand for services will require increased investment in infrastructure. Under all three scenarios, the infrastructure gap will be greatest in Queensland, WA and Victoria, with lesser gaps appearing in NSW and SA. The lower starting point for DEC in the other states/territories mean that the future gap in DEC is smaller in absolute terms, however as can be seen from the table, the gaps are significant in proportionate terms under all three scenarios – particularly for the Northern Territory.

14.6.2 Audit region impacts

Figure 179 sets out the regional differences in DEC for 2030-31 for the Higher population scenario and the Higher productivity scenario relative to the Baseline scenario.

The figure shows that the differences from the Baseline scenario are greatest in the metropolitan areas. It also highlights the greater variability in impact of the Higher population growth scenario, which has particularly significant impacts on the projections for Perth, Brisbane, Melbourne and the Gold Coast.

Figure 179 **Sensitivity analysis of DEC relative to Baseline scenario by region (2010-11 dollars)**



Source: ACIL Allen Consulting, 2014 calculations

14.6.3 Implications of the sensitivity analysis

The sensitivity analysis provides a useful check of the robustness of the analysis. Overall the sensitivity analysis suggests that the broad conclusions derived for the Baseline scenario are robust, in that the growth in demand for infrastructure in different regions is relatively consistent across the scenarios. In particular the fastest-growing states show significant increases in DEC across all scenarios. There are some points of differences however, particularly under the high population growth scenario. This indicates that for individual regions any variations in the rate population growth will influence the extent of the infrastructure gap.

14.7 Issues and implications of findings

The section above has identified the gap in infrastructure that is projected for 2030-31 for water and sewerage services by examining the economic contribution of these services to the economy.

However, this method of identifying future infrastructure gaps implicitly assumes that the water and sewerage sector is in “steady state” (with both the amount of infrastructure and the economic contribution of the infrastructure assumed to grow proportionately with the activity of the sector). In turn, this assumes that the industry is in a financial steady state, with revenues sufficient to cover all expenses and provide a return on the replacement cost of assets used to deliver services.

It is important to recognise, therefore, that such a steady state assumption may be less applicable to water than other, more market orientated sectors and to understand the implications for the interpretation of our results. The first issue is the one raised in Section 14.5 above, namely the under-pricing of water. The second is an issue that was raised in consultations and by the expert panel, and concerns under-allowance for replacement and renewals expenditure. A final issue concerns the importance of security of supply as distinct from volumes supplied and the “lumpy” nature of capital expenditure in the industry.

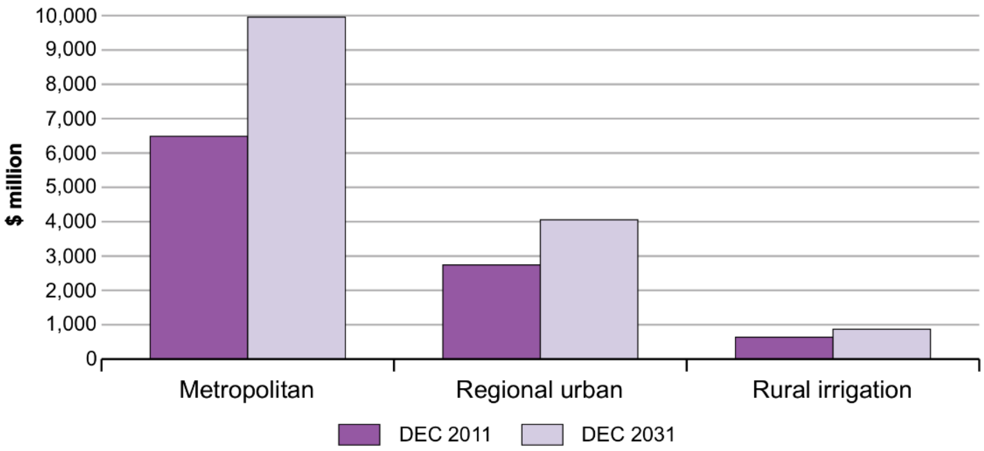
Under-pricing of water and sewerage services

As discussed above, prices for water and sewerage services have traditionally been under-priced in many jurisdictions, in the sense that the infrastructure base did not and still does not earn a full cost of capital. In the past, governments have funded significant investment in water infrastructure, without requiring a full economic return on that investment.

To see the potential extent and implications of water under-pricing, it is useful to group the regions into three broad types, metropolitan regional urban and rural. The metropolitan region covers the eight capital cities. Regional urban covers other urban and industrial areas. The rural irrigation region includes areas with significant irrigation services. Figure 180 shows the growth in DEC between 2011 and 2031, using this three-way classification of regions.[76]

[76] The analysis in this section considers only the DEC, and growth in DEC from the analysis of NWC data, to ensure comparability with the analysis of written down value which follows, since WDV is available only from the NWC data set and no equivalent data is available from the CGE data set.

Figure 180 **Growth in DEC of water and sewerage infrastructure to 2030-31, by region type (in 2010-11 dollars)**



Source: ACIL Allen Consulting, 2014 calculations

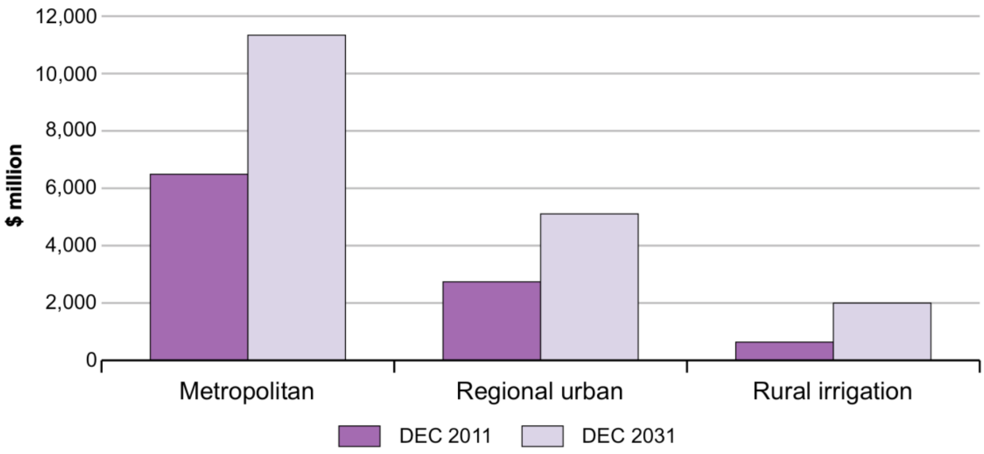
The figure shows that the growth in demand for services, and in DEC, is greatest in the metropolitan regions, with DEC increasing by 53 per cent over the twenty year period. This growth is despite the abatement in water demand (and associated sewerage services) expected to be achieved in the Sydney and Darwin regions as a result of demand management activities.

Growth in DEC in regional urban regions is slightly lower, at 48 per cent over the period, with DEC in rural regions projected to grow by 37 per cent.

Figure 181 below shows the implication for the growth in DEC, under our Baseline scenario, assuming full upper bound pricing (i.e. a full rate of return on and depreciation of the full value of all assets) is achieved by 2031. For this figure, upper bound pricing has been approximated by using the return on and of the WDV of assets rather than the actual return and depreciation allowance incorporated into revenues as per the NWC data[77]. As shown by the figure, the implied increase in pricing would result in substantial growth in DEC, some 75 per cent to 87 per cent for metropolitan and regional urban regions, with DEC more than tripling in rural areas.

77 Given the range of approaches for estimating WDV, there may still be some under-estimation of the value of assets, to the extent that business use an income rather than a cost approach to asset revaluation.

Figure 181 **Growth in DEC of water and sewerage infrastructure to 2030-31 under upper bound pricing (in 2010-11 dollars)**



Source: ACIL Allen Consulting, 2014 calculations

However for urban areas the movement towards upper bound pricing is not expected to be completed by 2030-31, and in many rural areas affordability is likely to preclude upper bound pricing altogether. Consequently just as Figure 180 under-estimates DEC, Figure 181 will tend to over-estimate the growth in DEC actually achieved by 2030-31. Indeed, the implication for prices of the new capital expenditures required to secure water supplies in the face of the recent drought have raised concerns about the general affordability of water and sewerage services. Nonetheless, commitments under the NWI, the arrangements for formal price regulation, and the efforts of governments to ensure full cost recovery will result in continuing upward pressure on prices and hence the growth in DEC required to meet infrastructure demands.

Under-recovery of the cost of renewals and replacement

A second issue for the projecting of DEC concerns the extent to which current prices and DEC make adequate provision for the replacement and renewal of assets. To the extent that all businesses have achieved lower bound pricing, and are moving steadily towards upper bound pricing, adequate provision for renewals and replacement should be incorporated within our DEC estimates. However, there is cause for concern that this is not the case for all businesses.

First, there is concern that at the time that independent regulation was established, not all businesses made sufficient provision for renewals and replacement – particularly in regional urban and rural areas. To the extent that was the case, the establishment of the regulatory “revenue building blocks” on the basis of past inadequate expenditures would have resulted in businesses needing to fund replacement/renewal from borrowing rather than it being funded through revenues.

A related issue concerns the calculation of the renewals annuity, and its replacement by depreciation on the regulatory asset base (RAB) under many of the jurisdictional price setting arrangements. The calculation of the renewals annuity involved taking account of all future expenditures expected to be incurred in maintaining the assets in serviceable condition. However in some cases the time frame used to assess the annuity was less than the life of the assets involved, with the result that the annuity was under-estimated for some businesses.

Even if the annuity represented a reasonable estimate of future renewals/replacement expenditure, a further issue has arisen with its replacement by depreciation on the RAB in some jurisdictions.

At the time that independent price regulation was introduced, many businesses (particularly businesses in rural regions) incorporated the renewals annuity in their building block revenue projections, rather than depreciation on the RAB.

However, since then many businesses stopped using the annuity and instead incorporated depreciation on the RAB into their price-setting proposals[78]. For businesses with regulatory asset bases that were set initially at zero or very low levels, this resulted in a reduction in the recovery of renewals expenses and hence prices. As a consequence, it is likely that the DEC for such businesses understates the capital economic contribution required for long term sustainability.

Many of the regional urban and metropolitan businesses opted for depreciation on the RAB rather than the annuity from the outset of independent price regulation. In theory, this should not have created any problem, since the combination of a return on and depreciation of the RAB was intended to provide for actual depreciation on assets plus a (low or zero) return on assets. However this means that the true funding requirement of the businesses to sustain their assets (as denoted by depreciation of the RAB) is misrepresented within revenue requirement presented by regulators. Moreover, in some jurisdictions a line-in-the-sand was drawn for initial asset values without any explicit consideration of the implied reallocation between returns and depreciation and whether the implicit allowance for renewals/depreciation was adequate.

The gearing of the businesses has been increasing steadily since price regulation was introduced, and is projected to increase beyond 50 per cent by 2016 for the industry as a whole. In this regard it is concerning to note that the performance of the Australian water industry with regard to financial ratios, such as interest cover, is worse than the UK despite debt being a lower proportion of regulatory asset value[79]. With the vast majority of future capital expenditure being for renewals/replacement purposes, there is considerable concern on the part of the industry regarding its ability to fund these capital expenditures. This suggests that in addition to the NWI related pricing pressures discussed above, there may be further upward pressure on prices, with the element of DEC needed to fund depreciation/renewals increasing over time.

Security of supply and lumpiness of capital expenditure

The final issue which will influence the appropriateness of a steady state assumption is the nature of capital expenditure in water and sewerage. Our assumption of a steady state implies that augmentations to the system, and the increases in DEC that follow, are proportional to the changes in services demanded as a result of increased population and economic activity.

In an industry with no economies of scale, this assumption provides a reasonable approximation, with new capacity being added as the demand for services increases. However in water there are two factors to be taken into account. First, not all capital expenditures are driven by changes in the demand for services, and secondly, the water

[78] In some cases, the transfer from the renewals annuity to depreciation on the RAB was required by the regulator.

[79] Presentation by Stuart Wilson, WSAA, “Best practice economic regulation of urban water April 2014”.

industry is subject to significant economies of scale which leads to “lumpy” capital expenditures.

Unlike other infrastructure, water faces very significant variations in supply capability as a result of climatic conditions.

This is in addition to sizeable weather-induced variations in the demand for water. As a result, water supply businesses play an important role in managing the security of their supplies, and well as meeting demand.

This means that over the short-to-medium term, climate change can be an important driver of capital expenditures, and in periods of climatic variability, changes in demand will not be the sole or even the major driver of investment.

The importance of economies of scale varies across the different elements of the supply chain. Economies of scale are very important for certain types of water resource assets (such as dams and desalination plants). Economies of scale are important but less so for water recycling capacity, and hardly at all for businesses that source their water from rivers or underground aquifers.

Likewise, economies of scale are important for the provision of treatment capacity for water and sewerage. However the ability to undertake expansion of treatment plan on an incremental basis means that economies of scale are less significant for treatment than for water resources. Economies of scale are even less relevant for water distribution and sewerage collection. Short term economies of scale can result in the oversizing of pipe networks relative to demand when they are first laid. However over the longer term, investment in pipes tends to be broadly proportional to the number of properties connecting to the system.

Consultations suggest that the additional infrastructure that will be needed to support projected growth largely relates to the distribution systems for water and sewerage. Additional expenditure is required on an incremental basis to meet the expansion of urban areas, to undertake renewals work and reinforce some existing pipe systems to meet increasing volumes of water demanded.

Some additional upgrading of water and sewerage treatment plants is also envisaged, again on an incremental basis. In most cities no major expenditures are envisaged for security of supply, or to improve environmental flows, although in some cases additional expenditures will be needed should drought conditions re-emerge. In the case of the NT, additional expenditure on security of supply for water and environmental issues for sewerage are envisaged, and all regions will be monitoring their exposure to climate risk.

Several jurisdictions reported that replacement and maintenance expenditures will be the major driver of capital expenditure for the foreseeable future. This is consistent with the focus on the distribution element of the supply chain. In several cases the amount of projected renewals expenditure is significant, raising concerns about its finance ability and the implications for affordability.

Overall, it is not clear what impact these factors will have on future capital requirements and the associated DEC. On the one hand, work on securing supplies is mostly complete for the time being, which suggests that future growth in capital expenditure will be less than proportional to current assets. On the other hand, future expenditure is concentrated on the distribution system, which requires broadly proportional expenditure, and in a number of regions a backlog of replacement and renewal work may push towards more than proportional expenditures.

Conclusions and policy implications

Figure 180 summarises our projected growth in DEC, assuming a steady state for the water industry. These results suggest that DEC will increase over the 2010-11 and 2030-31 period by:

- 53 per cent in metropolitan regions
- 48 per cent in regional urban regions, and
- 37 per cent in rural regions.

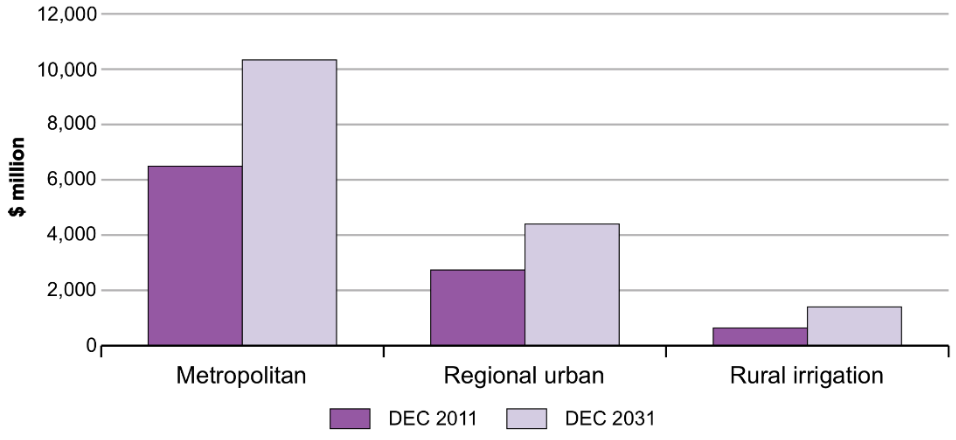
This growth in DEC reflects projected increases in the demand for water and sewerage services. However, the issues identified above will create a need for prices which rise in real terms over a prolonged period:[80]

- The NWI commitment to remunerate new capital expenditures at the full cost of capital will lead to ongoing increases in prices and DEC over the longer term
- Under-provision for renewals and replacement in some regions will create further increases in prices and DEC, to address the need for growing expenditure on replacement and renewals – especially in regions where there is a backlog of maintenance work, and
- Over the next 20 years, expenditure requirements may be somewhat less than proportional to the growth in demand, given recent expenditure on securing water supplies. However, the likely extent of this effect on the DEC projections is unknown and is unlikely to be sufficient to offset the other factors.

Figure 182 provides an illustration of how DEC might grow in the future, taking account of these various influences. To generate this projection we have assumed that:

- Over the period to 2031, the industry moves 27 per cent of the way towards recognising WDV for existing assets and new assets are included at full replacement cost for pricing purposes, and
- There will need to be a 40 per cent uplift in the amount provided for renewing and replacing assets.

Figure 182 **Projected growth in DEC – illustrative assumptions**



Source: ACIL Allen Consulting, 2014

[80] By more than assumed by the CGE model

Together these assumptions imply:

- a 62 per cent increase in DEC for metropolitan regions
- a 65 per cent increase in DEC for regional urban regions, and
- a 141 per cent increase in DEC in rural regions.

These results suggest there will be continued period of rising prices coupled with ongoing pressure on funding for at least some of the water businesses.

Yet the current emphasis on affordability of water and sewerage services indicates a limited appetite for the ongoing price rises required to ensure that all within the industry operate on a financially sustainable basis. Should such rises be resisted by government and/or regulators on affordability grounds, there will be a risk that the water businesses will begin to struggle to finance the required expansion of capacity without further injection of government funding.

The prospect for the rural sector looks particularly difficult. The scale of past under-pricing of water services coupled with the need to increase renewal spending in some regions implies large price rises over the forthcoming period. This will create very significant challenges for affordability within the rural sector.

15 Telecommunications

KEY FINDINGS

- This telecommunications services infrastructure examined ranges from the basic fixed voice network through to the National Broadband Network (NBN), involving all existing technologies. In addition, telecommunications services including person to person and machine to machine modes (both fixed and mobile) are included.
- The ubiquity of telecommunications services is indicated by most Australians and premises having access to telecommunications infrastructure, *albeit* different quality and availability. Currently 91 per cent of premises have access to fixed line broadband.
- The capacity and utilisation metrics reported for telecommunications services across Australia highlight the digital disparity in the provision of telecommunications services across Australia.
- Provision of telecommunications services is currently concentrated in the populated centres of Australia such as the capital cities. The economic contribution of telecommunications services is estimated to be $21 billion in 2010-11 with the Greater Sydney region being the audit region with the largest economic contribution, followed by Melbourne.
- The economic contribution of telecommunications services across Australia in 2030-31 is projected to be approximately $42.3 billion, nearly double the 2010-11 economic contribution of telecommunications services. The growth of telecommunications services is expected to be heavily concentrated in the capital city regions. This finding supports one of the Vertigan report's finding which found that there was the greatest net benefit from rolling out broadband in high population density areas where it sees the strongest demand and the best revenue and earnings potential.
- However the audit regions indicating the highest potential growth in telecommunications services is the Pilbara, Greater Perth and the Kimberley regions. This is a result of the projected growth in the mining and mining services sectors of the economy which are concentrated in the audit regions.
- A sensitivity analysis was carried out to estimate the sensitivity of the economic contribution projections to changes in key economic and demographic parameters. The projected economic contribution of telecommunications services is 2.6 per cent and 1.2 per cent higher respectively under the Higher population scenario and Higher productivity scenario in 2030-31 across Australia relative to the Baseline scenario.
- Most of the States have a higher economic contribution under the Higher population scenario except for New South Wales and Northern Territory, for which the economic contribution is higher under the Higher productivity scenario. This reflects the slower population growth expectations in these cities.

15.1 Telecommunications services in Australia

The telecommunications services industry in Australia represents a significant sector of the Australian economy which has a major influence on the competitiveness of other industries and makes an important contribution to economic activity in its own right.

Telecommunications infrastructure is among the more ubiquitous of the different infrastructure categories examined in this audit, in that virtually all Australians and premises have access to telecommunications infrastructure, *albeit* different quality and availability.

Telecommunications infrastructure producing telecommunications services comprises infrastructure that delivers customer access networks (CAN) and backhaul transmission networks. The key elements are:

— fixed line CAN infrastructure – represents the link between the telephone exchange and the customer and includes twisted pair copper wire and fibre-to-the-home/premises

- mobile CAN infrastructure – provides mobile telephone, data and multimedia services to mobile handsets
- backhaul infrastructure - connects telecommunication aggregation points to major nodes in capital cities or regional centres, and provides high-capacity links between capital cities, or from regional centres to capital cities.

These categories of telecommunications infrastructure need to be viewed together due to the convergence of the telecommunications technologies over time. While communications infrastructure has traditionally been based on vertically integrated and dedicated networks delivering separate services (such as radio, TV, fixed telephony and mobile telephony), modern telecommunication networks are converging to the use of a more horizontal network architecture that allows the delivery of multiple services to a single user device (such as a smartphone, a tablet or an laptop computer) via a common Internet-based platform.

