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Australian Infrastructure Audit

Our Infrastructure Challenges

Report – Volume 2

April 2015

Infrastructure Australia is an independent statutory body that is the key source of research and advice for governments, industry and the community on nationally significant infrastructure needs.

It leads reform on key issues including means of financing, delivering and operating infrastructure and how to better plan and utilise infrastructure networks.

Infrastructure Australia has responsibility to strategically audit Australia's nationally significant infrastructure, and develop 15 year rolling infrastructure plans that specify national and state level priorities.

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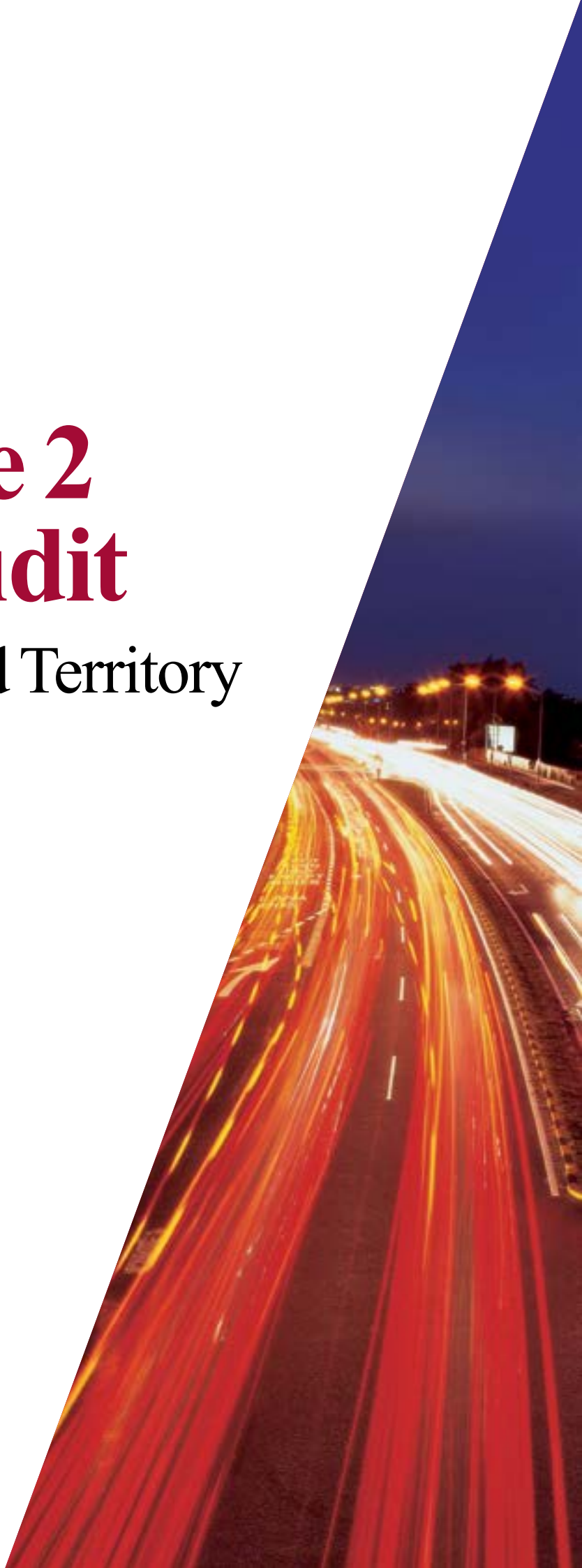
By State and Territory



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Audit observations – New South Wales

1.1 Structure of this chapter

This chapter presents observations from the Audit for the four infrastructure sectors – transport, energy, communications and water – across NSW. It provides data about the state's population and economy (i.e. the key drivers of demand for infrastructure), and the value-add attributable to NSW infrastructure, in 2011. It also outlines growth projections to 2031 for the state's population and economy, and for each of the infrastructure sectors. As noted in the Introduction to this report, these projections are based on economic and demographic analysis set out in two associated studies.[268]

The Audit uses the Direct Economic Contribution (DEC) methodology to quantify both the value-add attributable to infrastructure in 2011, and the projected change in overall demand for infrastructure from 2011 to 2031. When considered in the light of other factors, such as capacity limitations which might constrain economic growth, this approach helps to identify locations and sectors that are likely to warrant further attention in the Australian Infrastructure Plan (the Plan).

This chapter also considers other documents, including plans, studies and strategies, prepared by the NSW Government and others.

1.2 Drivers of infrastructure demand − population and economy

As shown in Table 32, the NSW population is projected to reach 9.1 million by 2031 − an increase of 1.9 million people, or 26 per cent, from 2011. Medium level projections by the NSW Government suggest the state's population will grow slightly faster, to around 9.2 million in 2031.[269] This is a little slower than projected national population growth of 37 per cent.

Gross State Product (GSP) is projected to increase to $734 billion by 2031 − an increase of 66 per cent from 2011. This is a little slower than projected national economic growth of 84 per cent.

As shown in Figure 47, the ABS projects that Sydney will account for 1.6 million of the state's population increase from 2011 to 2031.

NSW Government projections for growth in greater Sydney are consistent with this figure, showing growth of 1.64 million, from 4.61 million people in 2011 to 6.25 million people in 2031.[270]

The NSW Government expects major growth in the inner city, the North West corridor (Baulkham Hills/Blacktown/Rouse Hill), the South West corridor (including Liverpool, Fairfield, Camden and Campbelltown), and Western Sydney (Parramatta to Blacktown).[271]

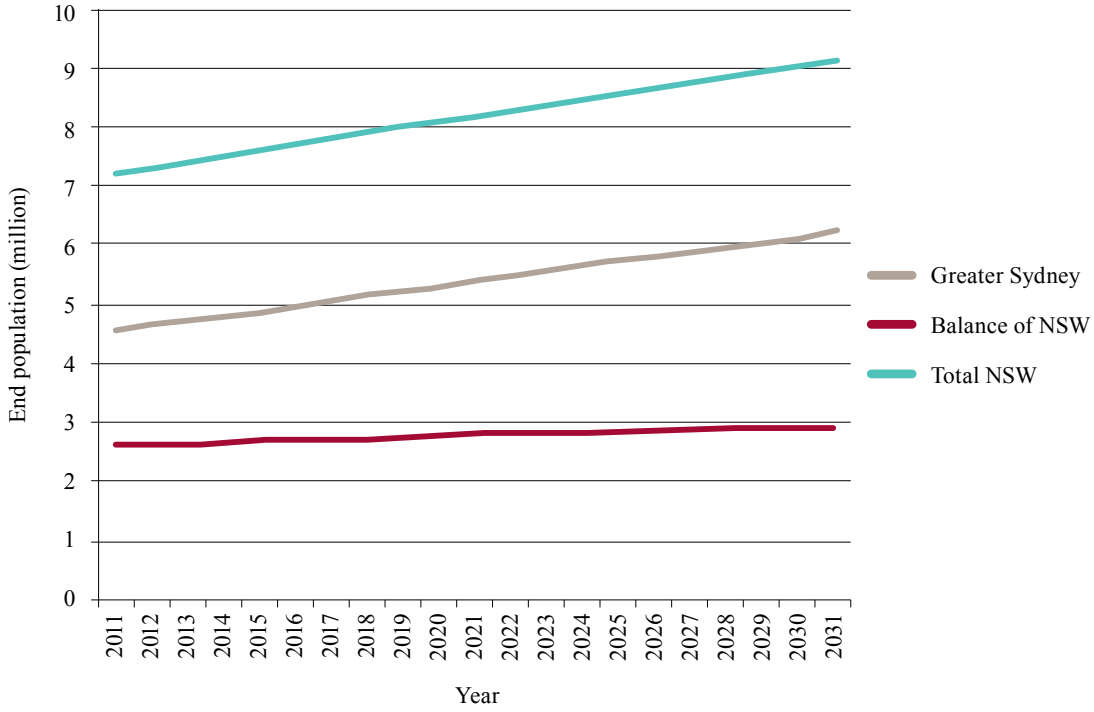
268. ACIL Allen Consulting (2014a) and Infrastructure Australia (2015b)
269. New South Wales Department of Planning and Environment (2014)
270. To ensure consistency with the Australian Bureau of Statistics' definition of the Sydney Greater Capital City Statistical Area, the reference to the NSW population projections above covers what the government refers to as Sydney Metropolitan Local Government Areas (LGAs), as well as the Gosford and Wyong LGAs (2014)
271. New South Wales Government (2014)

Table 32: Projected population and economic growth for New South Wales

	2011	% of National	2031	% of National	Increase % 2011–31
Population (persons)	7,218,529	32.3%	9,128,665	29.9%	26%
Gross State Product ($m)	441,249	31.4%	733,723	28.4%	66%

Source: ACIL Allen Consulting (2014a)[272]

Figure 47: Population projections for New South Wales – 2011 to 2031



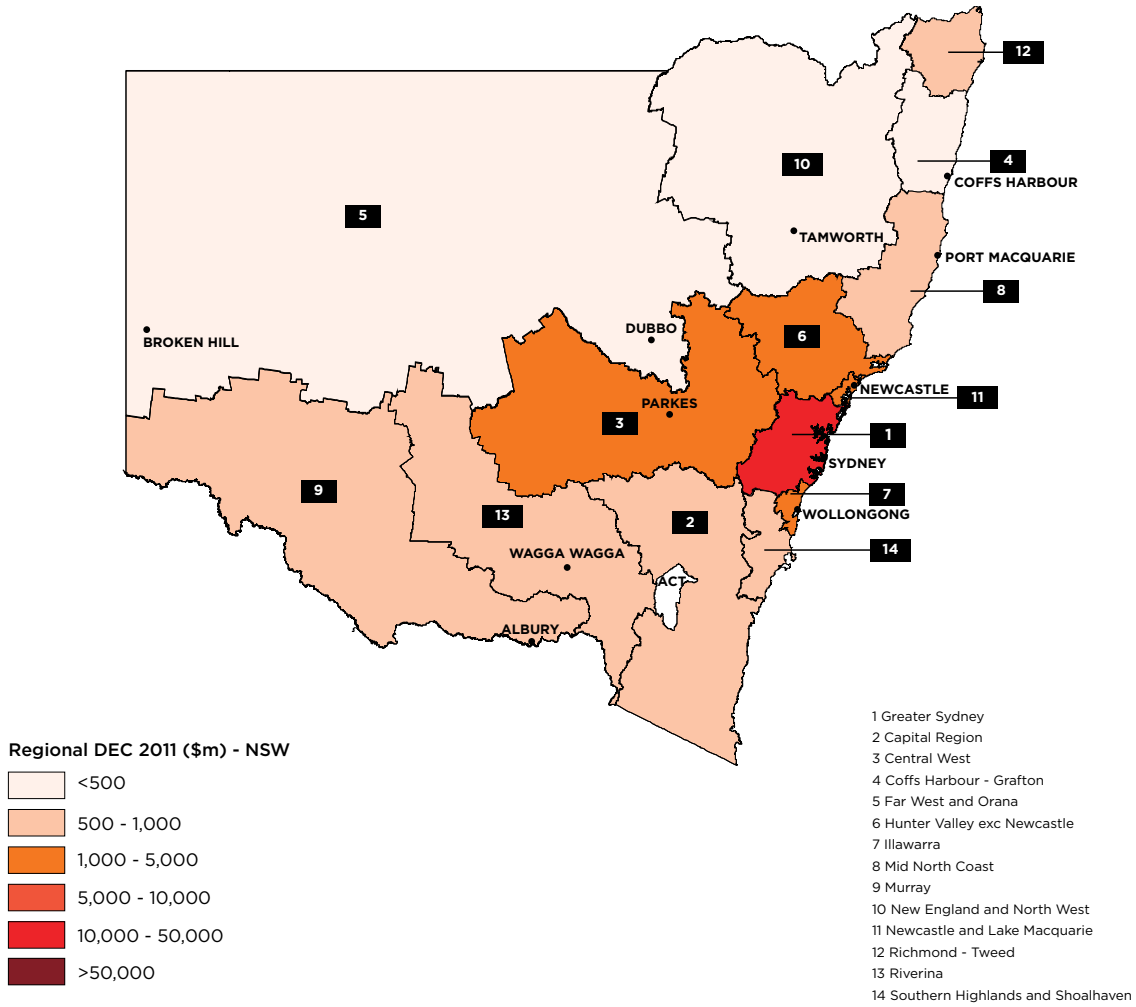
Source: Australian Bureau of Statistics (2013c)[273]

272. Gross State Product is in 2010–11 prices.
273. Series B (medium level) projections.

1.3 Summary of New South Wales infrastructure from 2011 to 2031

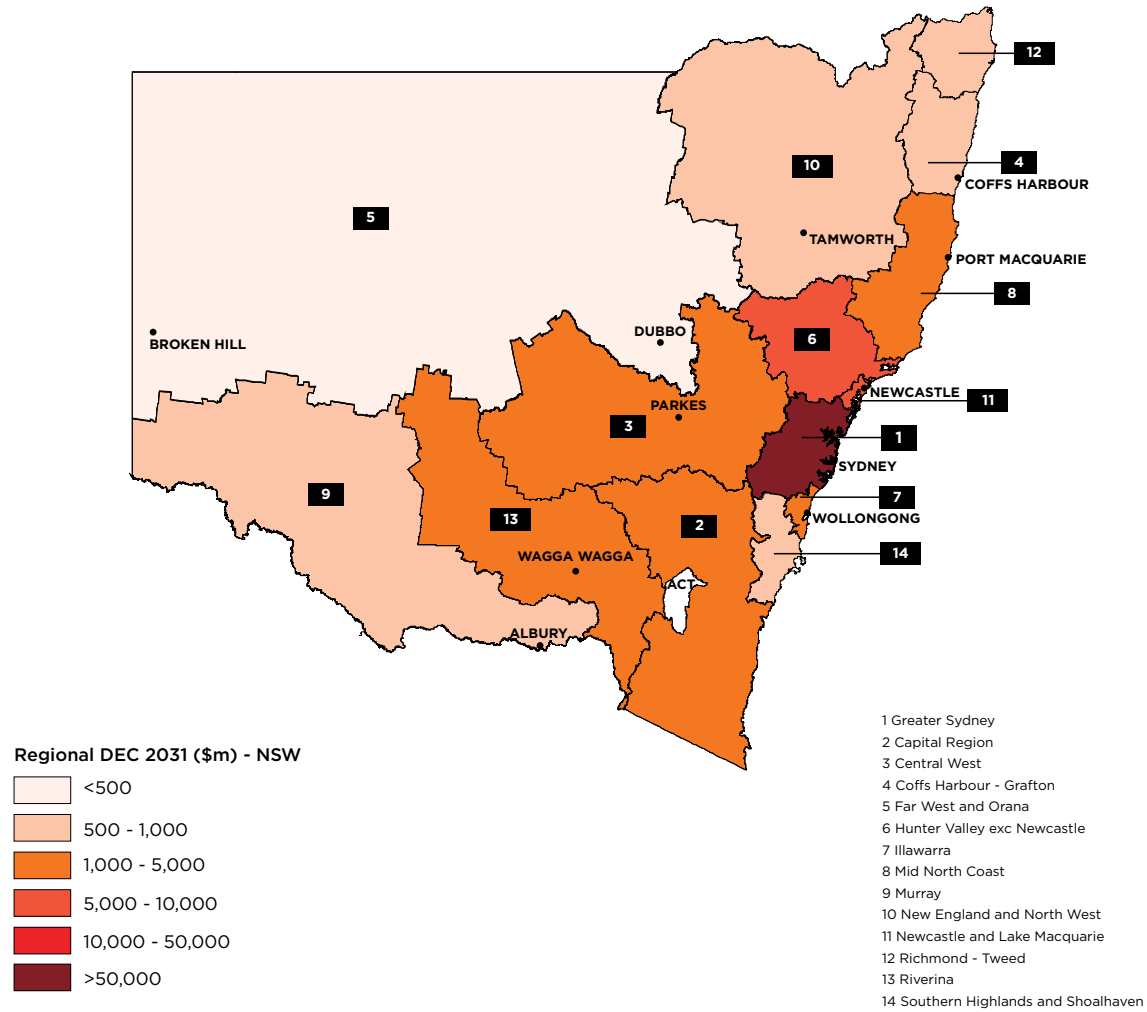
In 2011, the DEC of infrastructure in NSW was $60 billion, which was 32.3 per cent of the national figure. By 2031, NSW infrastructure DEC is projected to increase by around $47 billion, or 78 per cent, to $108 billion. This would represent 29 per cent of national DEC. Figure 48 and Figure 49 highlight the spread of infrastructure's economic contribution across the 14 Audit regions in NSW for 2011 and 2031 respectively. Consistent with population growth, DEC growth is projected to be greatest in the Sydney region, increasing by 85 per cent from $43 billion to $80 billion during the period from 2011 to 2031.

Figure 48: Direct Economic Contribution of infrastructure in New South Wales, 2011



Source: ACIL Allen Consulting (2014a)

Figure 49: Projected Direct Economic Contribution of infrastructure in New South Wales, 2031



Source: ACIL Allen Consulting (2014a)

Table 33 provides a snapshot of NSW economic infrastructure across the four sectors of transport, water, energy and telecommunications. The table notes the capacity of each subsector in general terms and its rate of utilisation in 2011, along with historical (2011) and projected (2031) DEC for each subsector.

Table 33: Overview of New South Wales infrastructure

	Subsector	Capacity 2011		Utilisation 2011		DEC 2011		Projected DEC 2031		Projected % increase in DEC
			% of Nat.		% of Nat.		% of Nat.		% of Nat.	2011-2031
Transport	Urban Roads	**615,600,000** Car VKT per day	28%	**132,200,000** Car VKT per day	31%	$27,504m	35%	$53,635m	31%	95%
	Urban Public Transport	**129,800,000** Passenger KT per day	49%	**29,200,000** Passenger KT per day	43%					
	National Highways	**5,114** km of nationally significant roads	15%	**754,494** vehicles per day	40%	$3,597m	38%	$5,297m	34%	47%
	Freight Rail	n/a	n/a	n/a	n/a	$862m	16%	$1,274m	13%	48%
	Ports	**237** Mt p.a. throughput	17%	**157** Mt p.a. throughput	15%	$5,261m	25%	$8,416m	20%	60%
		3.2 MTEU throughput	27%	**2.0** MTEU throughput	30%					
	Airports	**50** Count of airfields	18%	**39,452,460** Total RPT passenger movements	30%	$5,675m	27%	$10,278m	25%	81%
Energy	Electricity	**16,654** Installed capacity (MW) of Generation	31%	**67,611** Utilisation of Generation (GWh)	11%	$5,279m	33%	$8,201m	31%	55%
		13,563 Peak Demand Transmission (MW)	33%	**71,827** Utilisation of Transmission (GWh)						
		12,291 Peak Demand Distribution (MW)	33%	**61,797** Utilisation of Distribution (GWh)						
	Gas	n/a	n/a	**195.72** Transmission throughput (PJ/a)	15%	$123m	11%	$173m	5%	40%
		n/a	n/a	**105.23** Distribution throughput (PJ/a)	31%	$353m	29%	$495m	33%	40%
	Petroleum product terminals	n/a	n/a	**17,591** Annual throughput (ML)	22%	$239m	22%	$338m	20%	41%
Telecommunications		**4.58** Broadband average availability rating (out of 5)	n/a	**1,984** Total households with broadband internet access at home (‘000)	n/a	$8,630m	41%	$16,162m	38%	87%
		2.35 Broadband average quality rating (out of 5)	n/a							
Water & Sewerage	Water	**63,529** Length of water mains (km)	30%	**3,880,400** Water supplied (ML)	51%	$2,971m	28%	$3,403m	21%	15%
		13,630 Volume of water stored in dams (GL)	23%	**2,625** Properties served – water (‘000)	31%					
	Sewerage	**90,000** Desalination capacity (ML)	17%	**710,726** Sewage collected (ML)	37%					
		42,254 Length of sewer mains (km)	32%	**2,495** Properties served – sewerage (‘000)	32%					

Source: ACIL Allen Consulting (2014a)[274]

274. DEC figures in this table are rounded to the nearest $ million. Per cent changes may not tally exactly with rounded estimates. See Glossary for explanation of abbreviations and terms.

1.4 New South Wales Government plans and strategies

The NSW Government's strategic direction for infrastructure in the state is embodied in a number of plans and strategies.

NSW 2021: A Plan to Make NSW Number One is the Government's overarching or 'whole of government' 10 year strategic plan.[275] The plan, released in late 2011, sets out a range of objectives and targets across a broad range of public policy areas, including infrastructure issues. Progress reports are released periodically.

Integrated land use and infrastructure planning in NSW is shaped at a strategic level by:

- the Government's metropolitan strategy for Sydney, *A Plan for Growing Sydney*, released in December 2014. The plan indicates that Sydney will require 664,000 new dwellings between 2011 and 2031.[276]
- a series of regional plans based on new regional boundaries set by the NSW Government in June 2014. The regions include peri-urban areas such as the Central Coast, lower Hunter and Illawarra. These plans are in various stages of development.

The *State Infrastructure Strategy* released in 2012 and the *State Infrastructure Strategy Update* (SISU) released in 2014, both prepared by Infrastructure NSW, provide overarching advice to the NSW Government on infrastructure matters. The NSW Government's response to the SISU, Rebuilding NSW, outlines a plan to invest $20 billion, raised from leasing the state's electricity assets, in new infrastructure. Projects in *Rebuilding NSW* include upgrades to the road network and adding capacity to the rail network in Sydney, as well as spending on regional roads and water.

The *Long Term Transport Master Plan*,[277] released in 2012, and associated subordinate strategic documents such as the *NSW Freight and Ports Strategy*, set out the state's long-term objectives and intentions in relation to transport.

Under the *Water Management Act 2000*, a range of water sharing plans have been and are being prepared to guide the use of water across the state. The *Murray Darling Basin Plan*, agreed with the Australian Government and other jurisdictions, sets a broader context for many of these catchment-specific plans.

The *NSW Gas Plan*, released in late 2014, sets out the Government's response to a number of recent scientific and policy enquiries. The plan aims to secure sustainable gas supply to the state through the development of local supplies (provided they are supported by rigorous environmental assessment) and/or the development of gas pipelines from other jurisdictions.

NSW is part of the National Electricity Market (NEM). The *National Transmission Network Development Plan*, released by the Australian Energy Market Operator (AEMO) in December 2014, provides the medium to long-term planning framework for network infrastructure in the state.

1.5 Transport

1.5.1 Urban transport

For the urban transport component of the Audit, the top-down economic analysis used for the other sectors, which is based on national accounts and industry data, was complemented by bottom-up analysis based on detailed transport modelling for the six major capital cities.

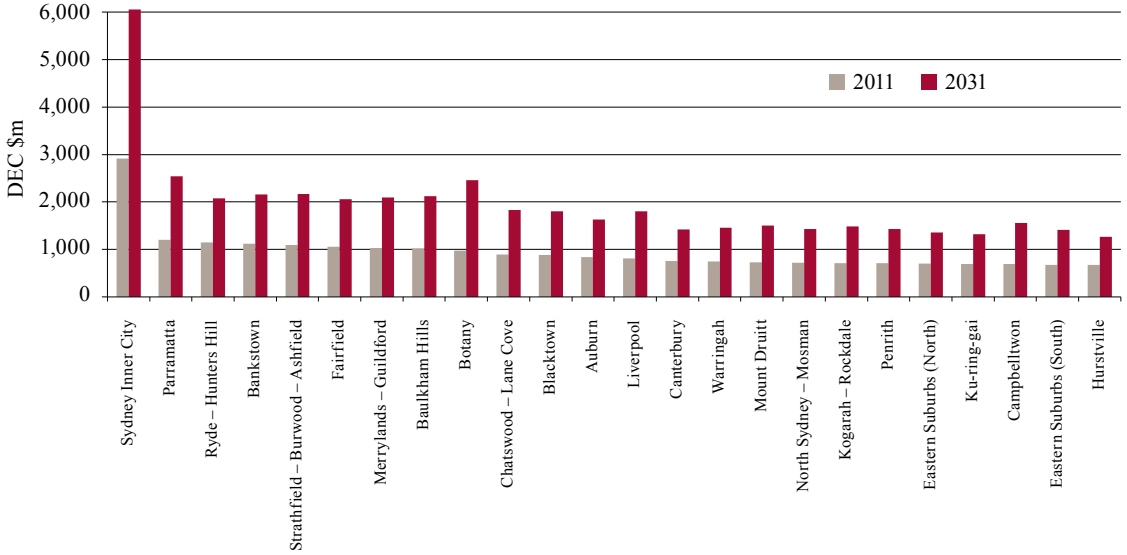
This modelling provides detailed information about trips within these cities by origin/destination, and by corridor, in 2011. It takes account of projected population and employment growth and spatial distribution to project demand for trips, also by origin/destination and corridor, in 2031.

For both road and rail corridors the model includes detailed information about capacity, showing where demand is projected to grow in excess of supply. For road corridors it quantifies the cost of delay, showing where interventions will likely provide the biggest economic return. For rail corridors the model assumes minimal delay (i.e. all passengers are able to board the next available train). This is to ensure the model does not displace rail passengers, and thus shows the full extent of demand for the rail corridor.

This analysis facilitates identification of the corridors with the highest levels of economic activity, and the corridors in which capacity constraints and/or delays impose the highest economic cost. Given the absence of rail delay cost from the model, projected delay cost is at best an approximation. However, rail delay cost is unlikely to represent more than a small proportion of total delay cost for most corridors. As such, road delay cost is a reasonable proxy for delay cost for most corridors.

275. New South Wales Government (2011b)
276. New South Wales Government (2014). On the Australian Bureau of Statistics' medium level projections, Sydney's population will grow from 4.6 million persons in 2011 to 8.5 million persons in 2061. Conceivably, this increase could require between 1.5 and 2.0 million new dwellings over that period.
277. Transport for New South Wales (2012)

Figure 50: Trips in Sydney-Newcastle-Wollongong by origin/destination for roads and public transport in 2011 and 2031, measured by DEC ($ million)



Source: Infrastructure Australia analysis of data from ACIL Allen Consulting (2014b) and Veitch Lister Consulting (2014b)

1.5.1.1 Urban transport in Sydney-Newcastle-Wollongong

The DEC of urban transport in the Sydney-Newcastle-Wollongong conurbation is projected to grow from $28 billion in 2011 to $54 billion in 2031 − an increase of 3.4 per cent per year. While this is a slower rate of growth than that projected for Perth and Brisbane, Sydney-Newcastle-Wollongong's urban transport DEC is projected to remain Australia's highest. On its own, Sydney-Newcastle-Wollongong's 2011 urban transport DEC represents 14.7 per cent of all national infrastructure DEC for 2011.

The cost of delay on Sydney-Newcastle-Wollongong's urban transport network in 2011 was around $6 billion. In the absence of any additional capacity (other than projects already under construction or funded), the cost of delay is projected to grow to around $15 billion in 2031.

1.5.1.2 Origins/destinations of trips in Sydney-Newcastle-Wollongong

Figure 50 shows trips in Sydney-Newcastle-Wollongong by origin/destination (O/D), across road and public transport modes, in terms of DEC for 2011 and projected DEC for 2031. The O/D regions used here are SA3 regions as defined by ABS.[278]

This analysis shows that the Sydney Inner City region is the largest O/D for trips within Sydney-Newcastle-Wollongong, by a significant margin. Other O/D regions for which high levels of growth are projected between 2011 and 2031 are Botany, regions in the south-west and north-west Sydney growth areas (Camden, Bringelly–Green Valley, Liverpool, Baulkham Hills) and regions with major employment centres (Chatswood, Ryde–Hunters Hill, Merrylands−Guildford and Eastern Suburbs South).

1.5.1.3 Road corridors in Sydney-Newcastle-Wollongong

The Audit dataset provides a broad range of data about corridors, and there are many ways of analysing this data. Given the focus of the Audit on economic indicators, the analysis in Table 34 and Table 35 focuses on delay cost. This applies a dollar cost to time delays, based on lost productivity, and takes account of the different costs applicable to different vehicle types.

Some users of the Audit dataset may prefer to use more traditional indicators of congestion, such as traffic V/C. This measure is included in Table 34 and Table 35, as is the DEC measure, which gives insight into the underlying value of activity on the corridor, and the proportion of DEC attributable to delay cost.

These measures are expressed per lane kilometre of road. This normalises the results to facilitate comparison across a wide range of corridor types − some very long, some consisting of multiple roads, and some relatively short single roads.

278. SA3s provide a standardised regional breakup of Australia and generally (although not always) have populations between 30,000 and 130,000 persons.

The modelling provides one method of measuring and projecting demand for transport infrastructure and the corridors identified in Table 34 and Table 35 reflect this approach. The NSW Government may have utilised other data, and different methods of analysis, to inform identification of infrastructure priorities. For further information on the assumptions, included projects and methodology applied in the model, refer to the supporting documentation by Veitch Lister Consulting.

Table 34 shows corridors ranked by delay cost per lane kilometre in 2011, with the equivalent projections for 2031 in Table 35. Taken together, these tables give an indication of which corridors warrant further study, and where interventions are likely to have the biggest economic return.

Table 34: Road corridors in Sydney-Newcastle-Wollongong 2011, by delay cost (>$1 million per lane km, 2011 dollars)

Rank	Road Corridor	State	Delay cost by lane km 2011 ($m)	DEC per lane km 2011 value ($m)	Volume Capacity Ratio 2011 AM Peak (7-9 AM)
1	Pennant Hills Rd – Parramatta to Hornsby	NSW	3.53	6.81	94%
2	King Georges Rd Corridor Princes Hwy – M4	NSW	2.28	6.36	83%
3	Chatswood to Narraweena via Warringah Rd	NSW	2.18	5.54	77%
4	Homebush Bay to Mona Vale Corridor (A3)	NSW	1.92	4.66	76%
5	Sutherland – Ryde/Parramatta Corridor (A6)	NSW	1.77	4.55	77%
6	Victoria Rd (A40) Corridor	NSW	1.73	5.08	73%
7	Parramatta Rd (M4) Corridor Ashfield – Strathfield	NSW	1.64	4.47	84%
8	Western Mwy (M4) Corridor Strathfield – Parramatta	NSW	1.37	4.17	79%
9	Parramatta Rd (A31) City West Link Corridor Sydney – Ashfield	NSW	1.23	4.09	75%
10	Nth Sydney – Northern Beaches Corridor	NSW	1.22	3.47	63%
11	M5/A34 Corridor	NSW	1.19	4.37	73%
12	Gore Hill/Warringah Fwys/SHB/ Eastern Dist	NSW	1.15	5.37	72%
13	Hume Hwy Corridor (A22) Lansdowne – Haberfield	NSW	1.12	4.09	74%
14	Cumberland Hwy (Hume Hwy-M4)	NSW	1.06	3.21	76%
15	NW Inner Corridor (M2/LCT)	NSW	1.00	3.66	64%

Source: Infrastructure Australia analysis of data from ACIL Allen Consulting (2014b) and Veitch Lister Consulting (2014b)

Table 35: Road corridors in Sydney-Newcastle-Wollongong 2031, by projected delay cost (>$1.75 million per lane km, 2011 dollars)

Rank	Road Corridor	State	Delay cost by lane km 2031 ($m)	DEC per lane km 2031 value ($m)	Volume Capacity Ratio 2031 AM Peak (7-9 AM)
1	Gore Hill/Warringah Fwys/SHB/ Eastern Dist	NSW	6.74	13.35	87%
2	Chatswood to Narraweena via Warringah Rd	NSW	6.16	11.16	89%
3	King Georges Rd Corridor Princes Hwy – M4	NSW	5.60	11.45	94%
4	Pennant Hills Rd – Parramatta to Hornsby	NSW	5.14	9.19	96%
5	Parramatta Rd (A31) City West Link Corridor Sydney – Ashfield	NSW	4.79	9.23	91%
6	Sutherland – Ryde/Parramatta Corridor (A6)	NSW	4.76	8.89	90%
7	Victoria Rd (A40) Corridor	NSW	4.69	9.68	85%
8	Homebush Bay to Mona Vale Corridor (A3)	NSW	4.48	8.41	88%
9	Airport to CBD	NSW	3.75	7.93	89%
10	M5/A34 Corridor	NSW	3.24	8.61	78%
11	Nth Sydney – Northern Beaches Corridor	NSW	3.03	6.35	73%
12	NW Middle Corridor (M7/M2)	NSW	2.99	7.19	85%
13	Cumberland Hwy (Hume Hwy-M4)	NSW	2.79	6.00	89%
14	Hume Hwy Corridor (A22) Lansdowne – Haberfield	NSW	2.64	6.97	84%
15	Western Mwy (M4) Corridor Strathfield – Parramatta	NSW	2.41	6.50	79%
16	Little Bay to CBD East	NSW	2.15	5.35	63%
17	NW Inner Corridor (M2/LCT)	NSW	2.10	6.49	72%
18	Cronulla to Kogarah	NSW	2.09	4.92	79%
19	The Horsley Drive Corridor	NSW	1.81	4.77	82%
20	Western Mwy (M4) Corridor Parramatta – M7	NSW	1.76	5.18	78%

Source: Infrastructure Australia analysis of data from ACIL Allen Consulting (2014b) and Veitch Lister Consulting (2014b)

Figure 51 and Figure 52 show projected road congestion, by V/C, in 2031 for the AM peak hour and daytime inter-peak periods respectively. These show the corridors and locations likely to reach or exceed maximum capacity by 2031, in the absence of any additional capacity.

During the AM peak hour a large part of the network shows significant congestion. In the inter-peak period there is surplus capacity across most of the network, except for key crossings over Sydney Harbour, Parramatta River, Middle Harbour and Georges River, access to the inner city, and access to the terminals at Sydney Airport. This suggests some scope for demand management to spread peak period transport flows.