A fixed broadband network can assist in the provision of wireless broadband services by enabling high bandwidth backhaul connectivity in previously underserved areas. In addition, as mobile networks reach maturity, mobile network operators will try to avoid high capital cost conventional expansions by adopting solutions involving Wi-Fi for cellular networks to address capacity issues.

The backhaul infrastructure is complemented by eight intercontinental submarine cables that transfer high data volumes between onshore nodes in Australia and other countries.

For the purposes of inclusion in this audit, telecommunications services range from the basic fixed voice network through to the National Broadband Network (NBN), involving all existing technologies. In addition, telecommunications services providing person to person and machine to machine modes, including both fixed and mobile, are included.

Telecommunications services are currently provided by the following types of entities:

- **Carriers -** Owners of networks used to supply carriage services to the, including;
  - Telstra – which is a fully integrated telecommunications company providing fixed line, wireless, pay TV, satellite, transmission, data and broadband offering
  - Optus – which is mainly a wireless provider and corporate data provider
  - Vodafone – which is mainly a mobile service provider
  - Pure broadband providers (e.g. iiNet, TPG), hundreds of niche broadband and data providers and niche corporate providers
- **Carriage service providers -** Organisations that use a carrier service to supply telecommunications services to the public using a carrier-owned network. Internet service providers (ISPs) are carriage service providers (e.g. iiNet)
- **Content service providers** - Organisations that supply radio and TV broadcasting and on-line services to the public (e.g. the ABC)
- **App developers -** Businesses that produce mobile applications for sale or to facilitate customer or business interactions

15.2 Telecommunications services in Australia

15.2.1 The significance of telecommunications services to economic activity

Telecommunication services represent a key sector in the Australian economy, both in terms of their direct contribution and in facilitating economic activity in other sectors. As of 2011-12, the Australian telecommunications industry:

- earned revenues of $40.8 billion[81]
- had capital expenditure in terms of gross fixed capital formation of $7.1 billion[82]
- had capital stock valued at $124.0 billion[83]

Telecommunications services have also played a key role in influencing and shaping social activity. The Internet has revolutionised the way businesses contract and communicate with customers and suppliers. It has also fundamentally altered the way people communicate with one another, transact with businesses, identify tastes and preferences, understand, learn and exchange information.[84] The impact of the Internet has been greatly amplified by the introduction of broadband technologies.

Broadband is an enabling technology that generates substantial benefits to the macroeconomy in terms of economic growth, employment, productivity, welfare and investment. Businesses benefit from broadband through productivity gains, reductions in operating costs and increased revenue through enhanced access to markets.

Broadband provides households with increased convenience and choice of recreational and personal services, as well as generating new ways of supporting and connecting communities. By making telecommunication more viable, facilitating improved distance education and improving access to markets, broadband helps regional, rural and remote areas overcome the barriers of distance.

Mobile telecommunications enhances business productivity by increasing the effectiveness of employees or managers, by saving time (labour productivity) or by increasing the effectiveness or reducing the need for computers, vehicles, office space or other capital (capital productivity).[85]

15.2.2 Regulatory and public policy framework for telecommunications

Telecommunications in Australia is essentially a national undertaking and is regulated nationally under the *Telecommunications Act 1997*. The larger providers within the sector are national businesses, in some cases international, although there are also smaller providers and niche operators. Over time, the Australian government has sought to introduce competition into the industry which has resulted in the existing market structure for the telecommunications industry (see Box 8 for more detail on the evolution of the industry).

Current regulatory framework

The Australian Government's strategic vision for telecommunications reflects the view that, while telecommunications is a significant contributor to the economy and to the lifestyle, health and safety of the community, market forces should be the primary driver of its provision and innovation.

Australia's telecommunications industry is currently subject to a regulatory framework defined by the *Telecommunications Act 1997*. Its core aim is to promote the long-term interests of end-users of telecommunications services. The framework relies on industry

81 IBISWorld Industry Report J7100: Telecommunications Services in Australia, May 2012.

82 BITRE, Australian infrastructure statistics: yearbook 2013.

83 ABS 5204.0 Australian System of National Accounts

84 Communication Alliance, *Economic Impacts of Broadband for Australia and Globally: Possibilities and opportunities in a digital world*, December 2008.

85 Deloitte Access Economics, *Mobile nation: The economic and social impacts of mobile technology*, February 2013.

self-regulation to develop codes and standards in all areas that apply to the sector. However, Government regulators have the power to intervene if industry self-regulation is deemed not to be working effectively in specific instances.

The documents underpinning industry self-regulation are:

- **Industry Codes**, which are rules or guidelines developed by industry governing particular aspects of telecommunications
- **Industry Standards**, which are rules or guidelines similar to industry codes, but determined by the Australian Communications and Media Authority (ACMA)
- **Technical Standards** that cover the technical parameters of customer equipment, such as cables and networks

Two other key elements of the regulatory framework are:

- *Telecommunications (Consumer Protections and Service Standards) Act 1999*, which legislates a number of consumer protection matters, particularly the Universal Service Regime, the National Relay Service, and continued access to untimed local calls
- *Trade Practices Act 1974*, which includes two telecommunications-specific parts, Parts XIB and XIC, covering anti-competitive conduct provisions and a telecommunications-specific access regime respectively.

Another significant development affecting the telecommunications sector is that traditional industry barriers between news, media free to air television, pay television and mobiles are breaking down and converging. This convergence is also meaning that device manufacturers (Samsung, Apple, Nokia), software, online news, media, radio, entertainment providers, data and entertainment streaming, applications (Google, Facebook, LinkedIn) are competing.

Since the election of the Coalition in 2013, the government has moved the delivery of the NBN from a fibre to the home model (FTTH) to a multi-technology mix which is a blend of fibre to the node (FTTN), FFTH, hybrid fibre-coaxial cable (HFC), wireless and satellite.

The NBN

On 7 April 2009, the Commonwealth Government announced that the NBN would operate as a wholesale-only, open access and non-discriminatory network and, by doing so, fundamentally reshaped the provision of telecommunications services in Australia. The Government's commitment to providing Australians with access to fast broadband is evidenced by:

> The Government is committed to completing the construction of the National Broadband Network and doing so ensure that all Australians have access to very fast broadband as soon, as cost-effectively and affordable as possible.
>
> *Turnball M. and Corman M., Government Expectations: Letter to NBNCo, 24 September 2013.*

Like all telecommunications industry participants, NBN Co is regulated under the *Telecommunications Act 1997* and the *Competition and Consumer Act 2010*. NBN Co specific requirements have been enacted by the *National Broadband Network Companies Act 2011* and the *Telecommunications Legislation Amendment (National Broadband Network Measures - Access Arrangements) Act 2011*.

NBN Co can supply services to carriers and carriage service providers, and to specified utilities, in which case the NBN Co services may only be used for the utilities' own use and must not be re-supplied. Fixed line and wireless broadband connections are sold to retail service providers (RSP), who then sell Internet access and other services to consumers.

NBN Co cannot supply content services, non-communications services or goods. The Communications Minister can require NBN Co to supply, or not supply, particular services.

All services provided by NBN Co are 'declared services' (that is, regulated) under Part XIC of the *Competition and Consumer Act*, and are subject to supply and non-discrimination requirements and oversight by the ACCC. NBN Co cannot discriminate in the supply of services between access seekers, or in activities related to the supply of those services, other than in relation to creditworthiness and non-compliance with terms and conditions.

Box 11 **Evolution of competition in telecommunication services**

In 1946, the Commonwealth Government established the Overseas Telecommunications Commission (OTC), which became a monopoly provider of all forms of telecommunications linking Australia and the rest of the world.

Telecommunications was separated from postal functions in 1975, with the passage of the Telecommunications Act 1975. This new legislation saw the establishment of two separate statutory authorities, the Australian Postal Commission and the Australian Telecommunications Commission (trading as Telecom Australia).

In 1989, the Australian Telecommunications Commission was restructured as the Australian Telecommunications Corporation while continuing to trade as Telecom Australia. That year saw the last domestic telegram handled by Telecom, with responsibility for telegram operations handed over to Australia Post.

In 1992, Telecom Australia and OTC merged to form the Australian and Overseas Telecommunications Corporation Limited (AOTC, still trading as Telecom Australia). AOTC was rebadged as Telstra Corporation in 1993, trading internationally as Telstra from that year and domestically as Telstra from 1995.

In 1981 AUSSAT Pty Ltd, another government agency, had been established to operate domestic satellite telecommunications and broadcasting services. In practice, AUSSAT's charter restricted it from acting as a competitor to Telecom, including a prohibition on interconnecting public switched traffic with Telecom's network.

In 1982, the Davidson Enquiry regarding private sector involvement in the delivery of existing/proposed telecommunications services recommended ending Telecom Australia's monopoly. However, this recommendation was not realised for many years.

Nearly a decade later, proposals for a merger of the failing AUSSAT and OTC (thereby permitting national delivery of telecommunication services in competition with Telecom) were rejected in favour of disposal of the satellite operator to a non-government entity that would be allowed to compete with Telecom.

Soon after this decision, in November 1991 Optus Communications – a private sector entity owned by a consortium that included UK telecommunications company Cable & Wireless and US telecommunications company BellSouth – was awarded Australia's second general carrier licence when it purchased AUSSAT's satellite assets, with many of the non-satellite assets remaining with the Government as part of Telstra. Cable & Wireless, privatised after several decades of UK government ownership, took a controlling stake in Optus in 1998 (under the banner Cable & Wireless Optus) before control passed to SingTel in 2001.

Optus was initially allowed to enter the Australian telecommunications marketplace for national long distance and international telephone calls. 'Pro-competition' mechanisms under the Trade Practices Act 1974 – such as guaranteed access to Telecom's existing infrastructure on reasonable terms – were established to ensure its viability.

In the meantime, Telstra also faced competition in market niches, such as long distance corporate voice and data services, from companies such as AAPT. In 1995, four years after its inception, AAPT launched a mobile phone service, using Vodafone as its network supplier. It gained a carrier licence the following year, enabling it to offer long distance services to the residential market.

Australia's telecommunications market was formally opened to full competition in July 1997, with removal of restrictions on the number of licensed operators and anti-competition mechanisms, which were replaced by general competition law under the oversight of the Australian Competition and Consumer Commission (ACCC). The new regime featured a single national phone numbering scheme and any-to-any connectivity requirements, with the expectation that mobile phones, fixed-line phones and other devices would be able to communicate with each other irrespective of whether the service was provided by Telstra or one of its competitors.

At the end of 1998 there were over 20 licensed telecommunications carriers controlling facilities in Australia, with several hundred other entities using those facilities to provide services to consumers. By May 2002, the number of telecommunications carriers had risen to 99.

While there are many industry players, the fixed line and mobile markets in Australia remain heavily concentrated. The fixed line market is dominated by Telstra (with a market share of 74 per cent in 2013), followed by Optus (9 per cent) and AAPT (9 per cent). In the mobile market, in 2013 Telstra had a market share of 40 per cent, Optus 27 per cent, Vodafone 25 per cent and AAPT 5 per cent.

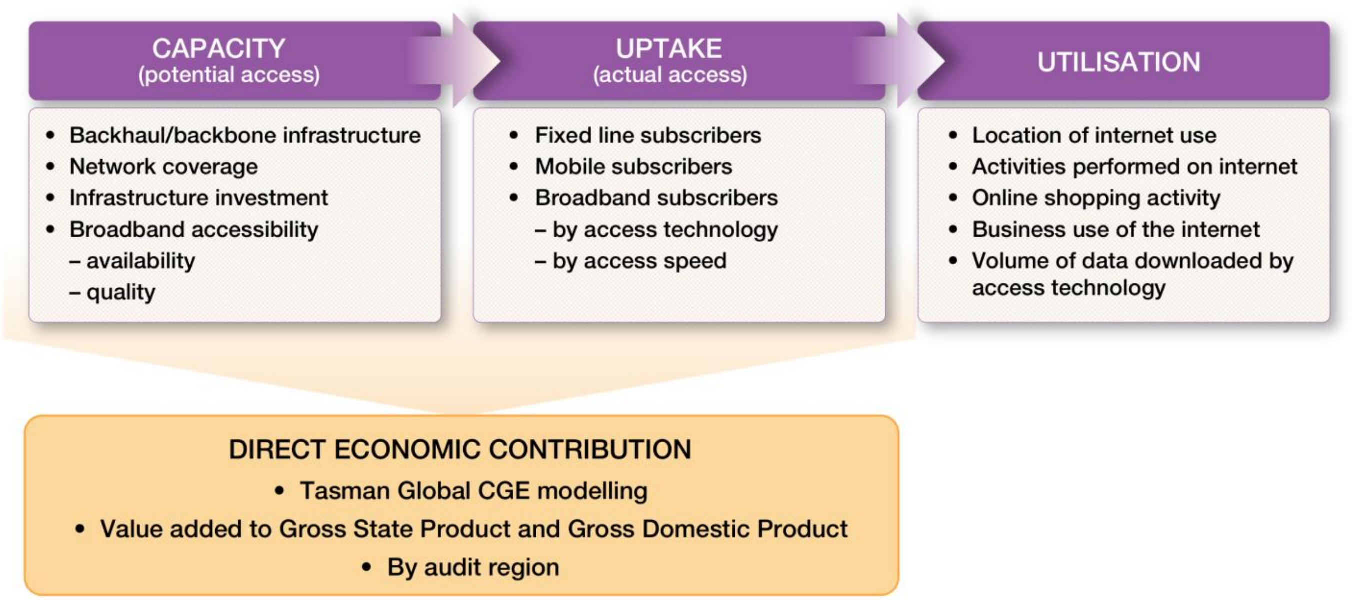
Source: ACIL Allen Consulting, 2014

15.3 Audit of existing telecommunications infrastructure

ACIL Allen’s analysis of the telecommunications infrastructure in Australia focuses on access to the Internet through various broadband technologies (both fixed and mobile).

Figure 183 highlights the data used to quantify the existing capacity (potential access) of the telecommunications sector, the uptake of services (actual access) by consumers and the utilisation of telecommunications services across Australia.

Figure 183 **Capacity, uptake and utilisation in the telecommunications sector**



Note: The dot points in each box reflect the data items analysed by ACIL Allen in this audit
Source: ACIL Allen Consulting, 2014

Metrics on capacity, uptake and access provide an indicator of the efficiency of telecommunications services in Australia. While investment in telecommunications infrastructure determines the potential capacity of telecommunications services, the capacity that is actually available to end users is determined by their uptake or subscription, which is influenced by factors such as the prices charged by providers of fixed broadband and mobile telecommunications services. In turn, the end users' utilisation of telecommunications services will often be constrained by their subscription choices. Obviously, the relationship between subscription and utilisation can be bi-directional in that a heavy user of telecommunications services might choose to subscribe to a more expensive mobile or fixed broadband plan that offers higher speeds and/or greater data limits.

15.3.1 Capacity of telecommunications infrastructure

One measure of telecommunications capacity that has been suggested in the literature is the data transmission/transfer rate, usually expressed as the number of bites of data per second. In computer networks, this is also known as the bandwidth of the network. A deficiency with this measure is that because an actual telecommunications network is made up of a succession of links, each with its own bandwidth, the slowest link (the bottleneck) often determines the overall data transfer rate of the network.

Availability of broadband

In Australia, approximately 9.9 million premises (91 per cent) have access to fixed line broadband services delivered via asymmetric digital subscriber line (ADSL) technology. Approximately 28 per cent of premises have access to a high speed broadband platform, which includes fibre to the premises (FTTP), fibre to the node (FTTN), hybrid coaxial (HFC) networks and fixed wireless networks. Six per cent of premises are unable to access a fixed broadband service.[86]

[86] Department of Communications, *Broadband Availability and Quality Report*, December 2013

To measure the capacity of the telecommunications sector in each audit region, ACIL Allen has drawn upon the Australian Government Department of Communication's dataset on broadband accessibility in Australia. Broadband accessibility is measured by two indicators: availability and quality.

As explained in its accompanying report, the dataset contains availability and quality ratings for approximately 94,000 Telstra Distribution Areas (DAs) across Australia. A DA is a network component of a Telstra Exchange Service Area (ESA), typically comprising 100-200 premises.[87] ACIL Allen has calculated the availability and quality ratings for each of our 73 audit regions by computing the average of the availability and quality ratings across the DAs in each audit region, weighted by the number of premises in each DA.

The availability rating of each DA (on a scale from 'A' to 'E', with 'A' being the highest rating, which has subsequently been converted by ACIL Allen to a corresponding numerical scale from 1 to 5) is awarded based on the proportion of premises in the DA which have access to at least one fixed broadband technology. The broadband availability rating scale is shown in Table 121.

For example, a DA is awarded a 'C' rating for broadband availability if 40-60 per cent of premises in the DA have access to at least one fixed broadband technology.

Table 121 **Fixed broadband availability rating scale**

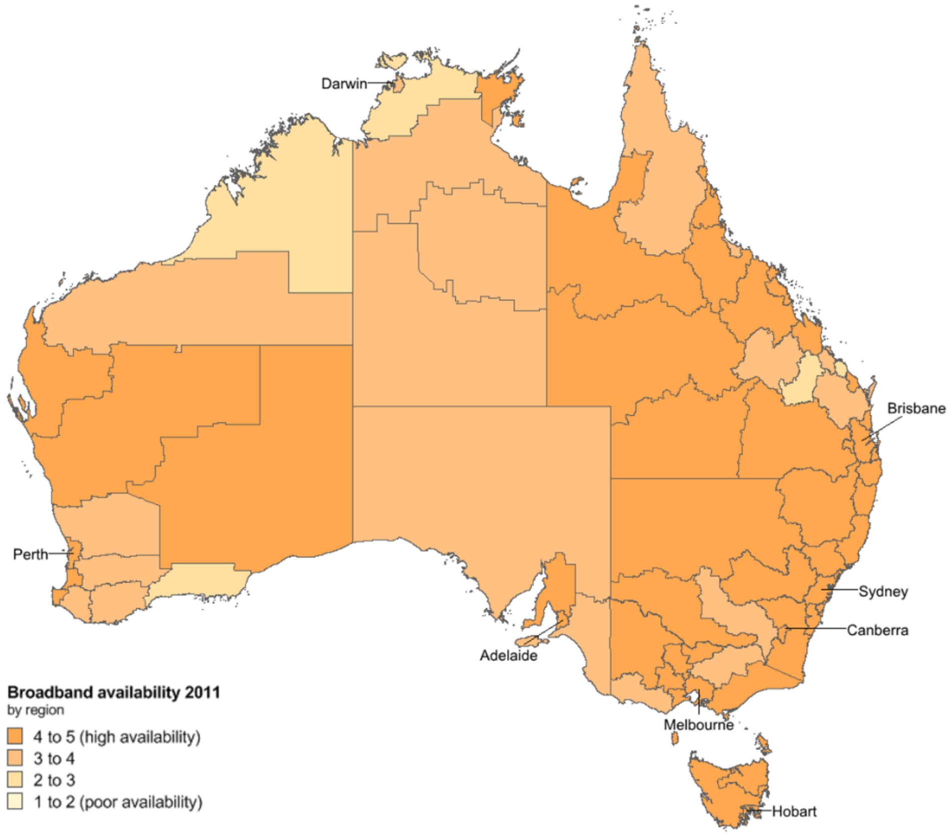
Rating (alphabetical)	Rating (numerical)	Description
E	1	This is the lowest availability rating. Between 0 and 20 per cent of premises in the area surrounding an address have access to at least one broadband technology
D	2	Between 21 and 40 per cent of premises in the area surrounding an address have access to at least one broadband technology
C	3	Between 41 and 60 per cent of premises in the area surrounding an address have access to at least one broadband technology
B	4	Between 61 and 80 per cent of premises in the area surrounding an address have access to at least one broadband technology
A	5	This is the highest availability rating. Between 81 and 100 per cent of premises in the area surrounding an address have access to at least one broadband technology

Source: Department of Communications, Broadband availability and quality dataset, ACIL Allen Consulting, 2014

Most regions of the country have reasonable broadband availability with access to at least one broadband technology: the exceptions being the more remote parts of Queensland, Western Australia and the Northern Territory – see Figure 184 which maps the average broadband availability across Australia by audit region.

[87] *Ibid.*

Figure 184 **Map of broadband availability by audit region**



Source: Department of Communications, Broadband availability and quality dataset, ACIL Allen calculations, 2014

It is noted that, even within regions with a good average availability rating (including metropolitan and outer metropolitan areas), there are pockets with very poor access to broadband.

Quality of broadband

In Australia, approximately 3.1 million premises (28 per cent) have access to peak download speeds of between 25 megabits per second (Mbps) and 100 Mbps.[88] The corresponding proportions in New Zealand, the UK and US are 27 per cent, 73 per cent and 83 per cent respectively.

A majority of premises in Australia (65 per cent) have access to peak median download speeds of less than 24 Mbps over the copper network. Of the 7.1 million premises with access to ADSL broadband services over copper, about 3.7 million are located in areas with an estimated peak median download speed of less than 9 Mbps while 920,000 are in areas with an estimated peak median download speed of less than 4.8 Mbps.

In the Department of Communications, broadband accessibility dataset, the quality rating of each DA (again on a scale from 'A' to 'E', with 'A' being the highest rating, and also subsequently converted by ACIL Allen to a corresponding numerical scale from 1 to 5) is awarded based on the range of broadband access technologies (with different speed implications) available to premises in the DA. The broadband quality rating scale is shown in Table 122.