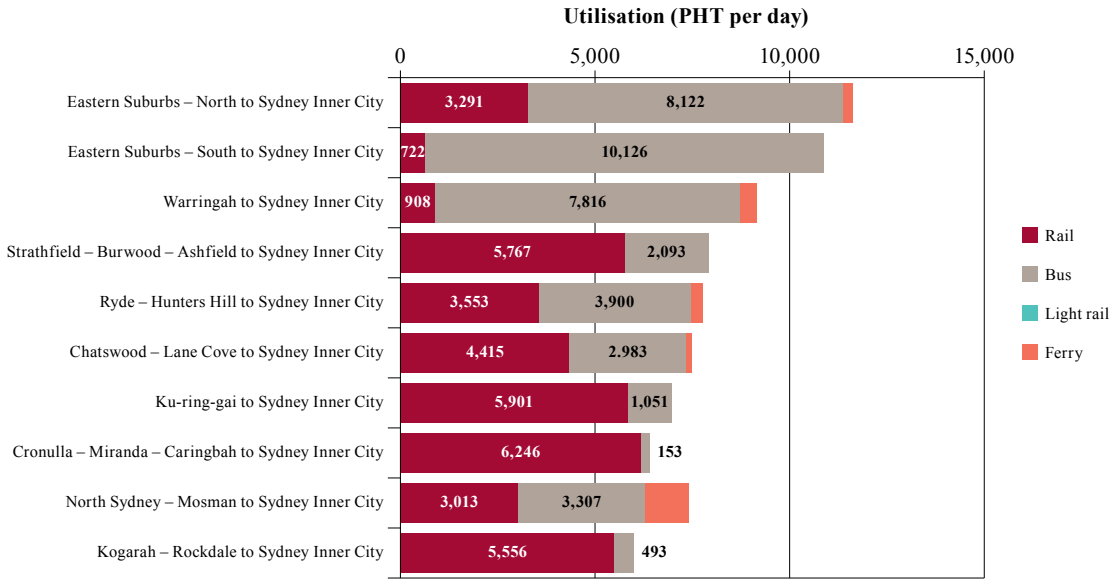
Figure 51: Sydney road network volume/capacity ratio in 2031 – AM maximum peak hour

Source: Veitch Lister Consulting (2014b)

Figure 52: Sydney road network volume/capacity ratio in 2031 – daytime inter-peak period

Source: Veitch Lister Consulting (2014b)

Figure 53: Top 10 Sydney origin/destination pairs by passenger hours travelled for public transport



Source: Infrastructure Australia analysis of data from Veitch Lister Consulting (2014b)

1.5.1.4 Public transport in Sydney-Newcastle-Wollongong

Figure 53 sets out the top 10 public transport O/D pairs in Sydney-Newcastle-Wollongong by passenger hours travelled (PHT), and by public transport mode. Sydney Inner City features in all 10 O/D pairs.

1.5.1.5 Rail trips in Sydney-Newcastle-Wollongong

Table 36 shows the top 12 destination SA3 regions for rail trips in Sydney-Newcastle-Wollongong. This shows that Sydney Inner City is by far the dominant destination for rail trips in the Sydney-Newcastle-Wollongong region.

1.5.1.6 Rail corridors in Sydney-Newcastle-Wollongong

Figure 54 shows that passenger loadings on Sydney's rail corridors are projected to increase over time, reaching or exceeding crush capacity before 2031 on the Western, North Shore and Illawarra lines, and inner parts of the Northern and Richmond lines.

These projections are different in some respects from projections in the *NSW Long Term Transport Master Plan*,[279] which projects significant congestion in 2031 on the following rail corridors:

- East Hills/Airport Line – with passenger displacement from Revesby to Green Square;
- Western Line – a high level of overcrowding from Strathfield to City and Westmead to Parramatta;
- North Shore Line – a high level of crowding from Chatswood to City;
- Northern Line – a high level of crowding from Ryde and on approach to Strathfield; and
- South and Inner West Lines – a high level of crowding from Auburn to Strathfield and to City.

This variation reflects the different methodologies used for the Audit and the *NSW Long Term Transport Master Plan* including, for example, different definitions of crush capacity.

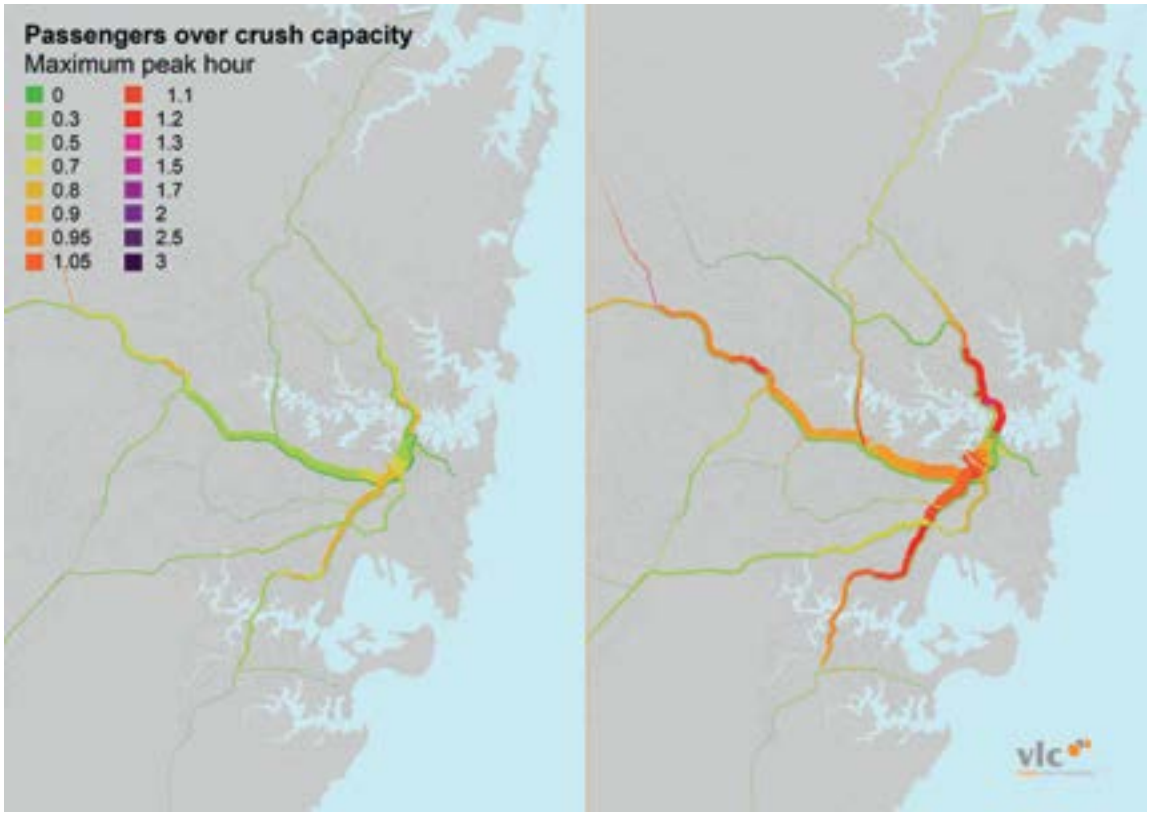
Table 36: Top 12 destinations in Sydney-Newcastle-Wollongong for rail trips by passenger hours travelled (PHT) in 2011 and projected in 2031

SA3 region	Rail PHT – 2011	Projected rail PHT – 2031
Sydney Inner City	128,708	196,556
Parramatta	18,653	25,513
Strathfield – Burwood – Ashfield	17,047	26,689
North Sydney – Mosman	16,807	23,979
Chatswood – Lane Cove	15,192	24,346
Ryde – Hunters Hill	13,822	21,146
Kogarah – Rockdale	12,472	19,543
Cronulla – Miranda – Caringbah	12,208	18,360
Ku-ring-gai	11,932	18,182
Hurstville	11,564	17,075
Bankstown	11,183	16,462
Botany	8,777	23,182

Source: Veitch Lister Consulting (2014b)

279. Transport for New South Wales (2012), p. 95

Figure 54: Sydney rail network weekday passenger demand relative to crush capacity in 2011 and projected in 2031



Source: Veitch Lister Consulting (2014b)

1.5.1.7 Bus trips in Sydney-Newcastle-Wollongong

Table 37 shows the top 10 destination SA3 regions for bus trips in Sydney-Newcastle-Wollongong.

This shows that Sydney Inner City is by far the dominant destination for bus trips in the Sydney-Newcastle-Wollongong region.

Table 37: Top 10 destinations in Sydney-Newcastle-Wollongong for bus trips by passenger hours travelled (PHT) in 2011 and projected in 2031

SA3 region	Bus PHT – 2011	Projected bus PHT – 2031
Sydney Inner City	85,793	134,973
Eastern Suburbs – South	16,170	20,698
Warringah	14,389	24,354
Eastern Suburbs – North	11,624	17,497
Parramatta	11,524	17,313
Baulkham Hills	11,494	14,798
North Sydney – Mosman	10,886	19,237
Ryde – Hunters Hill	10,819	16,046
Chatswood – Lane Cove	8,724	14,588
Pittwater	7,346	13,177

Source: Veitch Lister Consulting (2014b)

Table 38: Daily vehicle kilometres travelled by vehicle type 2011

		Utilisation (VKT/day)	Utilisation (VKT/day)	Utilisation (VKT/day)	LCV & HCV as % of daily VKT
From	**To**	**Car**	**LCV**	**HCV**	
Botany	Sydney Inner City	224,835	20,684	23,741	16.5%
Eastern Suburbs – North	Sydney Inner City	245,123	11,862	5,158	6.5%
Fairfield	Merrylands – Guildford	234,641	9,822	5,310	6.1%
Parramatta	Merrylands – Guildford	209,297	8,564	4,695	6.0%
Gosford	Wyong	583,132	21,126	14,210	5.7%
Eastern Suburbs – South	Sydney Inner City	224,666	9,192	4,406	5.7%
Fairfield	Liverpool	263,575	8,767	4,556	4.8%
Baulkham Hills	Parramatta	197,745	6,482	3,021	4.6%
Sutherland – Menai – Heathcote	Cronulla – Miranda – Caringbah	288,873	6,150	1,621	2.6%
Eastern Suburbs – South	Eastern Suburbs – North	175,123	2,544	541	1.7%

Source: Infrastructure Australia analysis of data from Veitch Lister Consulting (2014b)

1.5.1.8 Freight movements in Sydney-Newcastle-Wollongong

Table 38 shows the daily vehicle kilometres travelled by vehicle type (car, light commercial vehicle, heavy commercial vehicle) between major O/D pairs in the Sydney-Newcastle-Wollongong region. This shows that freight traffic constitutes a relatively high proportion of traffic for some O/D pairs, in particular for travel between the Botany and Sydney Inner City SA3 regions.

1.5.2 National highways

Of Australia's 34,656 km of national highways (which include the National Land Transport Network highways and other key freight routes) identified in the Audit, 5,114 km are in NSW. This includes the following national highway links connecting the capital cities:

- Sydney to Brisbane (Pacific Highway/Pacific Motorway Route 1 and New England Highway/ Cunningham Highway Route 15);
- Sydney to Canberra (Federal Highway Route 23);
- Sydney to Melbourne (Hume Highway Route 31); and
- Sydney to Adelaide Sturt Highway (Route 20).

Figure 55 shows the National Land Transport Network highways and the other key NSW freight routes included in the Audit. Together these routes play an important role in facilitating industry and enabling business and community activity.

Eleven per cent of NSW roads have a 1-star safety rating under the Australian Road Assessment Program (AusRAP), while 46 per cent are 2-star rated and 42 per cent are 3-star rated. The highest attainable rating is five stars. Overall, the safety rating for NSW roads is lower than that for Queensland, Victoria, SA and WA.

The DEC of NSW national highways and key freight routes is projected to increase from $4 billion in 2011 to $5 billion in 2031.

1.5.3 Freight rail

Freight rail networks in NSW fall into four categories:

- the main rail lines between capital cities including Sydney to Brisbane, Sydney to Melbourne and Sydney to Adelaide/ Perth, including the Sydney Metropolitan Freight Network;
- the nationally significant rail lines associated with mining, including those servicing the Port of Newcastle, and Port Kembla;
- strategically significant lines to regional/ agriculture centres such as between Sydney and Dubbo, and Sydney and Griffith; and
- regional freight networks and grain supply lines.

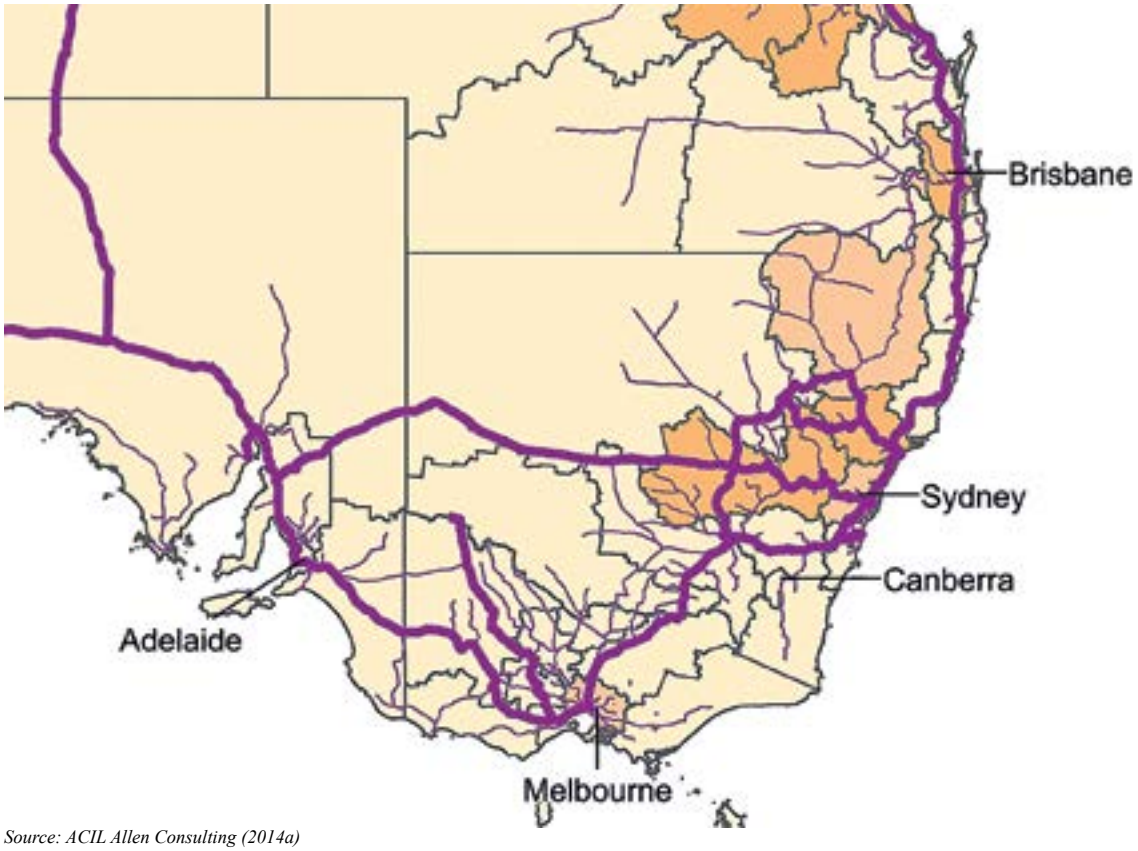
In terms of tonnage carried, mining freight dominates the NSW freight rail network.

Figure 55: National Land Transport Network highways and key freight routes in New South Wales 2011

The map shows highways identified in the Audit. Data was not available for all of these highways.
Source: ACIL Allen Consulting (2014a)

Rail's mode share for container transport increases with distance, as rail becomes more economically competitive with road. Rail mode share can be as high as 70 per cent between Sydney and Perth, but remains below 15 per cent on the Sydney–Brisbane and Sydney–Melbourne sectors. The container volumes on the north–south rail corridor (Brisbane to Melbourne via Sydney) have declined in total tonnes and market share since 2007–08.

Figure 56: Freight rail network – New South Wales in national context



Source: ACIL Allen Consulting (2014a)

Figure 56 shows the freight rail network within NSW, in the national context.

1.5.4 Ports

Responsibility for operation and future development of the main NSW ports (Port Botany, Port Kembla and the Port of Newcastle) has recently been transferred to the private sector. The expansion in capacity of these ports to meet projected increase in demand is expected to be financed by the operators. Governments have an ongoing role in ensuring efficient transport links to the ports from rail and road systems. There is potential for some of the costs associated with maintaining these links to be financed in part or whole by the application of freight access charges and tolls.

Table 39: New South Wales port tonnages – 2012–2013

	Total Throughput (mass tonnes)				Containerised trade in TEU			
Port	**Imports**	**Exports**	**Total**	**Total as % of national total**	**Imports**	**Exports**	**Total**	**Total as % of national total**
Port Botany (NSW Ports)	14,159,414	7,423,442	21,582,856	1.91%	1,074,291	1,051,977	2,126,268	29.68%
Newcastle Port Corporation	3,233,535	145,628,032	148,861,567	13.18%	7,273	7,086	14,359	0.20%
Port Kembla (NSW Ports)	5,414,621	18,520,447	23,935,068	2.12%	2,656	3,729	6,385	0.09%
Sydney Harbour (Sydney Ports)	3,915,537	158,896	4,074,433	0.36%	0	0	0	0.00%
Eden (Sydney Ports)	0	244,241	244,241	0.02%	0	18	18	0.00%
Yamba (Sydney Ports)	23	3,587	3,610	0.00%	0	6	6	0.00%
New South Wales Total	**26,723,130**	**171,978,645**	**198,701,775**	**17.60%**	**1,084,220**	**1,062,816**	**2,147,036**	**29.97%**

Source: Ports Australia (2014a)[280]

280. State totals include small ports not specifically listed.

1.5.4.1 Port Botany

Port Botany is the dominant container port in NSW. The DEC of Port Botany is projected to grow by 63 per cent, from $5 billion in 2011 to $8 billion in 2031. The NSW Government is projecting that container volumes passing through the port will grow from just over two million 20 foot equivalent units (TEU) at present to 7.8 million TEU in 2030, and 13.6 million TEU in 2040.[281]

The main infrastructure challenge at Port Botany is providing appropriate landside infrastructure for distributing containers across Sydney. This requires both road and rail facilities. The vast majority of containers to and from Port Botany are moved by road, producing around 3,900 truck movements daily, principally down the M5 corridor. Only 14 per cent of containers are moved by rail. This is a result of factors including:

- the lower cost of road transport over short distances;
- unreliable rail scheduling at Port Botany: according to the Sydney Ports Corporation,[282] fewer than half of rail journeys run on time; and
- inefficiency in port rail yards, which often means containers are handled several times.

The NSW Government has stated its intention to double the proportion of containers moved by rail.[283] The Australian Government has committed to facilitate the delivery of an intermodal terminal at Moorebank. The facility will allow for freight to be transferred to Moorebank by rail from Port Botany, reducing the demand for road transport from the port and providing a hub for the wider road and rail freight networks.[284]

1.5.4.2 Port Kembla

Port Kembla is Australia's largest vehicle import port, has the largest grain storage terminal on the east coast and is an important coal exporting facility.[285] NSW Ports projects the port has sufficient capacity for requirements over the next five years, but will require significant investment over the longer term to meet forecast growth in demand for container trade and bulk cargo exports.[286] Development of Port Kembla's Outer Harbour has commenced, with reclamation works having largely been completed. The planned construction of two new container terminals would provide an additional 1.2 million TEU per year capacity on completion in 2037, while development of the coal terminal would expand capacity from a nominal 18 Mtpa to 22.5 Mtpa.[287] However, while capacity at the port can be increased, this growth would be limited by constraints on the existing rail network servicing the port. NSW Ports has suggested that upgrades to the Unanderra−Moss Vale rail line or construction of the Maldon−Dombarton link would improve the efficiency of both freight and passenger rail connections in the Illawarra region.[288]

1.5.4.3 Port of Newcastle

The Port of Newcastle is the largest bulk shipping port on the east coast of Australia and the world's leading coal export port. A record 150.5 million tonnes of coal was exported from Newcastle in 2013, which was the fourth consecutive year of growth above 10 per cent for coal exports from the port.

The Port of Newcastle allocates production from the mines to available shipping in a way that maximises the capacity of the terminal. Nonetheless, capacity issues have been reported at the port and it has developed a pipeline of project expansions, both in terms of terminal capacity and supporting rail and road infrastructure, to facilitate the expected growth in demand.

1.5.5 Airports

The DEC of airports in the Sydney region is projected to increase by approximately 84 per cent from $5 billion in 2011 to $9 billion in 2031. Sydney (Kingsford Smith) Airport is the most significant airport in NSW by far, handling over a quarter of all air passenger numbers in the country. In 2011 Sydney Airport handled 24.13 million domestic and 11.64 million international passengers. Provisional data suggests these numbers had grown to 25.39 million and 13.24 million respectively by 2013–14.[289]

Joint work by the Australian and NSW Governments in 2011 and 2012 forecast that passenger numbers at Sydney Airport would grow to 76 million by 2035.[290] Projections prepared by the airport operator, suggesting a passenger throughput of 74.3 million in 2033, are consistent with these projections.[291] This would represent a doubling in passenger demand through the airport.

281. New South Wales Government (2013), p. 31
282. SPC (2010)
283. New South Wales Government (2011b)
284. Department of Infrastructure and Regional Development (2015)
285. New South Wales Ports (2014)
286. New South Wales Ports (2014)
287. New South Wales Government (2013)
288. New South Wales Ports (2014)
289. Bureau of Infrastructure, Transport and Regional Economics (2014i)
290. Australian Government and New South Wales Government (2012), p. 6. On these figures, the airport will be handling more passengers than London's Heathrow Airport handled in 2013 (72.4 million).
291. Sydney Airport Corporation Limited (2014), p. 49

Meeting this projected demand is likely to require an expansion of airport capacity beyond Sydney Airport. Some of this demand is expected to be absorbed by the planned Western Sydney Airport at Badgerys Creek. The expansion of capacity of these airports is expected to be financed by their operators.

The projections raise significant questions about land transport capacity between the airport and other parts of Sydney, notably the principal origins and destinations for airport-related movements broadly to the north of the airport.

Bankstown Airport is Sydney's primary general aviation airport. In 2011 it handled around 257,000 movements, although this figure fell to 221,000 movements in 2012–13. The airport operator projects this figure will increase to 282,000 movements in 2031. The airport is important for the operation of general aviation businesses such as flight training, aircraft maintenance, and air freight. The existing infrastructure at Bankstown Airport provides limited capacity for passenger operations, however no passenger services currently use the airport.[292]

Table 40 shows passenger and freight volumes for major NSW airports and illustrates the relative size of Sydney Airport in comparison to regional airports. In general, growth in demand for passenger and freight services at these airports is expected to follow regional population trends and to be met using existing airport assets.

Table 40: New South Wales airport passenger and freight volumes – 2013–14

	Revenue passenger (No.)				International Freight (tonnes)			
Airport	Domestic (incl. Regional) Airlines	International Airlines	Total passengers	Total as % of national total	Inbound	Outbound	Total	Total as % of national total
Sydney	25,390,875	13,238,077	38,628,952	26.36%	277,594	130,811	408,405	60.82%
Williamtown	1,200,214	0	1,200,214	0.82%	0	0	0	0.00%
Ballina	399,006	0	399,006	0.27%	0	0	0	0.00%
Coffs Harbour	383,051	0	383,051	0.26%	0	0	0	0.00%
Albury	253,004	0	253,004	0.17%	0	0	0	0.00%
Port Macquarie	229,407	0	229,407	0.16%	0	0	0	0.00%
Wagga Wagga	210,934	0	210,934	0.14%	0	0	0	0.00%
Dubbo	185,968	0	185,968	0.13%	0	0	0	0.00%
Tamworth	158,396	0	158,986	0.11%	0	0	0	0.00%

Source: Bureau of Infrastructure, Transport and Regional Economics (2014i)

292. Sydney Metro Airports (2014)

1.6 Energy

1.6.1 Electricity

The Audit found that, in 2011, NSW had an installed electricity generation capacity of 16,654 MW. Transmission peak demand was 13,563 MW and distribution peak demand was 12,291 MW. The utilisation of electricity in NSW in 2011 was 67,611 GWh for generation, 71,827 GWh for transmission and 61,797 GWh for distribution.

The DEC of electricity infrastructure in 2011 was approximately $5.3 billion. This was made up of $1.3 billion from generation, $0.8 billion from transmission and $3.2 billion from distribution.

The Audit forecasts a 48 per cent increase in the use of electricity from 2011 to 2031. This equates to 100,016 GWh for generation, 106,559 GWh for transmission and 91,554 GWh for distribution by 2031. Based on these forecasts, the Audit projects an increase of $3 billion in the DEC of electricity infrastructure – made up of $0.7 billion from generation, $0.5 billion from transmission and $1.8 billion from distribution.

Conversely, the Australian Energy Market Operator[293] (AEMO) forecasts declining electricity consumption in NSW, from 73,755 GWh in 2011 to 70,444 GWh in 2031. AEMO attributes the decline to reduced large industrial consumption, reduced residential and commercial consumption from increased rooftop photovoltaic (PV) output, increasing energy efficiency, and response to high electricity prices.

There are several reasons for caution in directly comparing AEMO's forecasts and the Audit projections for the DEC of electricity infrastructure. The Audit assumes an energy efficiency improvement rate of 1.5 per cent per year (compared to a historic rate of 0.5 to 1.0 per cent), whereas AEMO assumes much faster rates, exceeding 20 per cent in some years. Consequently the electricity use underlying the Audit's DEC measure is considerably higher than that for AEMO's forecast.

Additionally, AEMO reports and forecasts unit electricity consumption in gigawatt-hours, whereas DEC is a measure of the value-add provided by electricity infrastructure, expressed in dollar terms. The two are not necessarily perfectly correlated.

NSW is part of the NEM which also includes Victoria, SA, Queensland and Tasmania. Declining electricity demand has been an ongoing feature of the NEM in recent years. Annual energy sent out across the NEM fell seven per cent from 194.9 TWh in 2009–10 to 181.2 TWh in 2013–14.[294]

Based on existing and projected levels of supply and demand, coupled with the ongoing increase in supply available from renewable sources, there is likely to be little need for additional investment in generation capacity in NSW over the next 15 years.

The Large-scale Renewable Energy Target (and the previous Renewable Energy Target) have led to a substantial increase in the penetration of wind farms across the NEM. In NSW, the installed capacity of wind increased from zero in 2005 to 431 MW in 2013. At the same time, the Small-scale Renewable Energy Scheme, feed-in tariffs and other solar PV subsidies have led to a significant increase in the penetration of solar PV systems in the last five years. In NSW, installed solar PVs have increased from 26 MW at the start of 2010 to 776 MW as of October 2014. In its National Electricity Forecasting Report, AEMO forecast an increase in solar PV from 109 GWh in 2011 to 5154 GWh by 2031.

The combination of an unanticipated decline in demand and rising penetration of renewables has led to an ongoing structural change in the wholesale sector.

At the same time, there have been considerable rises in network charges across the NEM, due to a range of factors. The rising network charges have in turn influenced retail prices, creating an impetus for regulators to investigate options that may diminish, or delay, further expansion of the network. Consequently, the Australian Energy Market Commission (AEMC), on 27 November 2014,[295] made a new rule that establishes a new pricing objective and new pricing principles for electricity distribution businesses that will require that network prices reflect the efficient costs of providing network services. Distribution network prices will reflect the costs of providing the electricity to consumers with different patterns of consumption which has the potential to reduce demand during peak periods, and consequently also reduce future network infrastructure investment.

The implications of surplus capacity differ by sector. For the generation sector, surplus capacity and renewable policy settings are likely to result in the withdrawal of thermal generation assets. Indeed, since 2005, significant generation capacity has been 'mothballed' or retired in the NEM. Most recently, NSW has seen the mothballing of the Wallerawang power station (1000 MW coal-fired plant) and the shutdown of Redbank power station (150 MW coal-fired plant).

293. Australian Energy Market Operator (2014a)
294. Australian Energy Market Operator (2014a)
295. Australian Energy Market Commission (2014)

For the network sector, the decline in demand has diminished the need for augmentation investment. Indeed, AEMO has pointed out that several transmission network service providers have delayed or cancelled a number of proposed major network upgrades. For example, Transgrid has deferred the NSW to Queensland transmission capacity upgrade.

Lower levels of demand growth may reduce the need for expenditure to replace existing assets, although this depends on the profile of demand within a distribution network. Under the current regulatory framework, network companies are not required to seek AER approval to undertake investment in replacement assets. Network businesses therefore currently have an incentive to undertake investment, regardless of whether the replacement is justified.

1.6.2 Gas

In 2011, NSW gas transmission pipelines had an annual throughput of 196 petajoules (PJ). Gas distribution pipelines had an annual throughput of 105 PJ.

The DEC of gas pipelines in NSW in 2011 was estimated to be $476 million, made up of $123 million from transmission and $353 million from distribution.

The Audit projects an increase in the DEC of gas pipeline infrastructure in NSW of $191 million (a 40 per cent rise), made up of $49 million from transmission and $142 million from distribution. This is a relatively small increase, given that the state's economy is forecast to expand by 66 per cent over the same period.

In its 2013 *Gas Statement of Opportunities*, AEMO identified a potential supply shortfall in NSW based on increasing demand, continuing Liquefied Natural Gas (LNG) exports and slow development of coal seam gas (CSG) reserves in NSW. Any anticipated shortfalls are likely to be resolved by the market responding to the resultant price signals.

AEMO has forecast a modest decline in gas consumption in NSW, from 133 PJ in 2014 to 131 PJ in 2031, including a brief drop below 120 PJ per year early in the next decade.[296]

As with electricity, there are several reasons for the apparent inconsistency between the Audit's forecast rise in DEC in the gas sector, and AEMO's forecast of a fall in demand. In particular, the DEC analysis was finalised before the latest AEMO gas market forecasts were published. Those forecasts were the first to show a break in what had previously been a direct link between economic growth and rising energy consumption. Also, AEMO reports and forecasts gas consumption in petajoules, whereas DEC is a measure of the value-add provided by gas infrastructure, in dollars. The two are not necessarily perfectly correlated.

Although domestic gas consumption is forecast to continue declining, new LNG plants on the east coast have opened the market to export. Future value-add from gas infrastructure will come from both domestic usage (where demand may continue to fall), and from the export market. The impact of this will be felt largely in Queensland and the NT.

The NSW gas market is connected with Victoria, SA and (indirectly) Queensland via a number of gas pipelines. The main gas pipelines in NSW are the Moomba to Sydney Pipeline, Central West Pipeline (Marsden to Dubbo), Central Ranges Pipeline (Dubbo to Tamworth) and Eastern Gas Pipeline (Longford to Sydney). NSW has limited sources of conventional gas reserves, other than a small volume of deposits at Camden. Consequently, the majority of gas used in the state comes from Victoria, via the Eastern Gas Pipeline, and from the Cooper Basin, via the Moomba to Sydney pipeline.

Although NSW has limited conventional gas reserves, it has significant unconventional gas reserves, particularly in the form of CSG in the Gloucester and Gunnedah basins, with the Gunnedah Basin representing the largest undeveloped gas field in eastern Australia. However, the development of CSG reserves is a sensitive issue in NSW, with ongoing community concerns about the environmental impact of hydraulic fracturing. A recent report by the NSW Chief Scientist and Engineer concluded that the technical challenges and risks posed by the CSG industry can in general be managed 'within a clear, revised, legislative framework which is supported by an effective and transparent reporting and compliance regime and by drawing on appropriate expert advice'.[297]

Despite falling or, at best, low growth in gas demand in NSW, there is still a need for additional infrastructure investment over the next 10 or 15 years, driven by a combination of domestic and international factors. In the domestic context, conventional gas supplies from the Cooper and Bass basins – i.e., the main gas fields that supply NSW – are expected to diminish over time. Simultaneously, high demand for LNG in Japan and Korea has underwritten the construction of several massive LNG export terminals at the

296. Australian Energy Market Operator (2014b)
297. Kane, M. (2014), p. iv

port of Gladstone. The high prices earned by LNG exports will raise domestic prices, as the opportunity cost of selling into the domestic market rises.

There are two potential sources of gas that could provide additional supply to NSW. One option is to develop CSG in NSW. The other, which is under consideration, is development of a pipeline that links another gas market to eastern Australia.

There have been a number of proposed actions to help Australia and NSW manage the significant changes in the gas industry, including:

- AEMC's recommendation of a strategic review of the gas sector, including a review of future market developments over the next 10 to 15 years, and a review of the short term trading market and the declared wholesale gas market; and
- the NSW Government's release of the *NSW Gas Plan*, which seeks to implement a framework for the CSG industry to operate within.

1.6.3 Petroleum

The petroleum industry is broadly split into upstream and downstream petroleum sectors. The upstream sector refers to exploration and production of crude oil while downstream refers to refining of crude oil and the distribution and sale of petroleum products.

In 2011, consumption of petroleum products in NSW was 16,655 ML. Total throughput at petroleum terminals was 17,591 ML. The DEC of petroleum terminals was $239 million.

The Audit includes data from two domestic refineries in NSW that are now closed – the Caltex refinery at Kurnell in southern Sydney, which closed in 2014, and the Shell refinery at Clyde in western Sydney, which closed in 2013. In 2011, Caltex Kurnell had a throughput of 7,540 ML per year and Shell Clyde had a throughput of 4,930 ML per year.

The Audit projects an increase in throughput of 1.7 per cent per year in NSW. This equates to throughput of 24,863 ML per year by 2031 – an increase of 7,272 ML per year. This is projected to result in a growth in DEC of $99 million. Demand for diesel to service the mining and agricultural sectors is also projected to grow. A jet fuel pipeline may also be required to supply the proposed Western Sydney Airport.

1.6.3.1 Crude oil production

Australia's production of crude oil has been steadily declining. Oil production peaked in 2000 at 687 kb/day and has since declined to just over 410 kb/day. This downward trend is expected to continue at an average rate of 4.4 per cent per year from 2014–15 to 2049–50.[298] The majority of production comes from two major basins, the Carnarvon Basin in WA (77 per cent of production in 2011), and the Gippsland Basin in Victoria (less than 15 per cent of production in 2011). NSW does not currently have any significant oil producing basins and so there will be little need to build new related infrastructure in the future.

1.6.3.2 Refinery capabilities

In recent years the global oil refining industry has been undergoing significant structural change. Larger, more efficient 'mega-refineries' have been established in Asia, resulting in increased competitive pressures on established refining operations, including those in Australia. As noted above, the Clyde and Kurnell refineries have closed and there are no other refineries in operation in NSW. Australia now has just five major refineries in operation.

In 2013–14, 82 per cent of crude oil and other refinery feedstock was imported.[299] New refinery capacity is unlikely to be developed in Australia in the foreseeable future.

1.6.3.3 Petroleum products

Domestic demand for petroleum products grew at an average annual rate of around 1.5 per cent in the decade to 2011–12. It is expected to grow by around one per cent per year through to 2049–50, largely driven by population and economic growth. However, energy intensity (measured by total domestic energy consumption per dollar of gross domestic product) is projected to decline by around 1.7 per cent per year over the same period, compared to a decline of 1.3 per cent from 1989–90 to 2009–10. This decline indicates an accelerating improvement in energy efficiency. The transport sector uses more than 60 per cent of all petroleum consumed in Australia, and is the primary driver of demand growth. In addition, the expansion of the mining sector has contributed significantly to increased demand for diesel.[300]

Imported refined petroleum products account for approximately 40 per cent of total domestic consumption, and this share is forecast to rise. Refined petroleum products are imported from more than 20 countries, but 80 per cent of all

298. Bureau of Resources and Energy Economics (2014a)
299. Carson, L. (2014), p. 108
300. Bureau of Resources and Energy Economics (2014a)

such products come from just three: Singapore (53 per cent), South Korea (18 per cent) and Japan (12 per cent).[301] These petroleum products are imported via Port Botany, Port Newcastle and Port Kembla.

Demand for petroleum import facilities and the need for additional import infrastructure within the state is expected to grow. The closure of refineries in NSW has reduced the need for crude oil imports, but increased the need for imported petroleum products.

1.7 Telecommunications

The DEC of communications infrastructure in NSW was $8.6 billion in 2011. This is projected to increase by $7.5 billion, or 87.3 per cent, over the period to 2031.

The relatively dense population in NSW leads to generally high broadband availability ratings. On both availability and quality metrics, NSW generally ranks higher than the other states. This is largely driven by the availability of a hybrid-fibre co-axial (HFC) network across significant portions of metropolitan Sydney.

In NSW, 90 per cent of premises have access to ADSL, 84 per cent have 3G mobile coverage, 64 per cent have 4G coverage, 27 per cent have access to HFC and three per cent have access to fibre to the premise. Less than one per cent of premises have National Broadband Network fixed wireless.[302]

For overall quality of fixed broadband service, NSW lagged a little behind Victoria and the ACT at the end of 2013. By comparison, a larger proportion of premises in Queensland and Tasmania have access to the highest level of broadband service.

1.8 Water

Table 41: Direct Economic Contribution of water infrastructure in New South Wales

Regions	DEC ($m) 2011	DEC ($m) 2031	DEC Growth ($m)
Greater Sydney region	1,808	2,019	211
Riverina and Murray regions	215	250	35
Other regional areas	948	1,134	186
NSW Water sector totals	**$2,971**	**$3,403**	**$432 (15% growth)**

Source: ACIL Allen Consulting (2014a)

The DEC for water and sewerage infrastructure in NSW is projected to increase from $3 billion in 2011 to $3.4 billion in 2031, an increase of around 15 per cent. In 2011, 3,880 GL of water was supplied in NSW, including 550 GL in Sydney. In addition, 710 GL of sewage was collected, including 450 GL in Sydney.

Table 41 outlines the DEC associated with water and sewerage infrastructure in:

- greater Sydney;
- the Riverina and Murray regions; and
- other regional areas.

In the greater Sydney region, water and sewerage DEC is projected to grow from $1.8 billion in 2011 to $2 billion in 2031. This is an increase of 11.7 per cent over the 20 year period.

In the Riverina and Murray regions, which include a high proportion of water delivered for irrigation, DEC is projected to grow by $35 million or 16.2 per cent over the 20 years to 2031.

Across regional NSW more broadly, water and sewerage DEC is projected to grow to $1.2 billion by 2031. This constitutes an increase of $221 million or 19 per cent from 2011.

It is important to note that water and sewerage services have historically been under-priced, particularly in regional areas, and that this potentially leads to an understatement of DEC (which is derived from National Water Commission data).

In regional areas, under-pricing of water and sewerage services means that the income derived from water and sewerage infrastructure falls below the level needed to fund renewal of assets.

301. Australian Institute of Petroleum (2013a)
302. Department of Communications (2013)

1.8.1 Greater Sydney region

Currently, households consume about 73 per cent of all water used in greater Sydney. This demand is being met by the combined storage, desalination, water recycling and distribution capacity held by Sydney Catchment Authority, Sydney Desalination Pty Ltd and Sydney Water Corporation.

Sydney Water Corporation (Sydney Water) is the largest water utility in Australia. It has responsibility for distribution, retailing and wastewater services throughout an area covering greater Sydney and the Illawarra. Dams and some other assets are under the control of Water NSW, the newly created agency for bulk water management, formerly State Water. Sydney Water also owns and operates a stormwater network in some parts of the city, though this service is generally the responsibility of local councils.

Sydney Water currently supplies approximately 1.4 billion litres of potable water to its customers daily, with water treated at nine water treatment plants and supplied through a network of more than 21,000 km of water pipes, 251 reservoirs and 164 pumping stations. The city's largest water filtration plant is the Prospect Water Filtration Plant, which supplies approximately 80 per cent of Sydney's potable water. The Prospect plant is owned and operated privately. Sydney Water is also responsible for collecting and treating wastewater, with over 1.3 billion litres of wastewater treated daily through its network of 24,000 km of wastewater pipes, 680 pumping stations, 14 water recycling plants and 16 treatment plants. Three of the treatment plants − Fairfield, Bellambi and Port Kembla − are wet weather plants, used only during major storms. Sydney Water also provides stormwater services to about 525,000 properties through 442 km of stormwater channels and pipes, mainly in south and south-west Sydney.

Water efficiency programs and increased recycling initiatives in greater Sydney reduced demand from 506 litres per person per day in 1990–91 to 314 litres per person per day in 2009–10. The region reused about 33 billion litres of recycled water in 2009–10 for applications including industry, irrigation and agriculture as well as for flushing toilets, watering gardens, washing cars and other outdoor uses.

The key drivers of future water demand in greater Sydney continue to be population growth, land use development and the cost of provision. A review of the 2010 Metropolitan Water Plan is under way, with an updated plan due to be released in 2015. The State Infrastructure Strategy Update 2014 observed:

> *The metropolitan urban areas in Sydney, Illawarra, the Central Coast and Newcastle in the Lower Hunter are in reasonable shape due to a decade of intensive capital investment coupled with the success of demand management programs during an earlier period of prolonged drought. Long-term planning for these areas is on track and the metropolitan water utilities are self-funding and continue to comply with their operating licences.*

The *2010 Metropolitan Water Plan* concluded at the time that, under all modelled rainfall and dam scenarios, provisions in the plan would secure greater Sydney's supply through to 2025. The Plan included proposals for 70 GL of water to be saved through recycling schemes and a further 145 GL to be saved through water use efficiency measures. Beyond 2025, the Plan proposed a doubling in desalination capacity to 180 GL, to respond to drought and/or further population growth. These plans are currently subject to further adjustment under the review of the Plan to be released in 2015.

1.8.2 Riverina and Murray regions

Forty per cent of water supplied in NSW is for irrigation enterprises in the Riverina and Murray regions. The projected growth in DEC for water and sewerage in these regions is $35 million, from $215 million in 2011 to $250 million in 2031.

Water NSW is the primary supplier of bulk, untreated water to regional towns and for irrigation activities such as horticultural, pastoral, agricultural and silvicultural enterprises.

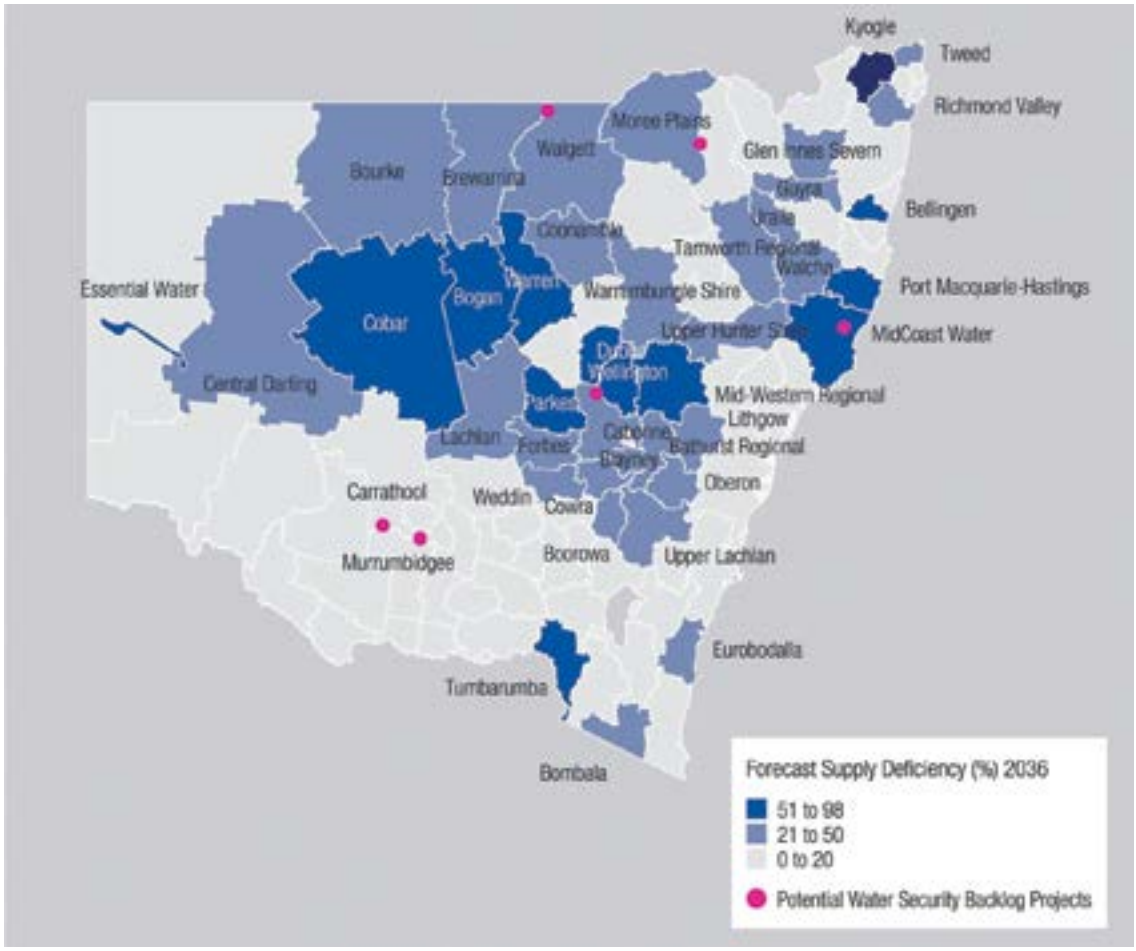
Privately owned irrigation companies and trusts in these regions have bulk water licenses to extract water and supply it via open channel and low pressure pipe distribution systems to customers.

In the irrigation sector, demand will continue to be influenced by water availability and macroeconomic factors such as commodity prices, market access and exchange rates. Other factors that will have an impact on future demand include more efficient irrigation technology and practices and the extent to which new greenfield irrigation areas are established.

In 2008, the Australian Academy of Technological Sciences and Engineering (ATSE) noted that:

> *The most significant impact from the climate change scenarios is drought in the more southern regions of Australia. The capacity of storages and the effectiveness of distribution systems required to survive extended periods of drought are seen as a high to extreme risk with effective adaptation capacity requiring major investment and national strategic planning.*

Figure 57: Forecast water supply deficiency for local water supply utilities in 2036



Source: Infrastructure New South Wales (2014), p.95

The Agricultural Competitiveness Review aims to support strong and vibrant regional communities, build the infrastructure of the twenty-first century and reduce unnecessary regulation at all levels of government and give greater ownership and rights to farmers.[303]

The SISU included a map of predicted rainfall changes to 2050 which shows a rainfall seasonality shift to summer dominance in the Riverina region and a significant loss in winter rainfall, with a small increase in summer rainfall in the Murray region.

Opportunities for augmentation of supply are limited in the Murray Darling Basin, as the resource is already overcommitted. Consequently, increased demand will need to be met through improved efficiency and water trade. The Basin Plan sets out the schedule for achieving sustainable levels of use through water buy back and investment in water saving infrastructure.

303. Australian Government (2014b)

1.8.3 Other regional areas

The total water and sewerage DEC across NSW regions except greater Sydney, Riverina and Murray is projected to grow by $186 million, or 19.7 per cent, from $948 million in 2011 to $1,134 million in 2031.

Local councils provide water and sewerage services in regional NSW. There are currently 106 regional water and sewerage suppliers in NSW, which may prove to be an unsustainably high number – by comparison, there are 13 such suppliers in Victoria.

Maintaining the current level of service for water and sewerage services in regional NSW is a significant issue which will likely require attention during the period to 2031. Figure 57 shows where prospective water supply constraints, particularly in the north and west of the state, will require attention. Options will need to acknowledge the requirements of the National Water Initiative and the Murray Darling Basin Plan, which requires a reduction in surface water extraction by 2019. A number of regional towns also face water quality issues.

The SISU recommended that the NSW Government allocate $1 billion from the Rebuilding NSW Initiative to:

- deliver projects in the Gwydir, Macquarie, Lachlan and upper Hunter River catchments;
- secure water supplies in Broken Hill and Cobar; and
- finalise the business cases for 71 projects aimed at ensuring regional towns meet water quality and environmental standards.[304]

Infrastructure NSW has also recommended that Water NSW should develop a best practice 20-year capital plan to provide an evidence base for pricing applications to support the funding of capital investment required for water security. The issues of scale and governance also need to be addressed through reform initiatives.

304. Infrastructure New South Wales (2014), p. 80

Audit observations – Victoria

2.1 Structure of this chapter

This chapter presents observations from the Audit for the four infrastructure sectors – transport, energy, communications and water – across Victoria. It provides data about the state's population and economy (i.e. the key drivers of demand for infrastructure), and the value-add attributable to Victoria's infrastructure, in 2011. It also outlines growth projections to 2031 for the state's population and economy, and for each of the infrastructure sectors. As noted in the Introduction to this report, these projections are based on economic and demographic analysis set out in two associated studies.[305]

The Audit uses the Direct Economic Contribution (DEC) methodology to quantify the value-add attributable to infrastructure in 2011, and to project the change in overall demand for infrastructure from 2011 to 2031. When considered in the light of other factors, such as capacity limitations which might constrain economic growth, this approach helps to identify locations and sectors that are likely to warrant further attention in the Australian Infrastructure Plan (the Plan).

This chapter also takes account of other documents, including plans, studies and strategies, prepared by the Victorian Government and others.

2.2 Drivers of infrastructure demand – population and economy

Based on medium level projections from the Australian Bureau of Statistics, the population of Victoria is projected to reach 7.6 million in 2031 – an increase of 2.1 million people, or 37 per cent, from 2011. The Victorian Government projects that the state's population will grow slightly faster than this, to around 7.7 million by 2031.[306]

As shown in Table 42, the Victorian economy is expected to grow by around 75 per cent over the 20 years to 2031. This is a slightly slower rate of growth than the country as a whole, reflecting the higher rates of growth expected in WA and Queensland. As a result, Victoria's share of the national economy is set to fall modestly, although it will remain the second largest of all the jurisdictions.

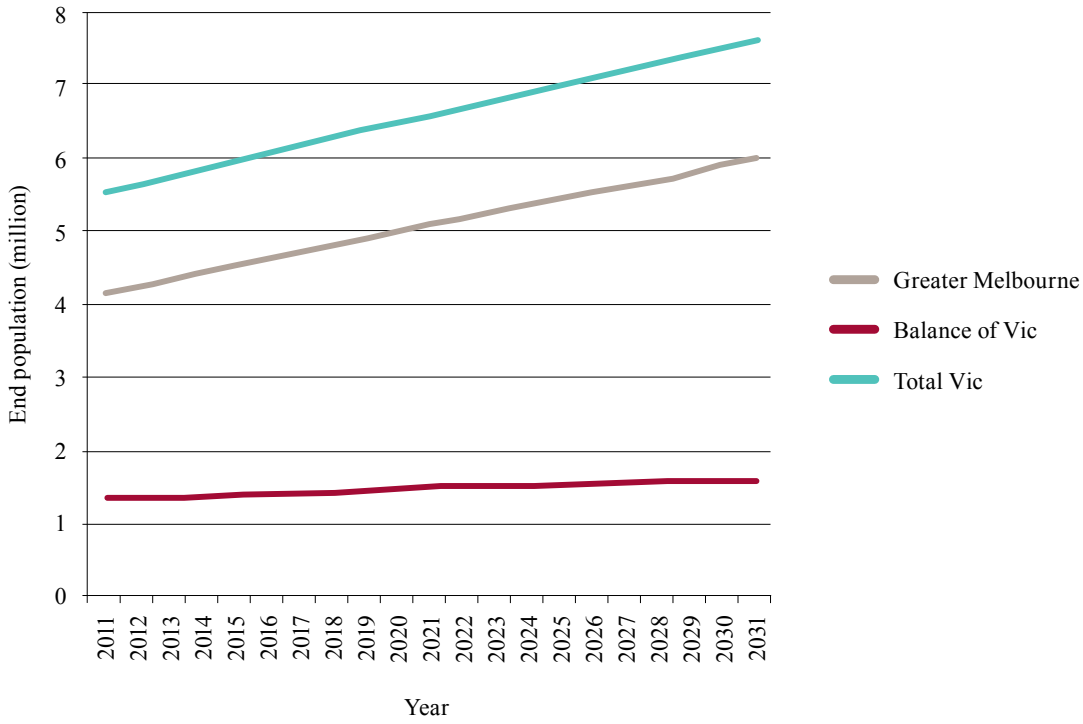
Table 42: Projected population and economic growth for Victoria

	2011	% of National	2031	% of National	Increase % 2011–31
Population (persons)	5,537,817	24.8%	7,584,869	24.9%	37%
Gross State Product ($m)	312,834	22.2%	550,015	21.3%	76%

Source: ACIL Allen Consulting (2014a)[307]

305. ACIL Allen Consulting (2014a) and Infrastructure Australia (2015b)
306. Victorian Department of Transport, Planning and Local Infrastructure (2014e)
307. Gross State Product is in 2010–11 prices.

Figure 58: Population projections for Victoria – 2011 to 2031



Source: Australian Bureau of Statistics (2013c)[308]

As shown in Figure 58, most of Victoria's population growth is projected to be in Melbourne. Both the Audit and the Victorian Government project Melbourne's population will increase by 1.8 million.

Population growth in Melbourne is projected to be strongest in the inner city, South Casey, Cardinia, Sunbury, Whittlesea-Wallan, Tullamarine-Broadmeadows, Melton-Bacchus Marsh and Wyndham. Major employment centres are projected to be in Melbourne inner city, Essendon, Yarra, Brunswick-Coburg, Darebin North, Brimbank, Casey South, Cardinia and Whittlesea.

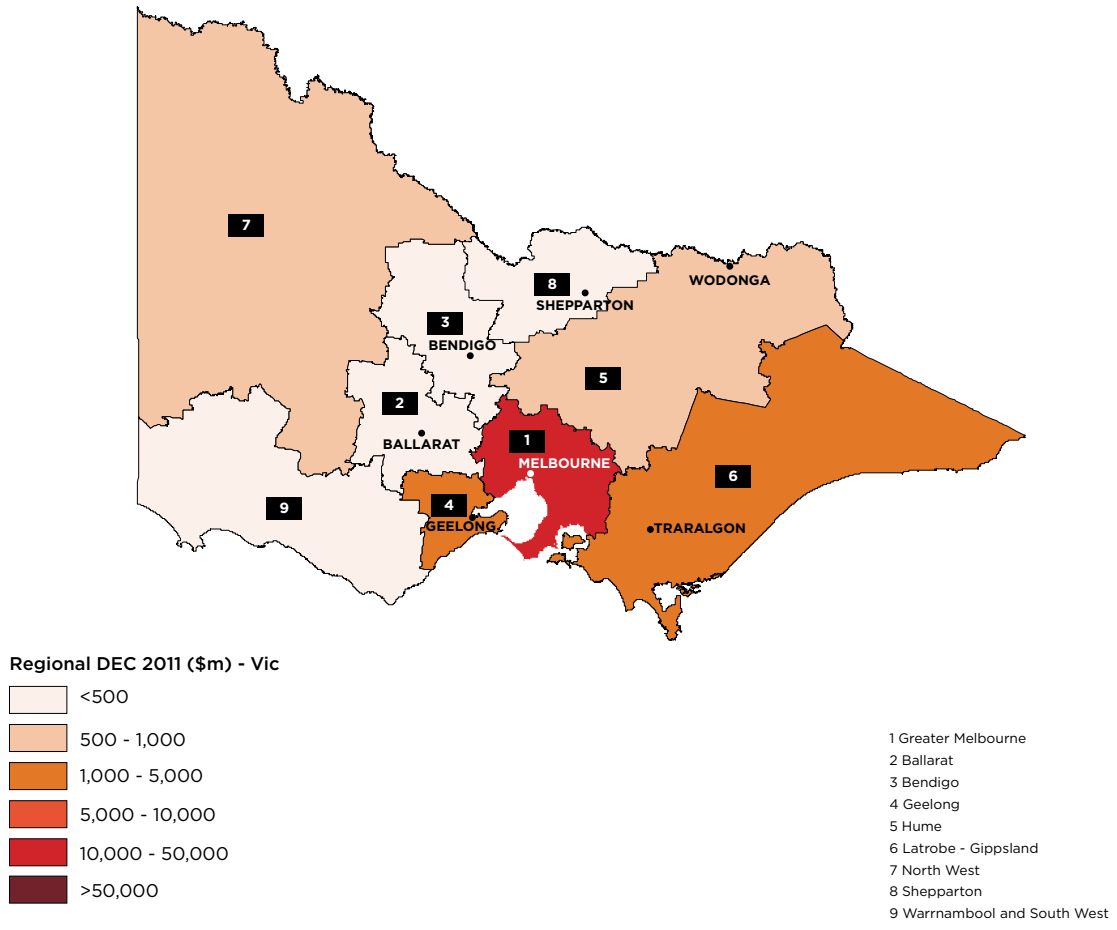
308. Series B (medium level) projections.

2.3 Summary of Victoria's infrastructure from 2011 to 2031

In 2011, the DEC of infrastructure in Victoria was $43 billion, which was 23 per cent of the national figure. In 2031, Victoria's infrastructure DEC is projected to increase by around $38 billion, or 90 per cent, reaching $81 billion, which would be around 22 per cent of the national figure.

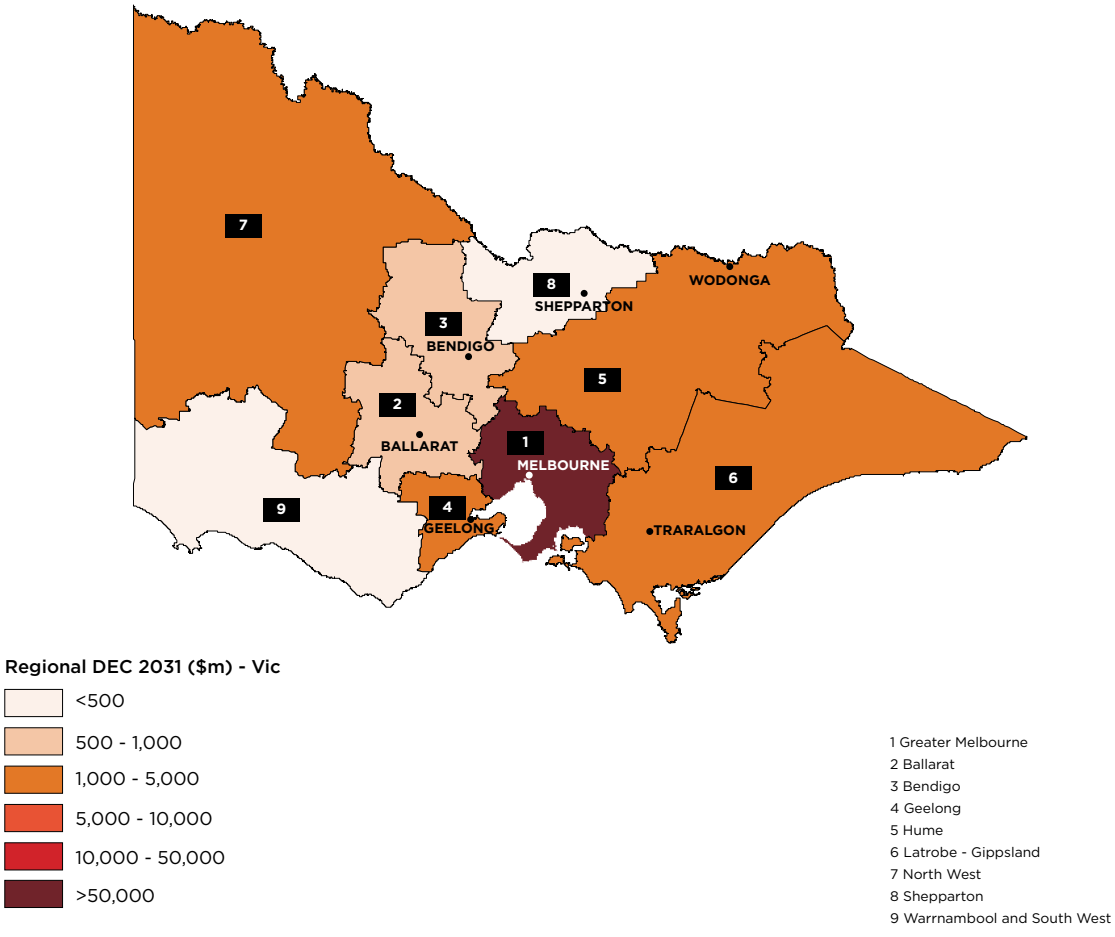
Figure 59 and Figure 60 show the spread of infrastructure DEC across the nine Audit regions in Victoria. Growth is highest in the Melbourne region, where DEC is projected to grow by 96 per cent.

Figure 59: Victoria regional DEC 2011



Source: ACIL Allen Consulting (2014a)

Figure 60: Victoria regional DEC 2031



Source: ACIL Allen Consulting (2014a)

Table 43 provides a snapshot of Victoria's economic infrastructure across the four sectors of transport, energy, communications and water. The table notes the capacity of each subsector in general terms and its rate of utilisation in 2011, along with historical (2011) and projected (2031) DEC for each subsector.

Table 43: Overview of Victorian infrastructure

	Subsector	Capacity 2011		Utilisation 2011		DEC 2011		DEC 2031		Projected % increase in DEC
			% of Nat.		% of Nat.		% of Nat.		% of Nat.	2011-2031
Transport	Urban Roads	**608,100,000** Car VKT per day	27%	**116,100,000** Car VKT per day	28%	$20,008m	26%	$40,796m	23%	104%
	Urban Public Transport	**72,200,000** Passenger KT per day	27%	**24,000,000** Passenger KT per day	36%					
	National Highways	**4,062** km of nationally significant roads	12%	**497,600** vehicles per day	27%	$1,492m	16%	$2,249m	14%	51%
	Freight Rail	n/a	n/a	n/a	n/a	$29m	1%	$39m	<1%	36%
	Ports	**74** Mt p.a. throughput	5%	**40** Mt p.a. throughput	4%	$4,718m	23%	$8,162m	19%	73%
		3.7 MTEU throughput	31%	**2.4** MTEU throughput	35%					
	Airports	**42** Count of airfields	15%	**28,200,561** Total RPT passenger movements	21%	$4,061m	20%	$8,064m	20%	99%
Energy	Electricity	**10,765** Installed capacity (MW) of Generation	20%	**55,050** Utilisation of Generation (GWh)	9%	$3,074m	19%	$4,709m	18%	53%
		9,982 Peak Demand Transmission (MW)	24%	**52,352** Utilisation of Transmission (GWh)						
		8,836 Peak Demand Distribution (MW)	24%	**43,319** Utilisation of Distribution (GWh)						
	Gas	n/a	n/a	**310.07** Transmission throughput (PJ/a)	23%	$144m	13%	$159m	5%	10%
		n/a	n/a	**161.60** Distribution throughput (PJ/a)	47%	$483m	40%	$532m	35%	10%
	Petroleum product terminals	n/a	n/a	**20,727** Annual throughput (ML)	26%	$282m	26%	$421m	24%	49%
Telecommunications		**4.60** Broadband average availability rating (out of 5)	n/a	**1,539**	n/a	$6,220m	30%	$12,641m	30%	103%
		1.78 Broadband average quality rating (out of 5)	n/a	Total households with broadband internet access at home ('000)						
Water & Sewerage	Water	**75,269** Length of water mains (km)	35%	**1,999,242** Water supplied (ML)	26%	$2,150m	20%	$3,252m	20%	51%
		9,703 Volume of water stored in dams (GL)	17%	**2,432** Properties served – water ('000)	28%					
		150,000 Desalination capacity (ML)	28%	**498,112** Sewage collected (ML)	26%					
	Sewerage	**35,623** Length of sewer mains (km)	27%	**2,190** Properties served – sewerage ('000)	28%					

Source: ACIL Allen Consulting (2014a)[309]

309. DEC figures are rounded to the nearest $ million, so percentage changes may not tally exactly with rounded estimates in this table. See Glossary for explanation of abbreviations and terms.

2.4 Victorian Government plans and strategies

A number of documents inform the strategic planning process in Victoria. Relevant plans include:

- *Plan Melbourne: Metropolitan Planning Strategy*,[310] which was based on projections that Melbourne's population will grow from 4.3 million in 2014 to 7.7 million in 2051, and acknowledges a need for increased use of public transport;
- the *Victorian Freight and Logistics Plan*,[311] which outlines a long-term strategy to improve freight efficiency; and
- the *Network Development Plan*,[312] which projected that average weekday boardings for rail will more than double to 1.7 million passengers per day by 2031, and sets out the introduction of a metro-style system within 10 years.

The newly-elected Government set out its policy goals in *Project 10,000*,[313] and its *Plan for Jobs and Growth*.[314]

Other relevant plans include:

- the City of Melbourne's *Future Living*,[315] which identified the need for an additional 42,000 homes in the City of Melbourne by 2031, to house an additional 80,000 people; and
- the Committee for Melbourne's *Melbourne Beyond 5 Million*,[316] which also identified anticipated population growth in the city, projecting a population of five million people by 2025 and noting the need for a 50-year plan to cater for Melbourne's growth – including land use, transport and physical and social infrastructure.

2.5 Transport

2.5.1 Urban transport

For the urban transport component of the Audit, the top-down economic analysis used for the other sectors, which is based on national accounts and industry data, was complemented by bottom-up analysis based on detailed transport modelling for the six major capital cities.

This modelling provides detailed information about trips within these cities by origin/destination, and by corridor, in 2011. It takes account of projected population and employment growth and spatial distribution to project demand for trips, also by origin/destination and corridor, in 2031.

For both road and rail corridors the model includes detailed information about capacity, showing where demand is projected to grow in excess of supply. For road corridors it quantifies the cost of delay, showing where interventions will likely provide the biggest economic return. For rail corridors the model assumes minimal delay (i.e. all passengers are able to board the next available train). This is to ensure the model does not displace rail passengers, and thus shows the full extent of demand for the rail corridor.

Given the absence of rail delay cost from the model, projected delay cost for road corridors is at best an approximation. However, rail delay cost is unlikely to represent more than a small proportion of total delay cost for most corridors. As such, road delay cost is a reasonable proxy for delay cost for most corridors, and serves as a useful indicator of which corridors warrant further study.

2.5.1.1 Urban transport in Melbourne-Geelong

The DEC of urban transport in the Melbourne-Geelong conurbation is projected to grow from $20 billion in 2011 to $41 billion in 2031 − an increase of 3.6 per cent per year. The cost of delay on Melbourne-Geelong's urban transport network in 2011 was around $3 billion. In the absence of any additional capacity (other than projects already under construction or funded), the cost of delay is projected to grow to around $9 billion in 2031.

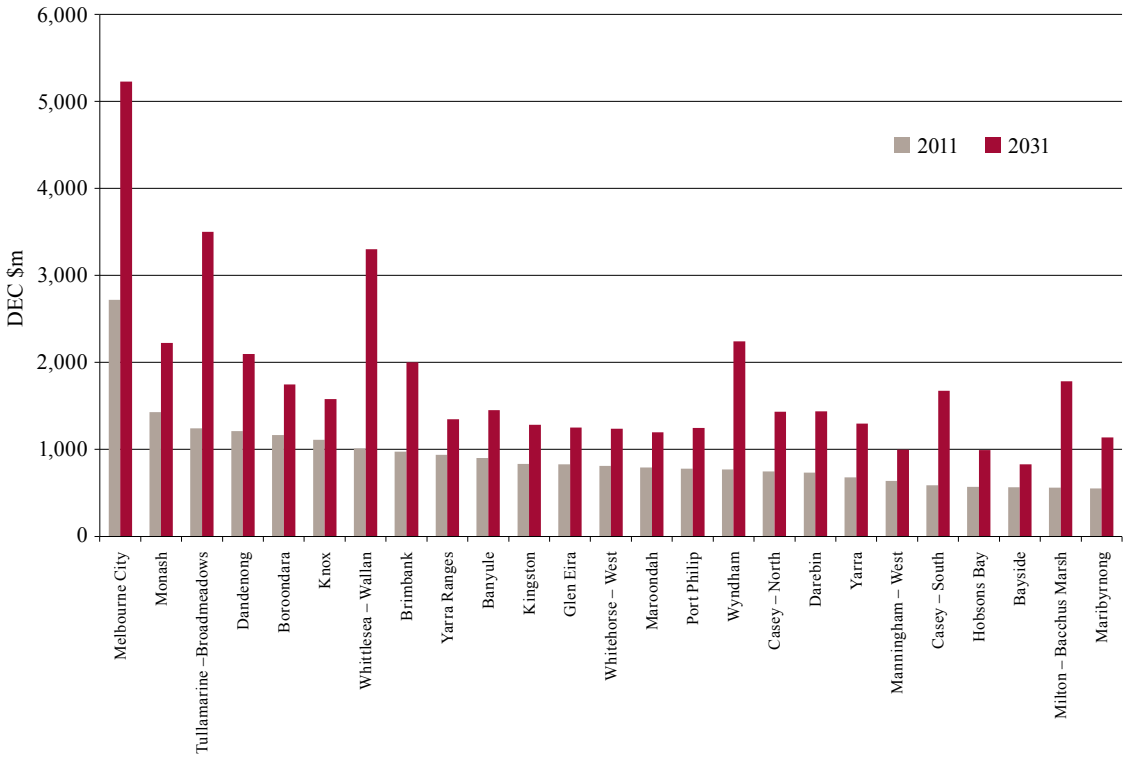
2.5.1.2 Origins/destinations of trips in Melbourne-Geelong

Figure 61 shows trips in Melbourne-Geelong by origin/destination (O/D), across road and public transport modes, in terms of DEC for 2011 and projected DEC for 2031. The O/D regions used here are SA3 regions as defined by ABS.[317]

This analysis shows that the Melbourne City region is the largest O/D for trips in Melbourne-Geelong, by a significant margin. Other O/D regions for which high levels of growth are projected between 2011 and 2031 are Tullamarine – Broadmeadows, Whittlesea – Wallan, Wyndham, Casey – South, and Melton – Bacchus Marsh.