88 Department of Communications, *Broadband Availability and Quality Report*, December 2013.

Table 122 **Fixed broadband quality rating scale**

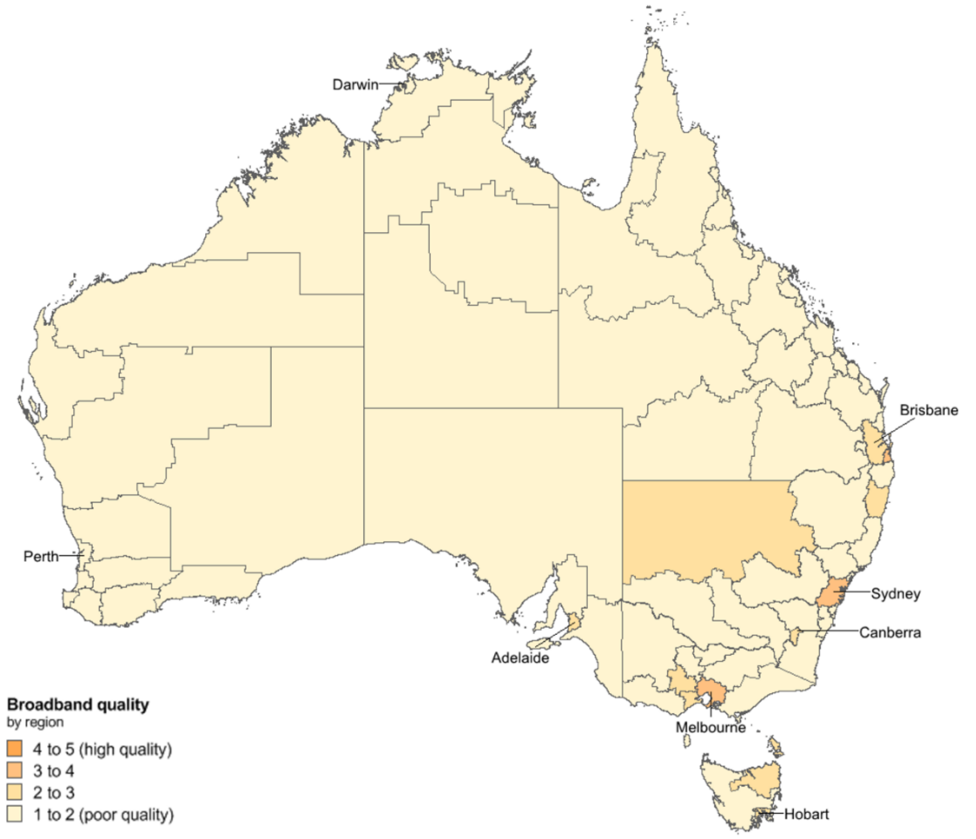
Rating (alphabetical)	Rating (numerical)	Description
E	1	Lowest quality rating: Typically premises will only have access to ADSL services. This rating also includes regions that have no access to any form of fixed broadband service. A small proportion of premises may have access to fixed wireless networks.
D	2	Typically the majority of premises in this group are likely to have access to ADSL services only, while some of the remaining premises will also have access to high quality services available by either FTTP, HFC or FTTN networks. A small proportion of premises may have access to fixed wireless networks.
C	3	Typically a larger proportion of premises are likely to have access to ADSL services, while remaining premises may also have access to high quality services available by either FTTP, HFC or FTTN networks. A small proportion of premises may have access to fixed wireless networks.
B	4	Typically premises in this group have good access to high quality services available by either FTTP, HFC or FTTN networks. A small proportion of premises may only have access to ADSL services.
A	5	This is the highest quality rating. The area surrounding an address has very good access to high quality services available by either FTTP, HFC or FTTN networks. ADSL services are generally available.

Source: Department of Communications, Broadband availability and quality dataset, ACIL Allen calculations, 2014

For example, a DA is awarded a ‘D’ rating for broadband quality if “typically the majority of premises are likely to have access to ADSL services only, while some of the remaining premises will also have access to high quality services available by FTTP (Fibre to the Premise), HFC (Hybrid Fibre Coaxial) or FTTN (Fibre to the Node) networks. A small proportion of premises may have access to fixed wireless networks.”

The Department of Communication’s dataset indicate that broadband quality is generally poor in Australia. Most of the audit regions (61 out of 73) only have broadband access via ADSL — see Figure 185 which maps the average broadband quality in each audit region.

Figure 185 **Map of broadband quality by audit region**



Source: Department of Communications, Broadband availability and quality dataset, ACIL Allen calculations, 2014

The results highlight the digital disparity with the capital city regions being the only regions to generally have access to broadband by HFC as well as ADSL. This is largely because of the cable TV infrastructure. FTTN and FTTP are only available to a small number of premises in certain pockets within some audit regions.

Mobile coverage

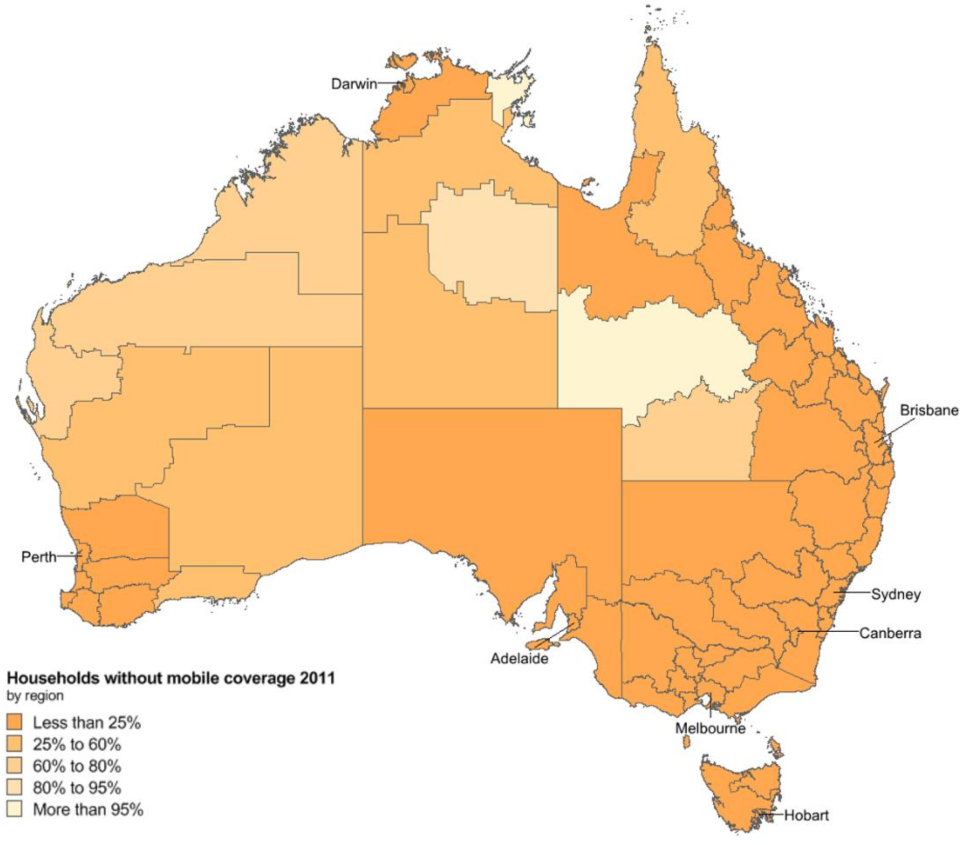
In Australia, approximately 8.8 million premises (81 per cent) have access to 3G mobile broadband services and about 6.4 million premises (59 per cent) have access to 4G services.[89]

The Department of Communications' broadband availability and quality dataset also contains data on mobile phone coverage in each DA. ACIL Allen converted this data so it could be analysed at the audit region level. In the audit dataset, we included data on the proportion of premises within an audit region which have:

- no mobile coverage
- 3G mobile coverage only
- 3G and 4G mobile coverage
- 4G mobile coverage only.

Figure 186 maps the audit regions where a significant proportion of premises currently have no mobile coverage. It is clear that this proportion is high in the more remote regions of Queensland, Western Australia and the Northern Territory.

Figure 186 **Map showing audit regions where a significant proportion of premises have no mobile coverage**



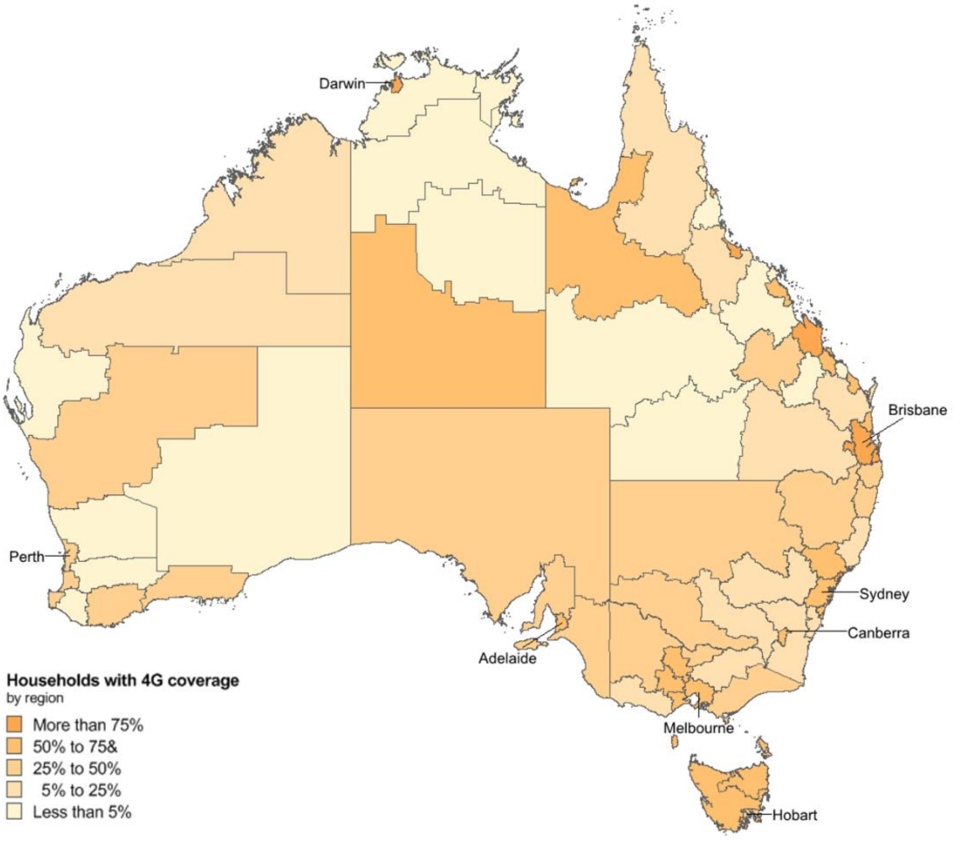
Source: Department of Communications, Broadband availability and quality dataset, ACIL Allen calculations, 2014

[89] Department of Communications, *Broadband Availability and Quality Report*, December 2013

It should be noted that there are pockets of very poor or no coverage (mobile black spots) even *within* regions that generally have good coverage (although this cannot be discerned from the audit region-level results depicted in Figure 186 and Figure 187.

Figure 187 maps the audit regions and highlights those regions where a significant proportion of premises have access to 4G coverage. It highlights that audit regions with the highest proportions of premises with 4G mobile coverage are not capital city regions (with the exception of Greater Brisbane), but rather regions including Newcastle and Lake Macquarie, Toowoomba, the Illawarra, the Gold Coast and Townsville.

Figure 187 **Map showing audit regions where a significant proportion of premises have 4G coverage**



Source: Department of Communications, Broadband availability and quality dataset, ACIL Allen calculations, 2014

International comparisons indicate that Australia has the fastest 4G network speeds in the world as of early 2014, with realised download speeds of 24.5 Mbps. However, 4G coverage in Australia lags behind countries such as Canada, US, Mexico, Denmark, Sweden, Japan, Hong Kong and Korea.[90]

Broadband uptake and subscriptions

In addition to broadband accessibility, ACIL Allen has also analysed the actual take-up of broadband access technologies and the use of these telecommunications technologies in terms of Internet activity.

90 OpenSignal, *The State of LTE*, February 2014

Data was drawn from two key ABS publications, *8146.0 Household Use of Information Technology, Australia* and *8153.0 Internet Activity, Australia*, as well as the Australian Communications and Media Authority (ACMA) annual *Communications Report*.

The number of subscribers across Australia with different types of broadband technologies and access speeds between June 2009 and December 2013 is shown in Figure 188. The data indicates that mobile phone Internet subscriptions far exceed mobile wireless subscriptions (relating to dongles, data cards and USB modems), which in turn surpassed fixed line DSL subscriptions in early 2011. In the past five years, broadband subscriptions with access speeds of 8 Mbps or faster have grown strongly.

Figure 188 **Number of subscribers (‘000), by broadband technology and access speed, June 2009 to December 2013**

Note: Mobile wireless refers to dongles, data cards and USB modems, as distinct from smartphones
Sources: ABS 8153.0 Internet Activity

According to OECD statistics for December 2013, Australia has the second highest wireless broadband penetration rate in the OECD area (with 114.4 subscriptions per 100 inhabitants), behind only Finland.[91] In contrast, Australia is ranked 21st in fixed broadband penetration with 26.0 subscriptions per 100 inhabitants, compared with 44.9 subscriptions per 100 inhabitants in highest-ranked Switzerland.

Not only does Australia have a fixed broadband penetration rate that is below the OECD average, in 2012 Australia had the fifth highest fixed broadband price in the OECD area (US$38.44 in purchasing power parity terms, compared with the OECD average of $30.68).[92]

According to the *Global Competitiveness Report 2013-14*, Australia is ranked 34th in the world for international Internet bandwidth (that is, Internet speed, measured in kilobits per second per user).[93]

Compared with leading edge countries, fibre accounts for a very small proportion of fixed broadband subscriptions in Australia. OECD statistics for December 2013 indicate that fibre accounts for 24.2 per cent of fixed broadband subscriptions in Korea, 19.6 per cent in Japan and 12.4 per cent in Sweden.[94] These three countries have the highest fibre proportions in the OECD as of December 2013. In the US, fibre accounts for 2.4 per cent of fixed broadband subscriptions.

While fibre connections are relatively scarce in Australia, they have grown rapidly in the last two years (surging by 121 per cent between June 2012 and June 2013), placing Australia sixth in the annual growth of fibre connections among OECD countries.[95]

15.3.2 Utilisation of telecommunications infrastructure

ACIL Allen has measured the utilisation of telecommunications infrastructure by measuring:

- the volume of data downloaded by types of telecommunications technology
- use of the Internet by businesses
- use of the Internet by households.

Volume of data downloaded

The volume of data downloaded by technology (fixed line, fixed wireless and mobile) between June 2009 and December 2013 is shown in Figure 189. Fixed-line broadband accounted for more than 90 per cent of all Internet downloads. While data is increasingly being downloaded via mobile technologies, this volume is still very small. This is largely because of the relatively high costs to mobile users.

91 www.oecd.org/sti/broadband/broadband-statistics-update.htm

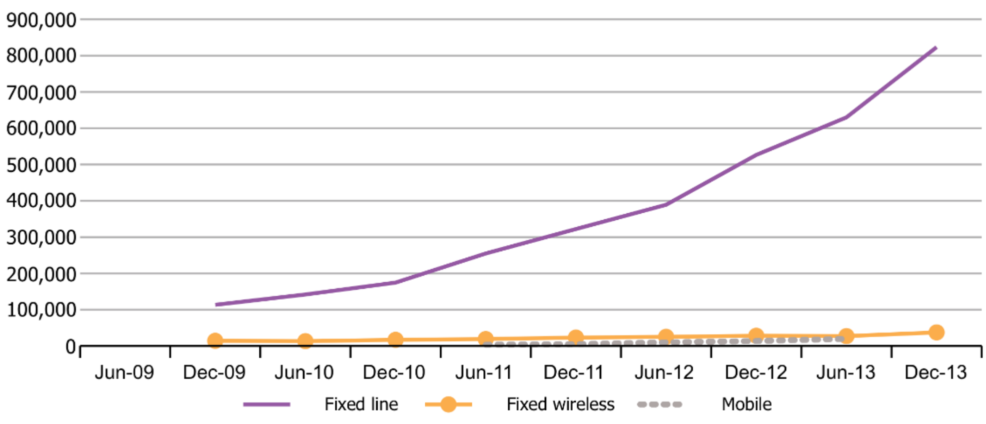
92 International Telecommunications Union, *ITU World Telecommunications/ICT Indicators 2013 database*

93 International Internet bandwidth is the sum of capacity of all Internet exchanges offering international bandwidth. This data was sourced from the International Telecommunication Union's *World Telecommunications/ICT Indicators 2013* (June 2013 edition).

94 http://www.oecd.org/sti/broadband/oecdbroadbandportal.htm

95 OECD, *OECD Communications Outlook 2013*

Figure 189 **Volume of data downloaded (Terabytes), June 2009 to December 2013**



Source: ABS 8153.0 Internet Activity

The cost of mobile data downloads, however, is expected to decrease significantly in the future.[96] CISCO therefore forecasts a 13-fold growth in mobile traffic between 2013 and 2018 in the Asia-Pacific (a compound annual growth rate of 67 per cent), with a consequent rise in mobile's share of total Internet traffic in the Asia-Pacific from three per cent in 2013 to 14 per cent in 2018.[97]

ACIL Allen expects the volume of data downloaded to continue to grow rapidly in the next decade. The rate of growth will be determined to a large extent by:

- the adoption and use of video-intensive applications (for leisure purposes as well as for telehealth, e-learning etc.)
- the increase in the number of devices (smart TVs, smartphones, tablets, laptop and desktop computers etc) per household
- user expectations about video quality.

CISCO forecasts Internet video traffic in the Asia-Pacific to grow four-fold between 2013 and 2018 (a compound annual growth rate of 30 per cent). It expects total Internet video traffic (business and consumer, combined) to constitute 73 per cent of Internet traffic in the Asia-Pacific in 2018, up from 56 per cent in 2013.[98]

Business use of the Internet

ACIL Allen has analysed the usage of the Internet by Australian business and households, as the type of Internet use can determine the impact of telecommunications on productivity in other sectors of the economy and on the need for future capacity and bandwidth (as discussed above).

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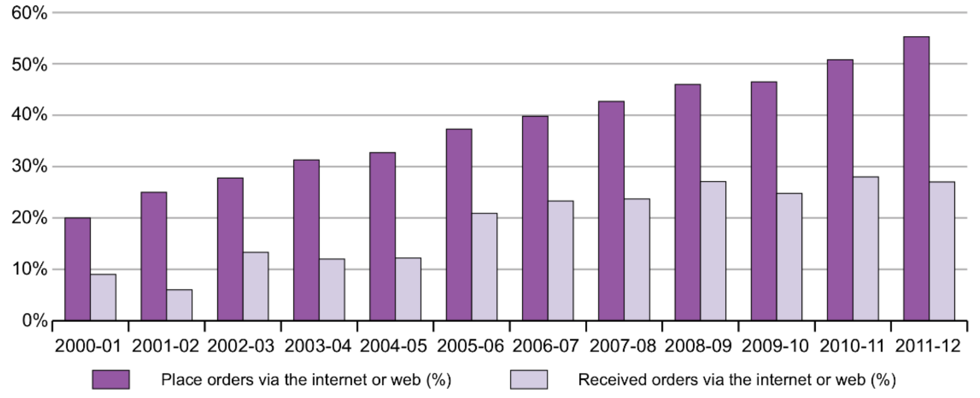
[96] For example, Plum Consulting expects the cost per gigabyte for LTE (4G) in the UK to decrease by 90 per cent between 2011 and 2020. See http:// http://www.plumconsulting.co.uk/pdfs/Plum_Insight_Jan2012_Mobile_data_growth_-_too_much_of_a_good_thing.pdf.

[97] http://www.cisco.com/web/solutions/sp/vni/vni_forecast_highlights/index.html

[98] Ibid.

The proportion of businesses in Australia that are engaged in Internet commerce is shown in Figure 190. The data indicates that the proportion of businesses receiving orders via the Internet has stagnated in recent years, however the proportion of businesses placing orders via the Internet has continued to rise with over 50 per cent of Australian businesses reporting that they have placed an order over the Internet.

Figure 190 **Proportion of Australian businesses engaged in Internet commerce, 2000-01 to 2011-12**



Source: ABS 8129.0 Business Use of Information Technology

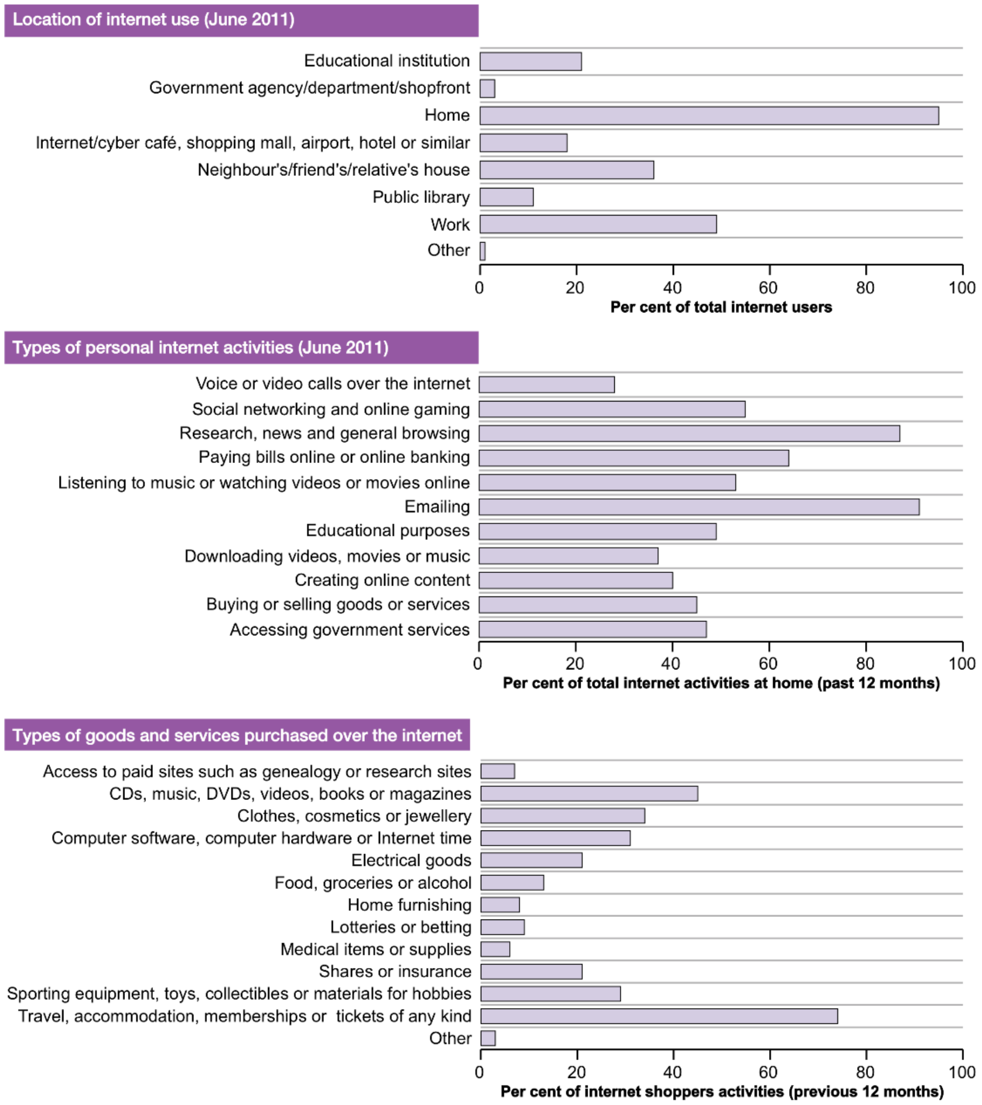
Household use of the Internet

ACIL Allen have analysed the usage of the Internet by Australian households by audit region using a customised ABS data on the *Household Use of Information Technology in 2010-11.* The data reports:

- frequency of internet access
- type of internet access (DSL, cable, mobile broadband, satellite, other)
- location of internet use in the previous 12 months
- Internet activities undertaken in the previous 12 months
- types of goods and services purchased or ordered over the internet in the previous 12 months

The national level data for the last three indicators is summarised in Figure 191.

Figure 191 **Location and type of internet use by household**



Sources: ABS 8146.0 Household Use of Information Technology

15.3.3 DEC of telecommunications services

ACIL Allen has used CGE modelling to estimate the Direct Economic Contribution (DEC) of telecommunications services in each audit region. The DEC measures the economic value-add arising from the use of telecommunications services by consumers in the economy.

National DEC

The DEC of telecommunications services across Australia in 2010-11 was $21.050 billion (in 2010-11 dollars).

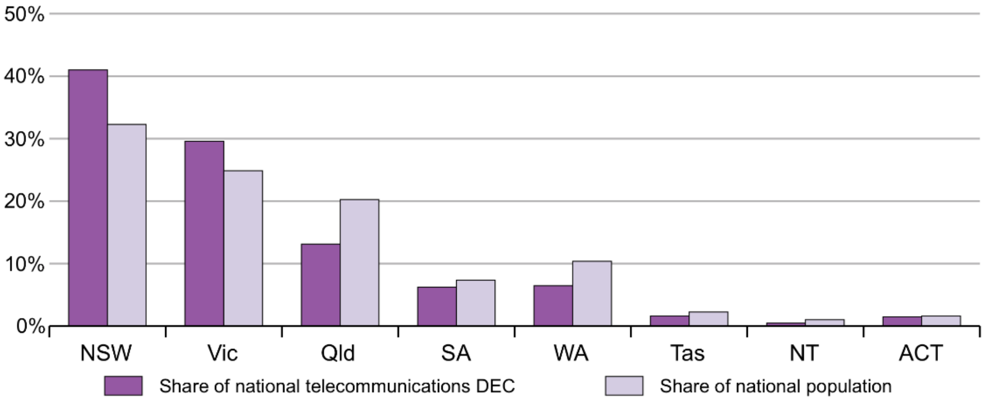
DEC by state/territory

The reported DEC estimates of telecommunications by state/territory for the three highest states are:

- New South Wales - $8.6 billion in 2010-11 dollars
- Victoria - $6.2 billion in 2010-11 dollars
- Queensland - $2.8billion in 2010-11 dollars

Each state/territory's share of the national DEC of telecommunications is compared with its share of the national population in Figure 192. The data indicates that New South Wales and Victoria provide a higher proportion of telecommunications services value to the economy (as measured by the DEC) than they account for in terms of their share of the Australian population.

Figure 192 **State/territory shares of total telecommunications DEC and national population, 2010-11**

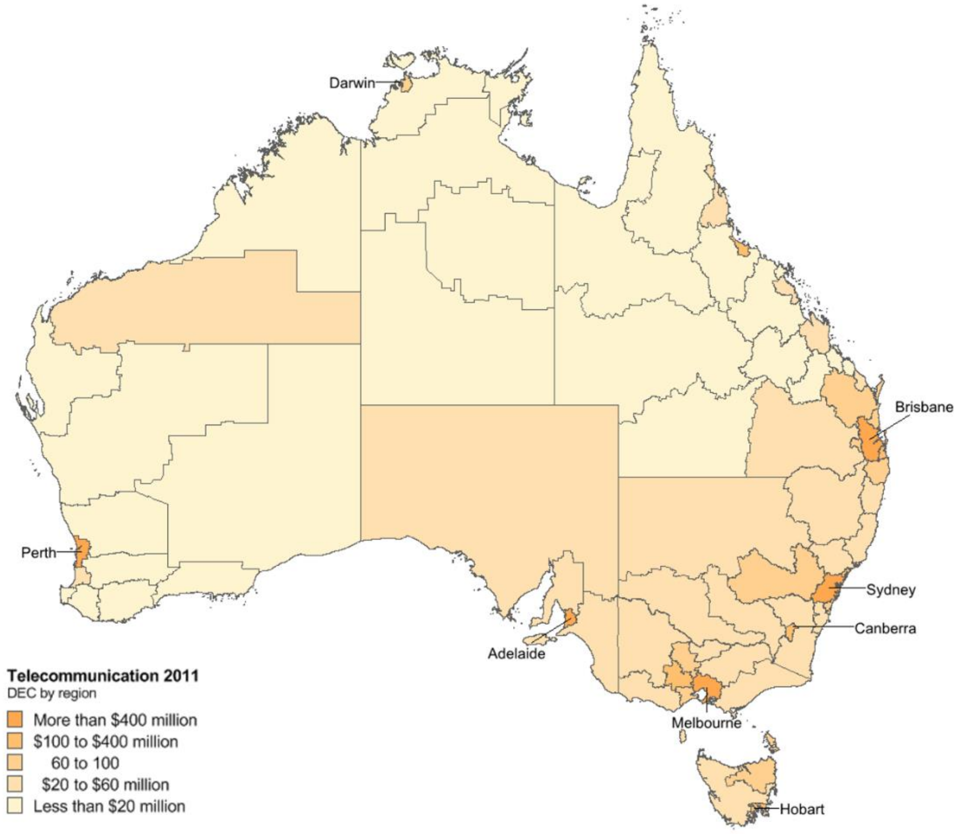


Source: ACIL Allen Consulting, 2014

DEC by audit region

Figure 193 maps the DEC of telecommunications services in 2010-11 by audit region. It indicates that the DEC of telecommunications services is more heavily concentrated in the capital city regions.

Figure 193 **Map of telecommunications DEC by audit region**



Source: ACIL Allen Consulting, 2014

15.4 Projections for telecommunications infrastructure needs

15.4.1 Projected telecommunications DEC in 2030-31

National DEC

The DEC of telecommunications services across Australia in 2030-31 is projected to be approximately $41.6 billion (in 2010-11 dollars), up from $20.7 billion in 2010-11.

DEC by state/territory

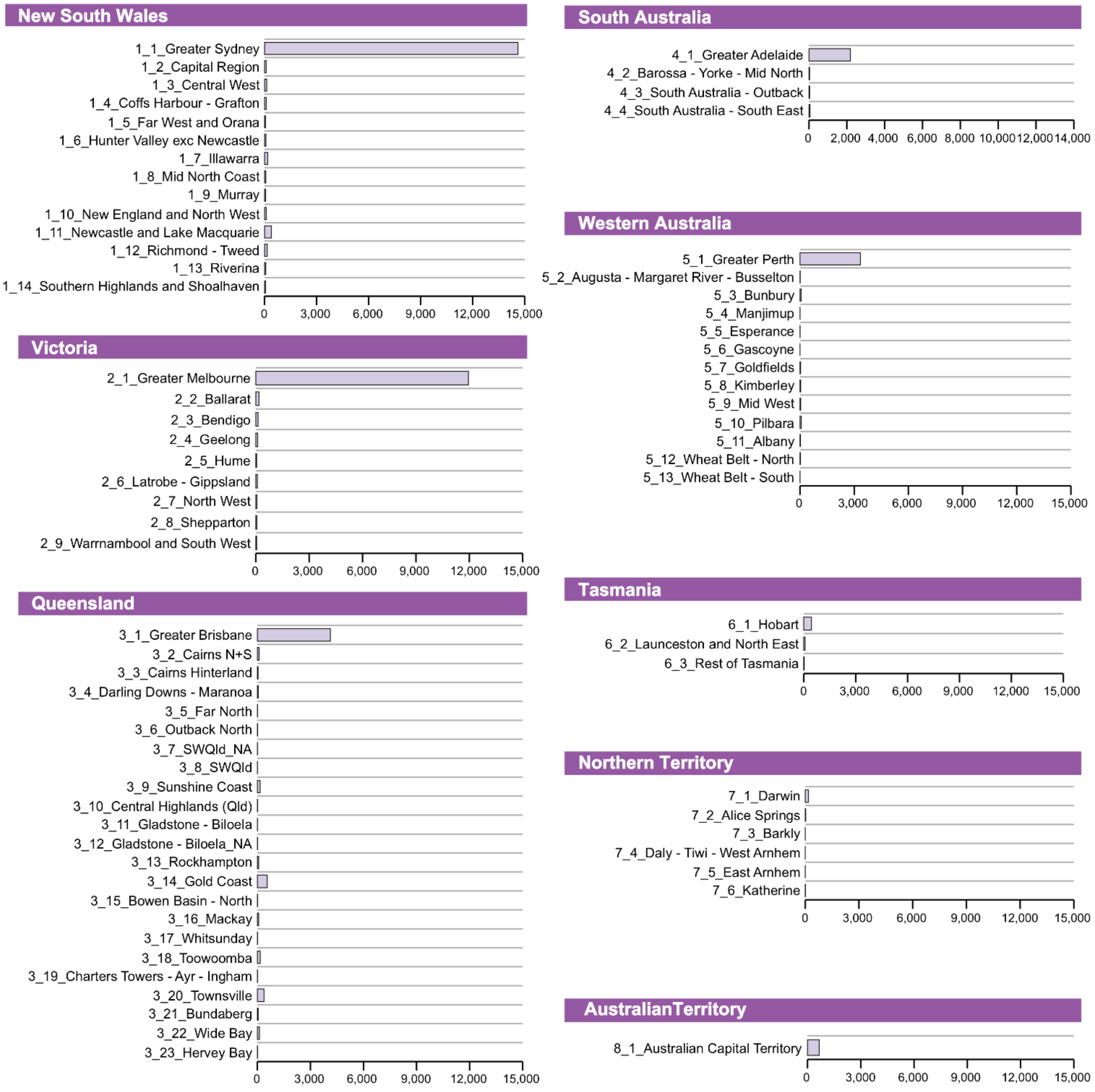
The projected DEC of telecommunications services by state/territory in 2030-31 is:

- New South Wales - $16.2 billion
- Victoria - $12.6 billion
- Queensland - $6.0 billion
- Western Australia - $3.7 billion
- South Australia - $2.3 billion
- Australian Capital Territory - $656 million
- Tasmania - $557 million
- Northern Territory - $225 million

DEC by audit region

The projected DEC of telecommunications services in 2030-31 by audit region is shown in Figure 194. As in 2010-11, the DEC of telecommunications services is expected to be heavily concentrated in the capital city regions. This finding supports one of the Vertigan Report's finding that rolling out broadband in high population density areas where it sees the strongest demand and the best revenue and earnings potential will result in the greatest net benefit to the economy.

Figure 194 **Direct economic contribution of telecommunication services by audit region, 2030-31 ($ millions, 2010-11 dollars)**

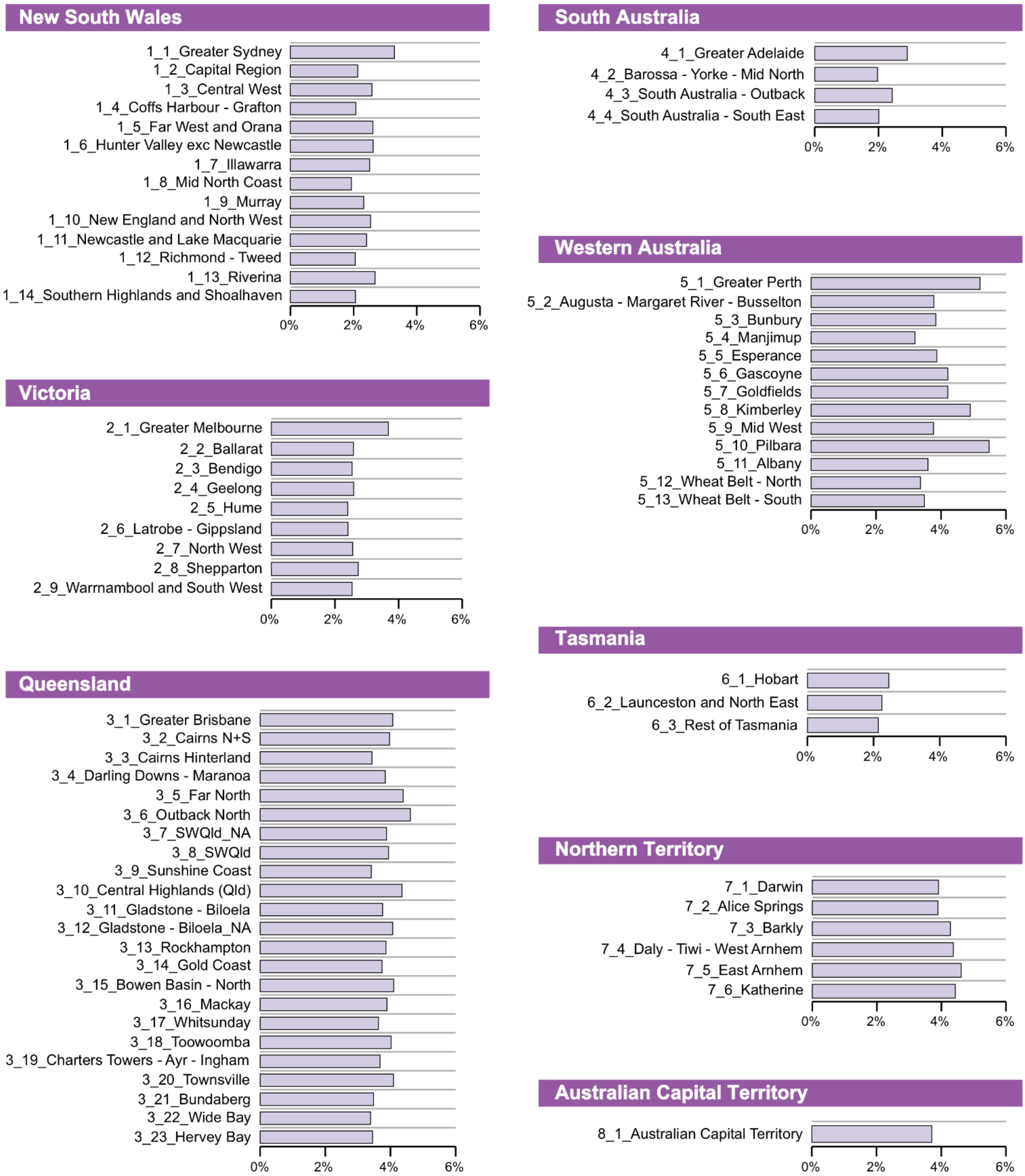


Source: ACIL Allen Consulting, 2014

15.4.2 Projected growth in DEC of telecommunications services

The projected compound annual growth rate (CAGR) in the DEC of telecommunications services between 2010-11 and 2030-31, by audit region, is shown in Figure 195. The data indicates that the CAGR is generally higher for audit regions in Queensland, Western Australia and the Northern Territory than in audit regions in the other states and territories.

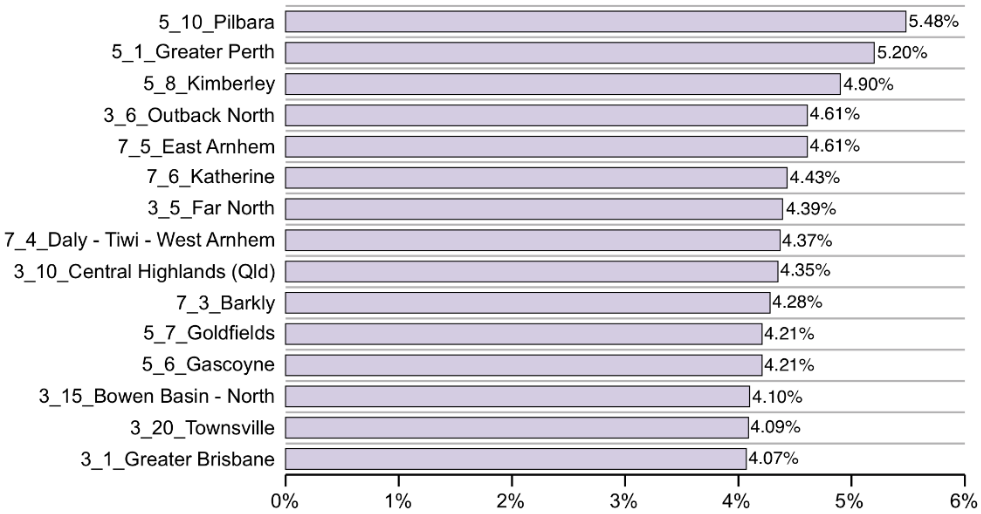
Figure 195 **Projected CAGR in DEC of telecommunication services between 2010-11 and 2030-31, by audit region**



Source: ACIL Allen Consulting, 2014

The top 15 audit regions in terms of growth in the DEC of telecommunications services between 2010-11 and 2030-31 are shown in Figure 196.

Figure 196 **Top 15 audit regions by CAGR in DEC of telecommunication services between 2010-11 and 2030-31**



Source: ACIL Allen Consulting, 2014

Relatively higher growth rates in the DEC of telecommunications services are expected in Queensland, Western Australia and the Northern Territory. These higher growth rates are likely to reflect in part the higher population and employment growth expected in these states and territories.