310. Victorian Department of Transport, Planning and Local Infrastructure (2014c). The Victorian Government indicated in late March 2015 that it is reviewing *Plan Melbourne*.
311. Victorian Department of Transport, Planning and Local Infrastructure (2013)
312. Public Transport Victoria (2012)
313. Victorian Labor (2014)
314. Victorian Labor (2012)
315. City of Melbourne (2013)
316. Committee for Melbourne (2010)
317. SA3s provide a standardised regional breakup of Australia and generally (although not always) have populations between 30,000 and 130,000 persons.

Figure 61: Trips in Melbourne-Geelong by origin/destination for roads and public transport in 2011 and 2031, measured by DEC ($ million)



Source: Infrastructure Australia analysis of data from ACIL Allen Consulting (2014b)

2.5.1.3 Road corridors in Melbourne-Geelong

The Audit dataset provides a broad range of data about corridors, and there are many ways of analysing this data. Given the focus of the Audit on economic indicators, the analysis in Table 44 and Table 45 focuses on delay cost. This applies a dollar cost to time delays, based on lost productivity, and takes account of the different costs applicable to different vehicle types.

Some users of the Audit dataset may prefer to use more traditional indicators of congestion, such as traffic volume compared to capacity (V/C). This measure is included in Table 44 and Table 45, as is the DEC measure, which gives insight into the underlying value of activity on the corridor, and the proportion of DEC attributable to delay cost.

These measures are expressed per lane kilometre of road. This normalises the results to facilitate comparison across a wide range of different corridor types − some very long, some consisting of multiple roads, and some relatively short single roads.

The modelling provides one method of measuring and projecting demand for transport infrastructure and the corridors identified in Table 44 and Table 45 reflect this approach. The Victorian Government may have utilised other data, and different methods of analysis, to inform identification of infrastructure priorities. For further information on the assumptions, included projects and methodology applied in the model, refer to the supporting documentation by Veitch Lister Consulting.

Following the decision of the Victorian Government not to proceed with the East West Link, neither Stage 1 nor Stage 2 of this project was included in the modelling. The modelling also does not incorporate the widening of CityLink and the Tullamarine Freeway. The decision to proceed with funding for the project was made after the modelling was conducted.

Table 44 shows corridors ranked by delay cost per lane kilometre in 2011, with the equivalent projections for 2031 in Table 45. Taken together, these tables give an indication of which corridors warrant further study, and where interventions are likely to have the biggest economic return.

Table 44: Top 10 road corridors in Melbourne-Geelong 2011, by delay cost (2011 dollars)

Rank	Road Corridor	State	Delay cost by lane km 2011 ($m)	DEC per lane km 2011 value ($m)	Volume Capacity Ratio 2011 AM Peak (7-9 AM)
1	City Link-Eastern Fwy connection north of CBD	VIC	1.56	5.49	70%
2	Eastern Fwy Corridor to Ringwood	VIC	1.29	5.77	76%
3	Western/Metropolitan Ring Road	VIC	1.13	5.52	76%
4	West Gate/Princes Freeway Corridor	VIC	0.94	4.43	51%
5	City Link Western Link	VIC	0.75	5.02	62%
6	Monash/Princes Fwy Corridor	VIC	0.73	4.07	61%
7	North-South Arterial – Northern Suburbs (St Georges Rd/High St)	VIC	0.71	3.20	63%
8	Tullamarine Freeway (Airport) Corridor	VIC	0.61	3.14	64%
9	North-South Arterials – Eastern Suburbs	VIC	0.61	3.04	61%
10	Geelong Rd Corridor	VIC	0.56	3.33	57%

Source: Infrastructure Australia analysis of data from ACIL Allen Consulting (2014b) and Veitch Lister Consulting (2014c)

Table 45: Top 10 road corridors in Melbourne-Geelong 2031, by projected delay cost (2011 dollars)

Rank	Road Corridor	State	Delay cost by lane km 2031 ($m)	DEC per lane km 2031 ($m)	Volume Capacity Ratio 2031 AM Peak (7–9 AM)
1	Hume Freeway Corridor	VIC	4.73	10.24	76%
2	Western/Metropolitan Ring Road	VIC	3.91	11.83	85%
3	Tullamarine Freeway (Airport) Corridor	VIC	3.52	7.67	81%
4	West Gate/Princes Freeway Corridor	VIC	3.17	9.26	67%
5	City Link-Eastern Fwy connection north of CBD	VIC	3.06	8.70	77%
6	Calder Freeway Corridor	VIC	2.55	6.47	69%
7	Sydney Rd Corridor	VIC	2.51	6.70	75%
8	Western Freeway Corridor	VIC	2.42	6.08	62%
9	Monash/Princes Fwy Corridor	VIC	2.39	7.69	72%
10	Eastern Fwy Corridor to Ringwood	VIC	2.29	8.39	80%

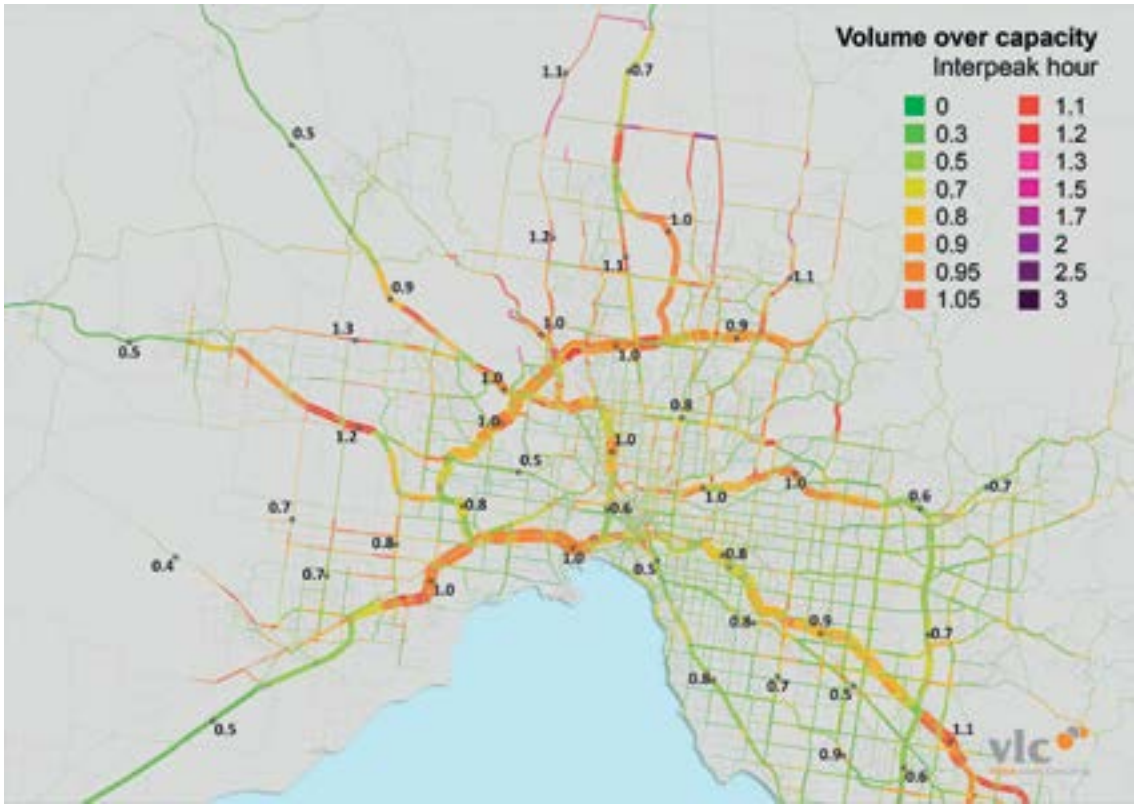
Source: Infrastructure Australia analysis of data from ACIL Allen Consulting (2014b) and Veitch Lister Consulting (2014c)

Figure 62 and Figure 63 show projected road congestion, by V/C, in 2031 for the AM peak hour and daytime inter-peak periods, respectively. These show the corridors and locations likely to reach or exceed maximum capacity by 2031, in the absence of any additional capacity. Note that in the inter-peak period there is surplus capacity across most of the network, except for access to Melbourne Airport, and access to some outer urban areas.

Figure 62: Melbourne road network volume/capacity ratio in 2031 – AM maximum peak hour

Source: Veitch Lister Consulting (2014c)

Figure 63: Melbourne road network volume/capacity ratio in 2031 – daytime inter-peak period

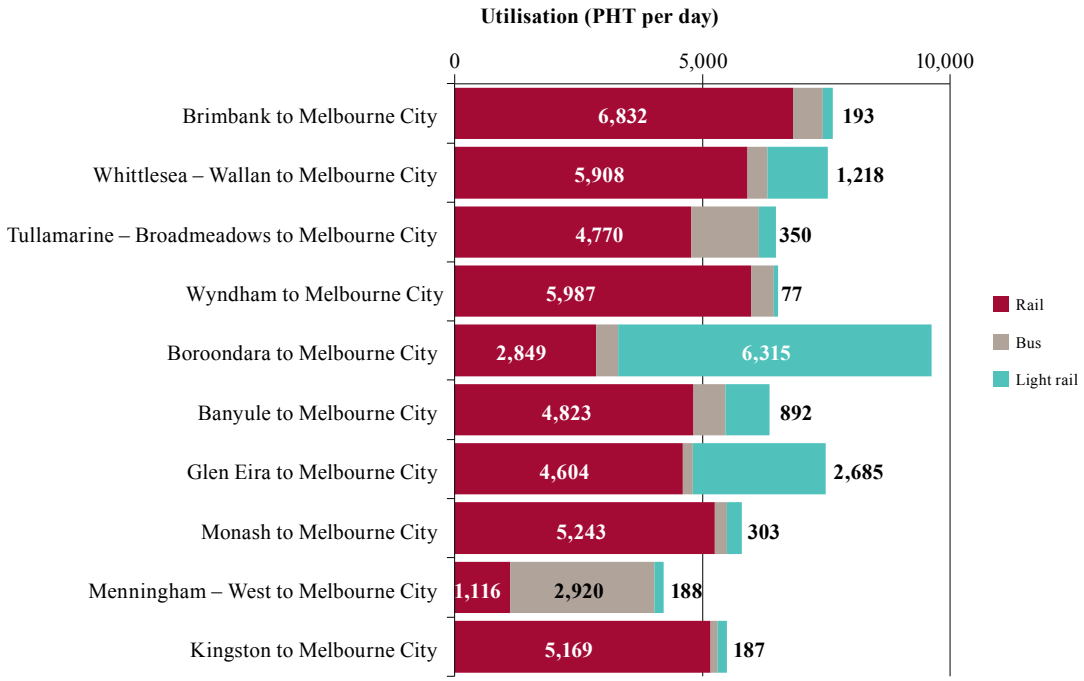


Source: Veitch Lister Consulting (2014c)

2.5.1.4 Public transport in Melbourne-Geelong

Figure 64 sets out the top 10 public transport O/D pairs in Melbourne-Geelong by passenger hours travelled (PHT), and by public transport mode. Melbourne City features in all 10 O/D pairs.

Figure 64: Top 10 Melbourne origin/destination pairs by hours travelled for public transport



Source: Infrastructure Australia analysis of data from Veitch Lister Consulting (2014c)

2.5.1.5 Rail trips in Melbourne-Geelong

Table 46 shows the top 12 destination SA3 regions for rail trips in Melbourne-Geelong. This shows that Melbourne City is by far the dominant destination for rail trips in the Melbourne-Geelong region.

Table 46: Top 12 destinations in Melbourne-Geelong for rail trips by passenger hours travelled (PHT), 2011 and projected 2031

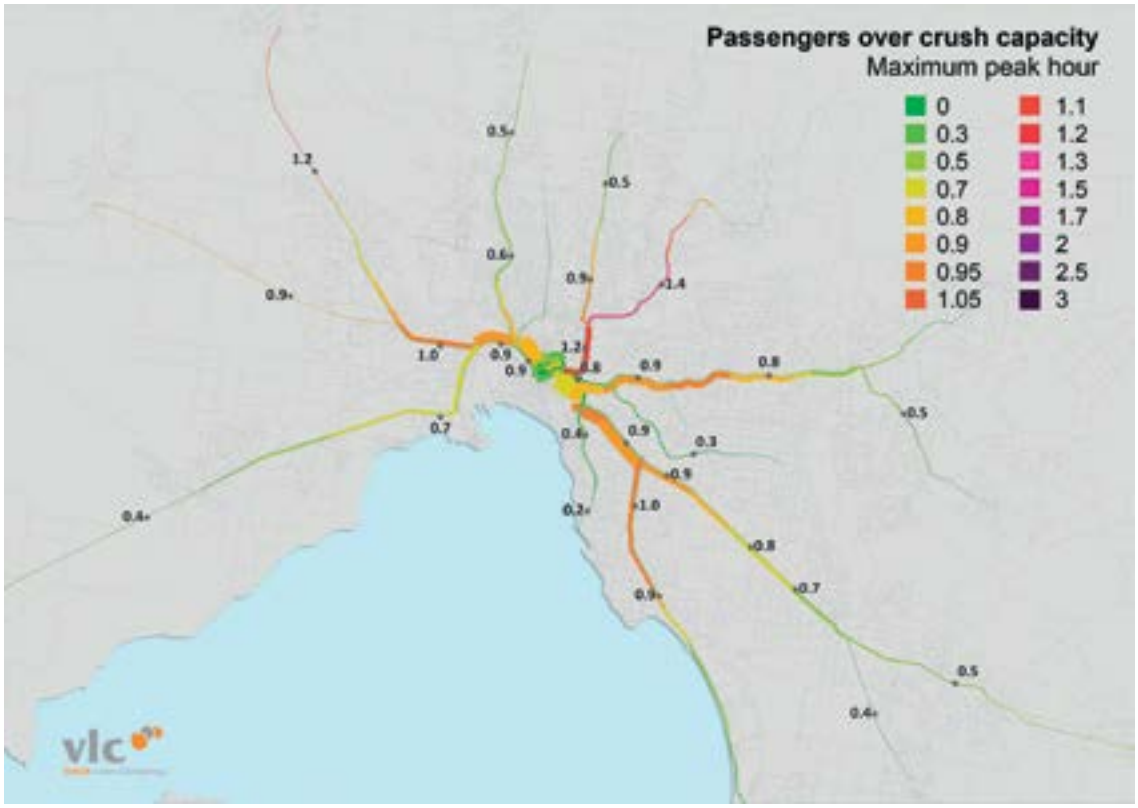
SA3 region	Rail PHT – 2011	Projected rail PHT – 2031
Melbourne City	119,696	263,564
Tullamarine – Broadmeadows	12,641	46,403
Brimbank	11,525	20,813
Monash	11,129	22,559
Glen Eira	10,149	18,280
Kingston	10,010	19,531
Wyndham	9,959	32,349
Dandenong	9,044	19,905
Boroondara	8,732	16,195
Whittlesea – Wallan	8,666	32,808
Banyule	8,302	16,437
Yarra Ranges	8,241	15,157

Source: Infrastructure Australia analysis of data from ACIL Allen Consulting (2014b) and Veitch Lister Consulting (2014c)

2.5.1.6 Rail corridors in Melbourne-Geelong

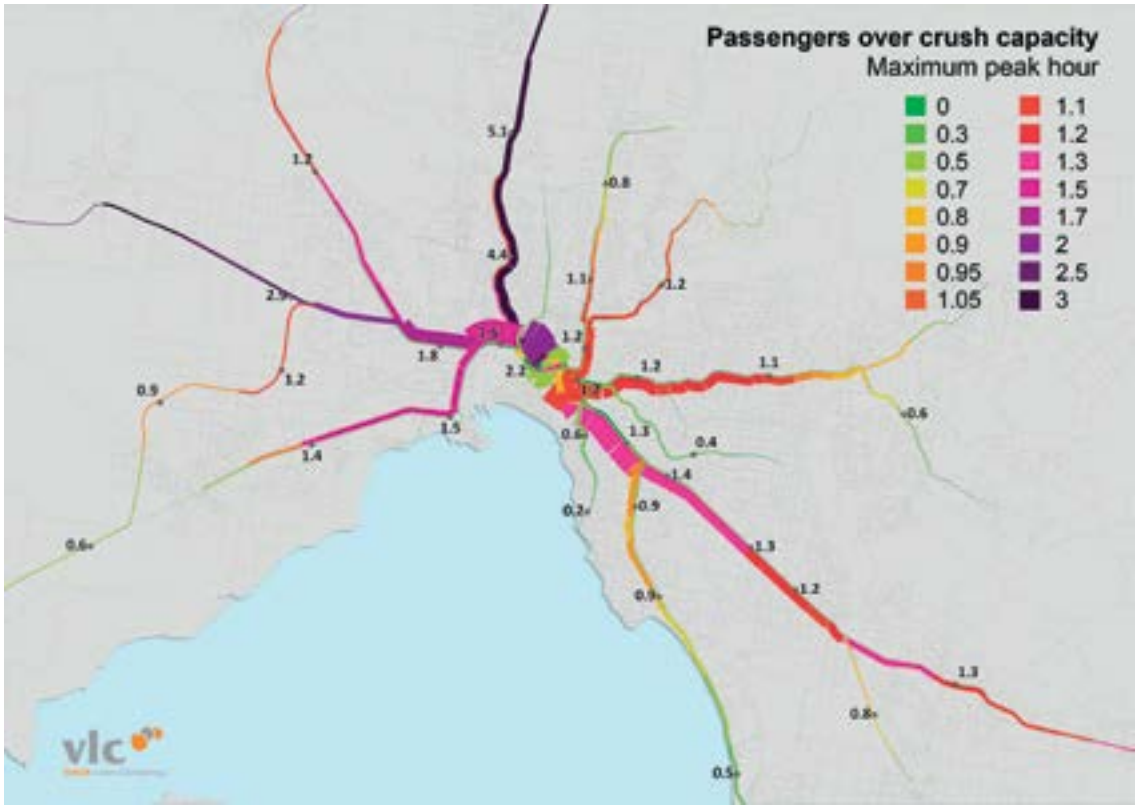
Figure 65 and Figure 66 show that passenger loadings on Melbourne's rail corridors are projected to increase over time, reaching or exceeding crush capacity on the Craigieburn, Sunshine, Werribee and Dandenong lines by 2031.

Figure 65: Melbourne rail network weekday passenger demand relative to crush capacity 2011



Source: Veitch Lister Consulting (2014c)

Figure 66: Melbourne rail network weekday passenger demand relative to crush capacity projected 2031



Source: Veitch Lister Consulting (2014c)

2.5.1.7 Light rail (tram) trips in Melbourne-Geelong

Melbourne has the most comprehensive light rail (tram) network in Australia. Table 47 shows the top five destination SA3 regions for light rail trips in Melbourne-Geelong. This shows that Melbourne City is by far the dominant destination for light rail trips in the Melbourne-Geelong region.

Table 47: Top five destinations in Melbourne-Geelong for light rail trips by passenger hours travelled (PHT), 2011 and projected 2031

	Melbourne City	Port Phillip	Boroondara	Yarra	Brunswick Coburg
2011	48,426	13,724	12,654	8,366	6,839
2031	86,352	21,508	17,438	15,072	11,537

Source: Veitch Lister consulting (2014c)

2.5.1.8 Bus trips in Melbourne-Geelong

Table 48 shows the top seven destination SA3 regions for bus trips in Melbourne-Geelong by passenger hours travelled. This shows that Melbourne City is the dominant destination for bus trips in the Melbourne-Geelong region.

Table 48: Top seven destinations in Melbourne-Geelong for bus trips by passenger hours travelled (PHT), 2011 and projected 2031

	Melbourne City	Monash	Manningham West	Dandenong	Knox	Tullamarine	Banyule
2011	14,908	7,986	6,503	5,984	5,799	9,125	4,697
2031	34,560	14,321	10,857	10,940	8,655	31,723	6,473

Source: Veitch Lister Consulting (2014c)

2.5.1.9 Freight movements in Melbourne-Geelong

Table 49 shows the daily vehicle kilometres travelled by vehicle type (car, light commercial vehicle, heavy commercial vehicle) between major O/D pairs in the Melbourne-Geelong region. This shows that freight traffic constitutes a significant proportion of traffic for some O/D pairs, in particular for travel between the Yarra Ranges and Knox SA3 regions.

Table 49: Daily vehicle kilometres travelled by vehicle type 2011

		Utilisation (VKT/day)	Utilisation (VKT/day)	Utilisation (VKT/ day)	LCV & HCV as % of daily VKT
From	**To**	**Car**	**LCV**	**HCV**	
Dandenong	Kingston	317,750	26,213	13,836	11.2%
Monash	Dandenong	387,737	24,964	13,803	9.1%
Casey – North	Dandenong	298,535	16,971	7,214	7.5%
Knox	Monash	323,031	15,700	6,687	6.5%
Tullamarine – Broadmeadows	Whittlesea – Wallan	473,815	22,266	10,412	6.5%
Yarra Ranges	Knox	416,586	17,025	6,578	5.4%
Yarra Ranges	Maroondah	396,674	15,950	4,816	5.0%
Whittlesea – Wallan	Banyule	274,916	7,901	2,968	3.8%
Casey – South	Casey – North	309,926	7,989	1,807	3.1%
Melton – Bacchus Marsh	Brimbank	364,674	8,363	2,453	2.9%

Source: Veitch Lister Consulting (2014c)

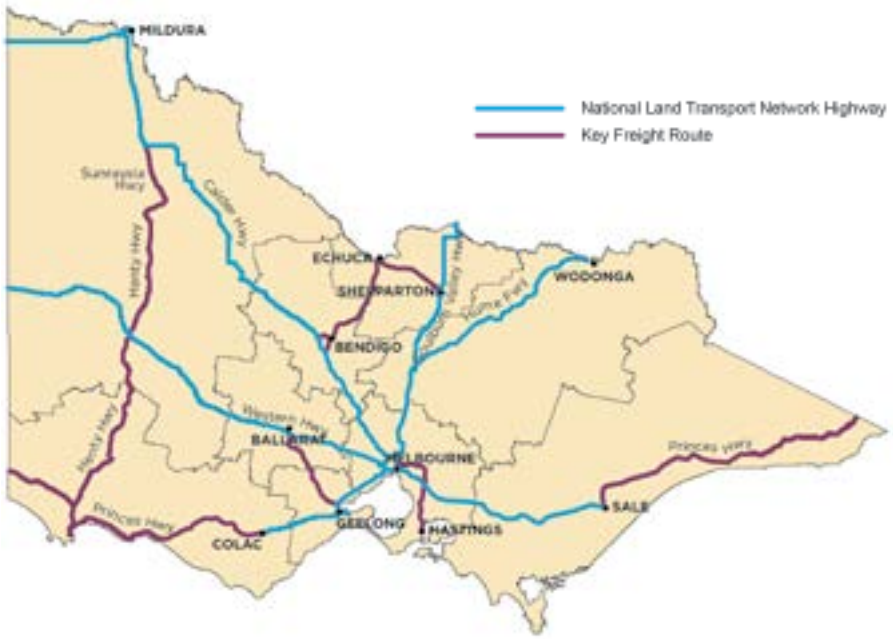
2.5.2 National highways

Of Australia's 34,656 km of national highways (which include the National Land Transport Network highways and other key freight routes) identified in the Audit, 4,062 km (12 per cent) are in Victoria. These roads accounted for 27 per cent of movements on the national highway network in 2011. National highways in Victoria include the following national highway links connecting the capital cities:

- Melbourne to Sydney (Hume Highway Route 31);
- Melbourne to Brisbane (Goulburn Valley Highway Route 39); and
- Melbourne to Adelaide (Western Highway Route 8).

Figure 67 shows the National Land Transport Network highways and the other key Victorian freight routes included in the Audit. Together these routes play an important role in facilitating industry and enabling business and community activity.

Figure 67: National Land Transport Network highways and key freight routes in Victoria 2011



The map shows highways identified in the Audit. Data was not available for all of these highways.
Source: ACIL Allen Consulting (2014a)

Two per cent of Victoria's roads have a 1-star safety rating under the Australian Road Assessment Program (AusRAP), while 33 per cent are 2-star rated and 60 per cent are 3-star rated. The highest attainable rating is five stars.

The DEC of Victoria's national highways is projected to increase from $1.5 billion in 2011 to $2.2 billion in 2031.

2.5.3 Freight rail

The DEC of freight rail in Victoria is projected to increase from $29 million in 2011 to $39 million in 2031, a rise of 36 per cent.

Victoria has an extensive rail network, which is shared by freight and passenger services. However, only one per cent of intrastate and interstate freight movements in Victoria are served by rail,[318] with road transport accounting for 89 per cent of movements, and sea transport 10 per cent. As in other states, rail freight struggles to compete with road freight, especially over short distances, where relatively low charges for road use make road freight more cost effective. Other factors explaining rail's low mode share are the low level of investment in intrastate freight rail networks, poor asset condition and performance, and need for transport from warehouse to rail depot and vice versa, which is uneconomical for short distances.

Victoria's freight task is projected to nearly double by 2031, from approximately 60 billion net tonne kilometres in 2008 to 110 billion net tonne kilometres in 2030, and from around 2.6 million twenty foot equivalent units (TEU) in 2008 to 6.6 million TEU in 2031.[319]

With this increased task, the Victorian Government notes that unless there is a significant modal shift from road to rail freight, road congestion in Victoria will lead to significant economic costs. As a result, the Victorian Government has recently increased investment in freight rail in order to increase rail's mode share of Victoria's total freight task. The rail freight task is forecast to rise from 8.4 billion net tonne kilometres in 2012 to 17 billion net tonne kilometres in 2031.[320]

318. Victorian Auditor-General's Office (2010)
319. Victorian Department of Transport, Planning and Local Infrastructure (2013)
320. Victorian Department of Transport, Planning and Local Infrastructure (2013)

2.5.4 Ports

Victoria is served by four major ports, as shown in Table 50. The DEC for ports across Victoria is projected to increase by 73 per cent from $4.72 billion in 2011 to $8.16 billion in 2031.

Table 50: Victorian port tonnages – 2012–13

	Total Throughput (mass tonnes)				Containerised trade in TEU			
Port	**Imports**	**Exports**	**Total**	**Total as % of national total**	**Imports**	**Exports**	**Total**	**Total as % of national total**
Melbourne Port Corporation	19,432,647	15,626,673	35,059,320	3.11%	1,267,685	1,244,456	2,512,141	35.06%
Geelong Port (Patrick)	7,916,991	4,919,657	12,836,648	1.14%	0	0	0	0.00%
Port of Portland	1,045,723	4,287,989	5,333,712	0.47%	0	0	0	0.00%
Port of Hastings (Patrick)	577,306	1,427,920	2,005,226	0.18%	0	0	0	0.00%
Victoria Total	**28,972,667**	**26,262,239**	**55,234,906**	**4.89%**	**1,267,685**	**1,244,456**	**2,512,141**	**35.06%**

Source: Ports Australia (2014a)

The Victorian Government has indicated it will investigate options for a second container port to provide additional container terminal capacity for Victoria. This may include options in the west of Port Phillip Bay or at the Port of Hastings. The Victorian Government has indicated it will establish Infrastructure Victoria and seek its expert advice on a preferred site for a second container port development.

2.5.4.1 Port of Melbourne

The Port of Melbourne is Victoria's busiest port and the largest container and general cargo port in Australia. It handled 2.5 million TEU in 2013–14[321] and is one of the most significant trade assets in South-East Australia. The facility is owned by the Victorian Government and managed by the state-owned Port of Melbourne Corporation. The Victorian Government plans to privatise the port in the near future,[322] expected in 2015.

Prior to its current expansion, the port faced capacity constraints as a result of rapid increase in container traffic, which has grown at a rate of around six per cent per year over the past two decades,[323] and was projected to reach capacity by 2015.[324] The constraints have been largely alleviated by a $1.6 billion redevelopment, which commenced in 2012 and will be completed in 2016. These projects include the development of a third container facility and a direct connection from Webb Dock to the West Gate Freeway, which will enhance the efficiency of container movements.[325] Taking into account these expansions, there will be adequate capacity in the medium term. However, demand for container facilities at the Port of Melbourne is projected to exceed capacity before 2031.[326]

2.5.4.2 Geelong Port

Geelong Port is regional Victoria's busiest port, handling over 12.8 million tonnes of throughput in 2012–13.[327] It is primarily owned by Patrick Corporation, with the Commonwealth and GrainCorp having minor holdings of port assets. It principally handles grain, crude oil, petroleum products and forestry products.[328] Throughput of commodities currently handled at the port is projected to increase from 13.2 million tonnes in 2015 to 23.6 million tonnes in 2050.[329]

While the port's existing infrastructure is considered to be adequate to meet short- to medium-term needs,[330] the potential to grow trade is dependent on the completion of several large scale infrastructure investments. The key constraints to growth are primarily around port accessibility.[331] Vehicle and rail access and

321. Port of Melbourne Corporation (2012)
322. Victorian Department of Treasury and Finance (2014)
323. Port of Melbourne Corporation (2012)
324. Australian Competition and Consumer Commission (2011)
325. Port of Melbourne Corporation (2012)
326. Port of Melbourne Corporation (2013)
327. Ports Australia (2014b)
328. Victorian Regional Channels Authority (2013)
329. GHD and Juturna Consulting (2013)
330. Victorian Regional Channels Authority (2013)
331. GHD and Juturna Consulting (2013)

capacity are both limited, which hampers freight movements to the port. In addition, the depth and width of the port's shipping channel restrict access for vessels over a certain size. The Greater Geelong City Council has proposed several projects[332] to alleviate these infrastructure issues.

2.5.5 Airports

Melbourne's Tullamarine Airport is Australia's second busiest airport. The airport's DEC was about $4 billion in 2011, and is projected to double by 2031.

The airport is privately operated under lease arrangements with the Australian Government. The number of passengers at Tullamarine is forecast to rise from 30.2 million in 2013 to 64.4 million in 2033.[333] The operator is currently planning to build a third runway, which is expected to be operational within the life of the Australian Infrastructure Plan.

Avalon Airport, between Melbourne and Geelong, also provides passenger services. The airport processed approximately 700,000 passenger movements in 2010.[334]

Table 51: Victorian airport passenger and freight volumes – 2013–14

	Revenue passenger (No.)				International Freight (tonnes)			
Airport	Domestic (incl. Regional) Airlines	International Airlines	Total passengers	Total as % of national total	Inbound	Outbound	Total	Total as % of national total
Melbourne	23,229,896	7,666,124	30,896,020	21.09%	131,012	121,809	252,821	23.80%
Mildura	217,886	0	217,886	0.15%	0	0	0	0.00%

Source: Bureau of Infrastructure, Transport and Regional Economics (2014i)

2.6 Energy

2.6.1 Electricity

The Audit found that, in 2011, Victoria had an installed electricity generation capacity of 10,765 MW. Transmission peak demand was 9,982 MW and distribution peak demand was 8,836 MW. Electricity generation in Victoria in 2011 was 55,050 GWh with end-use demand being 43,319 GWh.

The DEC from electricity infrastructure in 2011 was approximately $3.1 billion. This was made up of $1.2 billion from generation, $0.4 billion from transmission and $1.4 billion from distribution.

The Audit forecasts a 47 per cent increase in electricity use from 2011 to 2031. This equates to 82,911 GWh for generation, 77,042 GWh for transmission and 63,847 GWh for distribution by 2031. Based on these forecasts, the Audit projects an increase electricity infrastructure DEC from $3.1 billion to $4.7 billion. This 53 per cent rise is slower than forecast state-wide economic growth of 76 per cent over the same period.

The Australian Energy Market Operator (AEMO) forecasts[335] declining electricity consumption in Victoria, from 47,319 GWh in 2011 to 45,342 GWh in 2031. AEMO attributes the decline to reduced large industrial consumption, reduced residential and commercial consumption from increased rooftop photovoltaic (PV) output, increasing energy efficiency, and response to high electricity prices.

There are several reasons for caution in directly comparing AEMO's forecasts and the Audit projections for the DEC of electricity infrastructure. The Audit assumes an energy efficiency improvement rate of 1.5 per cent per year (compared to a historic rate of 0.5-1.0 per cent), whereas AEMO assumes much faster rates, exceeding 20 per cent in some years. Consequently the electricity use underlying the Audit's DEC measure is considerably higher than that for AEMO's forecast.

Additionally, AEMO reports and forecasts unit electricity consumption in gigawatt-hours, whereas DEC is a measure of the value-add provided by electricity infrastructure, expressed in dollar terms. The two are not necessarily perfectly correlated.

Victoria is part of the National Electricity Market (NEM) which also includes NSW, SA, Queensland and Tasmania. Electricity consumption and demand has fallen in the NEM in recent years. Annual energy sent out across the NEM fell seven per cent from 194.9 TWh in 2009–10 to 181.2 TWh in 2013–14.