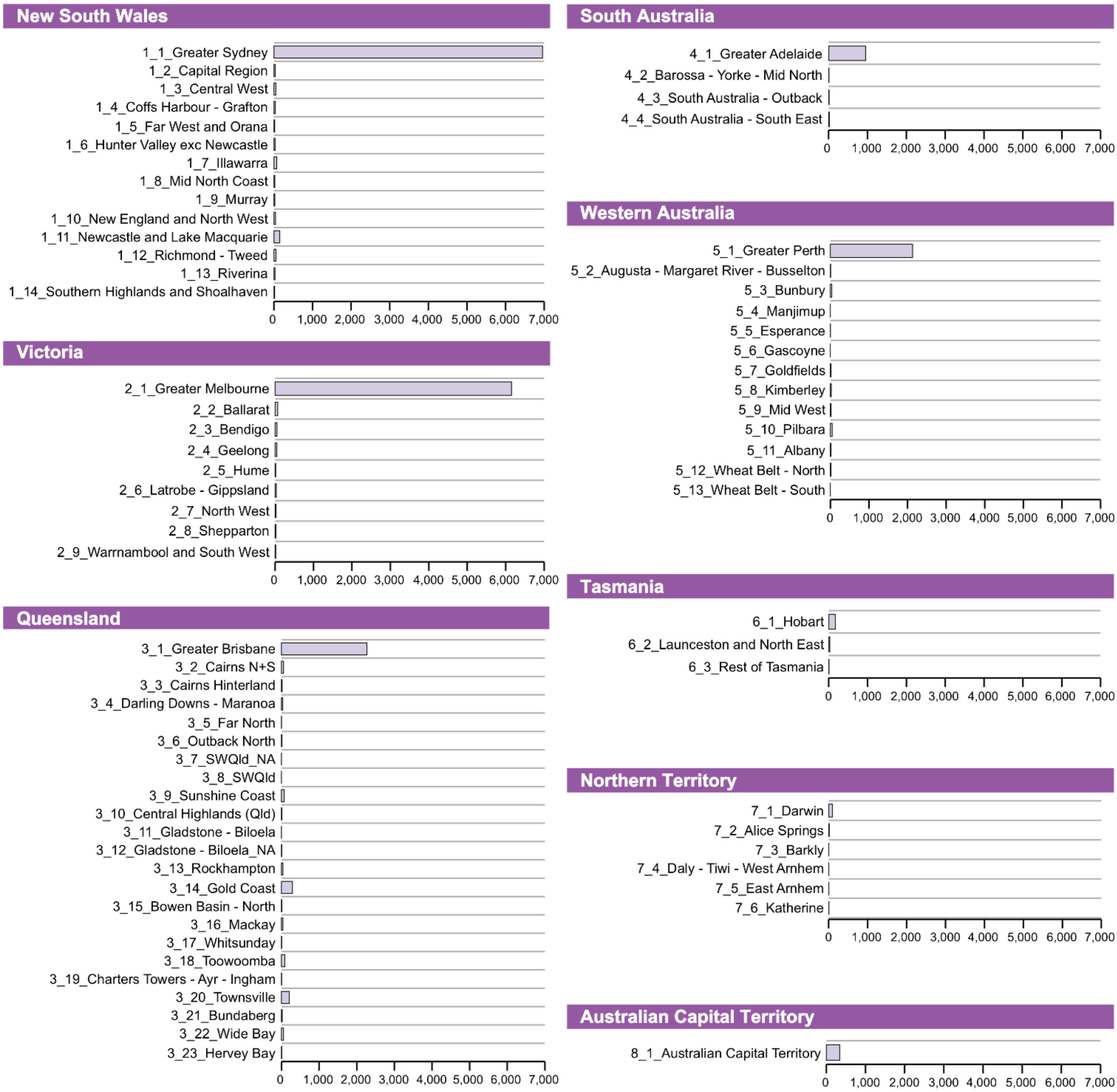
ACIL Allen's CGE modelling shows that growth in employment between 2011 - 2031 is forecast to be strongest in Western Australia (72 per cent over this period), followed by the Northern Territory (49 per cent) and Queensland (47 per cent). In addition, the modelling indicates that Gross State Product (GSP) growth will be highest in Western Australia (increasing by approximately 130 per cent between 2010-11 and 2030-31), followed by the Northern Territory (100 per cent) and Queensland (95 per cent).

ACIL Allen's projection of employment growth by state/territory reflects, in part, the ABS Series B population projections in which the populations of both Western Australia and Queensland are forecast to more than double between 2012 and 2061 (with increases of 163 per cent and 103 per cent respectively), while the Northern Territory is projected to increase by 93 per cent. In comparison, the projected population growth for Australia for the same period is 83 per cent.

15.5 Projection of additional need for telecommunications infrastructure

The projected increase in DEC of telecommunications services between 2010-11 and 2030-31 by audit region is shown in Figure 197.

Figure 197 **Projected increase in DEC of telecommunication services between 2010-11 and 2030-31, by audit region ($ millions, 2010-11 dollars)**



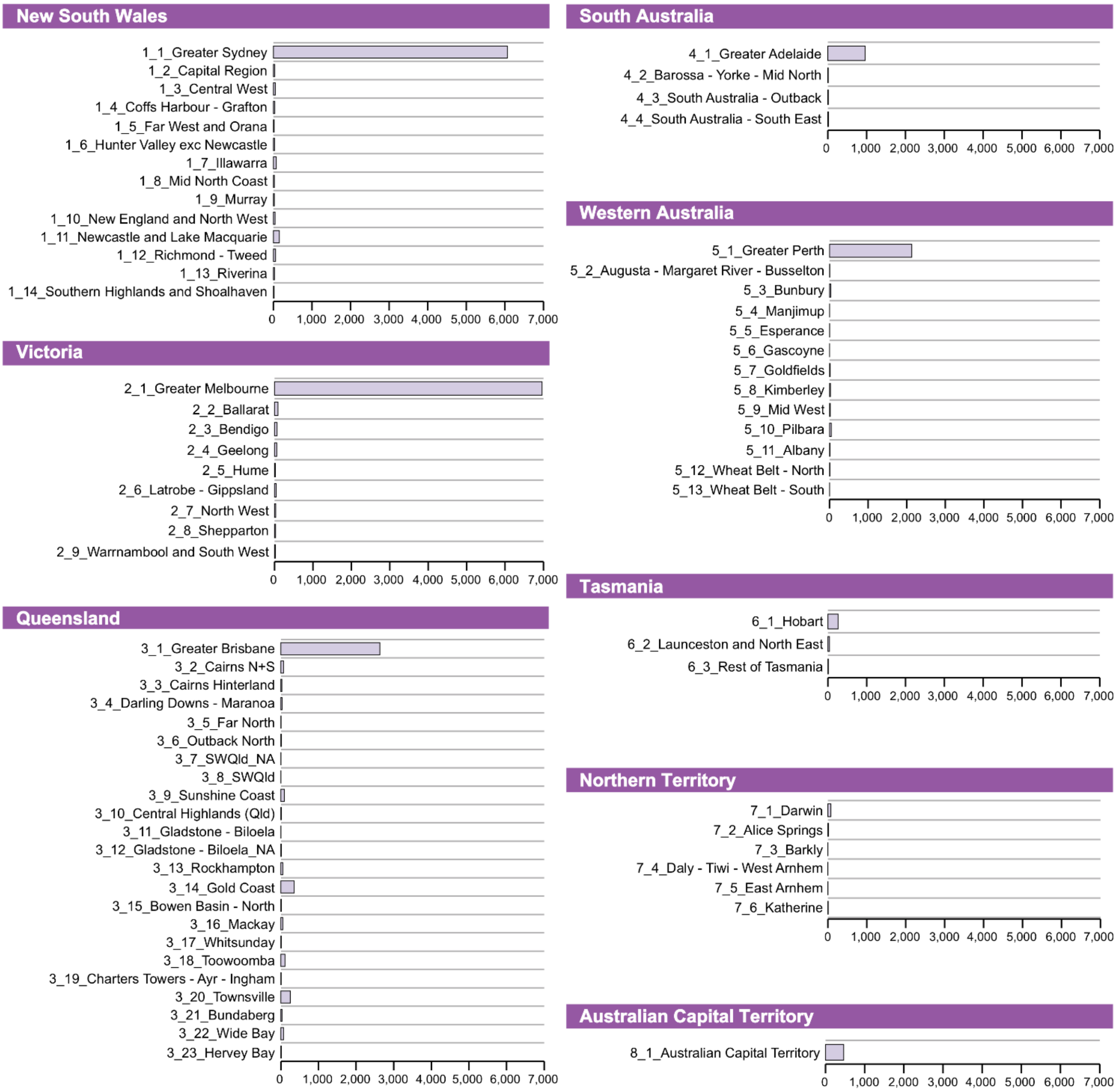
Source: ACIL Allen Consulting, 2014

15.6 Sensitivity analysis of projections for telecommunications services needs and DEC

15.6.1 Higher population growth scenario (Scenario 2)

The projected increase in direct economic contribution of telecommunication services between 2010-2011 and 2030-2031 by audit region in ACIL Allen's Higher population growth scenario is shown in Figure 198. This scenario assumes that Australian's population will be higher than in the Baseline scenario and is aligned with the ABS Series A demographic projections.

Figure 198 **Projected increase in DEC of telecommunications services between 2010-11 and 2030-31 – Higher population growth scenario, by audit region ($ millions, 2010-11 dollars)**



Source: ACIL Allen Consulting, 2014

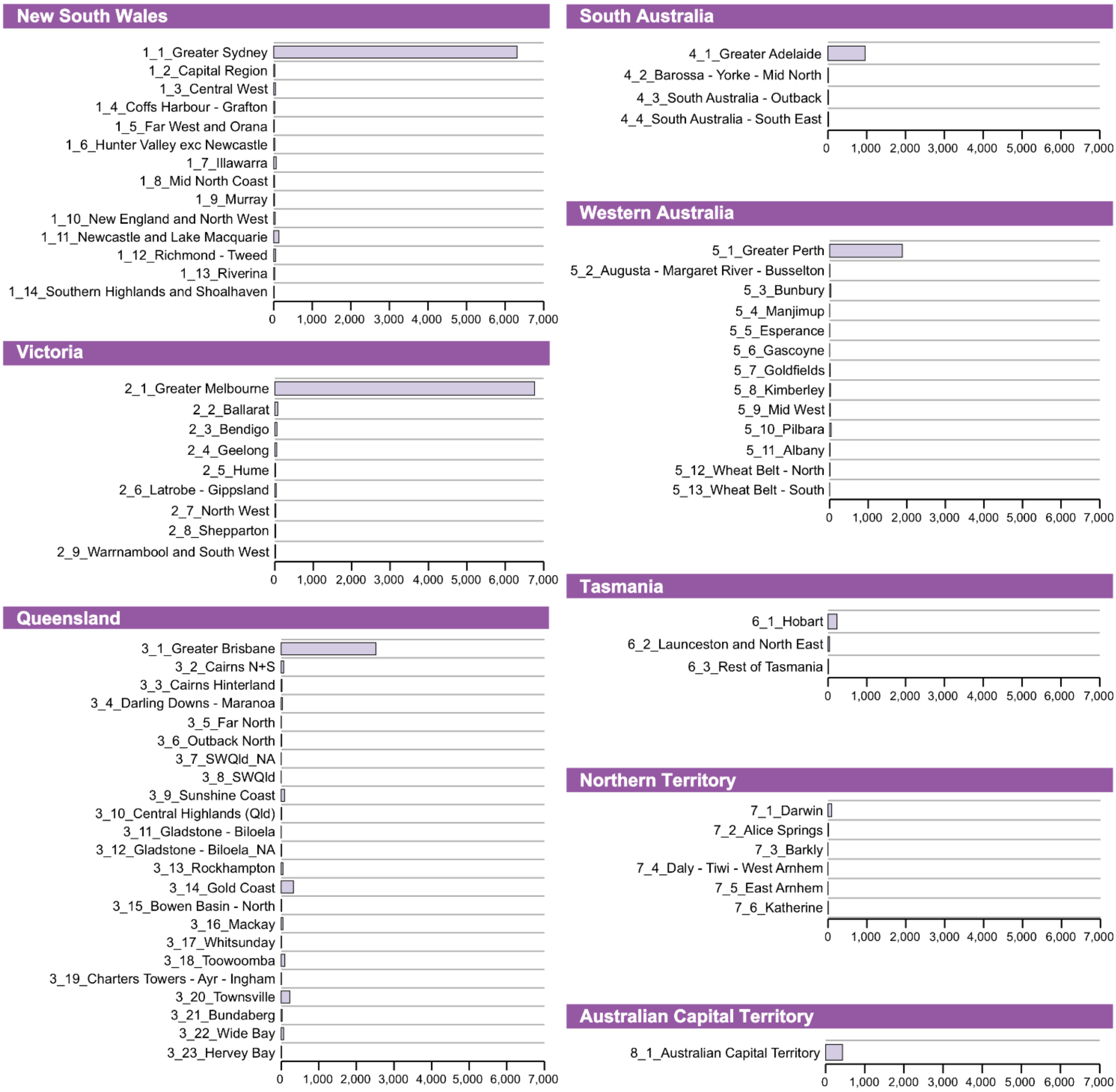
Compared with the Baseline scenario, the DEC of telecommunications services in the higher demographic growth scenario is higher in all capital city regions except for the Greater Sydney audit region and the Darwin audit region. This is because all capital cities except for Sydney and Darwin are projected to have a greater population increase between 2010-11 and 2030-31 under the ABS Series A demographic projection (which underpins the higher demographic growth scenario) than under the ABS Series B demographic projection (which underpins the baseline scenario).

15.6.2 Higher productivity growth scenario (Scenario 3)

The projected increase in direct economic contribution of telecommunications services between 2010-11 and 2030-31 by audit region in ACIL Allen's Higher population growth scenario is shown in Figure 199.

In all capital city regions, the DEC of telecommunications in 2030-31 is greater in the Higher productivity growth scenario than in the Baseline scenario.

Figure 199 **Projected increase in DEC of telecommunications services between 2010-11 and 2030-31 – Higher productivity growth scenario, by audit region ($ millions, 2010-11 dollars)**



Source: ACIL Allen Consulting, 2014

The differences in the DEC of telecommunications in 2030-31 at the state/territory level under the three scenarios modelled by ACIL Allen (Baseline scenario, Higher population growth scenario, Higher productivity growth scenario) are summarised in Table 123.

Table 123 **Differences in telecommunications DEC in 2030-31 between modelling scenarios by state/territory**

State/Territory	Projected difference in DEC between Higher population growth scenario relative to Baseline scenario	Projected difference in DEC between Higher productivity growth scenario relative to Baseline scenario
NSW	0.2%	1.4%
Victoria	3.1%	1.2%
Queensland	4.3%	1.0%
South Australia	1.5%	1.3%
Western Australia	8.4%	0.2%
Tasmania	5.5%	1.7%
Northern Territory	-5.2%	0.6%
Australian Capital Territory	5.0%	1.1%
Australia	**2.7%**	**1.2%**

Source: ACIL Allen Consulting, 2014

The modelling results indicate that in six of the eight states/territories, growth in the DEC of telecommunications services between 2010-11 and 2030-31 is highest in the 'Higher population growth' scenario, followed by the 'Higher productivity growth' scenario. The exceptions are NSW, where DEC growth is highest in the 'Higher productivity growth' scenario, and the Northern Territory, where DEC growth is actually lowest in the 'Higher population growth' scenario.

In the case of the Northern Territory, this is because population growth in Darwin, contrary to almost every other region in Australia, is much lower in the ABS Series A projection than in the ABS Series B projection. In the case of New South Wales, the result is explained by the fact that population growth in the Greater Sydney region is marginally lower in the ABS Series A projection relative to the ABS Series B projection.

Regardless of the economic growth parameters to 2030-31 clearly there will be a significant increase in the demand for telecommunications services in the capital cities across Australia, with Sydney and Melbourne expected to have the greatest increase in demand for telecommunications services.

15.7 Issues and implications of findings

The capacity of telecommunications services has been reported according to access and quality of access. It has been found that:

- Most regions across Australia have reasonable access to broadband with access to at least one type of broadband technology. The exceptions to this being the more remote areas of Queensland, Western Australia and the Northern Territory.
- The digital disparity however is highlighted by the quality of broadband available across Australia. The quality of broadband available in the audit regions has been found to be not as good with households (and businesses) only having access to ADSL/ADSL2/ADSL2+ technology in most audit regions (60 out of the 73 regions). Capital city regions (and major town regions) however were the exception with broadband access via ADSL variants as well as HFC (because of the cable TV infrastructure). FTTN and FTTP access was found only to be available to a small number of households or businesses in certain pockets within some audit regions.
- 4G coverage is improving over time and has been found to be available in most parts of the capital city regions and in many parts of audit regions incorporating major regional areas. However, there are a number of audit regions (primarily in Queensland, Western

Australia and the Northern Territory) within which there are significant areas that do not have mobile coverage.

- There do however remain pockets of very poor or no mobile coverage (mobile black spots) even *within* regions that generally have good coverage.

The utilisation of telecommunications services is growing:

- The volume of data downloaded over the Internet via fixed and mobile broadband has increased rapidly over time. It is expected to continue growing strongly over the 2011-2031 period, with the rate of growth primarily determined by the adoption and use of video-intensive applications (for leisure purposes and for tele-health, e-learning etc.), the increase in the number of devices per household and user expectation about video quality.
- Business and household use of the Internet has significantly grown over the past decade with both types of consumers reporting frequent and continual use of telecommunications services in business and their everyday life.

The increasing importance of telecommunications services in business has highlighted its value to the Australian economy. That is, its value-add to the economy as a result of the use of telecommunications services in Australia. The DEC of telecommunications services in 2010-11 was estimated to be $20.7 billion. This contribution is expected to double by 2030-31 as a result of forecast population and employment growth, with indications that the capital cities will exhibit the highest growth in demand for telecommunications services: Sydney, followed by Melbourne, Brisbane, Perth, Adelaide, Canberra, Hobart and Darwin.

Regulatory and government policies relevant to the telecommunications sector have changed and are currently changing the industry more than ever. The roll-out of the NBN is evidence of the significant impact that government has recently had on the industry.

To address the gaps in mobile coverage, the Australian Government has committed $100 million over four years to the delivery of the Mobile Black Spot Program. The program is expected to improve coverage along major transport routes, in small communities and in locations prone to experiencing natural disasters, as well as addressing unique (highly location-specific) mobile coverage problems.

It was envisaged that deficiencies in fixed broadband availability and quality would be addressed by the roll-out of the NBN. However, the NBN journey to this point has proven to be far from smooth. In November 2013, there were only 310,878 premises passed with fibre, rather than the 1,129,000 premises proposed in the original corporate plan.[99] The revised outlook also indicated that the fibre rollout project would cost much more and take three years longer to complete than indicated in the original corporate plan, with a revised end date of June 2024.

Addressing the current digital disparity and rolling out an open access, wholesale-only fast broadband network in a cost-effective manner are the key outstanding policy and regulatory challenges facing government and the telecommunications sector over the next 5 years.

[99] As of September 2013, construction of the back-end of NBN Co.'s network, including 65,600 kilometres of interstate fibre links and fibre exchanges, was on schedule and due to be completed in 2015.

16 Urban transport infrastructure

KEY FINDINGS

The audit of urban transport infrastructure has examined the capacity, utilisation, congestion and economic contribution in 6 major urban conurbations. It has examined the performance of major transport modes including road, rail, bus, tram/light rail and ferries. It has also examined performance in the major urban areas networks at large, in regions of the major urban areas, in corridors, routes and links.

The Audit of urban transport infrastructure in 2010-11 found that:

- Considerable capacity has been provided to facilitate mobility in Australia's major urban areas that house more 77 per cent of Australia's population.
- The capacity that is provided is used intensively.
- The demand for transport services and mobility already outstrips capacity at key times of the day and in key journeys and transit corridors. It is estimated that the cost of delays in car travel alone on urban roads amounted to $13.7 billion in 2010-11.

The direct economic contribution of urban transport infrastructure amounted to $78.25 billion in 2010-11 for the 6 major conurbations assessed in detail. When ACIL Allen Consulting's high-level estimates of the DEC for Darwin and Hobart were taken into account, the total urban transport infrastructure DEC accounted for $79.69 billion. This estimate includes the cost of delays over transport infrastructure networks and other costs faced by users. The urban transport networks are both high cost and high value infrastructure.

The Audit has provided projections of Urban Transport needs to 2030-31. This found that:

- Demand for mobility in every conurbation studied is expected to grow quite rapidly, exceeding the rate of national population growth and the rate of economic growth. The DEC for urban transport for the 6 conurbations is projected to grow to $175.1 billion by 2030-31.
- If capacity remains constrained to levels currently provided, transport demand is projected to outstrip capacity and drive large increases in delays. The costs of congestion on urban roads are projected to grow to $53.3 billion in 2030-31. Seating capacity and crush capacity on public transport facilities is projected to be exceeded in most of the major urban areas studied.
- Higher congestion costs are projected for all of the major urban areas examined (if there is no additional capacity added to transport networks).

The findings compare the projected performance of corridors and links in different major urban areas for the first time.

The top 20 corridors by DEC in 2010-11, 17 corridors are dominated by the most highly populated areas of Sydney-Newcastle-Wollongong region and the Melbourne-Geelong region. The DEC of any given corridor is influenced by a number of factors including the extent of the road network included, length and capacity of that network, average speeds, traffic and congestion. Overall, it is an estimate of the total value added in use of the road network for that corridor. A high DEC indicates a high base that transports solutions may provide benefit to. High congestion indicates opportunities to reduce avoidable costs.

16.1 Urban transport infrastructure in scope

This chapter provides an overview of the current and projected direct economic contribution (DEC) of urban transport infrastructure in the 6 conurbations of Adelaide, Brisbane, Canberra, Melbourne, Perth and Sydney. (A conurbation is an extended urban area, which might consist of several towns merging with the suburbs of a central city.) Conurbations cover a larger area than the Greater City Statistical Areas (GCCSA) used by the Australian Bureau of Statistics (ABS). Figure 200 shows the geographic area covered by each conurbation.

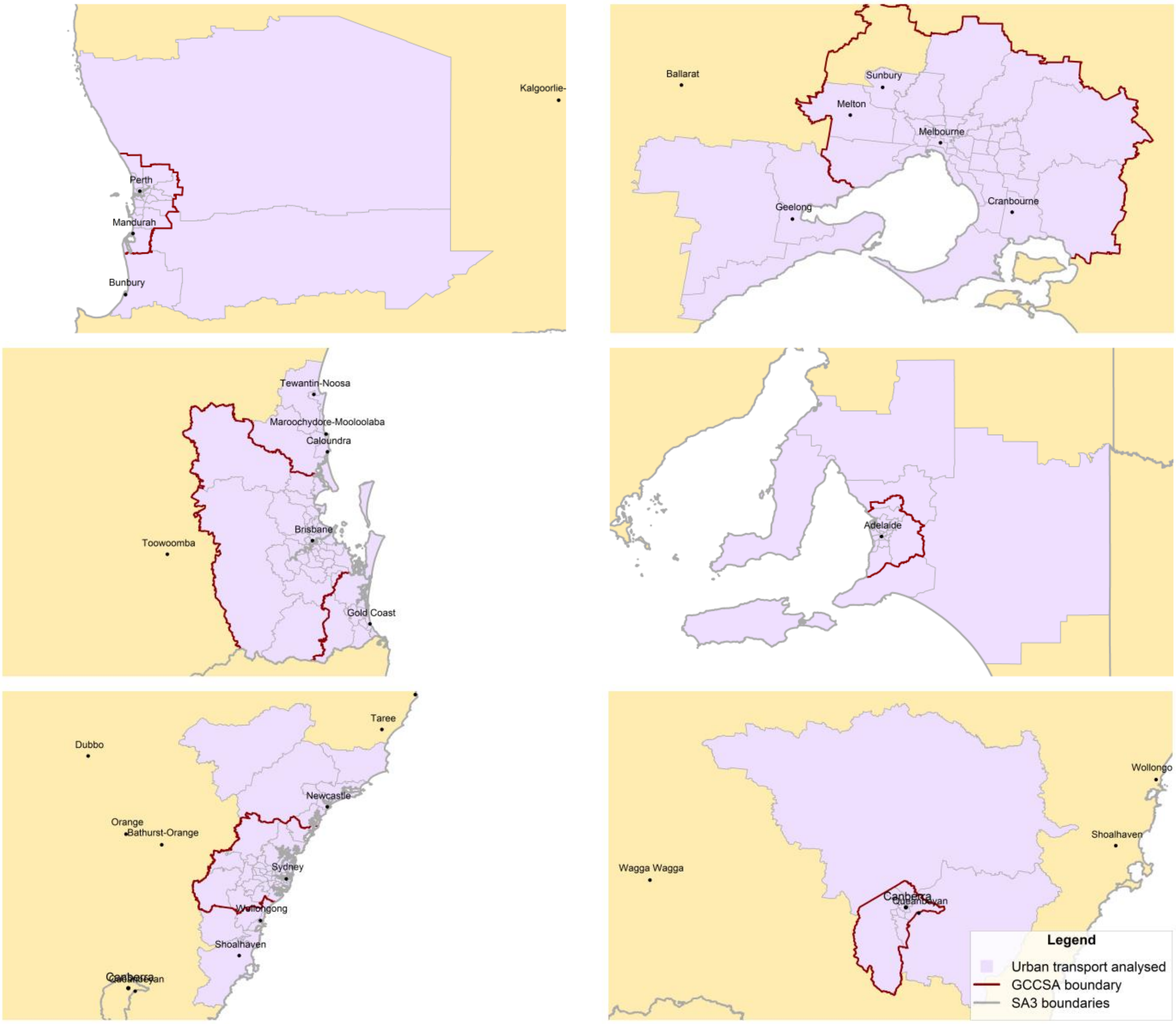
This chapter also identifies the capacity, utilisation and congestion of existing urban transport infrastructure and future infrastructure gaps under a “low investment” scenario (where only projects already committed to by governments are included in the modelling and analysis).

The estimate of DEC of urban transport infrastructure provided in this chapter is calculated using a methodology that makes the results comparable to those obtained for other infrastructure services as part of the broader AIA. The more detailed modelling of the urban transport networks in the 6 major conurbations was based upon Veitch Lister’s transport modelling. To provide an Australia-wide estimate for all 8 capital city urban transport networks, ACIL Allen Consulting undertook some top-down economic analysis to estimate the direct economic contribution of the Darwin and Hobart urban transport networks. However due to the top-down nature of the modelling, there is not as much detail. For this reason, most of the analysis concentrates on the 6 major conurbations. However where possible, Hobart and Darwin have been included to provide an estimate of the Australia-wide economic value of urban transport networks in the 8 capital cities across Australia.

The application of a consistent methodology for calculating DEC allows comparisons across different modes of urban transport infrastructure, cities and areas within cities. Hot-spots or areas where urban transport infrastructure has a high DEC and high congestion costs can be identified using this methodology.

The objective of this work is to allow Infrastructure Australia to conduct an evidence-based assessment of the current and future urban transport infrastructure needs in Australia’s major cities.

Figure 200 **Geographic area covered by each conurbation**



Source: ACIL Allen Consulting, 2014

There is a detailed report on urban transport infrastructure which complements this broader AIA.

16.2 Approach to the audit of urban transport

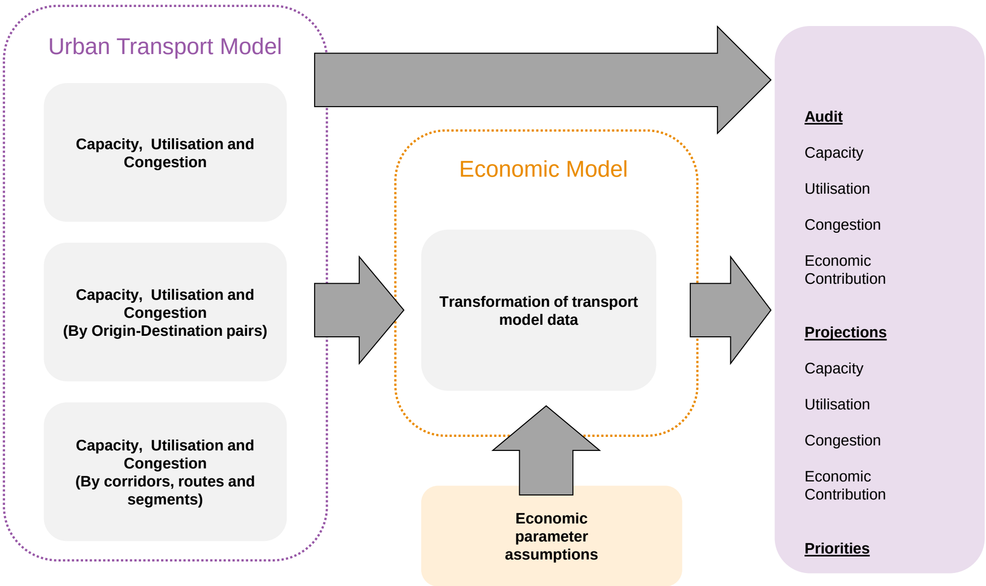
The approach taken for this study is a bottom-up approach combining transport modelling at a high spatial resolution by Veitch Lister Consulting (VLC) with economic modelling. Key steps in this process are:

1. Review existing urban transport infrastructure and project future capacity
2. Development of existing and future travel demand data
   a) Establish a baseline set of demographic data:
   b) Development of demand estimates for special travel demand generators:
   c) Projections of future travel demand:
3. Transport modelling using VLC's Zenith model for the 6 conurbations
   a) Simulation of transport systems for 2010-11 and 2030-31

4. Develop a set of economic parameters to convert transport modelling results to economic impact modelling results
   a) Shadow toll as an estimate of user willingness to pay, and fares paid on public transport
   b) Input cost as operating costs excluding labour
5. Economic modelling
   a) Economic parameters combined with measures of transport activity to derive economic contribution by mode
   b) Reconciliation of bottom-up measurements of DEC with top down estimates of DEC. where economic contribution is estimated using a combination of national accounts and household expenditure surveys.

Figure 201 provides an overview of the interactions between the transport modelling undertaken by VLC and the economic modelling undertaken by ACIL Allen.

Figure 201 **Overview of economic modelling of urban transport**



Source: ACIL Allen Consulting, 2014

The key output of the project is an audit data set that provides estimates of the capacity, utilisation, economic contribution and congestion of urban transport in 2010-11, and projections for these same measures in 2030-31.The measures are provided by conurbation, regions within conurbations, corridor, route and segment. Estimates and projections of DEC are also provided by pairs of origins and destinations within each greater capital city area.

This audit data highlights where urban transport provides the greatest economic contribution and where the greatest congestion costs are incurred. It also indicates where the contribution and congestion is projected to experience the greatest change.

The audit data provides an evidence base that may be used for further analysis of where transport solutions can maximise value. It does this by highlighting ‘hotspots’ which need to be further investigated. It does not, however, conclude where infrastructure projects or policy solutions, such as demand management, would be of net benefit. This would need to be done through rigorous cost benefit analysis.

16.3 Audit findings

16.3.1 Capacity and utilisation of urban transport in 2010-11

Capacity of urban transport in 2010-11

The capacity of urban transport by mode for each of the conurbations (extended urban areas beyond the GCCSAs[100]) is shown in Table 125. Sydney-Newcastle-Wollongong has the greatest carrying capacity for both roads and public transport. With the exception of light rail in Melbourne-Geelong and Adelaide-Yorketown, Sydney-Newcastle-Wollongong also has the greatest carrying capacity for each of the different public transport modes. Melbourne-Geelong contains a significant road network, of similar scale to Sydney-Newcastle-Wollongong.

Table 125 **Capacity by conurbation and mode (2010-11)**

Urban transport region	Road	Rail	Bus	Ferry	Light rail
	VKT per day	Passenger seat kms per day	Passenger seat kms per day	Passenger seat kms per day	Passenger seat kms per day
Sydney-Newcastle-Wollongong	615,617,472	103,294,968	24,176,934	2,270,280	82,870
Melbourne-Geelong	600,408,778	47,335,571	3,227,466	n/a	21,597,822
Brisbane-South-East-Queensland	457,374,113	16,494,696	12,753,276	487,447	n/a
Perth-Wheatbelt	300,045,588	8,999,781	8,691,320	6,533	n/a
Adelaide-Yorketown	169,385,298	2,565,689	7,237,787	n/a	163,743
Canberra-Goulburn-Yass	84,218,393	n/a	3,414,642	n/a	n/a

Note: n/a (not applicable) indicated where mode does not exist for conurbation
Source: (VLC, 2014)

Utilisation of urban transport in 2010-11

The utilisation of urban transport by mode for each of the conurbations (extended urban areas beyond the GCCSAs) in 2010-11 is shown in Table 126.

Table 126 **Utilisation by conurbation and mode (2010-11)**

Conurbation	Road	Rail	Bus	Ferry	Light rail
	VKT per day	Passenger kms per day	Passenger kms per day	Passenger kms per day	Passenger kms per day
Sydney-Newcastle-Wollongong	132,187,467	20,836,852	8,118,279	223,304	28,512
Melbourne-Geelong	116,880,115	17,622,360	2,312,022	n/a	4,075,718
Brisbane-South-East-Queensland	83,745,007	4,320,496	3,214,913	75,928	n/a
Perth-Wheatbelt	49,845,107	2,965,370	1,367,563	303	n/a
Adelaide-Yorketown	28,225,360	582,748	1,141,167	n/a	24,613
Canberra-Goulburn-Yass	9,906,834	n/a	652,146	n/a	n/a

Note: n/a (not applicable) indicated where mode does not exist for conurbation
Source: (VLC, 2014)

[100] Melbourne-Geelong conurbation is an exception, which includes most of the Melbourne GCCSA but does not include the Macedon Ranges SA3.

16.3.2 DEC of urban transport in 2010-11

Direct Economic Contribution of urban transport in 2010-11

The DEC of urban transport by mode for each of the conurbations is shown in Table 127.

Table 127 **DEC by conurbation and mode and types of road vehicle (2010-11)**

Conurbation	Car	LCV	HCV	Rail	Bus	Ferry	Light rail	Total urban transport
	$m	$m	$m	$m	$m	$m	$m	$m
Sydney-Newcastle-Wollongong	20,530	854	2,825	1,950	1,329	4	12	27,504
Melbourne-Geelong	15,537	641	779	1,744	985	n/a	322	20,007
Brisbane-South-East-Queensland	11,429	528	516	190	398	14	n/a	13,075
Perth-Wheatbelt	7,647	400	448	290	350	-0	n/a	9,134
Adelaide-Yorketown	5,830	194	383	42	254	n/a	1	6,705
Canberra-Goulburn-Yass	1,502	51	175	n/a	95	n/a	n/a	1,824
Total	**62,475**	**2,667**	**5,126**	**4,216**	**3,411**	**18**	**355**	**78,250**

Note: n/a (not applicable) indicated where mode does not exist for conurbation
Source: ACIL Allen Consulting, 2014

Using top-down economic modelling, the DEC of urban transport infrastructure in Hobart and Darwin is estimated to be $835 million and $600 million respectively in 2010-11. This increases the total DEC of urban transport infrastructure across the 8 capital cities to $79.69 billion in 2010-11.

Congestion in 2010-11

A summary of the congestion (car delay cost) of urban transport for each of the conurbations is provided in Table 128. Adelaide-Yorketown and Sydney-Newcastle-Wollongong are expected to have the highest car delay costs as a percentage of total DEC, while Melbourne-Geelong and Canberra-Goulburn-Yass are expected to have the lowest.

Table 128 **Congestion by conurbation (2010-11)**

Conurbation	Congestion (car delay cost)	DEC	Congestion (% of DEC)
	$m	$m	%
Sydney-Newcastle-Wollongong	5,555	27,504	20.2%
Melbourne-Geelong	2,837	20,007	14.18%
Brisbane-South-East-Queensland	1,914	13,075	14.64%
Perth-Wheatbelt	1,784	9,134	19.5%
Adelaide-Yorketown	1,442	6,705	21.5%
Canberra-Goulburn-Yass	208	1,824	11.4%

Source: ACIL Allen Consulting, 2014

16.3.3 Growth in capacity and utilisation of urban transport to 2030-31

Assumed growth in capacity of urban transport to 2030-31

Growth in capacity is assumed to follow a low investment scenario where only those projects go ahead for which funding has been allocated or where significant political capital has been invested. The capacity of urban transport by mode for each of the conurbations in 2030-31 is shown in Table 129.

Table 129 **Capacity by conurbation and mode (2030-31)**

Conurbation	Road	Rail	Bus	Ferry	Light rail
	VKT per day	Passenger seat kms per day	Passenger seat kms per day	Passenger seat kms per day	Passenger seat kms per day
Sydney-Newcastle-Wollongong	654,621,504	113,801,605	27,190,647	2,270,280	770,468
Melbourne-Geelong	636,098,134	70,739,099	4,033,120	n/a	35,654,678
Brisbane-South-East-Queensland	490,562,616	19,291,864	14,959,187	522,203	327,076
Perth-Wheatbelt	315,206,758	12,349,826	8,727,253	6,538	n/a
Adelaide-Yorketown	175,544,578	3,002,197	7,238,064	n/a	164,181
Canberra-Goulburn-Yass	91,517,327	n/a	3,414,642	n/a	n/a

Note: n/a (not applicable) indicated where mode does not exist for conurbation
Source: (VLC, 2014)

Table 130 provides a summary of assumed growth in capacity of urban transport by mode for each of the conurbations between 2010-11 and 2030-31.

Table 130 **Assumed compound annual growth rate (CAGR) of urban transport capacity between 2010-11 and 2030-31**

Conurbation	Road	Rail	Bus	Ferry	Light rail
	CAGR (%)	CAGR (%)	CAGR (%)	CAGR (%)	CAGR (%)
Sydney-Newcastle-Wollongong	0.3%	0.5%	0.6%	0.0%	11.8%
Melbourne-Geelong	0.3%	2.0%	1.1%	n/a	2.5%
Brisbane-South-East-Queensland	0.4%	0.8%	0.8%	0.3%	n/a
Perth-Wheatbelt	0.2%	1.6%	0.0%	0.0%	n/a
Adelaide-Yorketown	0.2%	0.8%	0.0%	n/a	0.0%
Canberra-Goulburn-Yass	0.4%	n/a	0.0%	n/a	n/a

Note: n/a (not applicable) indicated where mode does not exist for conurbation
Source: (VLC, 2014)

The assumed changes to urban transport infrastructure constitute a low investment scenario where only those projects go ahead for which capital has been allocated or where significant political capital has been invested.

Growth in utilisation of urban transport to 2030-31

The utilisation of urban transport by mode for each of the conurbations in 2030-31 is shown in Table 131. The ratio of utilisation to capacity is shown in brackets under the corresponding utilisation figure.

Table 131 **Utilisation by conurbation and mode (2030-31)**

Conurbation	Road	Rail	Bus	Ferry	Light rail
	VKT per day	Passenger seat kms per day	Passenger seat kms per day	Passenger seat kms per day	Passenger seat kms per day
Sydney-Newcastle-Wollongong	174,448,042	33,800,277	10,662,134	396,631	415,429
Melbourne-Geelong	163,880,115	40,956,587	3,794,382	n/a	8,360,219
Brisbane-South-East-Queensland	134,939,469	9,697,901	4,770,881	206,342	59,684
Perth-Wheatbelt	94,241,231	8,843,400	2,166,951	771	n/a
Adelaide-Yorketown	36,820,591	1,073,067	1,407,936	n/a	35,181
Canberra-Goulburn-Yass	13,593,001	n/a	1,066,222	n/a	n/a

Note: n/a (not applicable) indicated where mode does not exist for conurbation
Source: (VLC, 2014)

The ratio of utilisation to capacity provides another perspective on future pressures. The highest ratio of capacity to utilisation is observed for the Melbourne-Geelong bus network, followed by the Perth-Wheatbelt rail network. However, this should be interpreted in light of the capacity assumptions (no network augmentations beyond committed projects) and also that the selected measure of capacity is 'seats' rather than total capacity which would also include standing space.

Table 132 provides a summary of growth in utilisation of urban transport by mode for each of the conurbations between 2010-11 and 2030-31.

Table 132 **Compound Annual Growth Rate (CAGR) of urban transport utilisation between 2010-11 and 2030-31**

Conurbation	Road	Rail	Bus	Ferry	Light rail
	CAGR (%)	CAGR (%)	CAGR (%)	CAGR (%)	CAGR (%)
Sydney-Newcastle-Wollongong	1.4%	2.4%	1.4%	2.9%	14.3%
Melbourne-Geelong	1.3%	3.6%	1.8%	n/a	3.0%
Brisbane-South-East-Queensland	2.4%	4.1%	2.0%	5.1%	n/a
Perth-Wheatbelt	3.2%	5.6%	2.3%	4.8%	n/a
Adelaide-Yorketown	1.3%	3.1%	1.1%	n/a	1.8%
Canberra-Goulburn-Yass	1.6%	n/a	2.5%	n/a	n/a

Note: n/a (not applicable) indicated where mode does not exist for conurbation
Source: (VLC, 2014)

Utilisation is expected to grow at a faster rate than the capacity delivered by committed augmentations. Where growth occurs in already congested areas, the rate of growth highlights where pressures on networks could be experienced, in the absence of commensurate capacity. The greatest growth in utilisation is seen in Sydney light rail (coinciding with the adding of capacity to that network), Perth rail and Brisbane ferries.

16.3.4 Growth in DEC of urban transport to 2030-31

Direct Economic Contribution of urban transport in 2030-31

The DEC of urban transport by mode for each of the 6 conurbations modelled in detail in 2030-31 is shown in Table 133.

Table 133 **DEC by conurbation, mode and types of road vehicle (2030-31)**

Conurbation	Car	LCV	HCV	Rail	Bus	Ferry	Light rail	Total urban transport
	$m	$m	$m	$m	$m	$m	$m	$m
Sydney-Newcastle-Wollongong	39,487	1,740	5,489	4,073	2,649	45	152	53,635
Melbourne-Geelong	30,605	792	1,418	4,891	1,964	n/a	1,126	40,796
Brisbane-South-East-Queensland	27,686	658	1,078	795	805	67	13	31,103
Perth-Wheatbelt	28,699	1,489	1,599	1,007	826	-0.3	n/a	33,619
Adelaide-Yorketown	10,763	345	722	118	418	n/a	7	12,373
Canberra-Goulburn-Yass	2,956	101	308	n/a	212	n/a	n/a	3,577
Total	**140,196**	**5,125**	**10,613**	**10,885**	**6,874**	**113**	**1,298**	**175,104**

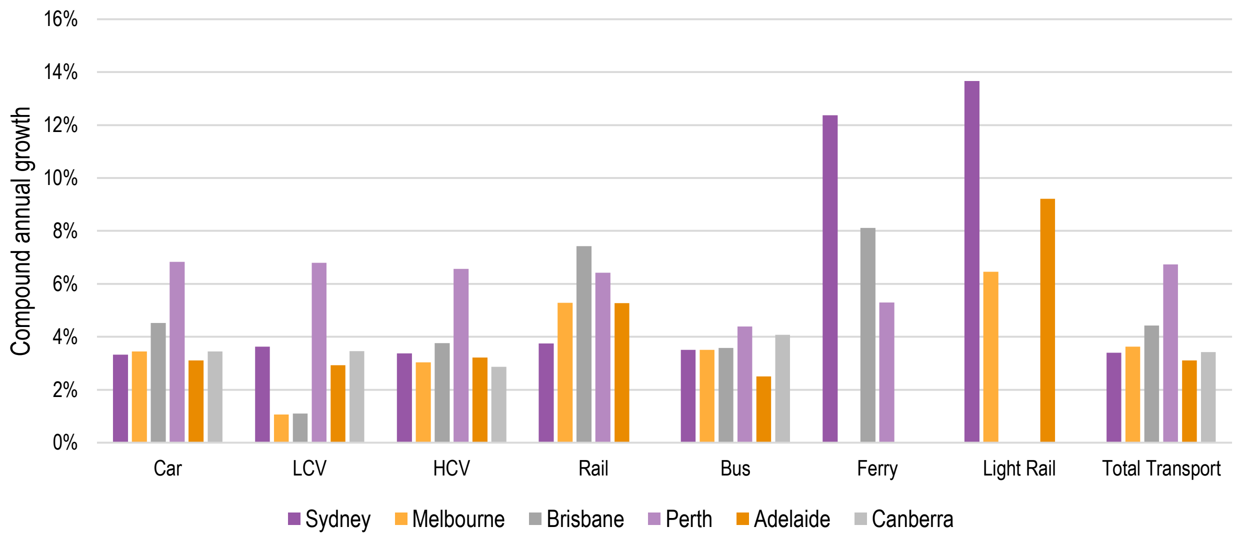
Note: n/a (not applicable) indicated where mode does not exist for conurbation
Source: ACIL Allen Consulting, 2014

Top-down economic modelling of the DEC of urban transport infrastructure for Hobart and Darwin are projected to be $1.48 billion and $1.43 billion respectively in 2030-31.