There is likely to be little need for additional investment in generation capacity in Victoria over

332. GHD and Juturna Consulting (2013)
333. Melbourne Airport (2013)
334. Avalon Airport (2011)
335. Australian Energy Market Operator (2014a)

the next 15 years based on existing and projected levels of supply and demand.

The Small-scale Renewable Energy Scheme, feed-in tariffs and other solar PV subsidies have led to a significant increase in the penetration of solar PV systems in the last five years. In Victoria, solar PV output increased from 25 GWh at the start of 2010 to 731 GWh in 2013–14. In its most recent forecast AEMO predicted an increase to 5,154 GWh by 2031.

The combination of an unanticipated decline in demand and rising penetration of renewables has led to an ongoing structural change in the wholesale sector.

At the same time, there have been considerable rises in network charges across the NEM, due to a range of factors. The rising network charges have in turn influenced retail prices, creating an impetus for regulators to investigate options that may diminish, or delay, further expansion of the network. Consequently, the Australian Energy Market Commission (AEMC), on 27 November 2014,[336] made a new rule that establishes a new pricing objective and new pricing principles for electricity distribution businesses that will require that network prices reflect the efficient costs of providing network services. Distribution network prices will reflect the costs of providing the electricity to consumers with different patterns of consumption which has the potential to reduce demand during peak periods, and consequently also reduce future network infrastructure investment.

The implications of surplus capacity differ by sector. For the generation sector, surplus capacity and renewable policy settings are likely to result in the withdrawal of thermal generation assets. Since 2005, significant generation of capacity has been 'mothballed' or retired in the NEM. Most recently, Victoria has seen the withdrawal of the Energy Brix power station in 2012. In addition, a number of generators in Victoria could withdraw in the near future in response to surplus capacity, the government's carbon reduction policy, and the approaching end of their useful life.

For the network sector, the decline in demand has diminished the need for augmentation investment. AEMO has pointed out that several transmission network service providers have delayed or cancelled a number of major network upgrades. For example, the proposed Geelong-Moorabool 220 kV line upgrade has been deferred beyond the 10-year planning horizon, mainly due to the closure of the Point Henry aluminium smelter. Lower levels of demand growth may reduce the need for expenditure to replace existing assets.

2.6.2 Gas

In 2011, Victorian gas transmission pipelines had an annual throughput of 310 petajoules (PJ). Gas distribution pipelines had an annual throughput of 162 PJ.

The DEC from gas pipelines in Victoria in 2011 was estimated at $627 million, made up of $144 million from transmission and $483 million from distribution.

The Audit projects a 10 per cent increase in the DEC of gas pipeline infrastructure in Victoria of $63 million to $690 million in 2031. The rise is made up of $14 million from transmission and $48 million from distribution. This is a relatively small increase, with the state's economy forecast to expand by 76 per cent over the same period.

AEMO identified a potential supply shortfall in Victoria in its 2013 Gas Statement of Opportunities. This may arise due to increasing demand, Liquefied Natural Gas (LNG) exports and slow development of coal seam gas reserves in Victoria. Any anticipated physical shortfalls are likely to be resolved by the interaction of market participants responding to the resultant price signals.

AEMO has forecast a modest decline in gas consumption in Victoria, from 213 PJ in 2014 to 196 PJ in 2031,[337] despite the expected population increase.

As with electricity, there are several reasons for the inconsistency between the Audit's forecast rise in DEC in the gas sector, and AEMO's forecast of a fall in demand. In particular, the DEC analysis was finalised before the latest AEMO gas market forecasts were published. Those forecasts were the first to show a break in what had previously been a direct link between economic growth and rising energy consumption. Also, AEMO reports and forecasts gas consumption in petajoules, whereas DEC is a measure of the value-add provided by gas infrastructure, in dollars. The two are not necessarily perfectly correlated.

The Victorian gas market is connected with NSW, SA and (indirectly) Queensland via a number of gas pipelines. The main pipelines in Victoria are the Longford to Melbourne, South West Pipeline, the VIC-NSW Interconnect, and the Eastern Gas Pipeline. Victoria is the largest source of conventional gas reserves in eastern Australia, with gas fields in the Gippsland Basin, Bass Basin and Otway Basin. The Longford gas plant is one of the largest existing gas plants in Australia. Victoria has historically exported gas to NSW via the Eastern Gas Pipeline and the VIC-NSW Interconnect pipeline.

336. Australian Energy Market Commission (2014)
337. Australian Energy Market Operator (2014b)

There are additional conventional and unconventional gas reserves, such as coal seam gas, that could be developed in Victoria.

Although domestic gas consumption is forecast to continue declining, new LNG plants on the east coast have opened the market to export. Value-add from gas infrastructure in future will come from both domestic usage (where demand may continue to fall), and from the export market. The impact of this will largely be in Queensland and the NT.

There is wide acknowledgement of an ongoing structural shift in the gas market as Australia significantly expands its ability to export gas. There is also uncertainty about whether existing gas market and regulatory frameworks are well suited to handle the shift. The AEMC recently conducted a gas market scoping study, which recommended Australia conduct a strategic review of the gas sector, including a review of future market developments over the next 10 to 15 years and a review of the short term trading market and the declared wholesale gas market.

2.6.3 Petroleum

The petroleum industry is broadly split into upstream and downstream petroleum sectors. The upstream sector refers to exploration and production of crude oil while downstream refers to refining of crude oil and the distribution and sale of petroleum products.

In 2011, consumption of petroleum products in Victoria was 10,988 ML. Total throughput at petroleum terminals was 20,727 ML. The DEC of petroleum terminals was $282 million.

The Audit identifies two refineries in Victoria – Mobil Altona Melbourne and Shell Geelong. In 2011, Mobil Altona Melbourne had a throughput of 4,530 ML per year and Shell Geelong had a throughput of 6,380 ML per year.

The Audit projects an increase in throughput of 2.0 per cent per year in Victoria. This equates to throughput of 30,975 ML per year by 2031 – a difference of 10,248 ML per year. This is projected to lead to growth in DEC from $282 million in 2011 to $421 million in 2031 (a 49 per cent rise).

2.6.3.1 Crude oil production

Australia's total production of crude oil has been steadily declining. Crude oil production peaked in 2000 at 722 kb/day and declined to just over 338 kb/day in 2013.[338] Oil production is forecast to decline at an annual average rate of 4.4 per cent from 2014–15 to 2049–50.[339] The majority of production comes from two major basins, the Carnarvon Basin in WA (77 per cent of production in 2011), and the Gippsland Basin in Victoria (less than 15 per cent of production in 2011).

2.6.3.2 Refinery capabilities

In recent years the global oil refining industry has been undergoing significant structural change. Larger, more efficient 'mega-refineries' have been established in Asia resulting in increased competitive pressures on established refining operations, including those in Australia.

In 2013–14, 82 per cent of crude oil and other refinery feedstock was imported.[340] It is unlikely there will be any new refinery capacity developed in Australia in the foreseeable future. The Shell Geelong refinery transferred ownership to Swiss energy group Vitol in 2014, and the company is focusing on selling most of the fuel produced into the domestic market.

2.6.3.3 Petroleum products

Domestic demand for petroleum products grew at an average annual rate of around 1.5 per cent in the decade to 2011–12. It is expected to grow by around one per cent per year through to 2049–50, largely driven by population and economic growth. However, energy intensity (measured by total domestic energy consumption per dollar of gross domestic product) is projected to decline by around 1.7 per cent per year over the same period, compared to a decline of 1.3 per cent from 1989–90 to 2009–10. This decline indicates an accelerating improvement in energy efficiency. The transport sector uses more than 60 per cent of all petroleum consumed in Australia, and is the primary driver of demand growth. In addition, the expansion of the mining sector has contributed significantly to increased demand for diesel.[341]

Imported refined petroleum products account for approximately 40 per cent of total domestic consumption, and this share is forecast to rise. Refined petroleum products are imported from more than 20 countries, but 80 per cent of all such products come from just three: Singapore (53 per cent), South Korea (18 per cent) and Japan (12 per cent).[342]

Demand for petroleum import facilities and associated import infrastructure in Victoria is expected to grow.

338. United States Energy Information Administration (2013)
339, Bureau of Resources and Energy Economics (2011)
340. Carson, L. (2014), p. 108
341. Bureau of Resources and Energy Economics (2014a)
342. Australian Institute of Petroleum (2013a)

2.7 Telecommunications

The DEC of telecommunications infrastructure in Victoria is projected to increase from $6.2 billion in 2011 to $12.6 billion in 2031.

As with NSW, Victoria is relatively densely populated and therefore has generally high broadband availability ratings. Victoria also generally ranks higher than most other states on quality and availability due to the availability of hybrid-fibre co-axial (HFC) in Melbourne.

In Victoria, 93 per cent of premises have access to ADSL, 85 per cent have 3G mobile coverage, 61 per cent have 4G coverage, 33 per cent have access to HFC and three per cent have access to fibre to the premises.[343] One per cent of premises also have National Broadband Network fixed network access, and this category is growing rapidly.

For overall quality of fixed broadband service, Victoria has a relatively small share of premises that receive the highest level of service, but the largest share of premises that receive the top and next best level in aggregate of any state.

2.8 Water

The DEC of water and sewerage infrastructure in Victoria is projected to grow from $2.1 billion in 2011 to $3.3 billion in 2031, an increase of 51 per cent. The Audit identified that 353 GL of water was supplied to greater Melbourne in 2011 and 1646 GL to other regions. Sewage collected in 2011 comprised 363 GL in greater Melbourne and 136 GL in other regions.

The highest projected growth in water and sewerage DEC is in greater Melbourne, with an increase of 60 per cent to $2.2 billion by 2031. In the other regional areas DEC is projected to grow by 35 per cent to a little over $1 billion in 2031.

It is important to note that water and sewerage services have historically been under-priced, particularly in rural and regional areas, and that this potentially leads to an understatement of DEC, which is derived from National Water Commission data.

In regional areas, under-pricing of water and sewerage services means that the income derived from water and sewerage infrastructure falls below the level needed to fund renewal of assets.

2.8.1 Greater Melbourne region

Greater Melbourne consumed 400 GL of drinking water in 2013–14.[344] During the recent drought, Melbourne's residents and businesses reduced their consumption substantially from the 10-year average of 500 GL (annual average from 2000–01 to 2011) to 343 GL (in 2011) − a reduction of approximately 30 per cent.

Household consumption accounts for 63 per cent of Melbourne's drinking water use. Non-residential water use accounts for about 26 per cent and the remaining 11 per cent is categorised as 'nonrevenue water', which includes loss of water from mains bursts and leaks, water used for fire-fighting and mains flushing, and water theft. This demand is met by Melbourne Water, the bulk water provider, and three retail water businesses (City West Water, Yarra Valley Water and South East Water).

Melbourne Water is the wholesale supplier of Melbourne's drinking water, recycled water and wastewater to three retail water corporations: City West Water, Yarra Valley Water and South East Water.

Melbourne Water's supply system comprises 157,000 hectares of protected catchments in the Yarra Ranges, 10 storage supply reservoirs and 38 service reservoirs located around suburban Melbourne with a combined total capacity of 1,812 GL. Water is treated through its 34 water treatment plants and supplied through its 1,057 km of water mains, 214 km of aqueducts, and 64 service reservoirs (including the currently decommissioned North-South Pipeline, formerly known as Sugarloaf Pipeline, which is a 70 km pipe that can carry water from the Goulburn River to Melbourne's storages at Sugarloaf Reservoir). The Winneke Treatment Plant in Christmas Hills is the major water treatment plant in Melbourne and provides up to 50 per cent of Melbourne's daily water needs. It is connected to Sugarloaf Reservoir, which receives water from Maroondah Reservoir and the Yarra River. In response to the recent drought the Victorian Government commissioned the 150 GL capacity Wonthaggi desalination plant owned and operated by AquaSure.

Each year Melbourne Water removes and treats more than 320 GL of sewage, which represents the majority of Melbourne's sewage (including trade waste), via its network of more than 400 km of sewers, nine pumping stations, two treatment plants (the Eastern Treatment Plant at Bangholme and the Western Treatment Plant at Werribee) and nine air treatment facilities. In 2013–14, the Eastern Treatment Plant produced 18 GL of

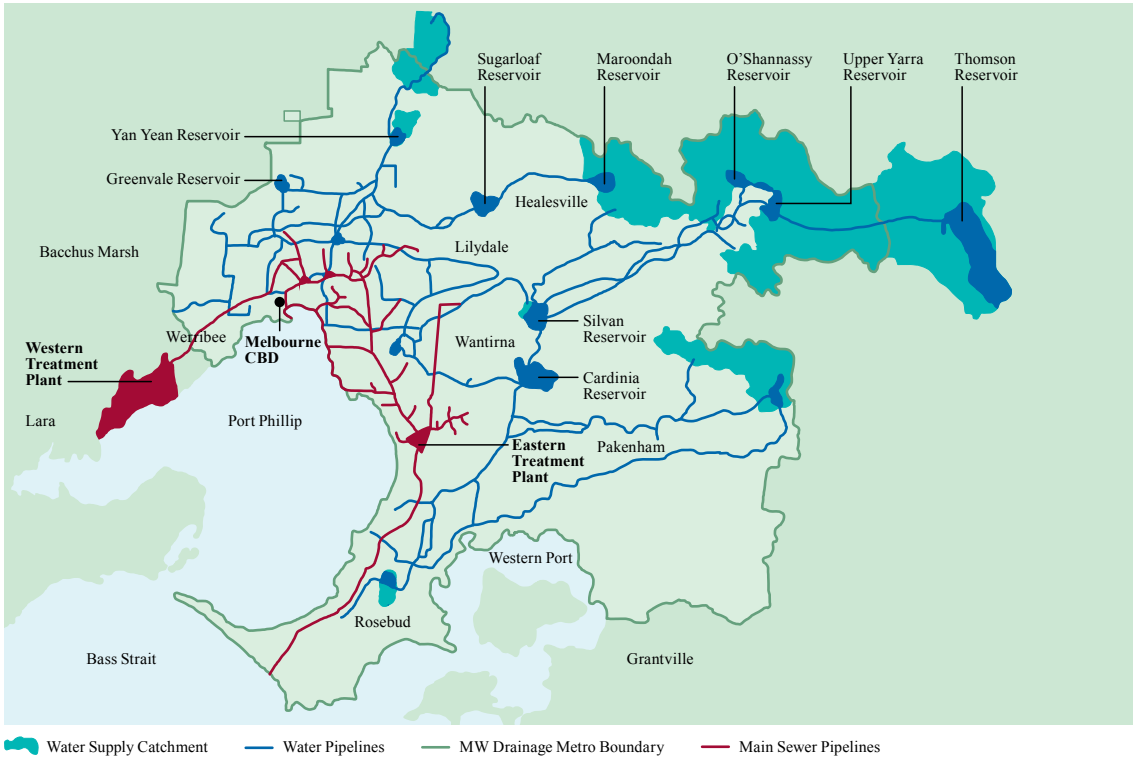
343. Department of Communications (2013)
344. Melbourne Water (2014)

recycled water, 12 GL of which was used onsite, with 4.5 GL supplied to the Water Infrastructure Group and 1.2 GL to South East Water. In the same year the Western Treatment Plant produced 12 GL of recycled water, 9.4 GL of which was used onsite (mostly Class C) for pasture irrigation and salinity management by the agricultural business MPH Agriculture.

Melbourne Water and local councils share responsibilities for most of Melbourne's drainage system. Melbourne Water is responsible for the installation and maintenance of more than 1,400 km of the regional drainage network, including large drains and stormwater infrastructure connecting with rivers, creeks and bays.

Figure 68 shows Melbourne Water's supply network of catchments, water supply systems, wastewater systems, recycled water supply and transmission, and drainage assets.

Figure 68: Melbourne Water major supply systems



Source: Melbourne Water (2014)

As outlined in *Melbourne's Water Future*,[345] Melbourne has been progressing towards a more holistic, whole-of-water cycle approach to water planning. Melbourne's water system faces a number of pressures that will steadily increase as a growing population consumes more water, discharges more wastewater and increases the intensity of the city's stormwater runoff through the construction of more hard surfaces. The city is growing quickly and is expected to continue to do so for the foreseeable future. Much of this growth will occur in the west and north, where traditional water system delivery is more difficult and expensive.

Managing supply and demand in the future will rely heavily on the desalination plant, and also on integrated water cycle planning and management. The Victorian Government has not ordered water for 2014–15 from the desalination plant, and the plant is now being maintained in long-term preservation mode. Ongoing operation of the plant and the whole-of-water cycle system will incur a significant operating cost, which will have an impact on water charges.

Melbourne's Water Future also acknowledges that a 'one size fits all' approach will not deliver the best outcomes at the lowest cost. The whole of system approach will inform the development and publication of a new water cycle planning framework for metropolitan Melbourne. It will include an outline of current and future required citywide infrastructure, guidelines for regional and local planning and overall pricing principles for the system.

345. Office of Living Victoria (2013)

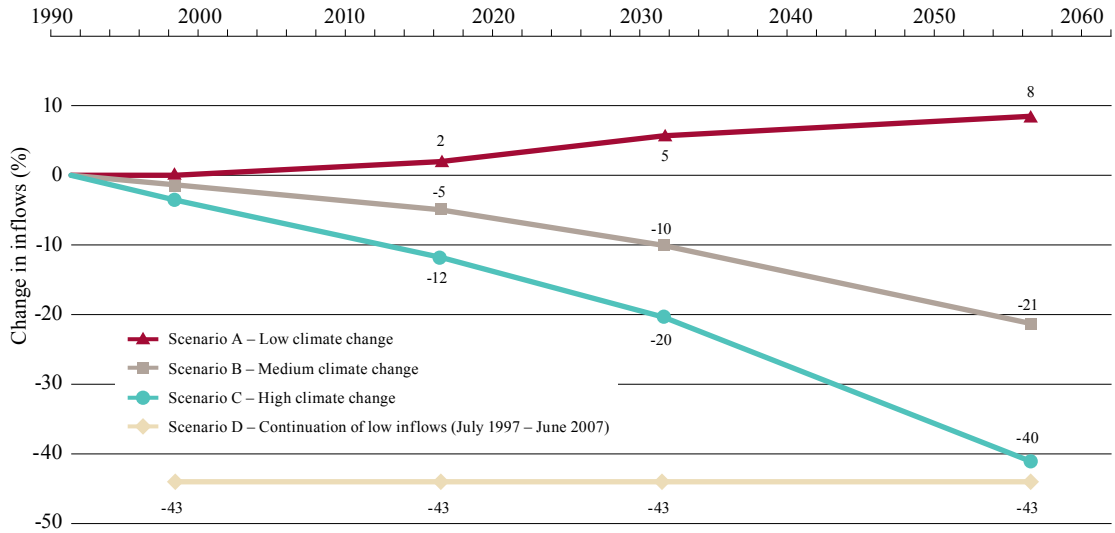
2.8.2 Northern region

The Northern region of Victoria is also known as the 'food bowl' of the state and encompasses Victoria's share of the River Murray and its Victorian tributaries – the Kiewa, Ovens, Broken, Goulburn, Campaspe and Loddon River systems. Victoria's 'food bowl' contributes significantly to the nation's prosperity through the production of food and fibre. The region's agricultural industry contributes about $3 billion a year to the Victorian economy.[346] The area supports both dry land and irrigation farming; it is a vast patchwork of grains, livestock, dairy, horticulture and wine grape enterprises ranging from small four-hectare properties to broad acre farms. This region roughly corresponds to the Audit regions of Hume, Shepparton, Bendigo and parts of North West.

The major water authorities for this region are Goulburn Murray Water (bulk supply), Lower Murray Water, Coliban Water, Goulburn Valley Water, Central Highlands Water and North East Water. The catchment management authorities (CMAs) responsible for the area are Mallee, North Central, Goulburn Broken, and North East. The region is part of the Murray-Darling Basin and water management is subject to the provisions of the *Murray Darling Basin Plan*.[347]

Based on the annual average yield and unrestricted annual demand calculations undertaken by the five water corporations for their urban water supply systems, while there is a combined annual surplus of 30.8 GL, about a third of the systems are in supply shortfall.[348] Climate change and variability are the biggest threats to water availability in the Northern region. Scenario planning to 2055 conducted by the Victorian Government[349] indicates that, under the most severe climate change scenario, the western catchments such as the Campaspe and Loddon are likely to be harder hit than eastern catchments such as the Kiewa and Ovens, as shown in Figure 69. There is a risk that, in some years, there will be insufficient water to run the channel system and deliver water to irrigators and domestic and stock customers. More restrictions on the use of groundwater and more frequent, extended water restrictions in urban areas are likely.

Figure 69: Forecast availability of total inflows for the Murray system to 2055 (Scenarios A to D compared with the long-term average)



Note: * Refers to total Murray system, not just Victoria's share.

Source: Victorian Department of Sustainability and Environment (2009)

346. Victorian Department of Sustainability and Environment (2009)
347. Murray-Darling Basin Authority (2012)
348. Based on average yield of 136. 5 GL per year and unrestricted annual demand of 105.7 GL per year.
349. Victorian Department of Sustainability and Environment (2009)

2.8.3 Western and Gippsland regions

2.8.3.1 Western region

The Western region includes the Avoca, Wimmera-Avon (including the Avon-Richardson River), Millicent Coast, Glenelg, Portland Coast, Hopkins, Lake Corangamite and Otway Coast river basins and the southern half of the Mallee river basin. Major towns include Horsham, Stawell, Ararat, Hamilton, Warrnambool and Portland.

Bulk water provider Southern Rural Water, along with five regional urban water corporations (Wannon Water, Grampians Wimmera Mallee Water (GWM Water), Barwon Water, Central Highlands Water and Coliban Water) supply water to the Western region's cities and towns. The CMAs responsible for this region are Corangamite, Glenelg Hopkins, Wimmera, Mallee and North Central.

Water resources vary throughout this region, with the south having a relatively reliable rainfall. The south and west of the region have good groundwater reserves, and conditions are drier to the north. On average there is 2,946 GL a year of surface water available in the region and about 246 GL of groundwater available for extraction. The majority (80 per cent) of the surface water is reserved for environmental use, while irrigation water use relies on groundwater sources.[350] The supply systems transfer some of the water from areas with more reliable water resources to support towns, farms and industry in drier parts of the region. Notably, the Wimmera-Mallee pipeline system is one of the largest piped stock and domestic systems in Australia.

Climate variability and drought create uncertainty about future water supplies, particularly away from the wetter coastal areas. Water management needs to consider the risks associated with possible repeats of past drought years. Other pressures include increased demand from towns, agriculture and industry, and activities that intercept water before it reaches rivers and aquifers.

2.8.3.2 Gippsland region

The Gippsland region spans the area south of the Great Dividing Range in Victoria from the Strzelecki Ranges and the Latrobe catchment to the NSW border in the east.

The Gippsland region's water and sewerage resources support important industries such as electricity generation, oil and gas production, dairying, fisheries, tourism, horticulture and forestry plantations. Bulk water provider Southern Rural Water, along with three regional urban water corporations − South Gippsland Water, Gippsland Water (Central) and East Gippsland Water − supply water to the Western region's cities and towns. The CMAs are East Gippsland and West Gippsland.

Currently, about 92 per cent of the total 2,181 GL of water extracted for towns, industry and agriculture in Gippsland is sourced from waterways, with the rest drawn from groundwater and a very small proportion drawn from alternative sources such as stormwater and recycled wastewater. Around 72 per cent has been reserved for environmental use, with the remainder shared between irrigation, urban and industry uses.[351] There is uncertainty over future water availability due to climate variability and drought. Other pressures on water availability include increased water demands from towns, agriculture and industry, and activities that intercept water before it reaches waterways and aquifers. If the 1997–2009 droughts were repeated, then the streamflows would be reduced to about 50 per cent in most basins.

350. Victorian Department of Sustainability and Environment (2011a)
351. Victorian Department of Sustainability and Environment (2011b)


MAERSK
SEALAND
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CAPITAL

Audit observations – Queensland

3.1 Structure of this chapter

This chapter presents observations from the Audit for the four infrastructure sectors – transport, energy, communications and water – across Queensland. It provides data about the state's population and economy (i.e. the key drivers of demand for infrastructure), and the value-add attributable to Queensland infrastructure, in 2011. It also outlines growth projections to 2031 for the state's population and economy, and for each of the infrastructure sectors. As noted in the Introduction to this report, these projections are based on economic and demographic analysis set out in two associated studies.[352]

The Audit uses the Direct Economic Contribution (DEC) methodology to quantify the value-add attributable to infrastructure in 2011, and to project the change in overall demand for infrastructure from 2011 to 2031. When considered in the light of other factors such as capacity limitations which might constrain economic growth, this approach helps to identify locations and sectors that are likely to warrant further attention in the Australian Infrastructure Plan (the Plan).

This chapter also takes account of other documents, including plans, studies and strategies, prepared by the Queensland Government[353] and others.

3.2 Drivers of infrastructure demand − population and economy

Based on medium level projections from the Australian Bureau of Statistics (ABS), the Queensland population is projected to reach 6.45 million in 2031 − an increase of almost two million people, or 44 per cent, from 2011.

Medium level Queensland Government projections point to a very similar level of growth, forecasting a population of 6.55 million in 2031. Both population and economic growth in Queensland are projected to be higher than the national average over the 20 years, and the state's share of each is set to increase, as shown in Table 52.

Table 52: Projected population and economic growth for Queensland

	2011	% of National	2031	% of National	Increase % 2011–31
Population (persons)	4,476,778	20.0%	6,445,737	21.1%	44%
Gross State Product ($m)	267,942	19.0%	522,464	20.2%	95%

Source: ACIL Allen Consulting (2014a)[354]

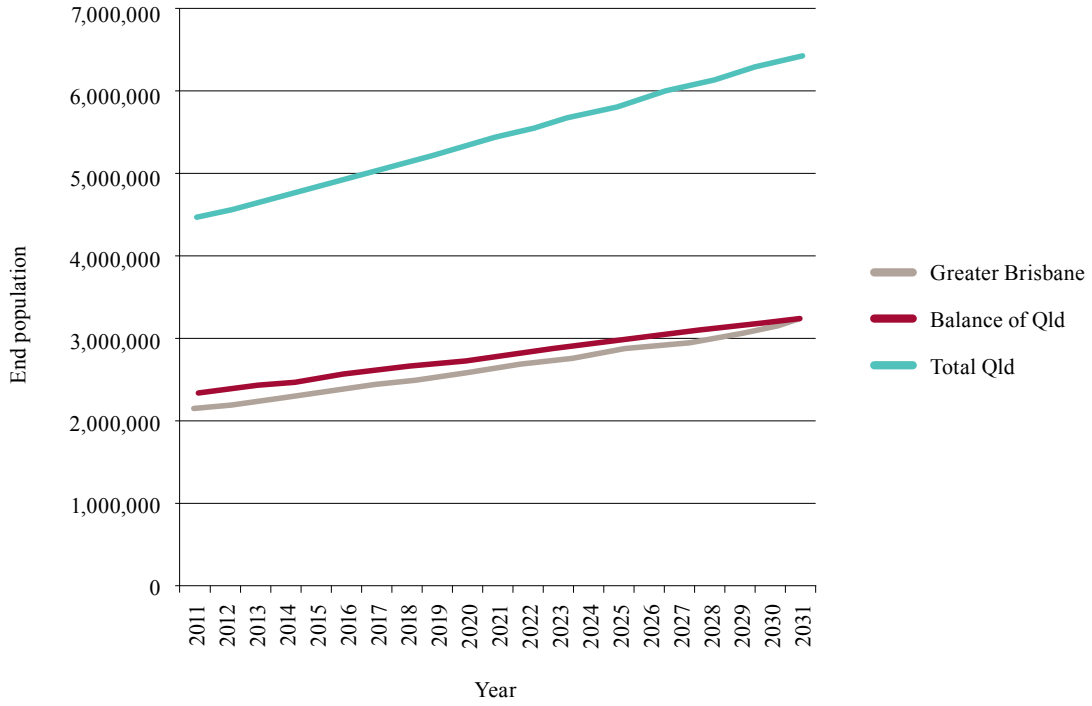
352. ACIL Allen Consulting (2014a) and Infrastructure Australia (2015b)
353. It should be noted that the *South East Queensland Regional Plan 2009-31*, which sets out a strategic growth management plan, was released in 2009 and is under review by the current state government.
354. Gross State Product is in 2010–11 prices.

3

Figure 70 shows population growth in Queensland is projected to be shared almost equally between Brisbane and the rest of the state, with Brisbane projected to grow at a slightly faster rate.

The key areas of population and employment growth in South East Queensland (SEQ) are Brisbane Inner City, Gold Coast, Ipswich, Sunshine Coast, Moreton Bay, Logan, Springfield-Redbank, Jimboomba, Beaudesert and Ormeau Oxenford.

Figure 70: Population projections for Queensland – 2011 to 2031



Source: Australian Bureau of Statistics (2013c)[355]

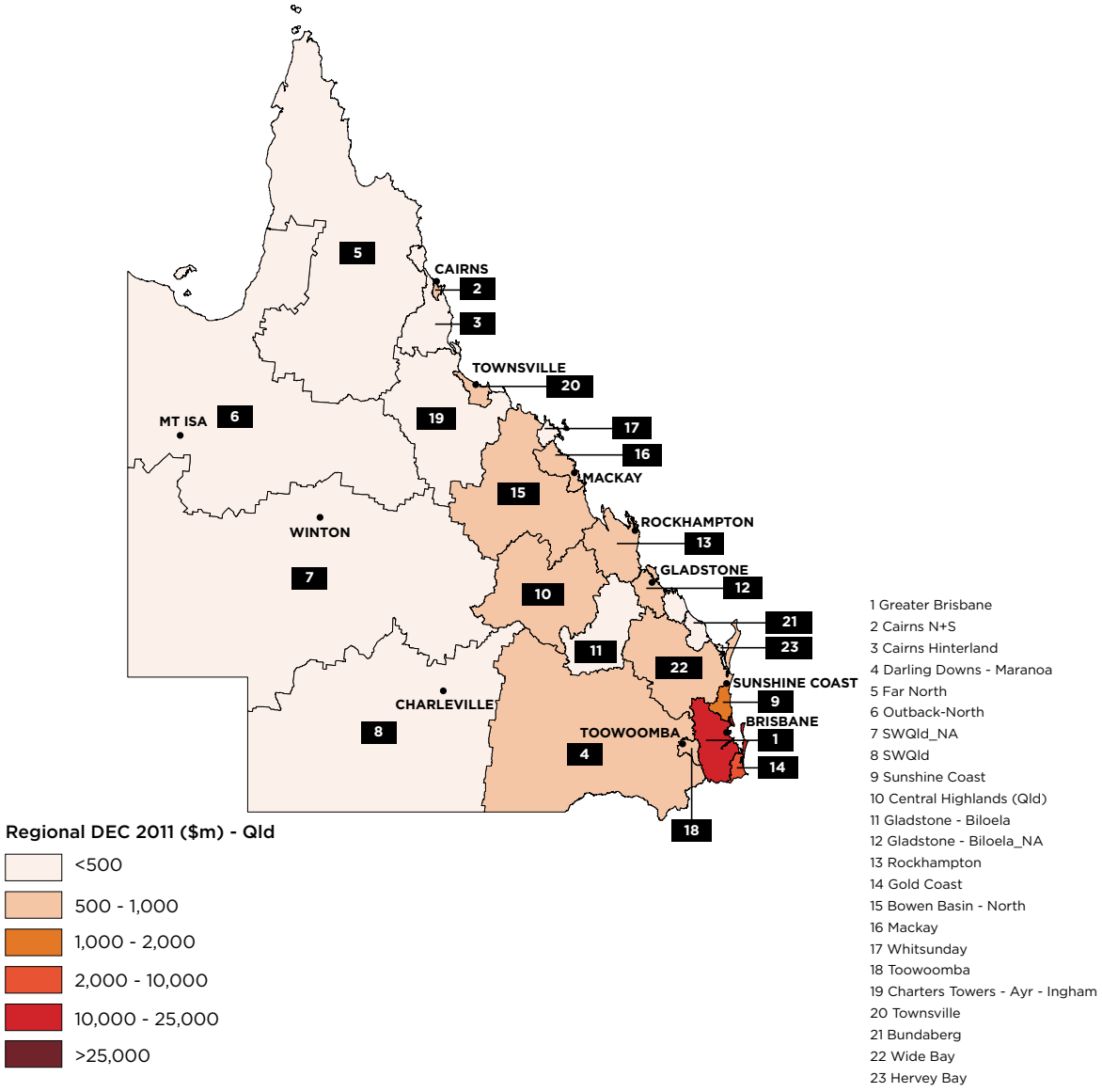
355. Series B (medium level) projections.

3.3 Summary of Queensland infrastructure from 2011 to 2031

In 2011, the DEC of infrastructure in Queensland was $36 billion, which was 19 per cent of the national figure. In 2031, Queensland infrastructure DEC is projected to increase by around $39 billion, or 107 per cent, reaching $74.6 billion (20 per cent of national DEC).

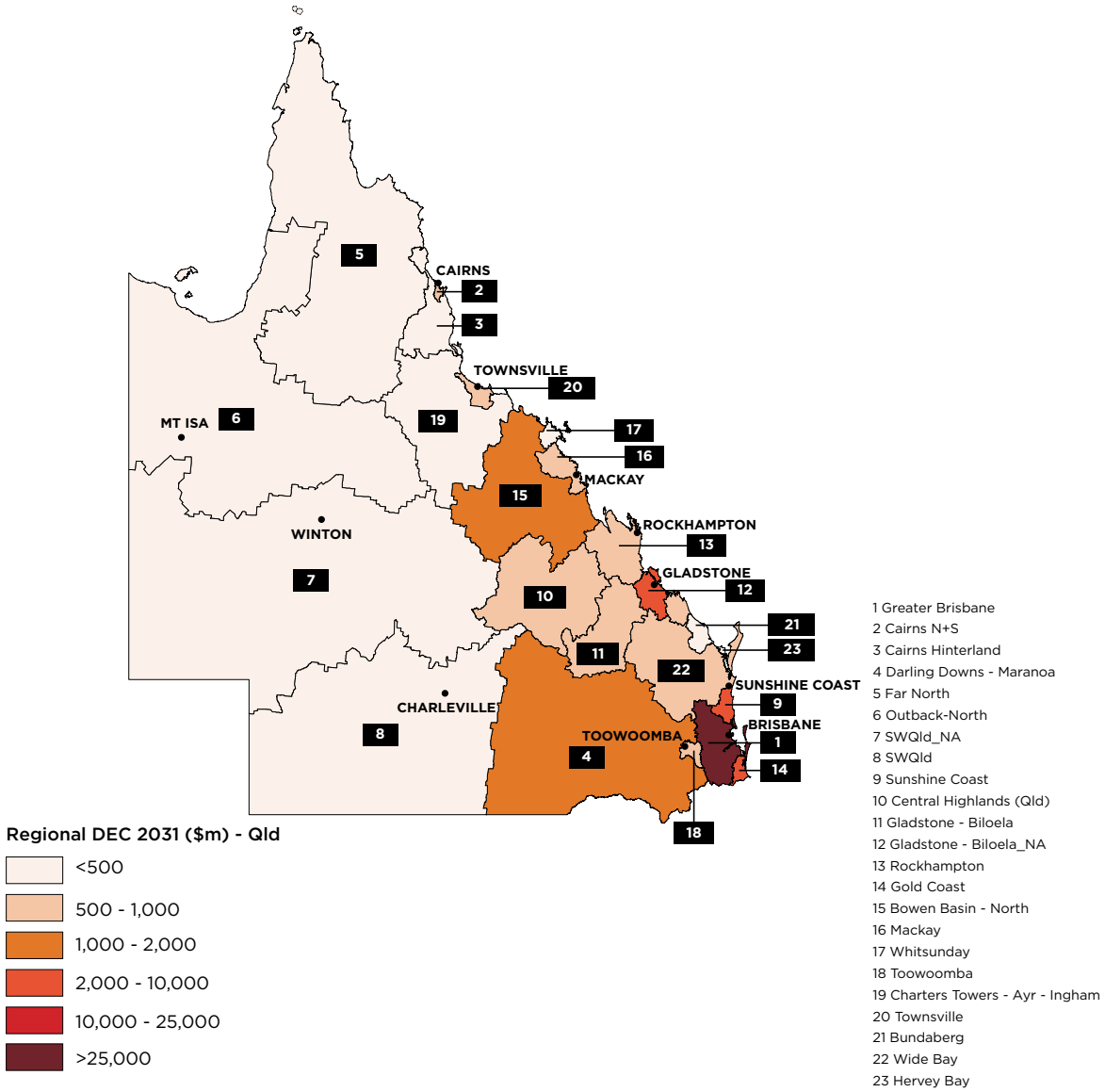
Figure 71 and Figure 72 highlight the spread of infrastructure's economic contribution across the Audit regions in Queensland for 2011 and 2031 respectively. DEC growth is expected to be fastest in South East Queensland and relatively high in Gladstone–Biloela (due to Liquefied Natural Gas development, agriculture and mining).

Figure 71: Queensland Regional DEC 2011



Source: ACIL Allen Consulting (2014a)

Figure 72: Queensland Regional DEC 2031



Source: ACIL Allen Consulting (2014a)

Table 53 provides a snapshot of Queensland's economic infrastructure across the four sectors of transport, water, energy and communications. The table notes the capacity of each subsector and its rate of utilisation in 2011, along with historical (2011) and projected (2031) DEC for each subsector.

Table 53: Overview of Queensland infrastructure

	Subsector	Capacity 2011		Utilisation 2011		DEC 2011		DEC 2031		Projected % increase in DEC
			% of Nat.		% of Nat.		% of Nat.		% of Nat.	2011-2031
Transport	Urban Roads	**457,400,000** Car VKT per day	20%	**83,700,000** Car VKT per day	20%	$13,075m	17%	$31,111m	18%	138%
	Urban Public Transport	**29,700,000** Passenger KT per day	11%	**7,600,000** Passenger KT per day	11%					
	National Highways	**6,838** km of nationally significant roads	20%	**360,800** vehicles per day	19%	$2,391m	25%	$4,471m	29%	87%
	Freight Rail	n/a	n/a	n/a	n/a	$1,769m	33%	$2,615m	28%	48%
	Ports	**405** Mt p.a. throughput	29%	**259** Mt p.a. throughput	25%	$4,287m	21%	$7,743m	18%	81%
		2.5 MTEU throughput	21%	**1.0** MTEU throughput	15%					
	Airports	**92** Count of airfields	34%	**35,619,474** Total RPT passenger movements	27%	$5,430m	26%	$10,940m	27%	101%
Energy	Electricity	**12,644** Installed capacity (MW) of Generation	23%	**59,603** Utilisation of Generation (GWh)	9%	$3,270m	20%	$5,147m	20%	57%
		8,109 Peak Demand Transmission (MW)	20%	**47,341** Utilisation of Transmission (GWh)						
		6,993 Peak Demand Distribution (MW)	19%	**38,540** Utilisation of Distribution (GWh)						
	Gas	n/a	n/a	**265.30** Transmission throughput (PJ/a)	20%	$214m	19%	$1,872m	59%	776%
		n/a	n/a	**18.15** Distribution throughput (PJ/a)	5%	$69m	6%	$87m	6%	25%
	Petroleum product terminals	n/a	n/a	**21,211** Annual throughput (ML)	27%	$288m	27%	$478m	28%	66%
Telecommunications		**4.50** Broadband average availability rating (out of 5)	n/a	**1,256**	n/a	$2,763m	13%	$6,040m	14%	119%
		1.55 Broadband average quality rating (out of 5)	n/a	Total households with broadband internet access at home ('000)						
Water & Sewerage	Water	**36,090** Length of water mains (km)	17%	**954,523** Water supplied (ML)	12%	$2,439m	23%	$4,062m	25%	67%
		9,726 Volume of water stored in dams (GL)	17%	**1,482** Properties served – water ('000)	17%					
	Sewerage	**49,000** Desalination capacity (ML)	9%	**372,107** Sewage collected (ML)	19%					
		26,055 Length of sewer mains (km)	20%	**1,344** Properties served – sewerage ('000)	17%					

Source: ACIL Allen Consulting (2014a)[356]

356. DEC figures are rounded to the nearest $ million, so percentage changes may not tally exactly with rounded estimates in this table. See Glossary for explanation of abbreviations and terms.

3.4 Queensland Government plans and strategies

The new Queensland Government has committed to developing a State Infrastructure Plan (SIP) by the end of 2015. The SIP will provide a coordinated and integrated approach to infrastructure planning, prioritisation, funding and delivery in Queensland. It will set out policies and initiatives to support economic growth, productivity enhancement and job creation.

The SIP will identify Queensland's state-wide infrastructure priorities and provide a pipeline of government projects and programs in the short and medium-to-long-term that is anticipated to be updated annually.

The SIP will be developed in parallel with the establishment of a new statutory body called Building Queensland, incorporating its key principles and objectives: robust assessment, cost benefit analysis, prioritisation and efficient procurement.

In relation to ports, the *Queensland Ports Strategy*[357] aims to drive economic growth through the efficient use and development of Queensland's long-established major port areas, while protecting and managing Queensland's outstanding environmental assets.

A key policy issue for Queensland is whether population and employment growth should occur in south, south-west, south-east and northern parts of Brisbane, or whether increased densification and public transport use should be supported in the inner city and middle ring suburbs.

3.5 Remote Indigenous services in Queensland

As discussed in Section 5.1.3 of Volume 1, infrastructure provision is a critical issue for remote Indigenous communities, with many areas lacking even basic services. Improving the delivery of infrastructure to these areas can bring considerable social benefits in terms of access to services and economic opportunities, and is fundamental to the governments' broader agenda of *Closing the Gap in Indigenous Disadvantage*.

The remote Indigenous communities in Queensland are largely scattered around Cape York and Torres Strait, near the coast to the north and south of Cairns, and in the very north-west of the state near the Gulf of Carpentaria. Many of these communities are very remote, reinforcing the need for considerable investment in essential infrastructure to ensure Indigenous people in these areas have access to services that can support better health, education and employment outcomes in their communities.

3.6 Transport

3.6.1 Urban transport

For the urban transport component of the Audit, the top-down economic analysis used for the other sectors, which is based on national accounts and industry data, was complemented by bottom-up analysis based on detailed transport modelling for the six major capital cities.

This modelling provides detailed information about trips within these cities by origin/destination, and by corridor, in 2011. It takes account of projected population and employment growth and spatial distribution to project demand for trips, also by origin/destination and corridor, in 2031.

For both road and rail corridors the model includes detailed information about capacity, showing where demand is projected to grow in excess of supply. For road corridors it quantifies the cost of delay, showing where interventions will likely provide the biggest economic return. For rail corridors the model assumes minimal delay (i.e. all passengers are able to board the next available train). This is to ensure the model does not displace rail passengers, and thus shows the full extent of demand for the rail corridor.

This analysis facilitates identification of the corridors with the highest levels of economic activity, and the corridors in which capacity constraints and/or delays impose the highest economic cost. Given the absence of rail delay cost from the model, projected delay cost is at best an approximation. However, rail delay cost is unlikely to represent more than a small proportion of total delay cost for most corridors. As such, road delay cost is a reasonable proxy for delay cost for most corridors.

3.6.1.1 Urban transport in Brisbane-Gold Coast-Sunshine Coast

The DEC of urban transport in the Brisbane-Gold Coast-Sunshine Coast conurbation is projected to grow from $13 billion in 2011 to $31 billion in 2031, with over 90 per cent of this DEC growth attributed to road infrastructure. This is a faster rate of growth than either Sydney or Melbourne.

The cost of delay on Brisbane-Gold Coast-Sunshine Coast's urban transport network in 2011 was around $2 billion. In the absence of any additional capacity (other than projects already under construction or funded), the cost of delay is projected to grow to around $9 billion in 2031.[358]

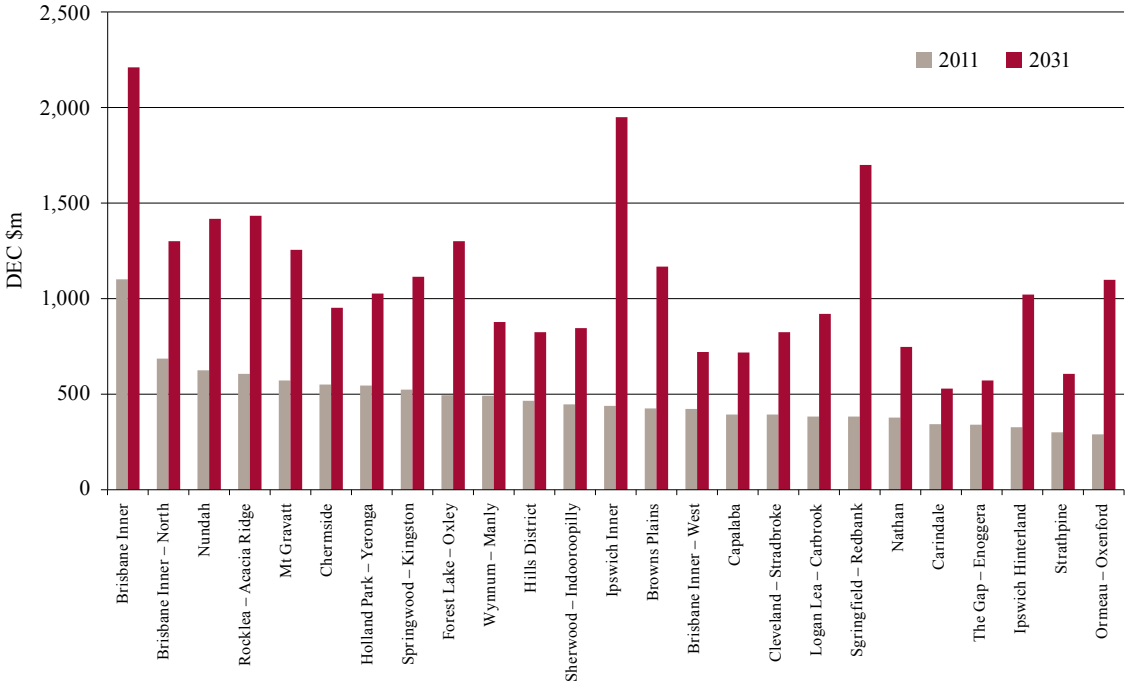
357. Queensland Department of State Development, Infrastructure and Planning (2014)
358. The treatment of delay costs and their relationship to DEC is explained further in the Appendix 1.

3.6.1.2 Origin/destination analysis of trips in Brisbane-Gold Coast-Sunshine Coast

Figure 73 shows trips in Brisbane-Gold Coast-Sunshine Coast by origin/destination (O/D), across road and public transport modes, in terms of DEC for 2011 and projected DEC for 2031. The O/D regions used here are SA3 regions as defined by ABS.[359]

The analysis shows that Inner Brisbane is the largest O/D for trips in the region and is projected to remain so. Between 2011 and 2031, some of the highest growth is forecast in the outer suburbs of Brisbane, with Jimboomba, Ipswich/Springfield-Redbank and Beaudesert all projected to increase at least four-fold.

Figure 73: Trips in Brisbane-Gold Coast-Sunshine Coast by origin/destination for roads and public transport in 2011 and 2031, measured by DEC ($ million)



Source: Infrastructure Australia analysis of modelling data from Veitch Lister Consulting (2014d) and ACIL Allen Consulting (2014b)

3.6.1.3 Road corridors in Brisbane-Gold Coast-Sunshine Coast

The Audit dataset provides a broad range of data about corridors, and there are many ways of analysing this data. Given the focus of the Audit on economic indicators, the analysis in Table 54 and Table 55 focuses on delay cost. This applies a dollar cost to time delays, based on lost productivity, and takes account of the different costs applicable to different vehicle types.

Some users of the Audit dataset may prefer to use more traditional indicators of congestion, such as traffic V/C. This measure is included in Table 54 and Table 55, as is the DEC measure, which gives insight into the underlying value of activity on the corridor, and the proportion of DEC attributable to delay cost.

These measures are expressed per lane kilometre of road. This normalises the results to facilitate comparison across a wide range of different corridor types − some very long, some consisting of multiple roads, and some relatively short single roads.

The modelling provides one method of measuring and projecting demand for transport infrastructure and the corridors identified in Table 54 and Table 55 reflect this approach. The Queensland Government may have utilised other data, and different methods of analysis, to inform identification of infrastructure priorities. For further information on the assumptions, included projects and methodology applied in the model, refer to the supporting documentation by Veitch Lister Consulting.

Table 54 shows corridors ranked by net DEC per lane kilometre in 2011, with the equivalent projections for 2031 in Table 55. Taken together, these tables give an indication of which corridors warrant further study, and where interventions are likely to have the biggest economic return.

359. SA3s provide a standardised regional breakup of Australia and generally (although not always) have populations between 30,000 and 130,000 persons.

Table 54: Top 10 road corridors in Brisbane-Gold Coast-Sunshine Coast 2011, by delay cost (2011 dollars)

Rank	Road Corridor	State	Delay cost by lane km 2011 ($m)	DEC per lane km 2011 value ($m)	Volume Capacity Ratio 2011 AM Peak (7-9 AM)
1	Indooroopilly – City	QLD	1.45	3.62	86%
2	Ipswich Mwy	QLD	1.14	4.26	66%
3	Inner City | North – South	QLD	0.86	4.23	63%
4	City – Brisbane North	QLD	0.84	2.79	74%
5	Ipswich Mwy – Indooroopilly	QLD	0.73	2.34	79%
6	Logan River – Gateway Mwy	QLD	0.61	3.02	66%
7	Inner City | East – West	QLD	0.61	3.20	63%
8	Southport – Burleigh Heads	QLD	0.60	2.96	66%
9	Pacific Mwy | City – Beenleigh	QLD	0.53	2.46	76%
10	Redland | East – West	QLD	0.51	1.77	71%

Source: Infrastructure Australia analysis of data from ACIL Allen Consulting (2014b) and Veitch Lister Consulting (2014d)

Table 55: Road corridors in Brisbane-Gold Coast-Sunshine Coast 2031, by projected delay cost (>$1.75 million per land km, 2011 dollars)

Rank	Road Corridor	State	Delay cost by lane km 2031 ($m)	DEC per lane km 2031 ($m)	Volume Capacity Ratio 2031 AM Peak (7–9 AM)
1	Ipswich Mwy	QLD	3.74	8.98	84%
2	Ipswich – Wacol	QLD	3.56	6.70	94%
3	Pacific Mwy | Beenleigh – Helensvale	QLD	3.48	7.32	98%
4	Ipswich Mwy – Indooroopilly	QLD	3.28	5.92	93%
5	Pacific Mwy | City – Beenleigh	QLD	2.64	6.11	88%
6	Logan River – Gateway Mwy	QLD	2.57	7.00	84%
7	Helensvale – Southport	QLD	2.45	6.51	84%
8	Inner City | North – South	QLD	2.24	7.53	78%
9	Indooroopilly – City	QLD	2.23	6.40	64%
10	Southport – Burleigh Heads	QLD	2.19	6.03	83%
11	City – Brisbane North	QLD	1.88	5.51	77%
12	City – Airport	QLD	1.81	5.36	65%

Source: Infrastructure Australia analysis of data from ACIL Allen Consulting (2014b) and Veitch Lister Consulting (2014d)

Congestion levels and delay costs are projected to worsen significantly to 2031, with Queensland set to experience the second highest level of population and employment growth in Australia, after WA. The outer areas (such as Jimboomba, Ipswich, Springfield-Redbank, Beaudesert, Ormeau Oxenford and Ipswich Hinterland) will have the highest growth rates.

Figure 74 and Figure 75 show projected road congestion, by V/C, in 2031 for the AM peak hour and daytime inter-peak periods respectively. These show the corridors and locations likely to reach or exceed maximum capacity by 2031, in the absence of any additional capacity. In the inter-peak period there is surplus capacity across most of the network, except for key crossings over the Brisbane River and on some corridors approaching the CBD, as well as certain stretches of the Pacific Motorway and the M2 towards Ipswich.

Figure 74: SEQ road network volume/capacity ratio in 2031 – AM maximum peak hour

Source: Veitch Lister Consulting (2014d)

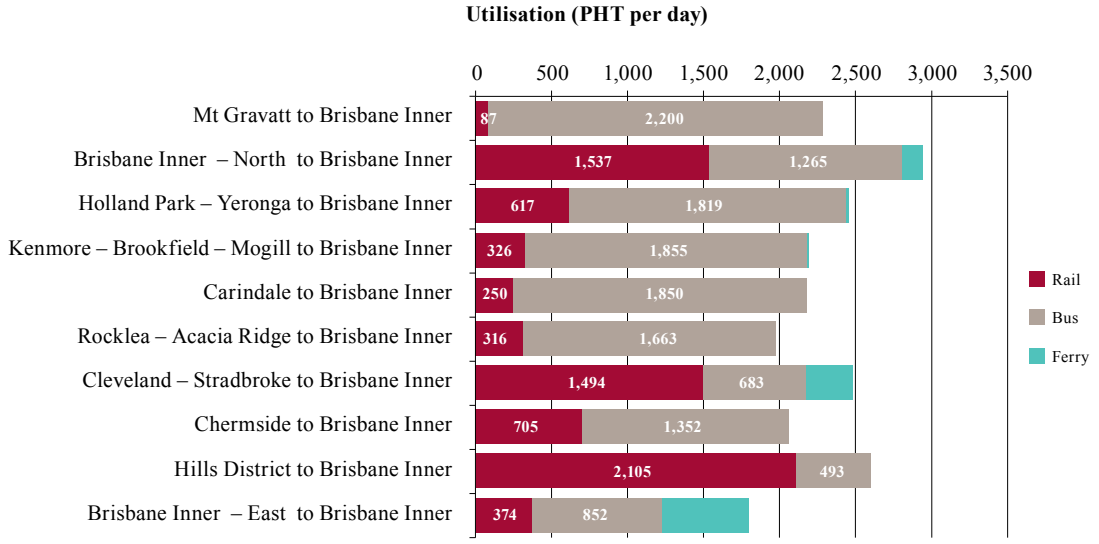
Figure 75: SEQ road network volume/capacity ratio in 2031 – daytime inter-peak period

Source: Veitch Lister Consulting (2014d)

Public transport in Brisbane-Gold Coast-Sunshine Coast

Figure 76 sets out the top 10 public transport O/D pairs in Brisbane-Gold Coast-Sunshine Coast by passenger hours travelled (PHT), and by public transport mode. Inner Brisbane is comfortably the largest O/D in the city, and is serviced by mix of rail, bus and ferry travel.

Figure 76: Top 10 Brisbane-Gold Coast-Sunshine Coast origin/destination pairs by hours travelled for public transport



Source: Infrastructure Australia analysis of data from Veitch Lister Consulting (2014d)

3.6.1.4 Rail trips in Brisbane-Gold Coast-Sunshine Coast

Table 56 shows the top five destination SA3 regions for passenger hours travelled across the rail network. Brisbane Inner City is the dominant destination for rail trips in the Brisbane-Gold Coast-Sunshine Coast conurbation.

Table 56: Top five destinations in Brisbane-Gold Coast-Sunshine Coast for rail trips by passenger hours travelled (PHT), 2011 and projected 2031

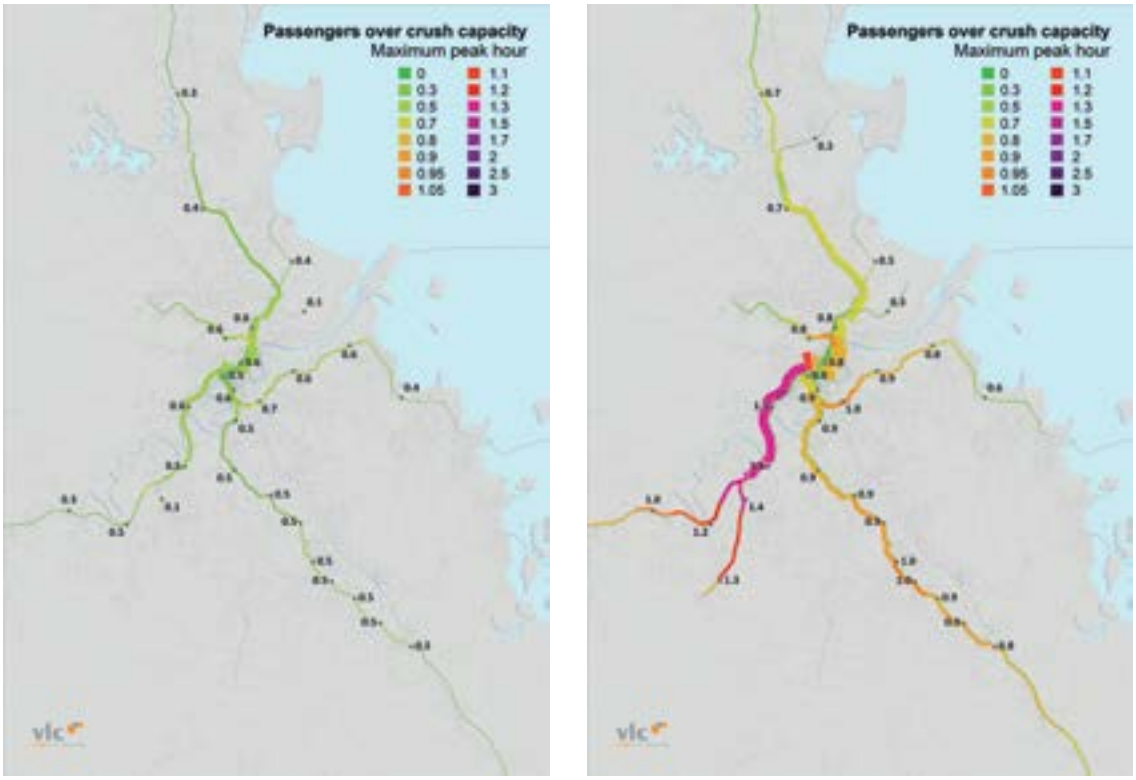
	Brisbane Inner City	Sherwood – Indooroopilly	Brisbane Inner North	Nundah	Cleveland – Stradbroke
2011	34,349	4,748	4,433	3,729	3,405
2031	64,567	7,813	9,666	9,494	6,321

Source: Veitch Lister Consulting (2014d)

3.6.1.5 Rail corridors in Brisbane-Gold Coast-Sunshine Coast

Figure 77 shows that passenger loadings on Brisbane-Gold Coast-Sunshine Coast's rail network are projected to increase over time, reaching or exceeding crush capacity on the Ipswich and Springfield lines by 2031.

Figure 77: Brisbane rail network weekday passenger demand relative to crush capacity, 2011 and projected 2031



Source: Veitch Lister Consulting (2014d)

3.6.1.6 Bus trips in Brisbane-Gold Coast-Sunshine Coast

Table 57 shows the top five destination SA3 regions for passenger hours travelled across the bus network. Brisbane Inner City is the dominant destination for bus trips in the Brisbane-Gold Coast-Sunshine Coast region.

Table 57: Top five destinations in Brisbane-Gold Coast-Sunshine Coast for bus trips by passenger hours travelled (PHT), 2011 and projected 2031

	Brisbane Inner City	Mt Gravatt	Sherwood – Indooroopilly	Brisbane Inner North	Holland Park – Yeronga	Cleveland – Stradbroke
2011	27,346	4,850	4,108	3,912	3,666	3,543
2031	41,489	7,470	6,091	5,960	5,439	4,161

Source: Veitch Lister Consulting (2014d)

3.6.1.7 Freight movements in Brisbane-Gold Coast-Sunshine Coast

Table 58 shows the proportion of daily vehicle kilometres travelled by cars, light commercial vehicles, and heavy commercial vehicles between major origins and destinations in the Brisbane-Gold Coast-Sunshine Coast region. This shows that freight traffic constitutes a relatively high proportion of traffic for some O/D pairs, in particular for travel between the Forest Lake-Oxley and Rocklea-Acacia Ridge SA3 regions, the Nundah and Brisbane Inner North regions, and the Nundah and Chermside regions.

Table 58: Daily vehicle kilometres travelled by vehicle type 2011

		Utilisation (VKT/day)	Utilisation (VKT/day)	Utilisation (VKT/day)	LCV & HCV as % of daily VKT
From	**To**	**Car**	**LCV**	**HCV**	
Forest Lake – Oxley	Rocklea – Acacia Ridge	118,377	11,853	10,431	15.8%
Nundah	Brisbane Inner – North	146,308	9,802	3,715	8.5%
Nundah	Chermside	136,265	9,081	2,874	8.1%
Springfield – Redbank	Ipswich Inner	197,690	7,627	2,270	4.8%
Chermside	Brisbane Inner – North	128,107	4,682	1,224	4.4%
Ipswich Hinterland	Ipswich Inner	409,636	13,163	3,726	4.0%
Brisbane Inner – North	Brisbane Inner	125,683	4,031	887	3.8%
Caboolture	Narangba – Burpengary	177,944	5,254	1,249	3.5%
Loganlea – Carbrook	Springwood – Kingston	170,892	4,213	960	2.9%
Cleveland – Stradbroke	Capalaba	203,290	4,535	913	2.6%

Source: Infrastructure Australia analysis of data from Veitch Lister Consulting (2014d)

3.6.2 National highways

Of the 34,656 km of national highways (which include the National Land Transport Network highways and other key freight routes) identified in the Audit, 6,838 km (almost 20 per cent) are in Queensland. 360,800 vehicles used this network per day in 2011. This includes the following national highway links connecting key urban centres:

- Sydney to Brisbane (Pacific Motorway/Pacific Highway M1 and Cunningham Highway/New England Highway A15);
- Brisbane to Cairns (Bruce Highway M1/A1);
- Brisbane to Darwin (Warrego, Landsborough and Barkly Highways) (M2); and
- Townsville to Mt Isa (Flinders Highway A6).

Figure 78 shows the National Land Transport Network highways and the other key Queensland freight routes included in the Audit. Together these routes play an important role in facilitating the production processes for industry and enabling the activities of business and the community.

Queensland performs better than NSW and the NT in terms of road safety on a per kilometre basis, but worse than other jurisdictions.

The DEC of Queensland's national highways and key freight routes is projected to increase from $2.39 billion in 2011 to $4.47 billion in 2031.

3.6.3 Freight rail

Queensland is one the world's major coal mining regions[360] with exports exceeding 200 million tonnes in 2014.[361] Freight rail transports the majority of the coal directly to Queensland's ports for export.

The DEC of freight rail in Queensland is projected to increase by 48 per cent from $1.77 billion in 2011 to $2.62 billion in 2031.

The regional freight rail network in Queensland is owned by the Government through Queensland Rail (QR). The Central Queensland Coal Network is leased by Aurizon, a private company.[362]

While there has been significant investment in upgrading the QR freight network, it has capacity issues and bottlenecks in some areas.

There is no rail network in the Galilee Basin, and various miners are developing plans to build their own lines in that area. Adani Group, the lease applicant of the proposed Carmichael Mine, has plans to construct a rail link between the mine and the Port of Abbot Point.[363] GVK Hancock is developing a joint venture with Aurizon to develop

360. Queensland Department of Mines and Energy (2009)
361. Queensland Department of Natural Resources and Mines (2014)
362. Department of Infrastructure and Regional Development (2014b)
363. Adani Mining (2012)

a rail line in the Galilee Basin from Alpha Mine to Abbot Point. Both the GVK and Adani Group rail lines would converge at Scottsville.

In 2013, the Australian Government committed $300 million[364] to finalise plans, fund engineering design and carry out environmental assessment for development of an inland freight line between Brisbane and Melbourne. The proposed route is projected to cut freight transportation time between Brisbane and Melbourne by 10 hours and increase the competitiveness of rail transport relative to road transport.[365] Significant productivity gains could be realised by use of 1,800 metre trains, with the potential for a shift to 3,600 metre trains in future.

Figure 78: National Land Transport Network highways and key freight routes in Queensland 2011

The map shows highways identified in the Audit. Data was not available for all of these highways.
Source: ACIL Allen Consulting (2014a)

3.6.4 Ports

The DEC of ports in the state is projected to increase by 81 per cent from $4.29 billion in 2011 to $7.74 billion in 2031.

The *Queensland Ports Strategy*[366] sets out details for the establishment of five priority port development areas at long-established major ports in the state: Abbot Point, Brisbane, Gladstone, Hay Point/ Mackay and Townsville. The new Government is expected to introduce legislation to mandate master planning for four of these ports, except Brisbane. The legislation will allow for planning 'beyond the port boundaries' and will prohibit dredging in the Great Barrier Reef World Heritage Area, to develop new ports, or expand existing facilities outside these ports. The new Queensland Government has pledged not to privatise state-owned ports.[367]

Port of Brisbane

The Port of Brisbane is Australia's third busiest container port,[368] approaching 38 million tonnes of total throughput in 2012–13.[369] The construction of several additional wharves and container terminals has increased cargo capacity. The construction of two new bridges to the port, including a duplication of the Sir Leo Hielscher Bridge (Gateway Bridge), will cater for projected road freight traffic requirements.

Despite these developments, constraints on the rail system accessing the port reduce the efficiency of the port's operations. The capacity for coal trains to access the port is constrained by the priority given to passenger trains, where passenger and freight trains share the network.

364. Truss, MP (2015)
365. Australian Rail Track Corporation (2014)
366. Queensland Department of State Development, Infrastructure and Planning (2014)
367. Queensland Labor (2014)
368. Port of Brisbane (2010)
369. Queensland Department of State Development, Infrastructure and Planning (2013)

Table 59: Queensland port tonnages – 2012–2013

	Total Throughput (mass tonnes)				Containerised trade in TEU			
Port	**Imports**	**Exports**	**Total**	**Total as % of national total**	**Imports**	**Exports**	**Total**	**Total as % of national total**
Port of Brisbane Pty Ltd	18,158,429	19,404,992	37,563,421	3.33%	542,923	526,958	1,069,881	14.93%
Townsville (Townsville)	6,671,391	5,434,413	12,105,804	1.07%	25,953	24,220	50,173	0.70%
Cairns (Ports North)	647,717	407,891	1,055,608	0.09%	7,890	7,871	15,761	0.22%
Gladstone (Gladstone Ports)	20,650,809	64,642,951	85,293,760	7.55%	2,996	3,198	6,194	0.09%
Port Alma (Rockhampton) (Gladstone Ports)	265,908	83,802	349,710	0.03%	1,243	325	1,568	0.02%
Hay Point (NQBP)	0	96,540,226	96,540,226	8.55%	0	0	0	0.00%
Weipa (NQBP)	116,964	28,924,608	29,041,572	2.57%	0	0	0	0.00%
Abbot Point (NQBP)	0	17,744,621	17,744,621	1.57%	0	0	0	0.00%
Mackay (NQBP)	1,592,937	1,677,030	3,269,967	0.29%	0	0	0	0.00%
Cape Flattery (Ports North)	0	1,678,060	1,678,060	0.15%	0	0	0	0.00%
Karumba (Ports North)	1,088	893,949	895,037	0.08%	0	0	0	0.00%
Mourilyan (Ports North)	0	533,331	533,331	0.05%	0	0	0	0.00%
Lucinda (Townsville)	6,105	438,308	444,413	0.04%	0	0	0	0.00%
Bundaberg (Gladstone Ports)	0	204,800	204,800	0.02%	0	0	0	0.00%
Thursday Island (Ports North)	64,787	12,701	77,488	0.01%	0	0	0	0.00%
Quintell Beach (Ports North)	1,453	0	1,453	0.00%	0	0	0	0.00%
Skardon River (Ports North)	0	0	0	0.00%	0	0	0	0.00%
Queensland Total	**48,177,588**	**238,621,683**	**286,799,271**	**25.40%**	**581,005**	**562,572**	**1,143,577**	**15.96%**

Source: Ports Australia (2014a)[370]

3.6.4.1 North Queensland Bulk Ports Corporation

The North Queensland Bulk Ports Corporation is the landlord of ports at Weipa, Abbot Point, Mackay and Hay Point.