16.3.5 Growth in Direct Economic Contribution of urban transport to 2030-31

The growth in DEC of urban transport by mode for each of the conurbations (extended urban areas beyond the GCCSAs) between 2010-11 and 2030-31 is illustrated in Figure 202. Perth-Wheatbelt is projected to have the highest overall growth in DEC, followed by Brisbane-South-East-Queensland. Ferry and light rail are projected to have the highest growth rates of all modes, although they account for a small proportion of DEC and are not present in every conurbation.

Figure 202 **Growth in DEC by mode and types of road vehicle for each conurbation**



Note: The figure above is for the conurbations (e.g., Sydney is for Sydney-Newcastle-Wollongong). The full conurbation name is shortened for clearer graphic presentation.
Source: ACIL Allen Consulting, 2014

16.3.6 Congestion in 2030-31

The congestion (car delay cost) of urban transport for each of the conurbations in 2030-31 is summarised in Table 134.

Table 134 **Congestion by conurbation (2030-31)**

Conurbation	Congestion (car delay cost)	DEC	Congestion (% of DEC)
	$m	$m	%
Sydney-Newcastle-Wollongong	14,790	53,635	27.6%
Melbourne-Geelong	9,007	40,796	22.1%
Brisbane-South-East-Queensland	9,206	31,103	29.6%
Perth-Wheatbelt	15,865	33,619	47.2%
Adelaide-Yorketown	3,747	12,373	30.3%
Canberra-Goulburn-Yass	703	3,577	19.7%

Source: ACIL Allen Consulting, 2014

16.3.7 Growth in congestion to 2030-31

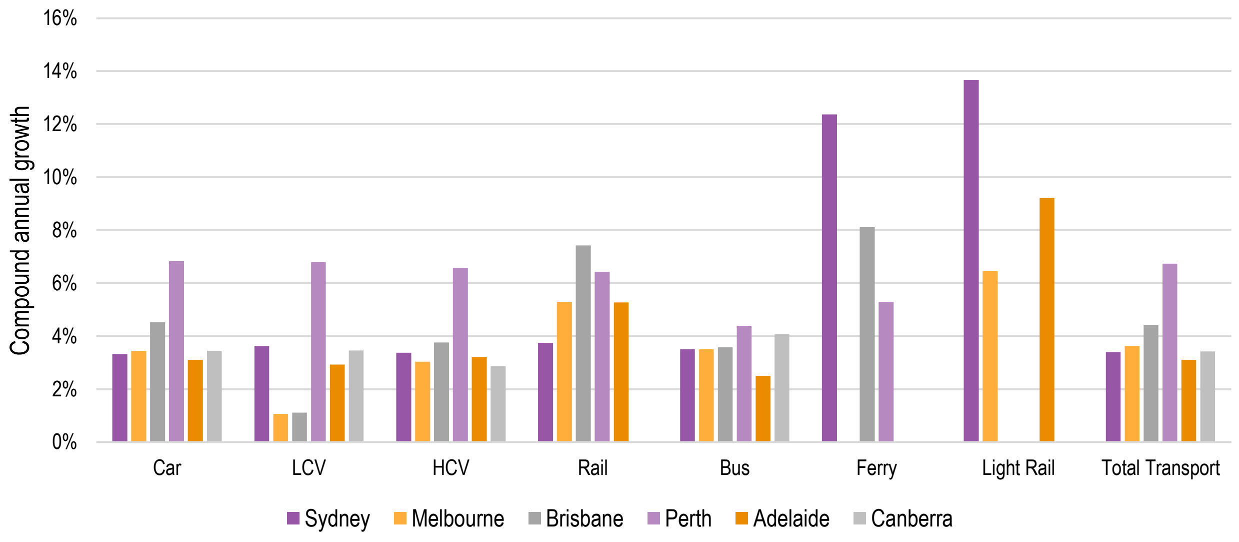
The growth in congestion of urban transport by mode for each of the conurbations between 2010-11 and 2030-31 is shown in Table 135 and illustrated in Figure 203.

Table 135 **Compound Annual Growth Rate (CAGR) of urban transport congestion and DEC between 2010-11 and 2030-31**

Conurbation	Congestion (car delay cost)	DEC
	CAGR (%)	CAGR (%)
Sydney-Newcastle-Wollongong	5.0%	3.4%
Melbourne-Geelong	4.5%	2.9%
Brisbane-South-East-Queensland	8.2%	4.4%
Perth-Wheatbelt	11.5%	6.7%
Adelaide-Yorketown	4.9%	3.1%
Canberra-Goulburn-Yass	6.3%	3.4%

Source: ACIL Allen Consulting, 2014

Figure 203 **Growth ($m) in DEC by mode and types of road vehicle**



Note: The figure above is for the conurbations (e.g., Sydney is for Sydney-Newcastle-Wollongong). The full conurbation name is shortened for clearer graphic presentation.
Source: ACIL Allen Consulting, 2014

In all conurbations, congestion grows at a faster rate than DEC. In the case of Brisbane-South-East-Queensland and Perth-Wheatbelt, congestion also grows by a higher amount in absolute terms than DEC.

This follows from the assumption that the demand for travel will significantly outpace capacity brought about by existing committed augmentations. The detailed analysis for each conurbation will identify hotspots which may be further explored in the context of transport solutions.

16.3.8 Analysis of demand by origin destination pairs

For each conurbation, ACIL Allen has calculated the DEC of road journeys from each Australian Bureau of Statistics (ABS) SA3 spatial unit to all other SA3 spatial units within the conurbation. SA3s are generally clusters of related suburbs around urban commercial and transport hubs within the major urban areas.

As an example, Figure 204 shows a matrix of the DEC in 2010-11 for origin-destination pairs in the Sydney Greater City Statistical Area (GCCSA). The Sydney GCCSA is a subset of the Sydney-Newcastle-Wollongong conurbation. Each cell represents the DEC of road journeys from an origin (rows of the matrix) to a destination (column of the matrix). For example, the first row shows the DEC of journeys originating in the SA3 'Sydney Inner City' whereas the first column shows the DEC of trips ending in the SA3 'Sydney Inner City'. The DEC is colour coded from green to red where green indicates a low DEC and red indicates a high DEC. The figure does not show the DEC of travel within SA3s i.e. the DEC of trips that originate and end in the same SA3.

Figure 204 **Roads – GCCSA origin-destination pairs – DEC 2010-11 $millions – Sydney GCCSA**

SA3 Origin / Destination	Sydney Inner City	Eastern Suburbs - North	Marrickville - Sydenham - Petersham	Leichhardt	Strathfield - Burwood - Ashfield	Botany	Eastern Suburbs - South	Kogarah - Rockdale	Canterbury	Hurstville	Cronulla - Miranda - Caringbah	Sutherland - Menai - Heathcote	Liverpool	Campbelltown (NSW)	Bankstown	Merrylands - Guildford	Auburn	Fairfield	Bringelly - Green Valley	Penrith	Camden	Blue Mountains - South	Wollondilly
Sydney Inner City		58.9	35.1	41.7	48.8	103.9	63.5	38.0	22.3	15.6	19.1	13.8	11.5	9.5	17.6	10.3	13.0	6.8	5.9	9.0	5.2	1.8	9.4
Eastern Suburbs - North	58.1		5.6	6.6	8.5	24.1	38.7	10.0	4.5	4.5	5.5	3.9	2.6	2.1	3.6	1.9	2.5	1.4	1.4	2.0	1.5	0.2	1.3
Marrickville - Sydenham - Petersham	32.2	5.5		7.6	13.5	14.7	7.4	13.3	8.4	5.0	4.5	3.3	2.8	2.1	4.3	1.7	2.4	1.2	1.3	1.0	1.3	0.3	1.1
Leichhardt	35.0	5.7	6.7		14.3	9.3	4.8	5.6	5.7	3.1	2.6	2.5	2.3	1.8	4.4	2.2	3.0	1.2	1.0	1.4	1.2	0.3	1.0
Strathfield - Burwood - Ashfield	47.3	8.4	15.6	16.1		22.1	9.2	20.1	30.9	14.3	8.6	9.1	10.5	6.6	27.4	11.3	23.2	6.8	4.3	4.2	3.9	1.0	3.5
Botany	101.5	24.4	15.3	14.3	22.5		34.0	29.1	13.7	13.7	18.6	15.9	15.4	16.1	16.1	15.3	13.2	14.8	9.5	11.8	9.5	0.8	6.8
Eastern Suburbs - South	61.8	39.8	7.4	6.1	8.8	33.8		15.8	5.9	6.4	7.8	5.7	3.5	2.7	4.5	1.9	2.3	1.7	1.7	1.9	1.8	0.2	1.5
Kogarah - Rockdale	35.7	9.8	13.1	7.0	19.6	29.3	15.8		24.2	29.0	27.3	18.5	7.9	5.8	13.6	4.3	5.0	3.8	3.7	1.9	3.3	0.3	2.8
Canterbury	20.7	4.4	9.2	6.4	31.4	13.4	6.3	24.3		22.4	9.00	9.6	9.8	6.1	27.6	6.6	8.8	5.6	4.1	2.2	3.3	0.4	2.3
Hurstville	14.4	4.3	5.3	3.7	14.2	13.9	6.8	29.9	22.7		17.3	16.3	9.5	5.7	24.1	5.5	6.5	4.3	3.8	1.8	2.8	0.3	1.8
Cronulla - Miranda - Caringbah	17.8	5.3	4.8	3.7	8.5	19.5	8.1	28.5	9.6	17.8		26.7	5.9	4.4	10.6	3.9	4.3	3.0	2.7	1.7	2.3	0.2	2.0
Sutherland - Menai - Heathcote	12.8	3.6	3.5	3.0	8.9	16.4	5.9	19.2	10.0	17.2	27.2		10.2	5.8	22.0	5.6	5.7	5.1	3.8	1.7	2.3	0.2	1.6
Liverpool	9.4	2.3	2.9	2.4	9.0	14.9	3.6	7.4	8.6	8.8	9.7	11.2		46.9	35.3	27.1	11.7	51.7	54.1	9.1	20.3	0.8	10.1
Campbelltown (NSW)	8.5	2.0	2.2	2.0	5.9	16.2	2.8	5.7	5.7	5.7	6.4	11.2	45.6		15.9	10.3	6.1	17.1	32.5	7.7	79.3	1.4	24.3
Bankstown	16.2	3.6	5.8	5.0	26.9	16.8	5.6	14.4	27.8	24.6	12.3	22.0	39.8	17.3		31.0	27.2	26.8	14.9	6.0	9.0	0.9	6.6
Merrylands - Guildford	9.7	1.9	2.4	2.4	11.8	15.5	2.4	4.4	6.6	5.4	5.6	6.0	27.1	13.7	31.0		31.9	50.4	14.9	12.2	6.0	0.9	5.7
Auburn	12.1	2.4	3.3	3.2	23.9	13.2	2.7	5.2	8.8	6.5	4.8	5.9	11.4	6.3	28.3	32.3		13.4	5.2	5.6	2.8	0.7	2.9
Fairfield	6.5	1.4	1.6	1.4	7.0	14.6	2.0	3.8	5.7	4.3	5.2	6.0	53.4	21.2	27.0	53.0	14.7		47.2	15.8	11.2	1.0	7.1
Bringelly - Green Valley	5.3	1.3	1.4	1.3	4.2	9.1	1.7	3.6	3.7	3.5	4.5	5.1	54.7	32.3	13.7	16.4	7.1	48.4		15.1	31.4	1.2	10.1
Penrith	8.5	1.9	1.1	1.4	4.3	11.1	1.9	1.8	2.1	1.6	1.9	1.9	9.3	8.8	6.0	13.2	6.4	20.0	15.5		9.3	2.5	5.6
Camden	4.8	1.4	1.3	1.3	3.6	9.5	1.8	3.2	3.2	2.8	3.1	4.8	20.3	78.3	9.0	6.2	3.8	11.0	36.3	9.3		2.8	33.5
Blue Mountains - South	0.2	0.1	0.1	0.0	0.2	0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.6	1.3	0.4	0.6	0.2	0.9	1.2	2.4	3.0		1.7
Wollondilly	9.3	1.2	1.1	1.0	3.4	7.1	1.6	2.8	2.3	1.9	2.4	2.4	10.3	24.7	6.7	5.7	3.0	6.8	11.0	5.4	35.1	1.6	
Canada Bay	25.0	4.8	5.4	10.5	29.8	11.2	3.8	6.0	8.2	4.3	2.8	3.1	3.5	2.5	8.9	4.6	9.6	2.3	1.5	2.1	1.3	0.4	1.3
Pennant Hills - Epping	2.3	0.7	0.5	1.0	3.0	3.6	0.6	0.6	1.1	0.5	0.3	0.4	1.0	0.5	2.2	3.5	3.7	1.6	0.7	1.0	0.3	0.2	0.4
Carlingford	7.1	1.8	1.5	2.2	6.5	8.7	1.4	1.8	2.4	1.8	1.6	1.8	4.0	2.2	7.7	13.9	15.5	6.3	2.0	3.8	0.8	0.4	1.3
Ryde - Hunters Hill	26.3	6.0	4.8	10.3	21.2	18.5	5.0	4.3	6.5	3.8	2.5	2.5	4.0	2.1	10.9	9.7	15.7	4.1	1.8	3.3	1.3	0.8	1.6
Parramatta	10.7	2.4	2.3	2.8	12.7	21.4	2.3	3.9	5.2	4.4	3.7	4.4	14.7	8.6	18.0	64.0	31.6	27.8	8.7	15.3	3.5	0.9	3.8
Blacktown	5.1	1.2	1.0	1.4	4.7	13.0	1.1	1.4	2.2	1.6	1.5	1.7	8.4	6.6	6.9	26.1	8.6	23.5	7.7	14.8	3.2	0.6	3.1
Richmond - Windsor	1.4	0.1	0.2	0.2	0.7	3.1	0.1	0.4	0.4	0.2	0.3	0.1	1.2	1.2	0.9	2.1	0.9	2.7	1.7	13.4	1.1	0.3	0.8
St Marys	2.0	0.5	0.4	0.6	1.9	4.3	0.5	0.4	0.8	0.4	0.7	0.6	4.0	3.1	2.3	6.8	2.9	8.3	4.8	19.4	1.6	0.2	1.0
Hawkesbury	1.4	0.4	0.2	0.3	0.8	2.5	0.3	0.4	0.3	0.3	0.2	0.2	1.0	1.1	1.1	2.1	1.0	2.4	1.4	9.2	0.8	0.0	0.4
Blue Mountains	1.6	0.5	0.2	0.3	1.1	4.3	0.3	0.4	0.4	0.2	0.3	0.2	2.1	1.7	1.5	3.2	1.4	3.9	2.6	18.5	1.4	3.0	0.5
Rouse Hill - McGraths Hill	1.4	0.4	0.3	0.3	1.0	2.8	0.3	0.4	0.5	0.3	0.4	0.3	1.3	1.5	1.2	3.1	1.5	2.8	1.3	5.7	0.7	0.2	0.9
Mount Druitt	5.4	1.1	0.9	1.1	4.4	14.5	0.8	1.2	2.0	1.1	2.0	1.8	8.5	8.1	5.7	19.6	7.4	23.1	10.4	32.0	4.2	0.6	3.8
Blacktown - North	2.1	0.5	0.3	0.7	1.9	5.3	0.6	0.5	0.8	0.4	0.4	0.4	2.9	2.9	2.4	7.6	3.1	7.2	3.0	8.8	1.3	0.2	1.4
North Sydney - Mosman	40.1	11.4	4.2	7.2	7.5	18.0	9.0	4.7	3.1	2.2	2.9	2.0	1.8	1.7	2.7	2.3	2.7	1.1	0.9	1.5	0.8	0.3	1.4
Chatswood - Lane Cove	42.0	12.0	4.9	9.2	13.4	20.8	9.3	5.3	4.5	2.7	3.6	2.6	2.6	2.3	5.4	4.3	5.7	2.2	1.2	2.3	1.1	0.7	2.2
Ku-ring-gai	12.6	4.3	2.0	3.5	8.2	11.0	3.3	2.2	2.7	1.6	1.2	1.0	1.5	0.8	4.8	4.1	5.7	2.0	0.6	1.7	0.5	0.3	0.5
Hornsby	2.6	0.4	0.5	1.0	2.7	5.2	0.6	0.4	1.1	0.6	0.3	0.4	1.2	1.0	2.6	3.9	3.5	2.0	0.7	1.3	0.3	0.1	0.7
Dural - Wisemans Ferry	3.0	0.9	0.5	0.9	2.1	3.3	0.8	0.6	0.8	0.5	0.3	0.3	1.3	0.8	2.5	4.0	3.7	2.3	0.8	2.1	0.4	0.0	0.4
Baulkham Hills	6.3	2.0	1.4	2.4	7.4	13.8	1.9	1.4	3.0	1.8	1.1	1.6	5.7	4.5	8.6	22.5	14.3	12.3	4.2	7.9	2.3	0.5	2.6
Manly	9.3	2.8	0.9	1.7	2.1	5.9	2.3	1.4	0.8	0.6	0.8	0.5	0.5	0.3	0.8	0.8	0.8	0.4	0.3	0.6	0.2	0.1	0.3
Warringah	25.3	7.4	3.0	4.7	7.1	19.0	5.8	3.7	2.5	2.0	2.3	1.7	1.7	1.6	4.0	3.5	4.0	1.8	1.0	1.8	0.8	0.3	1.3
Wyong	2.8	0.2	0.2	0.5	0.7	8.4	0.4	0.3	0.5	0.2	0.4	0.3	0.7	0.4	1.1	1.5	1.1	0.9	0.4	1.7	0.2	0.0	0.8
Pittwater	7.4	2.4	1.0	1.5	2.9	8.1	1.8	1.1	1.1	0.6	0.8	0.5	1.0	0.5	2.0	1.8	2.3	1.0	0.3	0.9	0.2	0.1	0.3
Gosford	3.0	0.2	0.3	0.4	0.8	7.9	0.2	0.4	0.3	0.4	0.3	0.4	0.8	0.6	1.6	1.8	1.3	1.2	0.5	1.6	0.4	0.0	0.6