The port of Abbot Point recorded 22.9 million tonnes[371] of throughput in 2013–14, all of which was coal. Abbot Point is the logical export port for coal mines proposed for the Galilee Basin. The Adani group is proposing to develop the Carmichael mine, including the construction of a standard gauge railway from the mine to Abbot Point and the development of the T0 terminal site at Abbot Point. Adani is expecting the first coal exports from the Carmichael mine in 2017. GVK Hancock is proposing to develop the Alpha and Kevin's Corner mines in the Galilee Basin. GVK Hancock is also proposing to develop, in joint venture with Aurizon, a narrow gauge railway to Abbot Point and the T3 terminal site at Abbot Point. Other mining companies have proposals for new mines in the Galilee Basin. The proximity of Abbot Point to the Great Barrier Reef means

370. State totals include small ports not specifically listed.
371. North Queensland Bulk Ports Corporation (2014)

that environmental matters associated with port expansion and dredging are being addressed in government approval processes.

3.6.5 Airports

The DEC of the state's airports was estimated at $5.43 billion in 2011. This is projected to grow to $10.94 billion by 2031.

South East Queensland and the northern Queensland tourist destinations have experienced significant growth in economic activity over the last 10 years. The major airports of Brisbane, Gold Coast, Sunshine Coast, Cairns and, to a lesser extent, Townsville and Mackay, have seen aviation and passenger growth above the national average. The DEC of Brisbane Airport is projected to more than double from $3 billion in 2011 to $6.15 billion in 2031. The regional airports of Gold Coast, Sunshine Coast, Townsville and Cairns are projected to experience similar rates of growth, with combined DEC projected to grow from $2.02 billion in 2011 to $3.99 billion in 2031. Projected growth rates range from 82 per cent on the Sunshine Coast to 108 per cent in Townsville.

Brisbane, Gold Coast, Townsville, Cairns and Mackay airports are privately operated. Sunshine Coast Airport is owned by local government. A new airport at Wellcamp, 17 km west of Toowoomba, is privately owned and operated. Operations commenced in November 2014 and the airport offers services to Sydney and regional Queensland destinations.

The higher than national average growth projected for all major airports in Queensland is likely to put pressure on existing infrastructure.

Brisbane Airport's operator, Brisbane Airport Corporation, has identified the need for significant investment,[372] including a new runway and associated passenger facilities, which are currently being developed. The airport handled 21.8 million passengers in 2013–14, and Brisbane Airport Corporation expects this to rise to around 48.7 million by 2033–34. Additional passenger facilities, including terminal extensions, are also likely to be needed.

Table 60: Queensland airport passenger and freight volumes – 2013–2014

	Revenue passenger (No.)				International Freight (tonnes)			
Airport	Domestic (incl. Regional) Airlines	International Airlines	Total passengers	Total as % of national total	Inbound	Outbound	Total	Total as % of national total
Brisbane	17,013,305	4,807,841	21,821,146	14.89%	54,263	55,895	110,158	9.38%
Gold Coast	4,908,531	875,310	5,783,841	3.95%	3,179	787	3,966	1.27%
Cairns	3,826,752	469,584	4,296,336	2.93%	1,759	3,439	5,198	43.00%
Townsville	1,522,912	0	1,522,912	1.04%	0	0	0	0.00%
Mackay	1,033,188	0	1,033,188	0.71%	0	0	0	0.00%
Sunshine Coast	893,307	8,026	901,333	0.62%	0	0	0	0.00%
Rockhampton	681,526	0	681,526	0.47%	0	0	0	0.00%
Gladstone	501,140	0	501,140	0.34%	0	0	0	0.00%
Hamilton Island	477,312	0	477,312	0.33%	0	0	0	0.00%
Emerald	263,393	0	263,393	0.18%	0	0	0	0.00%
Proserpine	244,467	0	244,467	0.17%	0	0	0	0.00%
Roma	243,901	0	243,901	0.17%	0	0	0	0.00%
Mount Isa	238,039	0	238,039	0.16%	0	0	0	0.00%
Moranbah	185,086	0	185,086	0.13%	0	0	0	0.00%
Bundaberg	159,212	0	159,212	0.11%	0	0	0	0.00%
Hervey Bay	149,443	0	149,443	0.10%	0	0	0	0.00%

Source: Bureau of Infrastructure, Transport Regional Economics (2014i)

Brisbane Airport is served by a rail line to and from the Brisbane CBD and the Gold Coast. The railway's existing level of utilisation and spare capacity mean that major rail capacity

372. Brisbane Airport Corporation (2014)

improvements are unlikely to be needed over the next 20 years.

Cairns and Gold Coast airports are projected to have the highest levels of passenger growth of any airports in Australia. They will require significant new infrastructure to provide adequate runway capacity and terminal capacity. Passenger numbers through Gold Coast Airport are projected to rise from around 5.8 million in 2013–14 to 16.3 million by 2031/32.[373] Both airport[374] Master Plans outline planned improvements over the next 10 years.

Sunshine Coast Airport is also likely to require some expansion over the next 10 years. The base forecasts underlying the airport's master plan[375] are for around 1.9 million passenger movements by 2020. This compares to just under one million in 2013–14.

The privately owned Wellcamp Airport outside Toowoomba opened in late 2014.

Queensland has a large number of regional airports, providing access to regional and remote communities. Most of these airports are owned and operated by local governments, which in many cases subsidise operations and maintenance.

3.7 Energy

3.7.1 Electricity

The Audit found that, in 2011, Queensland had an installed electricity generation capacity of 12,644 MW. Transmission peak demand was 8,109 MW and distribution peak demand was 6,993 MW. The utilisation of electricity in Queensland in 2011 was 59,603 GWh for generation, 47,341 GWh for transmission and 38,540 GWh for distribution.

The DEC from electricity infrastructure in 2011 was $3.3 billion. This was made up of $0.6 billion from generation, $0.7 billion from transmission and $2 billion from distribution.

The Audit forecasts a 39 per cent increase in the use of electricity from 2011 to 2031. This equates to 90,401 GWh for generation, 78,861 GWh for transmission and 53,520 GWh for distribution by 2031. Based on these forecasts, the Audit projects an increase of $1.9 billion (57 per cent) in the DEC of electricity infrastructure to $5.1 billion. This is made up of $0.3 billion from generation, $0.6 billion from transmission and $1 billion from distribution.

Unlike the other eastern states, the Australian Energy Market Operator[376] (AEMO) forecasts a rise in electricity consumption in Queensland, from 47,621 GWh in 2011 to 55,830 GWh in 2031.

There are several reasons for caution in directly comparing AEMO's forecasts and the Audit projections for the DEC of electricity infrastructure. The Audit assumes an energy efficiency improvement rate of 1.5 per cent per year (compared to a historic rate of 0.5-1.0 per cent), whereas AEMO assumes much faster rates, exceeding 20 per cent in some years. Consequently, electricity use underlying the Audit's DEC measure is considerably higher than that for AEMO's forecast.

Additionally, AEMO reports and forecasts unit electricity consumption in gigawatt-hours, whereas DEC is a measure of the value-add provided by electricity infrastructure, expressed in dollar terms. The two are not necessarily perfectly correlated.

Queensland is part of the National Electricity Market (NEM) which also includes NSW, SA, Victoria and Tasmania. Electricity demand has fallen in the NEM in recent years. Annual energy sent out across the NEM fell seven per cent from 194.9 TWh in 2009–10, to 181.2 TWh in 2013–14. The decline in demand in Queensland has been less than the NEM average.

Based on existing and projected levels of supply and demand conditions, coupled with the ongoing increase in renewable sources, there is likely to be little need for additional investment in capacity in Queensland over the next 15 years. Following commissioning of the LNG projects at Gladstone, the availability of low cost gas for generation will likely reduce.

The Large-scale Renewable Energy Target (and the previous Renewable Energy Target) have led to a substantial increase in the penetration of wind farms across the NEM. However, wind farms are not currently a significant component of generation in Queensland. At the same time, the Small-scale Renewable Energy Scheme, feed-in tariffs, and other photovoltaic (PV) subsidies have led to a significant increase in the penetration of solar PV systems in the last five years. In the *National Electricity Forecasting Report Update*, AEMO forecast an increase in solar PV output from 207 GWh in 2011, and 1,562 GWh in 2014, to 6,982 GWh by 2031 in Queensland.

The combination of an unanticipated decline in demand and rising penetration of renewables has led to an ongoing structural change in the wholesale sector, although for Queensland high levels of low-cost gas generation also had an impact.

At the same time, there have been considerable rises in network charges across the NEM, due to a range of factors. The rising network charges have in

373. Gold Coast Airport (2011)
374. Cairns Airport (2012)
375. Sunshine Coast Airport (2007)
376. Australian Energy Market Operator (2014a)

turn influenced retail prices, creating an impetus for regulators to investigate options that may diminish, or delay, further expansion of the network. Consequently, the Australian Energy Market Commission (AEMC), on 27 November 2014,[377] made a new rule that establishes a new pricing objective and new pricing principles for electricity distribution businesses that will require that network prices reflect the efficient costs of providing network services. Distribution network prices will reflect the costs of providing the electricity to consumers with different patterns of consumption which has the potential to reduce demand during peak periods, and consequently also reduce future network infrastructure investment.

The implications of surplus capacity differ by sector. For the generation sector, surplus capacity and renewable policy settings are likely to result in the withdrawal of thermal generation assets. Indeed, since 2005, a significant amount of capacity has been 'mothballed' or retired in the NEM. In 2014 Queensland saw the shutdown of the Swanbank power station for three years as well as units at the Tarong and Calllide power stations put into reserve shut down during the non-peak (winter) season.

For the network sector, the decline in demand has diminished the need for augmentation investment. AEMO has pointed out that several transmission network service providers have delayed or cancelled a number of major network upgrades. Lower levels of demand growth may reduce the need for expenditure to replace existing assets.

Following the 2015 change of government in Queensland, there are likely to be policy changes affecting the electricity market. The incoming Government has pledged not to privatise state-owned electricity assets. The three network businesses (Ergon, Energex and Powerlink) will be consolidated into one, as will the two generation businesses (CS Energy and Stanwell).[378]

3.7.2 Gas

In 2011, Queensland gas transmission pipelines had an annual throughput of 265 petajoules (PJ). Gas distribution pipelines had an annual throughput of 18 PJ.

The DEC from gas pipelines in Queensland in 2011 was estimated to be $283 million – made up of $214 million from transmission and $69 million from distribution.

The Audit projects a rise in the DEC of gas pipeline infrastructure to $2 billion by 2031, driven by demand for LNG projects in the Gladstone region. This increase is made up of $1.7 billion from transmission and $17 million from distribution pipelines. This near nine-fold rise in DEC is in line with the state's broader economy growing by 95 per cent over the same period.

The main pipelines in Queensland are the North Queensland Gas Pipeline, Queensland Gas Pipeline (Wallumbilla to Gladstone), Carpentaria Pipeline (Ballera to Mount Isa), Berwyndale to Wallumbilla Pipeline, Roma (Wallumbilla) to Brisbane Pipeline, and South West Queensland Pipeline (Ballera to Wallumbilla).

High international demand for gas will lead to a structural shift in the Australian gas market. Australia's gas exports are predicted to increase from 56 billion cubic metres (BCM) in 2012 to 130 BCM in 2020, driven mostly by the start of a number of LNG export terminals, heavily focused in Queensland. This increase will mean that the majority of gas production is exported, and is the main driver of current gas infrastructure investment in Australia.

AEMO[379] also forecast a very large rise in gas consumption in Queensland, driven by LNG export, from 252 PJ in 2014 to 1570 PJ in 2031, but a sizeable decline if LNG is excluded. Non-LNG consumption of gas in the state is forecast to fall from 211 PJ in 2011 to 145 PJ in 2031.

The unprecedented rise, driven by LNG export, masks an inconsistency between the Audit's forecast of gas infrastructure DEC, and AEMO's forecast of gas consumption. The DEC analysis was finalised before the latest AEMO gas market forecasts were published. Those forecasts were the first to show a break in what had previously been a direct link between economic growth and rising (domestic) energy consumption. Also, AEMO reports and forecasts gas consumption in petajoules, whereas DEC is a measure of the value-add provided by gas infrastructure, in dollars. The two are not necessarily perfectly correlated.

The strong demand for gas exports means that there are significant opportunities to develop both conventional and unconventional gas fields in Queensland. The Surat and Bowen basin has the largest proved and probable gas reserve in eastern Australia − around 42,000 PJ.[380] Most of the reserves in the Surat and Bowen basin are coal seam gas (CSG). Further development of these reserves may require additional investment

377. Australian Energy Market Commission (2014)
378. Queensland Labor (2014)
379. Australian Energy Market Operator (2014b)
380. Queensland Department of Natural Resources and Mines (2014)

in pipeline capacity and associated works by the private sector. The location of pipelines will depend on the location of new gas supplies.

There is wide acknowledgement of an ongoing structural shift in the gas market as Australia significantly expands its ability to export gas. There is also uncertainty about whether existing gas market and regulatory frameworks are well suited to handle the shift. Within this context, the AEMC recently conducted a gas market scoping study, which recommended Australia conduct a strategic review of the gas sector, including a review of future markets and the Victorian declared wholesale gas market. The AEMC initiated a review of the design, function and roles of facilitated gas markets and gas transportation agreements on the east coast of Australia on 20 February 2015. Further recent declines in oil and LNG prices, by as much as 50 per cent, have had an impact on the profitability of LNG projects.

3.7.3 Petroleum

The petroleum industry is broadly split into upstream and downstream petroleum sectors. The upstream sector refers to exploration and production of crude oil while downstream refers to refining of crude oil and the distribution and sale of petroleum products.

In 2011, consumption of petroleum products in Queensland was 12,241 ML. Total throughput at petroleum terminals was 21,211 ML. The DEC of petroleum terminals was $288 million.

The Audit identifies two refineries in Brisbane – the Caltex refinery at Lytton, and the BP facility at Bulwer Island. In 2011, Caltex's Lytton refinery had a throughput of 5,110 ML per year and BP's Bulwer Island facility had a throughput of 6,270 ML per year. The BP refinery at Bulwer Island is currently scheduled to close in 2015.

The Audit projects an increase in throughput of 2.6 per cent per year in Queensland. This equates to throughput of 35,156 ML per year by 2031 – an increase of 13,945 ML per year. This is projected to result in growth in DEC of $190 million (66 per cent) to $478 million in 2031.

3.7.3.1 Crude oil production

Australia's total production of crude oil has been steadily declining. Crude oil production peaked in 2000 at 722 kb/day and declined to just over 338 kb/day in 2013.[381] Oil production is forecast to decline at an annual average rate of 4.4 per cent from 2014–15 to 2049–50.[382] The majority of production comes from two major basins: the Carnarvon Basin in WA (77 per cent of production in 2011), and the Gippsland Basin in Victoria (less than 15 per cent of production in 2011).

3.7.3.2 Refinery capabilities

In recent years the global oil refining industry has been undergoing significant structural change. Larger, more efficient 'mega-refineries' have been established in Asia, resulting in increased competitive pressures on established refining operations, including those in Australia. As noted above, there were two refineries operating in Queensland in 2011, although the refinery at Bulwer is scheduled to close in 2015.

In 2013–14, 82 per cent of crude oil and other refinery feedstock was imported.[383] New refinery capacity is unlikely to be developed in Australia in the foreseeable future.

3.7.3.3 Petroleum products

Domestic demand for petroleum products grew at an average annual rate of around 1.5 per cent in the decade to 2011–12. It is expected to grow by around one per cent per year to 2049–50, largely driven by population and economic growth. However, energy intensity (measured by total domestic energy consumption per dollar of gross domestic product) is projected to decline by around 1.7 per cent per year over the same period, compared to a decline of 1.3 per cent from 1989–90 to 2009–10. This decline indicates an accelerating improvement in energy efficiency. The transport sector uses more than 60 per cent of all petroleum consumed in Australia, and is the primary driver of demand growth. In addition, the expansion of the mining sector has contributed significantly to increased demand for diesel.[384]

Imported refined petroleum products account for approximately 40 per cent of total domestic consumption, and this share is forecast to rise. Refined petroleum products are imported from more than 20 countries, but 80 per cent of all such products come from just three: Singapore (53 per cent), South Korea (18 per cent) and Japan (12 per cent).[385]

Demand for petroleum import facilities and the need for additional import infrastructure within Queensland is expected to grow over the next 15 years.

381. United States Energy Information Administration (2013)
382. Bureau of Resources and Energy Economics (2011)
383. Carson, L. (2014), p. 108
384. Bureau of Resources and Energy Economics (2014a)
385. Australian Institute of Petroleum (2013a)

3.8 Telecommunications

The DEC of telecommunications infrastructure in Queensland is projected to increase from $2.8 billion in 2011 to $6 billion in 2031, a 119 per cent rise. This is a larger increase than the 95 per cent cumulative growth projected for Queensland's economy over the same period.

In Queensland, 90 per cent of premises have access to ADSL, 77 per cent have 3G mobile coverage, 75 per cent have 4G coverage, 26 per cent have access to hybrid-fibre co-axial (HFC) and four per cent have access to fibre to the premises.[386] One per cent of premises also have National Broadband Network access, although this will increase rapidly.

For overall quality of fixed broadband service, Queensland has the third largest share of premises receiving the highest level of broadband service of any jurisdiction, behind Tasmania and the ACT. However, Queensland also has a relatively large share of premises that only receive the lowest level of service, more than either NSW or Victoria. This may be explained by Queensland being less capital city-centric (in terms of both population and economic activity) than NSW or Victoria.

3.9 Water

The DEC for water and sewerage infrastructure in Queensland is projected to increase by 67 per cent from $2.4 billion in 2011 to $4.1 billion in 2031. The Audit identified that 176 GL of water was supplied to South East Queensland in 2011, and 777 GL to other regions. A total of 277 GL of sewage was collected in South East Queensland in 2011, and 93 GL in other regions.

The highest projected growth in water and sewerage DEC is in South East Queensland (comprising greater Brisbane, the Gold Coast and the Sunshine Coast), where DEC is projected to grow from $1.8 billion in 2011 to $2.8 billion in 2031. In the regional areas DEC is projected to increase from $0.7 billion to $1.3 billion over the same period.

It is important to note that water and sewerage services have historically been under-priced, particularly in regional areas, and that this potentially leads to an understatement of DEC as measured by the National Water Commission data (and as incorporated into the national accounts and GDP numbers). In regional areas the under-pricing of water and sewerage services means that the return on the capital base is a long way below the level needed to fund the full replacement cost of assets.

3.9.1 South East Queensland region

In 2012–13 SEQ consumed, on average, 255 litres of drinking water per person per day.

The Department of Energy and Water Supply (DEWS) has prepared an annual report on the current *South East Queensland Water Strategy*,[387] which was developed by the former Queensland Water Commission. These reports review the SEQ water supply/demand balance, taking into account population growth, regional water consumption trends, water use efficiency measures and the operation of the SEQ bulk water supply system.

The *South East Queensland Water Strategy* will be superseded by a new water security program being developed by Seqwater, which is expected to be completed by mid–2015.[388] This program will outline the arrangements and measures to facilitate the desired level of service objectives established by the Queensland Government. The program will include information about operating the bulk water supply system, potential future bulk water infrastructure needs and drought response. Seqwater will be responsible for reporting against the program annually, in a similar fashion to DEWS' annual reporting on the current Strategy.

The Queensland Water Commission[389] has reported that water supply in SEQ is secure until at least 2027, under a conservative demand forecast. The nature and timing of infrastructure upgrades and other responses to ensure water supply security for SEQ is the subject of review and will be included in Seqwater's Water Security Program.

DEWS undertook a prefeasibility study[390] which considered several options for increasing flood mitigation storage to reduce urban flood inundation in the Brisbane River floodplain, downstream of Wivenhoe Dam and in particular around Brisbane and Ipswich. The nine highest ranked flood mitigation development scenarios involve potential works at Wivenhoe Dam, with or without a dam on the upper Brisbane River near Linville. The DEWS report recommended further assessment of various combinations of dam safety upgrades for Wivenhoe and Somerset dams, raising of the Wivenhoe Dam and a new dam near Linville.

3.9.2 Regional Queensland

Outside the metropolitan regions, SunWater provides bulk water services to approximately 70 regional local councils and bulk water for irrigation. In 2013–14 SunWater supplied a total

386. Department of Communications (2013)
387. Queensland Department of Energy and Water Supply (2013)
388. Queensland Department of Energy and Water Supply (2014)
389. Queensland Water Commission (2010)
390. Queensland Department of Energy and Water Supply (2014)

of 1,628 GL of water for urban, irrigation and industrial uses.[391] In the long-term, SunWater's projected supply of urban water averages around 1.2 GL per year, although actual supply varies based on water availability and climatic conditions. Local councils provide treatment, distribution, and retail water and wastewater services to residents and businesses.

Planning functions are predominantly the responsibility of local government water service providers working with SunWater, DEWS and other Queensland Government departments.

To assist certain local governments in undertaking this function DEWS is developing Regional Water Supply Security Assessments (RWSSAs) in partnership with local governments and water service providers to reach a common understanding of future demand and the performance of the existing bulk water supply systems used by the local governments to supply their communities. These assessments will forecast water demand for various population growth scenarios, taking into account water availability, reliability and multiple water users sharing the same resource. RWSSAs are currently being developed for Charters Towers, Gladstone, Whitsunday communities, Maryborough, Hervey Bay, Bundaberg, Rockhampton, Mackay, Townsville, Cairns and Mt Isa. SunWater is progressing a number of supply augmentation schemes, including Nathan Dam and pipelines and Fitzroy River infrastructure options. Further water supply augmentations will be required in regional areas before 2031 to service population growth, greenfield urban development and industry development. The nature and timing of this augmentation will be determined by the local governments responsible for supplying water services to their communities using the RWSSAs as input where they are available.

391. Sunwater (2014)

Audit observations – Western Australia

4.1 Structure of this chapter

This chapter presents observations from the Audit outcomes for the four infrastructure sectors – transport, energy, communications and water – across WA. It provides data on the state's population and economy (as the key drivers of demand for infrastructure), and the value attributable to WA infrastructure in 2011. It also details growth projections to 2031 for the state's population and economy, and for each of the infrastructure sectors. As noted in the Introduction to this report, these projections are based on economic and demographic analysis set out in two associated studies.[392]

The Audit uses the Direct Economic Contribution (DEC) methodology to quantify both the value attributable to infrastructure in 2011, and the projected change in overall demand for infrastructure from 2011 to 2031. When considered in the light of other factors, such as capacity limitations which might constrain economic growth, this approach helps to identify locations and sectors that are likely to warrant further attention in the Australian Infrastructure Plan (the Plan).

The chapter also takes account of other documents, including plans, studies and strategies, prepared by the WA Government and others.

4.2 Drivers of infrastructure demand – population and economy

Based on medium level projections by the Australian Bureau of Statistics, WA's population is projected to reach 3.97 million in 2031 – an increase of 1.62 million people, or 69 per cent, from 2011. This is higher than the WA Government's medium level population projection of 3.69 million in 2031.[393]

As shown in Table 61, the state's economy is projected to grow considerably faster than the population, and both are projected to grow at a higher rate than any other state or territory in the 20 years to 2031. WA's share of the country's economy and population is projected to increase markedly over the period.

Employment in Perth is projected to grow from one million to 1.68 million by 2031. Most of this growth will be located in Perth City, Swan, Stirling and Wanneroo.

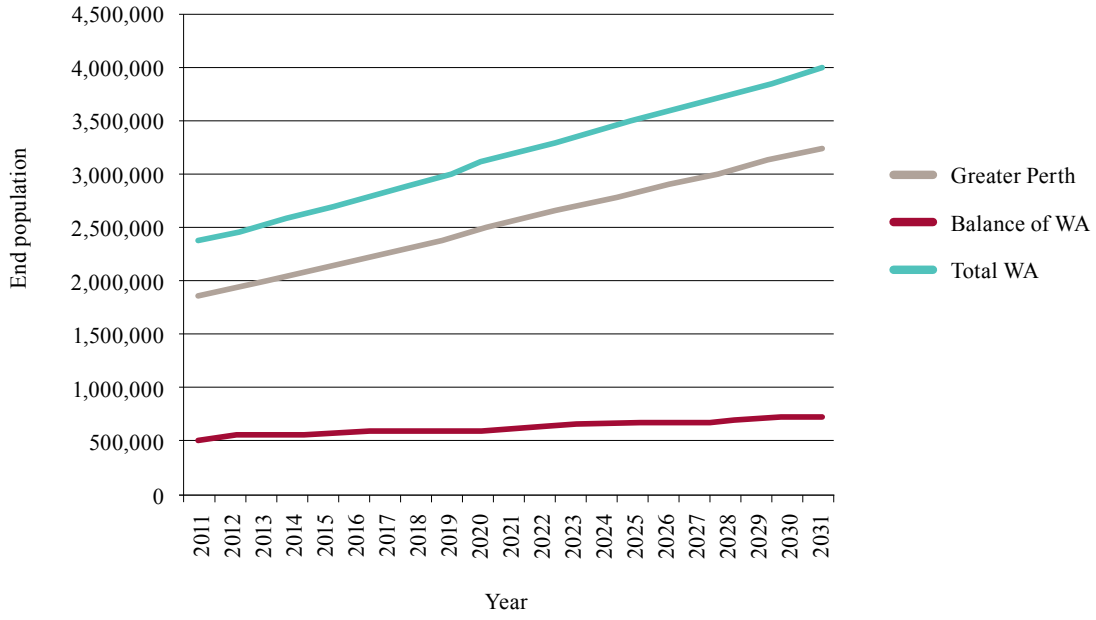
Table 61: Projected population and economic growth for Western Australia

	2011	% of National	2031	% of National	Increase % 2011–31
Population (persons)	2,353,409	10.5%	3,970,021	13.0%	69%
Gross State Product ($m)	221,852	15.8%	513,007	19.9%	131%

Source: ACIL Allen Consulting (2014a)[394]

392. ACIL Allen Consulting (2014a) and Infrastructure Australia (2015b)
393. At the time of writing the WA Government had not updated its population projections to take account of 2011 Census data.
394. Gross State Product is in 2010–11 prices.

Figure 79: Population projections for Western Australia, 2011–31



Source: Australian Bureau of Statistics (2013c)[395]

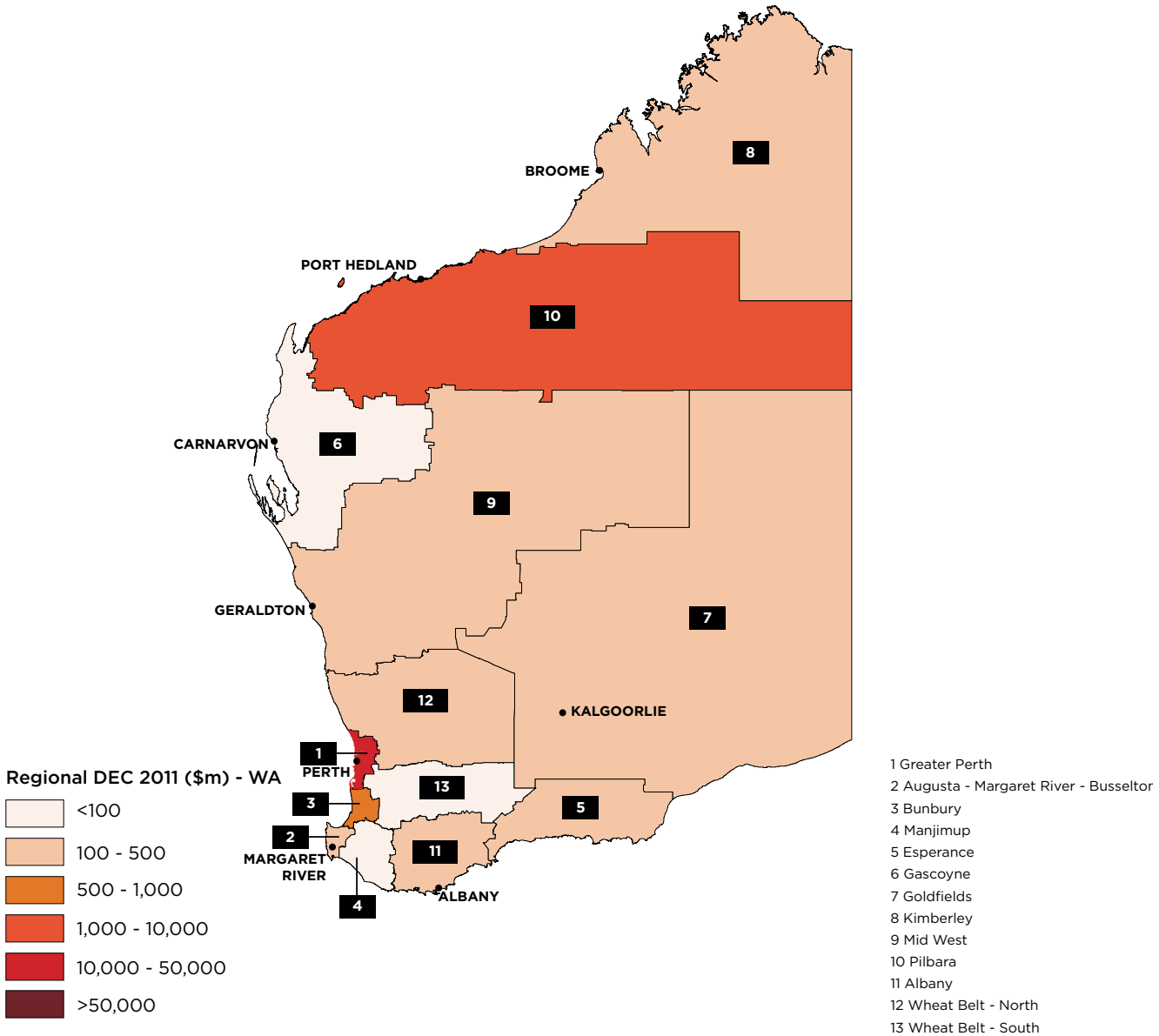
395. Series B (medium level) projections.

4.3 Summary of Western Australian infrastructure from 2011 to 2031

In 2011, the DEC of infrastructure in WA was $25.5 billion, which was 14 per cent of the national figure. By 2031, WA's infrastructure DEC is projected to increase by around $49 billion, or 192 per cent, reaching $74.2 billion (20 per cent of national DEC).

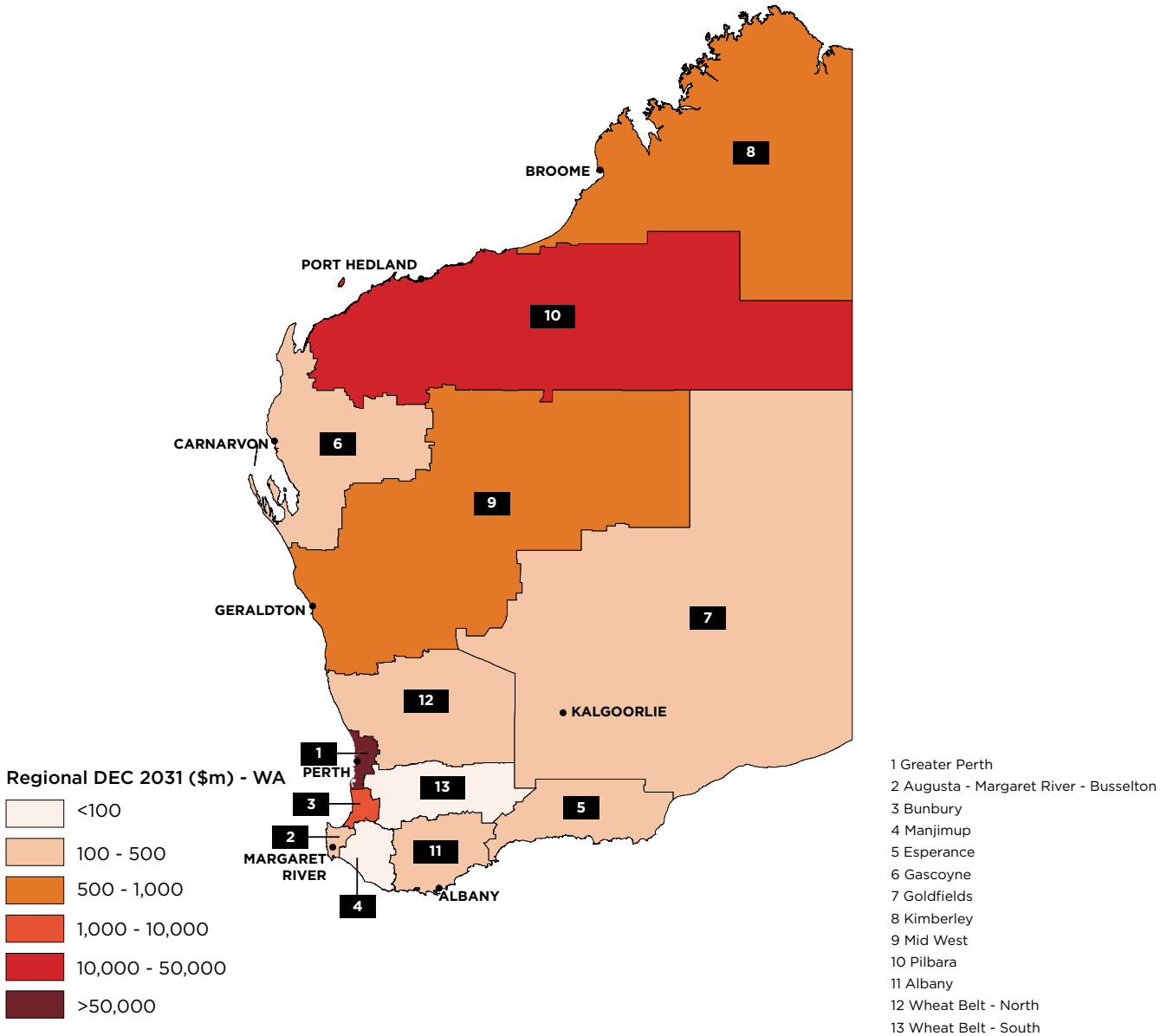
Figure 80 and Figure 81 show the spread of infrastructure's DEC across the 13 Audit regions in WA in 2011 and 2031 respectively. Growth will be fastest in the greater Perth region, where DEC is projected to grow by 208 per cent from $18 billion to $54 billion during the period, and in the Pilbara region, where DEC is projected to grow by 187 per cent from $5 billion in 2011 to $15 billion in 2031.