SA3 Origin / Destination	Canada Bay	Pennant Hills - Epping	Carlingford	Ryde - Hunters Hill	Parramatta	Blacktown	Richmond - Windsor	St Marys	Hawkesbury	Blue Mountains	Rouse Hill - McGraths Hill	Mount Druitt	Blacktown - North	North Sydney - Mosman	Chatswood - Lane Cove	Ku-ring-gai	Hornsby	Dural - Wisemans Ferry	Baulkham Hills	Manly	Warringah	Wyong	Pittwater	Gosford
Sydney Inner City	25.2	4.7	8.3	26.4	11.0	5.1	1.4	2.2	1.5	2.1	1.6	9.8	7.1	46.3	47.5	14.6	4.2	4.4	10.7	11.4	30.5	3.4	8.5	3.7
Eastern Suburbs - North	4.6	0.9	1.8	5.5	2.3	1.1	0.1	0.6	0.3	0.6	0.4	1.6	1.1	11.8	12.4	4.8	0.6	1.0	2.5	3.1	8.1	0.3	2.6	0.2
Marrickville - Sydenham - Petersham	4.6	0.5	1.1	3.8	1.7	0.8	0.2	0.3	0.2	0.2	0.2	0.9	0.6	4.0	4.4	1.7	0.5	0.5	1.4	1.0	2.9	0.2	1.0	0.3
Leichhardt	9.8	1.2	2.1	8.9	2.6	1.3	0.2	0.6	0.3	0.4	0.3	1.4	1.1	7.0	8.5	3.5	1.1	0.9	2.6	1.7	4.5	0.5	1.5	0.4
Strathfield - Burwood - Ashfield	29.9	3.8	6.9	20.2	11.7	4.3	0.7	1.8	0.8	1.3	0.9	4.6	2.6	8.0	13.1	8.4	3.1	2.4	7.9	2.2	7.5	0.8	3.0	0.8
Botany	11.0	3.7	8.7	17.3	20.0	12.5	3.2	4.6	2.6	5.2	2.8	15.8	6.4	17.6	20.3	11.0	5.5	3.5	14.3	6.1	19.6	8.9	8.3	7.5
Eastern Suburbs - South	3.5	0.8	1.3	4.5	2.0	0.9	0.2	0.5	0.3	0.3	0.2	1.1	0.9	8.8	9.1	3.4	0.6	0.9	2.1	2.4	6.0	0.4	1.8	0.2
Kogarah - Rockdale	5.9	0.7	1.9	3.9	3.6	1.4	0.4	0.5	0.4	0.5	0.4	1.5	0.9	4.4	5.0	2.1	0.4	0.6	1.6	1.4	3.8	0.3	1.2	0.4
Canterbury	8.5	1.3	2.6	6.4	4.8	2.1	0.4	0.8	0.3	0.5	0.5	1.9	1.1	3.2	4.5	2.8	1.1	0.8	3.2	0.9	2.7	0.5	1.2	0.3
Hurstville	4.4	0.7	1.9	3.7	4.2	1.5	0.2	0.5	0.3	0.3	0.3	1.3	0.6	2.1	2.6	1.6	0.6	0.5	2.0	0.6	2.0	0.2	0.6	0.4
Cronulla - Miranda - Caringbah	2.7	0.5	1.5	2.1	2.9	1.0	0.3	0.5	0.2	0.4	0.3	1.5	0.5	2.6	3.3	1.2	0.2	0.3	0.9	0.8	2.3	0.4	0.8	0.3
Sutherland - Menai - Heathcote	3.0	0.5	1.9	2.4	4.1	1.3	0.1	0.5	0.2	0.3	0.3	1.4	0.4	1.9	2.4	1.0	0.4	0.3	1.5	0.5	1.7	0.3	0.5	0.4
Liverpool	3.3	1.0	4.2	3.7	13.4	8.1	1.2	3.9	1.2	2.6	1.4	7.9	2.8	1.6	2.2	1.3	1.3	1.2	5.2	0.5	1.6	0.8	0.9	0.8
Campbelltown (NSW)	2.2	0.4	1.6	1.7	5.0	4.6	1.0	2.5	1.0	2.0	1.2	6.0	2.3	1.5	2.0	0.6	1.0	0.6	3.0	0.4	1.5	0.4	0.4	0.6
Bankstown	9.1	2.6	7.8	9.9	16.1	6.3	0.9	2.3	1.1	1.9	1.2	5.4	2.6	2.7	5.0	4.6	2.9	2.5	8.1	0.9	4.0	1.2	2.0	1.6
Merrylands - Guildford	5.9	3.9	16.4	11.1	61.7	24.6	2.1	6.5	2.3	4.3	3.2	17.6	7.3	2.5	4.6	4.3	5.1	3.9	21.5	0.9	3.7	1.6	1.8	1.9
Auburn	10.8	4.4	16.6	15.3	31.6	8.1	0.8	2.7	1.0	1.7	1.6	6.7	3.4	3.0	5.9	5.9	4.2	3.7	14.2	0.9	4.2	1.2	2.4	1.3
Fairfield	2.9	1.8	7.7	5.7	26.8	22.8	2.2	7.6	2.3	4.9	2.8	21.3	6.7	1.1	2.3	2.2	2.8	2.3	11.8	0.4	1.9	1.0	1.0	1.2
Bringelly - Green Valley	1.5	0.7	2.5	2.2	8.4	7.8	1.6	4.8	1.5	3.2	1.4	10.1	3.0	0.9	1.2	0.7	0.9	0.8	4.0	0.3	1.0	0.5	0.3	0.5
Penrith	2.3	1.1	4.5	4.1	15.7	15.3	13.8	20.3	9.9	20.1	6.0	32.0	8.8	1.5	2.4	1.8	1.7	2.2	7.7	0.6	1.9	1.8	0.9	1.6
Camden	1.3	0.3	1.0	1.3	3.4	3.1	1.1	1.6	0.9	1.6	0.7	3.9	1.2	0.8	1.1	0.5	0.4	0.4	2.1	0.2	0.7	0.3	0.2	0.4
Blue Mountains - South	0.0	0.0	0.1	0.1	0.5	0.5	0.2	0.3	0.0	3.3	0.1	0.5	0.1	0.0	0.1	0.0	0.0	0.0	0.2	0.0	0.1	0.0	0.0	0.0
Wollondilly	1.1	0.3	1.1	1.3	3.3	2.9	0.8	1.0	0.4	0.6	0.9	3.4	1.3	1.3	2.0	0.4	0.6	0.3	2.1	0.3	1.3	0.8	0.3	0.6
Canada Bay		2.9	5.3	21.7	6.7	2.2	0.2	0.8	0.3	0.6	0.5	2.1	1.5	5.2	12.4	7.3	2.3	1.6	4.7	1.4	5.1	0.5	2.1	0.7
Pennant Hills - Epping	2.6		9.0	10.0	10.3	3.2	0.3	0.5	0.3	0.4	1.0	1.5	1.6	1.4	3.7	6.3	8.8	3.4	15.5	0.3	2.1	0.4	1.2	0.7
Carlingford	5.9	9.2		19.0	41.7	9.3	0.8	1.9	0.9	1.3	1.9	4.8	4.1	2.5	6.3	6.2	6.4	4.8	23.4	0.9	3.7	0.8	1.8	1.2
Ryde - Hunters Hill	24.5	10.7	19.4		23.4	5.9	0.5	1.3	0.6	0.7	1.4	3.6	3.9	10.3	30.5	28.4	6.9	4.8	15.8	2.6	12.7	1.1	6.2	1.1
Parramatta	9.0	11.0	46.2	25.5		47.1	2.6	8.5	3.5	5.9	6.8	23.5	15.2	3.6	7.6	9.3	11.7	9.6	65.2	1.1	5.5	2.1	3.1	2.5
Blacktown	3.1	3.4	11.6	9.8	46.9		5.1	9.2	5.4	5.3	8.9	46.8	33.7	1.9	3.9	4.5	7.2	5.4	49.5	0.5	3.0	1.4	1.6	1.6
Richmond - Windsor	0.3	0.3	0.9	0.9	3.5	5.0		2.2	20.1	3.4	10.7	6.5	7.0	0.3	0.7	0.6	0.5	2.6	2.8	0.1	0.6	0.3	0.1	0.3
St Marys	1.0	0.5	2.2	1.7	8.3	9.3	2.1		1.6	2.5	1.9	27.2	4.0	0.3	0.8	0.5	0.8	0.7	3.7	0.1	0.5	0.1	0.2	0.2
Hawkesbury	0.4	0.3	0.9	0.8	3.7	4.7	20.5	1.5		2.9	8.0	5.0	5.8	0.4	1.0	0.6	0.8	1.6	3.8	0.2	0.5	1.0	0.3	1.0
Blue Mountains	0.6	0.4	1.0	0.6	4.2	3.3	3.1	2.9	2.8		1.3	4.4	1.6	0.2	0.6	0.3	0.3	0.3	1.8	0.1	0.2	0.1	0.1	0.2
Rouse Hill - McGraths Hill	0.6	1.0	2.1	1.9	6.7	7.8	10.9	1.8	8.7	1.7		6.6	15.4	0.5	1.2	1.4	2.0	5.3	14.7	0.2	0.8	0.5	0.5	0.6
Mount Druitt	2.5	1.6	6.3	5.3	23.7	48.2	6.8	27.4	5.7	7.4	7.2		19.8	1.1	2.1	2.0	2.9	2.7	15.4	0.5	1.6	1.1	0.8	1.3
Blacktown - North	1.2	1.5	4.4	3.9	15.3	34.2	7.3	4.0	6.5	2.4	16.3	19.9		1.0	2.2	2.2	2.8	4.7	32.1	0.4	1.4	0.6	0.6	0.7
North Sydney - Mosman	5.1	1.5	2.3	8.6	3.0	1.6	0.3	0.3	0.4	0.2	0.5	1.9	2.2		31.1	9.1	1.7	1.5	4.1	12.0	20.7	0.8	4.4	0.8
Chatswood - Lane Cove	12.9	4.4	6.2	28.3	6.8	3.4	0.6	0.7	1.0	0.7	1.2	3.1	4.7	31.1		31.0	8.0	3.6	9.8	7.0	33.1	1.9	9.4	2.1
Ku-ring-gai	7.3	6.8	6.1	27.2	8.7	4.0	0.5	0.4	0.6	0.4	1.2	2.0	2.7	9.1	29.5		20.9	4.0	13.1	2.5	19.2	1.3	7.3	2.0
Hornsby	2.3	8.4	6.0	6.4	9.2	4.5	0.4	0.5	0.7	0.4	1.4	2.1	2.3	1.9	8.0	20.3		7.0	16.7	0.9	6.9	2.0	3.7	2.8
Dural - Wisemans Ferry	1.7	3.5	5.1	4.7	9.5	5.3	2.7	0.6	1.9	0.4	5.4	2.6	4.8	1.3	3.4	4.3	7.5		23.9	0.4	2.1	0.7	0.8	1.1
Baulkham Hills	5.4	16.0	25.9	17.5	66.4	50.5	3.1	3.8	4.7	2.9	15.7	15.8	32.3	3.3	8.6	13.6	21.2	24.6		1.1	5.9	1.9	3.4	2.2
Manly	1.3	0.4	0.8	2.4	1.0	0.4	0.0	0.1	0.2	0.1	0.2	0.8	0.6	11.4	6.8	2.4	0.9	0.5	1.3		15.9	0.2	3.0	0.3
Warringah	5.1	2.6	3.7	11.8	5.2	2.7	0.5	0.5	0.6	0.2	0.8	2.5	3.0	20.6	30.9	18.4	6.8	2.5	8.1	15.8		1.3	24.2	1.7
Wyong	0.4	0.4	0.8	0.9	2.0	1.3	0.3	0.1	0.9	0.1	0.5	1.1	0.5	0.8	1.7	1.2	1.8	0.7	1.8	7.6	1.3		0.7	50.2
Pittwater	2.1	1.5	1.9	6.0	3.0	1.5	0.1	0.2	0.2	0.1	0.5	1.0	1.0	4.7	9.2	7.2	3.8	0.9	4.2	3.0	25.3	0.6		0.8
Gosford	0.7	0.8	1.2	1.0	2.5	1.5	0.4	0.2	1.0	0.2	0.6	1.3	0.8	0.8	2.2	1.9	2.8	1.1	2.3	2.7	1.7	56.5	0.9	

Source: ACIL Allen Consulting, 2014

The heat map provides a broad overview of the DEC of journeys between origin-destination pairs in the Sydney GCCSA. It can be seen that high DEC journeys are concentrated in the top left quadrant of the matrix where the SA3s closer to the city's centre can be found.

Hotspots include journeys to and from the Sydney Inner City, Bankstown, Fairfield, Ryde, Hunters Hill and Parramatta. Journeys between the SA3s 'Gosford' and 'Wyong' are another hotspot. It is important to note that SA3s are not the same size. SA3s such as 'Wyong' or 'Gosford' can cover geographical areas multiple times larger than some of the SA3s closer to the city centre. As a result the DEC calculated for these areas and other SA3s further from the city centre is spread out over a larger area.

For each conurbation, ACIL Allen also produced heat maps of the DEC of public transport journeys by origin-destination pairs (aggregated across all public transport modes).

16.3.9 Major urban transport corridors

In addition to analysing the, utilisation, DEC and delay costs of urban transport in each conurbation by origin-destination pairs, ACIL Allen also analysed these metrics for major corridors in the conurbations. A corridor is a commonly travelled route and might consist of multiple parallel roads. As an example, a set of 34 major road corridors was analysed for the Sydney conurbation.

The following table provides a summary for the top 20 corridors by DEC in 2010-11 across all conurbations. Of these, 8 are located in the Melbourne-Geelong conurbation, 6 in the Sydney-Newcastle-Wollongong conurbation and 4 in the Brisbane-Gold Coast-Sunshine Coast conurbation.

Table 136 **Top 20 corridors by DEC in 2010-11**

Conurbation	Description	Total capacity	Utilisation	Congestion (Volume-to-capacity during typical work day)	Delay cost	DEC
		VKT per hour	VKT per day	%	$m	$m
Melbourne-Geelong	Monash/Princes Fwy Corridor	962,280	8,974,207	39%	180	994
Melbourne-Geelong	North-South Arterials - Eastern Suburbs	560,679	4,601,362	34%	174	862
Sydney-Newcastle-Wollongong	Sydney to Central Coast	831,633	7,724,994	39%	158	852
Perth	Perth Mandurah Corridor	1,193,302	6,728,635	23%	218	769
Melbourne-Geelong	Eastlink/Frankston Fwy Corridor	683,742	5,335,131	33%	87	612
Melbourne-Geelong	East-West Arterials - Lilydale Corridor	439,378	3,350,758	32%	97	546
Melbourne-Geelong	West Gate/Princes Freeway Corridor	638,072	5,193,777	34%	105	498
Sydney-Newcastle-Wollongong	East West corridor	313,134	3,419,907	46%	128	470
Sydney-Newcastle-Wollongong	Mittagong to SW Sydney via Hume Mwy	636,827	4,591,610	30%	72	433
Sydney-Newcastle-Wollongong	South Coast to Sydney	420,307	3,246,397	32%	107	431
Melbourne-Geelong	Western/Metropolitan Ring Road	334,294	4,076,503	51%	87	426
Melbourne-Geelong	East-West Arterials - Wantirna Corridor	303,901	2,310,501	32%	65	391
Brisbane-Gold Coast-Sunshine Coast	Logan River - Gateway Mwy	438,272	3,815,916	36%	75	369
Melbourne-Geelong	Inner Beach Suburbs Corridor	304,426	2,245,022	31%	61	362
Brisbane-Gold Coast-Sunshine Coast	Pacific Mwy | City - Beenleigh	353,893	3,859,594	45%	75	349
Sydney-Newcastle-Wollongong	Homebush Bay to Mona Vale Corridor (A3)	156,685	1,685,038	45%	135	328
Perth	Mitchell Fwy Corridor	288,527	2,783,612	40%	114	319
Brisbane-Gold Coast-Sunshine Coast	North Brisbane - Sunshine Coast	570,335	4,168,199	30%	17	297
Brisbane-Gold Coast-Sunshine Coast	City - Brisbane North	154,024	1,577,282	48%	87	290
Sydney-Newcastle-Wollongong	Sutherland - Ryde/Parramatta Corridor	130,052	1,492,970	49%	113	290

Source: ACIL Allen Consulting, 2014

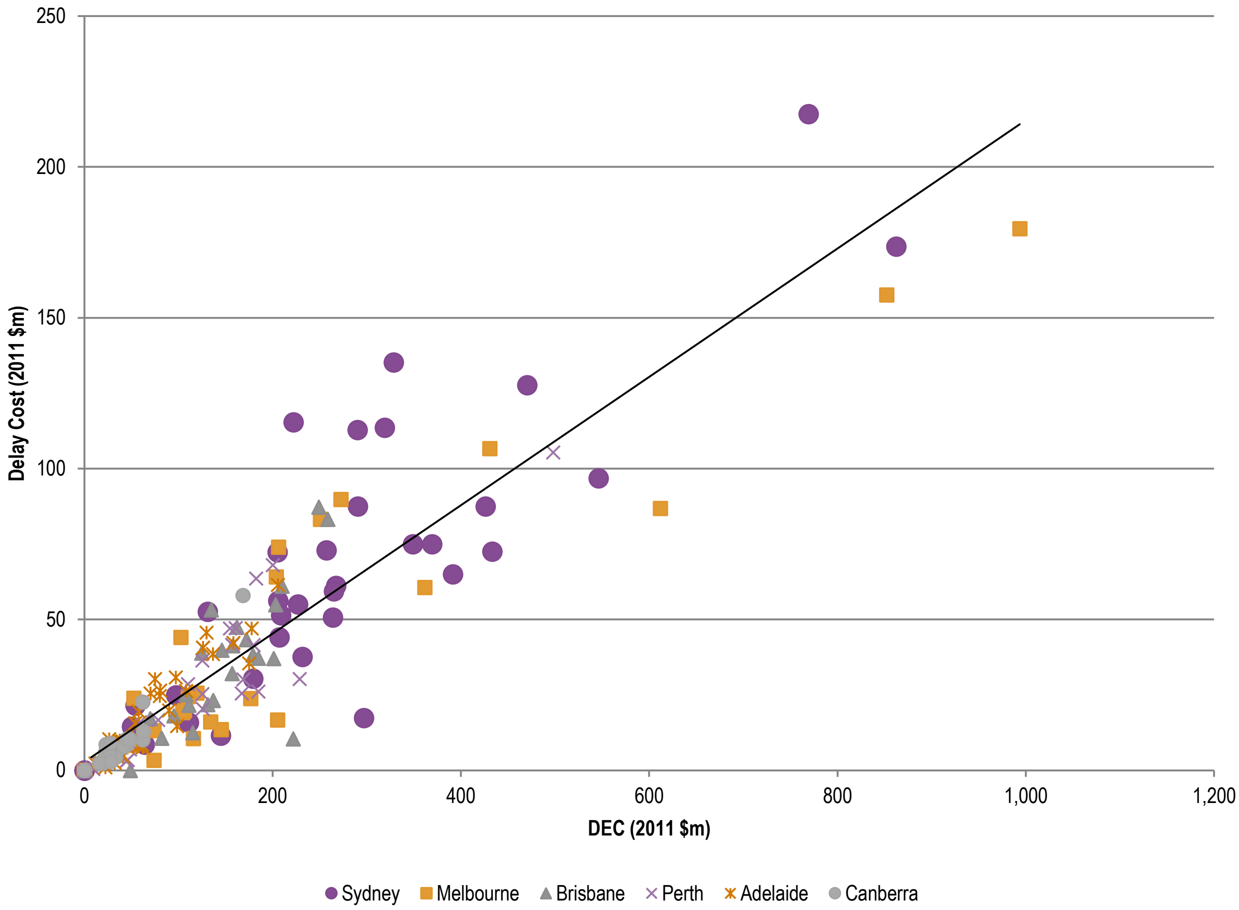
The DEC of any given corridor is influenced by a number of factors including extent of road network included, length and capacity of that network, average speeds, traffic and congestion. Overall, it is an estimate of the total value added in use of the road network for that corridor. Therefore, a high DEC indicates a high base that transports solutions may provide benefit to. High congestion indicates opportunities to reduce avoidable costs.

High DEC corridors tend to be those that are highly utilised and, to a lesser extent, of high capacity. The major arterials that connect distant regions within conurbations or to regions outside of them have the highest DECs.

16.3.10 Comparison of DEC and congestion of corridors

The following figure presents a plot of corridor DEC against delay cost across all conurbations. There is a clear relationship between DEC and delay costs. This is expected since delay costs directly contribute to higher DEC (due to increasing the total time in travel).

Figure 205 **DEC and delay cost for urban transport corridors**



Note: The figure above is for the conurbations (e.g., Sydney is for Sydney-Newcastle-Wollongong). The full conurbation name is shortened for clearer graphic presentation.
Source: ACIL Allen Consulting, 2014

Corridors represented by points above the line are estimated to have a higher than average delay cost per unit of DEC. These are dominated by corridors in Sydney-Newcastle-Wollongong conurbations.

The analysis of corridors can be used to identify where transport solutions could maximise value. It does this by showing the relative economic contribution of corridors and more importantly, corridors with disproportionately high congestion costs. The projections for corridors, show where DEC and congestion grow the fastest under the assumption that no new projects are undertaken beyond those that are already committed. This highlights gap areas where transport solutions could be considered.

16.4 Implications of findings

The audit of urban transport infrastructure has examined the capacity, utilisation, congestion and economic contribution in 6 major urban conurbations. It has examined the performance of major transport modes including road, rail, bus, trams/light rail and ferries. It has also examined performance in the major urban areas networks at large, in regions of the major urban areas, in corridors, routes and links.

The Audit of transport infrastructure in 2010-11 found:

- Considerable capacity has been provided to facilitate mobility in Australia's major urban areas that house more 77 per cent of Australia's population.
- The capacity that is provided is used intensively.
- The demand for transport services and mobility already outstrips capacity at key times of the day and in key journeys and transit corridors. It is estimated that the cost of delays in car travel alone on urban roads amounted to $13.7 billion in 2011. There are indicators of congestion and delays in key public transport networks at key times in many of the urban areas.
- The direct economic contribution of existing urban transport infrastructure is very large. It amounted to $78.25 billion in 2010-11 for the 6 major conurbations. This estimate includes the cost of delays over transport infrastructure networks and other costs faced by users. The urban transport networks are both high cost and high value infrastructure. When Darwin and Hobart urban transport estimates are included, the DEC of urban infrastructure in 2010-11 increases to $79.69 billion.

The Audit provides projections of urban transport needs to 2030-31:

- Demand for mobility in every conurbation studied is expected to grow quite rapidly, exceeding the rate of national population growth and the rate of economic growth. The DEC for urban transport is projected to grow to $175.1 billion by 2031.
- If capacity remains constrained to levels currently provided (or merely include projects that are already underway or are funded), transport demand is projected to outstrip capacity and drive large increases in delays. The costs of congestion on urban roads are projected to grow to $53.3 billion in 2030-31. Seating capacity and crush capacity on public transport facilities is projected to be exceeded in most of the major urban areas studied.
- Higher congestion costs are projected for all of the major urban areas examined (if there is no additional capacity added to transport networks).
- The findings compare the projected performance of corridors and links in different major urban areas for the first time.
- Of the top 20 corridors by DEC in 2010-11, 17 corridors are dominated by the most highly populated Sydney-Newcastle-Wollongong region and the Melbourne-Geelong region. The DEC of any given corridor is influenced by a number of factors including the extent of the road network included, length and capacity of that network, average speeds, traffic and congestion. Overall, it is an estimate of the total value added in use of the road network for that corridor. A high DEC indicates a high base that transports solutions may provide benefit to. High congestion indicates opportunities to reduce avoidable costs.