Figure 80: Western Australia Regional DEC 2011



Source: ACIL Allen Consulting (2014a)

Figure 81: Western Australia Regional DEC 2031



Source: ACIL Allen Consulting (2014a)

Table 62 provides a snapshot of WA's economic infrastructure across the four sectors of transport, water, energy and communications. The table notes the capacity of each subsector and its rate of utilisation in 2011, along with historical (2011) and projected (2031) DEC for each subsector.

Table 62: Overview of Western Australian infrastructure

	Subsector	Capacity 2011	% of Nat.	Utilisation 2011	% of Nat.	DEC 2011	% of Nat.	DEC 2031	% of Nat.	Projected % increase in DEC 2011-2031
Transport	Urban Roads	**300,000,000** Car VKT per day	13%	**49,800,000** Car VKT per day	12%	$9,134m	12%	$33,619m	19%	268%
	Urban Public Transport	**17,700,000** Passenger KT per day	7%	**4,300,000** Passenger KT per day	6%					
	National Highways	**9,946** km of nationally significant roads	29%	**46,157** vehicles per day	2%	$726m	8%	$1,416m	9%	95%
	Freight Rail	n/a	n/a	n/a	n/a	$2,744m	51%	$5,512m	58%	101%
	Ports	**616** Mt p.a. throughput	43%	**526** Mt p.a. throughput	50%	$4,852m	23%	$15,315m	37%	216%
		1.2 MTEU throughput	10%	**0.6** MTEU throughput	9%					
	Airports	**48** Count of airfields	18%	**13,467,006** Total RPT passenger movements	10%	$1,889m	9%	$5,081m	12%	169%
Energy	Electricity	**6,224** Installed capacity (MW) of Generation	12%	**18,814** Utilisation of Generation (GWh)	3%	$2,340m	15%	$5,165m	20%	121%
		3,581 Peak Demand Transmission (MW)	9%	**17,838** Utilisation of Transmission (GWh)						
		3,696 Peak Demand Distribution (MW)	10%	**18,270** Utilisation of Distribution (GWh)						
	Gas	n/a	n/a	**386.85** Transmission throughput (PJ/a)	29%	$528m	46%	$775m	24%	47%
		n/a	n/a	**28.00** Distribution throughput (PJ/a)	8%	$94m	8%	$156m	10%	67%
	Petroleum product terminals	n/a	n/a	**14,313** Annual throughput (ML)	18%	$195m	18%	$383m	22%	97%
Telecommunications		**4.36** Broadband average availability rating (out of 5)	n/a	**648**	n/a	$1,356m	6%	$3,673m	9%	171%
		1.31 Broadband average quality rating (out of 5)	n/a	Total households with broadband internet access at home ('000)						
Water & Sewerage	Water	**17,248** Length of water mains (km)	8%	**453,510** Water supplied (ML)	6%	$1,605m	15%	$3,143m	20%	96%
		8,861 Volume of water stored in dams (GL)	15%	**854** Properties served – water ('000)	10%					
	Sewerage	**150,000** Desalination capacity (ML)	28%	**137,607** Sewage collected (ML)	7%					
		13,253 Length of sewer mains (km)	10%	**769** Properties served – sewerage ('000)	10%					

Source: ACIL Allen Consulting (2014a)[396]

396. DEC figures are rounded to the nearest $ million, so percentage changes may not tally exactly with rounded estimates in this table. See Glossary for explanation of abbreviations and terms.

4.4 Western Australian Government plans and strategies

A number of documents underlie broad strategic planning in WA, including the following:

- *State Planning Strategy 2050* – provides the strategic context for planning and development decisions throughout the State. The Strategy envisages a doubling of Western Australia's population by 2056 and outlines the role of the State's northern and central regions as hotspots for capital investment with an increasing contribution to Australia's Gross Domestic Product.
- *Directions 2031 and beyond – Metropolitan Planning beyond the horizon*[397] – a high level plan that establishes a vision for future growth in Perth and the Peel region. It is based on an expectation that the population of the city as a whole will grow to 2.2 million by 2025, a low figure given the rate of growth observed since the document was published in 2010. The document encourages a long-term approach to infrastructure provision. Further direction is provided in the *Central Metropolitan Perth, Outer Metropolitan Perth and Peel* sub-regional strategies.
- building on the metropolitan plan, *Public Transport for Perth in 2031*[398] identifies the public transport network needed to support Perth's growing population and links to and between strategic centres. It points to a doubling of public transport use in Perth from 2011 to 2031. The greatest need for investment is identified within 15 km of the city centre.
- the *Western Australian Regional Freight Transport Network Plan* – articulates the Western Australian Government's planning, policy and project priorities to ensure the regional transport network continues to perform effectively.[399]
- the WA Department of Transport has prepared a draft *Moving People Network Plan* to set out of the management of the metropolitan transport network over the coming decades. The draft Plan identifies a key role for Intelligent Transport Systems across a number of outcome areas for the safety and mobility benefits that it can provide.[400]

A number of regional plans also operate in Western Australia. The State's Regional Development Commissions are in the process of completing Regional Investment Blueprints, which anticipate infrastructure needs for regional growth to 2031 and in some cases to 2050. In addition, the Department of Planning has published Regional Planning and Infrastructure Frameworks as well as a State Planning Strategy.[401]

A key policy issue for the WA Government is whether population and employment growth should occur in the urban fringes such as south-west and north-west Perth, or whether increased densification and public transport use should be supported in the inner city and middle ring suburbs. Under the current projections, trips will be longer, congestion will be spread across multiple routes from the inner city to the fringes, and funding costs will increase.

4.5 Remote Indigenous services in Western Australia

As discussed in Section 5.1.3 of Volume 1, infrastructure provision is a critical issue for remote Indigenous communities, with many areas lacking even basic services. Improving the delivery of infrastructure to these areas can bring considerable social benefits in terms of access to services and economic opportunities, and is fundamental to the governments' broader agenda of *Closing the Gap in Indigenous Disadvantage*.

Remote Indigenous communities in WA are scattered across the state, with a particular concentration in the Kimberley region. Many of these areas are more than 2,000 km from the state's primary economic centre of Perth, reinforcing the need for considerable investment in essential infrastructure to ensure Indigenous people in these areas have access to services that can support better health, education and employment outcomes in their communities.

In November 2014, the WA Government announced its intention to close between 100 and 150 of the 274 remote communities in WA, largely due to the high costs of service provision to people in these areas.

4.6 Transport

4.6.1 Urban transport

For the urban transport component of the Audit, the top-down economic analysis used for the other sectors, which is based on national accounts and industry data, was complemented by a bottom-up analysis based on detailed transport modelling for the six major capital cities.

397. Western Australian Planning Commission (2010)
398. Western Australian Department of Transport (2011)
399. Western Australian Department of Transport (2013)
400. Western Australian Department of Transport (2014a)
401. Western Australian Planning Commission (2014)

This modelling provides detailed information about trips within these cities by origin/destination (O/D), and by corridor, in 2011. It takes account of projected population and employment growth and spatial distribution to project demand for trips, also by O/D and corridor, in 2031.

For both road and rail corridors the model includes detailed information about capacity, showing where demand is projected to grow in excess of supply. For road corridors it quantifies the cost of delay, showing where interventions will likely provide the biggest economic return. For rail corridors the model assumes minimal delay (i.e. all passengers are able to board the next available train). This is to ensure the model does not displace rail passengers, and thus shows the full extent of demand for the rail corridor.

Given the absence of rail delay cost from the model, projected delay cost for road corridors is at best an approximation. However, rail delay cost is unlikely to represent more than a small proportion of total delay cost for most corridors. As such, road delay cost is a reasonable proxy for delay cost for most corridors, and serves as a useful indicator of which corridors warrant further study.

4.6.1.1 Urban transport in greater Perth

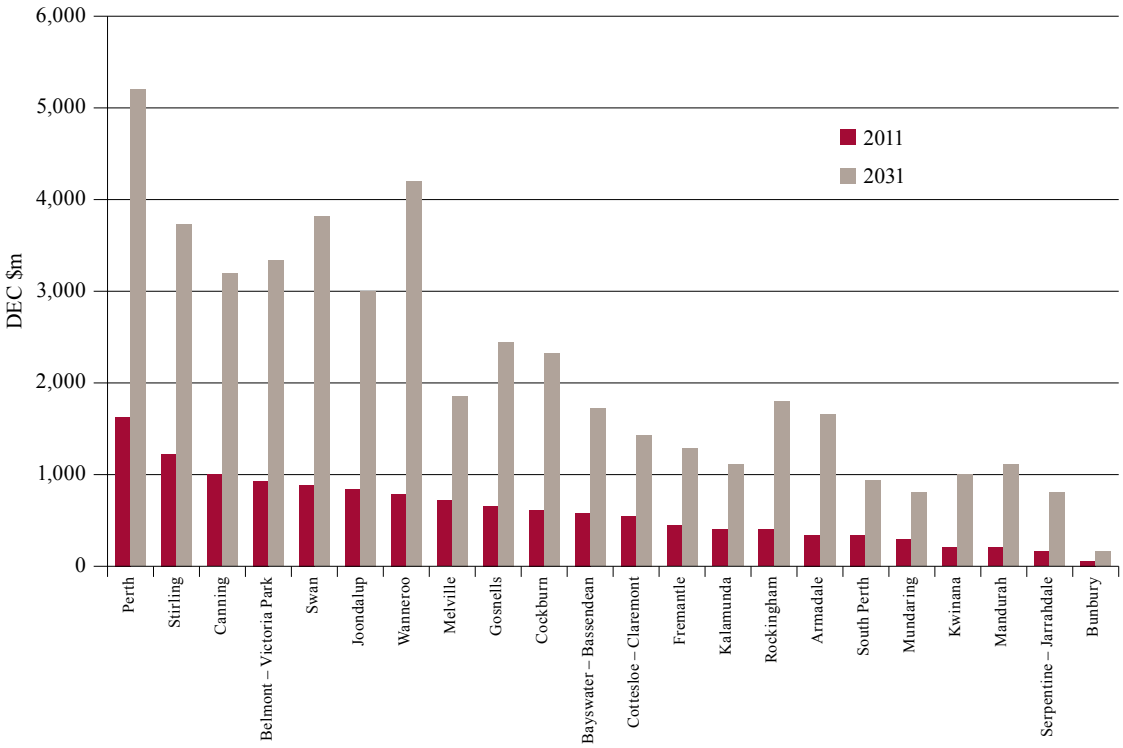
Perth's urban transport DEC is projected to grow from $9.13 billion in 2011 to $33.62 billion in 2031 − an increase of 6.7 per cent per year. The cost of delay on greater Perth's road network in 2011 was around $2 billion. In the absence of any additional capacity (other than projects already under construction or funded), and based on the high levels of population growth projected in the Audit, the cost of delay is projected to grow to around $16 billion in 2031.

4.6.1.2 Origins/destinations of trips in greater Perth

Figure 82 shows trips in greater Perth by O/D, across road and public transport modes, in terms of DEC for 2011 and projected DEC for 2031. The O/D regions used here are SA3 regions as defined by the ABS.[402]

This analysis shows that Perth City is the largest O/D for these trips, and is projected to remain so. However, particularly strong population and employment growth is forecast across greater Perth, with high levels of growth projected for many regions, in particular Wanneroo, Swan, Stirling, Belmont-Victoria Park, Canning and Joondalup.

Figure 82: Trips in greater Perth by origin/destination for roads and public transport in 2011 and 2031, measured by DEC ($ million)



Source: Infrastructure Australia analysis of modelling data from Veitch Lister Consulting (2014e) and ACIL Allen Consulting (2014b)

402. SA3s provide a standardised regional breakup of Australia and generally (although not always) have populations between 30,000 and 130,000 persons.

4.6.1.3 Road corridors in greater Perth

The Audit dataset provides a broad range of data about corridors, and there are many ways of analysing this data. Given the focus of the Audit on economic indicators, the analysis in Table 63 and Table 64 focuses on delay cost. This applies a dollar cost to time delays, based on lost productivity, and taking account of the different costs applicable to different vehicle types.

Some users of the Audit dataset may prefer to use more traditional indicators of congestion, such as traffic volume compared to capacity (V/C). This measure is included in Table 63 and Table 64, as is the DEC measure, which gives insight into the underlying value of activity on the corridor, and the proportion of DEC attributable to delay cost.

These measures are expressed per lane kilometre of road. This normalises the results to facilitate comparison across a wide range of different corridor types − some very long, some consisting of multiple roads, and some relatively short single roads.

The modelling provides one method of measuring and projecting demand for transport infrastructure and the corridors identified in Table 63 and Table 64 reflect this approach. The WA Government may have utilised other data, and different methods of analysis, to inform identification of infrastructure priorities. For further information on the assumptions, included projects and methodology applied in the model, refer to the supporting documentation by Veitch Lister Consulting.

Table 63 shows corridors ranked by delay cost per lane kilometre in 2011, with the equivalent projections for 2031 in Table 64. Taken together, these tables give an indication of which corridors warrant further study, and where interventions are likely to have the biggest economic return.

Table 63: Top 10 road corridors in greater Perth area 2011, by delay cost (2011 dollars)

Rank	Road Corridor	State	Delay cost by lane km 2011 ($m)	DEC per lane km 2011 value ($m)	Volume Capacity Ratio 2011 AM Peak (7-9 AM)
1	Mitchell Fwy Corridor	WA	1.96	5.52	70%
2	Leach Hwy Corridor	WA	1.21	3.97	61%
3	Canning Hwy/Great Eastern Hwy (west) Corridor	WA	1.20	3.41	62%
4	Graham Farmer Fwy/Orrong Rd/Welshpool Rd East Corridor	WA	1.20	3.49	62%
5	Roe Hwy Corridor	WA	0.81	2.99	65%
6	Reid Hwy Corridor	WA	0.80	2.48	62%
7	Tonkin Hwy Corridor	WA	0.76	2.40	50%
8	South St/Ranford Rd Corridor	WA	0.71	2.43	56%
9	Albany Hwy Corridor	WA	0.63	2.36	42%
10	Kwinana Freeway	WA	0.55	1.93	40%

Source: Infrastructure Australia analysis of data from ACIL Allen Consulting (2014b) and Veitch Lister Consulting (2014e)

Table 64: Road corridors in greater Perth metropolitan area 2031, by projected delay cost (>1.75 million per lane km, 2011 dollars)

Rank	Road Corridor	State	Delay cost by lane km 2031 ($m)	DEC per lane km 2031 ($m)	Volume Capacity Ratio 2031 AM Peak (7–9 AM)
1	Mitchell Fwy Corridor	WA	10.03	16.19	86%
2	Tonkin Hwy Corridor	WA	7.57	11.42	82%
3	Graham Farmer Fwy/Orrong Rd/Welshpool Rd East Corridor	WA	7.50	11.64	82%
4	Marmion Ave/West Coast Hwy Corridor	WA	6.75	9.57	85%
5	Wanneroo Rd Corridor	WA	6.38	9.04	88%
6	Leach Hwy Corridor	WA	6.06	10.65	80%
7	Roe Hwy Corridor	WA	5.84	9.47	87%
8	Canning Hwy/Great Eastern Hwy (west) Corridor	WA	5.52	9.49	80%
9	Albany Hwy Corridor	WA	4.63	7.90	64%
10	Kwinana Freeway	WA	4.21	7.33	70%
11	Reid Hwy Corridor	WA	4.20	7.01	84%
12	South St/Ranford Rd Corridor	WA	3.48	6.34	74%
13	Perth Landsdale Corridor	WA	2.99	6.29	69%
14	Nicholson Rd Corridor	WA	2.95	4.79	73%
15	Great Eastern Hwy (east)/Guildford Rd Corridor	WA	2.92	5.41	52%
16	Gnangara Rd Corridor	WA	2.20	3.94	70%
17	North Lake Rd Corridor	WA	2.08	4.54	62%
18	Morley Dr/Karrinyup Rd Corridor	WA	1.98	4.72	66%
19	Scarborough Beach Rd Corridor	WA	1.94	4.72	58%
20	Pinjarra Rd Corridor	WA	1.81	3.67	51%
21	Beeliar Dr/Armadale Rd Corridor	WA	1.76	3.45	66%

Source: Infrastructure Australia analysis of data from ACIL Allen Consulting (2014b) and Veitch Lister Consulting (2014e)

Figure 83 and Figure 84 show projected road congestion in 2031 in the AM peak hour and daytime inter-peak periods respectively. These show the corridors and locations likely to reach or exceed maximum capacity by 2031, in the absence of any additional capacity.

During the AM peak hour several parts of the network show significant congestion in 2031, particularly the Swan River crossings between Perth City and South Perth. In the inter-peak period there is surplus capacity across the network. This suggests some scope for demand management to spread peak period transport flows.

Figure 83: Perth road network volume/capacity ratio in 2031 – AM maximum peak hour

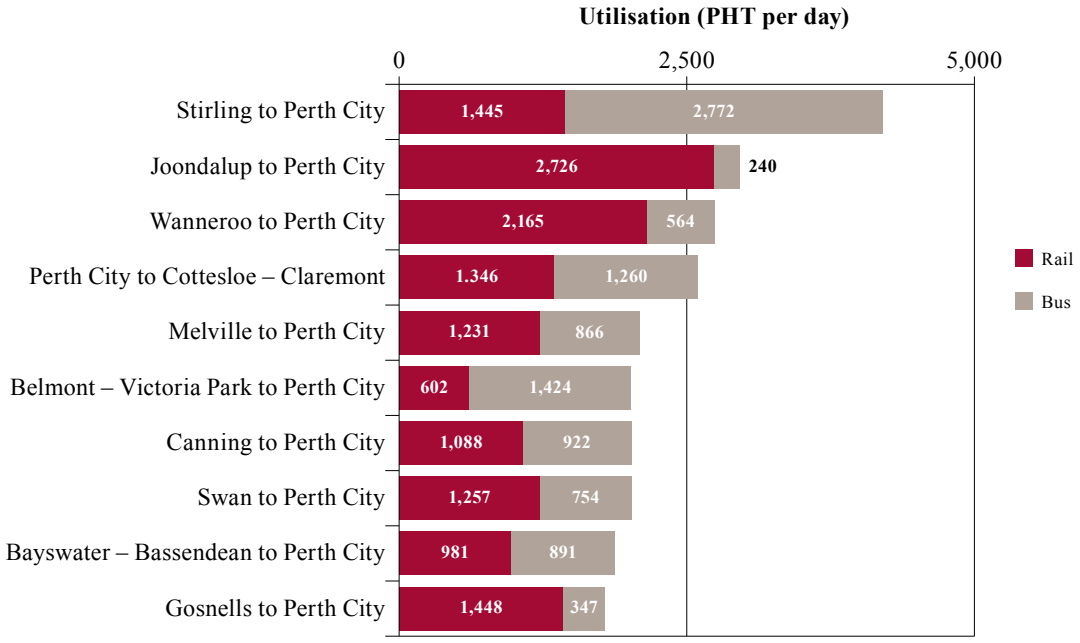
Figure 84: Perth road network volume/capacity ratio in 2031 – daytime inter-peak period

Source: Veitch Lister Consulting (2014e)

4.6.1.4 Public transport in greater Perth

Figure 85 sets out the top 10 public transport O/D pairs in greater Perth by passenger hours travelled, and by public transport mode. Perth City is by far the largest O/D region for public transport activity in greater Perth, with a reasonably even split between bus and rail.

Figure 85: Top 10 Perth origin/destination pairs by passenger hours travelled for public transport



Source: Infrastructure Australia analysis of data from Veitch Lister Consulting (2014e)

4.6.1.5 Rail trips in greater Perth

Table 65 shows the top five SA3 regions for passenger hours travelled across the rail network in greater Perth. Perth City is the dominant O/D region, and is projected to remain so.

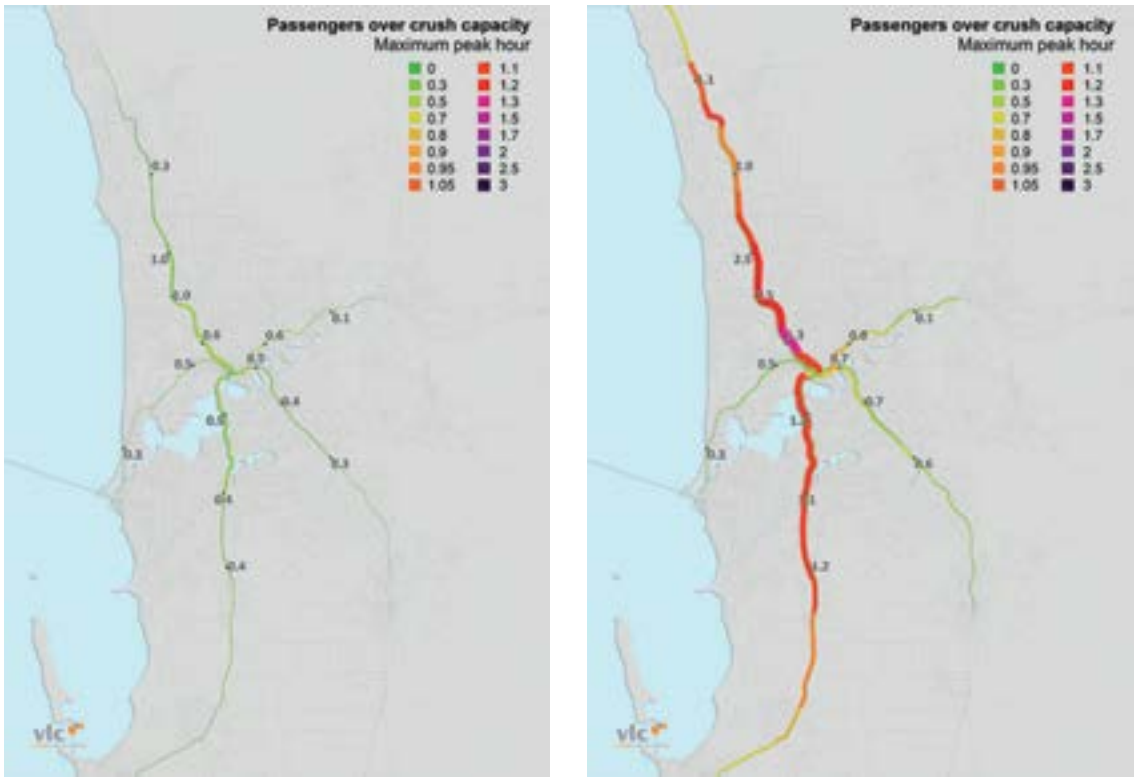
Table 65: Top 5 destinations in greater Perth for rail trips by passenger hours travelled (PHT), 2011 and projected 2031

	Perth City	Joondalup	Wanneroo	Cottesloe	Gosnells
2011	22,816	4,195	2,777	2,384	2,290
2031	53,212	9,730	17,983	5,019	5,551

Source: Veitch Lister Consulting (2014e)

Figure 86 shows that passenger loadings on Perth's rail corridors are projected to increase over time, reaching or exceeding crush capacity on the Joondalup and Mandurah lines by 2031.

Figure 86: Perth rail network weekday passenger demand relative to crush capacity in 2011 and projected in 2031



Source: Veitch Lister Consulting (2014e)

4.6.1.6 Bus trips in greater Perth

Table 66 shows the top five destination SA3 regions for bus trips in greater Perth by passenger hours travelled. Again, Perth City is the dominant O/D region.

Table 66: Top 5 destinations in greater Perth for bus trips by passenger hours travelled (PHT), 2011 and projected 2031

	Perth City	Stirling	Canning	Cottesloe	Belmont – Victoria Park
2011	15,421	5,908	4,861	3,081	2,994
2031	26,342	9,400	9,458	4,864	5,771

Source: Veitch Lister Consulting (2014e)

4.6.1.7 Freight movements in greater Perth

Table 67 shows the proportion of daily vehicle kilometres travelled by cars, light commercial vehicles and heavy commercial vehicles between major O/D pairs in the greater Perth region.

Commercial vehicles account for a significant proportion of traffic between Canning and Belmont-Victoria Park.

Table 67: Daily vehicle kilometres travelled by vehicle type 2011

		Utilisation (VKT/day)	Utilisation (VKT/day)	Utilisation (VKT/day)	LCV & HCV as % of daily VKT
From	**To**	**Car**	**LCV**	**HCV**	
Canning	Belmont – Victoria Park	255,705	20,725	13,510	11.8%
Stirling	Swan	318,353	19,642	8,899	8.2%
Wanneroo	Stirling	389,627	19,509	8,300	6.7%
Swan	Perth City	263,796	11,891	4,566	5.9%
Gosnells	Canning	340,424	14,232	6,878	5.8%
Belmont – Victoria Park	Perth City	271,759	10,818	4,453	5.3%
Stirling	Joondalup	533,625	17,134	5,429	4.1%
Wanneroo	Joondalup	663,661	19,971	7,018	3.9%
Stirling	Perth City	590,775	17,054	5,553	3.7%
Perth City	Cottesloe – Claremont	261,094	6,078	1,614	2.9%

Source: Infrastructure Australia analysis of data from Veitch Lister Consulting (2014e)

4.6.1.8 Regional Transport

The WA Department of Transport has developed a Regional Freight Transport Network Plan to ensure the state has an effective freight network and that key infrastructure can continue to meet the state's freight task to 2031 and beyond.

Key infrastructure to support the export of agricultural production includes common use facilities for airports and ports, roads, and industrial land for businesses to distribute products, including facilities such as cold storage.

The WA Department of Regional Development will be undertaking a detailed evaluation of its agricultural export infrastructure supply chain to identify infrastructure constraints to the efficient operation and expansion of the WA agrifood and fibre products sector. The evaluation will include identification of:

- supply chain infrastructure bottlenecks in moving agrifood products from farm and/or processing/packing/storage facilities to maritime and aviation export facilities; and
- other supply chain infrastructure bottlenecks such as industrial land, energy, water, telecommunications and technologies that could help with improved forecasting of production.

The evaluation is anticipated for completion in late 2015.

4.6.2 National highways

WA is the largest state geographically. Of Australia's 34,656 km of national highways (which include the National Land Transport Network highways and other key freight routes) identified in the Audit, 9,946 km (29 per cent) are in WA. This includes the following national highway links connecting the capital cities:

- Perth to Adelaide (Great Eastern Highway/Eyre Highway Routes 1 and 94); and
- Perth to Darwin (Great Northern Highway Routes 1 and 95).

Figure 87 shows the National Land Transport Network highways and the other key WA freight routes included in the Audit. Together these play an important role in facilitating industry and enabling of business and community activity.

Many of the more remote parts of central, eastern and north-western WA do not have national highways or designated key freight routes.

Figure 87: National Land Transport Network highways and key freight routes in Western Australia 2011

The map shows highways identified in the Audit. Data was not available for all of these highways.
Source: ACIL Allen Consulting (2014a)

Five per cent of WA's roads have a 1-star safety rating under the Australian Road Assessment Program (AusRAP), while 23 per cent are 2-star rated and 69 per cent are 3-star rated. The highest attainable rating is 5 stars.

The DEC of WA's national highways is projected to increase from $726 million in 2011 to $1.42 billion in 2031, a rise of 95 per cent. The largest economic contribution comes from the mining areas of Bunbury, Pilbara and Mid West, as well as Esperance, Gascoyne, Albany, where the DEC is projected to grow by 200 to 260 per cent from 2011 to 2031.

4.6.3 Freight rail

The DEC of freight rail in WA is projected to double from $2.74 billion in 2011 to $5.51 billion in 2031.

Mineral resources and agricultural industries in WA use national, state and privately owned rail lines to transport mainly bulk freight to ports. Transport to Fremantle Port from surrounding areas and the eastern states often uses the East West Corridor rail line, which is owned by the Australian Rail Track Corporation east of Kalgoorlie, and by the WA Government (leased to Brookfield Rail) west of Kalgoorlie.

The two key ports in the Pilbara are Port Dampier and Port Hedland. Private freight rail lines with direct access to these ports have been constructed by companies operating in the region. These direct links to the ports have contributed to substantial growth in exports of iron ore, crude oil and Liquefied Natural Gas (LNG).[403] The private rail infrastructure in the Pilbara has underpinned the performance of the ports.

The East West Corridor rail line is the backbone of interstate rail transportation of goods between Perth, Adelaide, Melbourne and Sydney. The transportation of bulk freight between Perth and

403. Western Australian Department of Transport (2013)

Kalgoorlie is expected to grow strongly. This will rely on WA's section of the East West Corridor.

The *Western Australia Regional Freight Transport Network Plan* forecasts that the rail freight task serviced by state-owned lines will more than double by 2031.[404] While the quality of the track and signalling system is regarded as sufficient for current usage, improvements will be needed to meet future capacity and efficiency requirements. Core challenges to upgrading or constructing freight rail lines are land costs, zoning requirements and meeting the varying needs of operators planning to use the line.[405] Despite these challenges, the importance of interstate rail will increase with the growing competition and the availability of intermodal ports. The existing rail infrastructure poses a constraint on the growth of interstate bulk goods transport, and could have a detrimental impact on the overall growth of the mineral resources and agricultural industries.

4.6.4 Ports

The DEC of WA's ports is projected to grow strongly from $4.85 billion in 2011 to $15.31 billion in 2031, an increase of more than 200 per cent.

In 2014, WA's eight port authorities were consolidated into five, including the Southern Ports Authority, Mid West Ports Authority, Kimberley Ports Authority and the Pilbara Ports Authority. The existing standalone Fremantle Port Authority is the fifth.[406] The aim of this consolidation was to improve the authorities' ability to undertake strategic development planning at the regional level and to better manage the risks associated with the operation of ports and shipping.

Capacity at WA's ports has been expanded substantially following the mining boom. Table 68 shows the throughput of the ports in 2012–13. New or improved facilities developed or in the pipeline include projects at Dampier, Port Hedland and Anketell.[407]

Table 68: Western Australia port tonnages – 2012–13

	Total Throughput (mass tonnes)				Containerised trade in TEU			
Port	**Imports**	**Exports**	**Total**	**Total as % of national total**	**Imports**	**Exports**	**Total**	**Total as % of national total**
Fremantle Ports	14,030,544	17,949,694	31,980,238	2.83%	343,900	326,382	670,282	9.36%
Esperance Ports	841,071	13,033,973	13,875,044	1.23%	16,290	16,431	32,721	0.46%
Broome Port Authority	239,696	49,874	289,570	0.03%	2,069	2,370	4,439	0.06%
Port Hedland Port Authority	1,938,347	286,504,692	288,443,039	25.55%	1,363	129	1,492	0.02%
Dampier Port Authority	509,368	179,856,505	180,365,873	15.98%	0	0	0	0.00%
Geraldton Port Authority	632,330	14,812,513	15,444,843	1.37%	0	0	0	0.00%
Bunbury Port Authority	1,716,047	13,615,859	15,331,906	1.36%	0	0	0	0.00%
Albany Port Authority	121,412	3,979,222	4,100,634	0.36%	0	0	0	0.00%
Western Australia Total	**20,028,815**	**529,802,332**	**549,831,147**	**48.70%**	**363,622**	**345,312**	**708,934**	**9.89%**

Source: Ports Australia (2014a)[408]

However, even allowing for existing spare capacity, the projected growth in DEC for both the Fremantle and Pilbara ports indicates a need for additional infrastructure. In the case of the Pilbara ports, this is likely to be met by private capital. The Port of Fremantle is held by the WA Government, although there is also significant privately owned infrastructure.

Fremantle

Fremantle is the primary container port for the west coast, accounting for 78 per cent of WA's imports.[409] It had a DEC of $2.65 billion in 2011, which is projected to grow by 140 per cent to $6.36 billion in 2031. Fremantle is a mixed use port handling containers, 10 Mtpa of bulk liquids (crude and refined oil imports and exports) and 9.3 Mtpa of mixed bulk. Fremantle's annual container capacity is 1.2-1.4 million twenty foot equivalent units (TEU), only 50 per cent of which was utilised in 2011. It is forecast to have the strongest growth rate in the country, apart from the bulk commodity Pilbara ports.

404. Western Australian Department of Transport (2013)
405. Freight and Logistics Council of Western Australia (2013)
406. Western Australian Department of Transport (2015)
407. Western Australian Department of Transport (2014)
408. State totals include small ports not specifically listed, but not Port Walcott (also known as Cape Lambert), a privately owned port which exported 85 million tonnes in 2012–13.
409. Ports Australia (2014b)

Pilbara ports

The three Pilbara ports (Hedland, Dampier and Walcott) exported 420 million tonnes of iron ore in 2011. The combined DEC of these ports is projected to grow by almost 350 per cent from $1.85 billion to $8.28 billion over the period to 2031. This is an exceptionally strong rate of increase, even in the national context, resulting from forecast growth in iron ore exports, which are projected to increase at an average annual rate of 6.9 per cent.

Liquefied Natural Gas is another important trade in the Pilbara, which is set to grow significantly in coming years.

Other ports are smaller. Esperance handles iron ore and grain, Albany handles wood chips and grain, and Bunbury handles alumina, woodchips and caustic soda imports. Geraldton handles iron ore and grain, and Broome handles petroleum imports, livestock exports, and services the offshore oil and gas industry.

4.6.5 Airports

Perth Airport is the fourth busiest in the country, with DEC projected to increase by 169 per cent from $1.89 billion in 2011 to $5.08 billion in 2031. The airport faces capacity challenges related to rapidly rising demand created by the resources boom. The airport operator's draft master plan[410] forecasts passenger numbers will more than double from 13.7 million in 2013 to 28.5 million in 2034. The DEC is projected to increase at a rate of 5.1 per cent per year.

In order to respond to this rapid increase in demand, the master plan identifies construction of a parallel runway, a new domestic terminal and a multi-storey car park, and expansion of T2 terminal. Airport roads are being upgraded and further improvements to airport access are planned, through improved road access (Perth Gateway) and a proposed new airport rail link to Perth CBD.

Regional airports will continue to play a role in enabling ongoing regional development in Western Australia. Tourism will be an important driver for regional development. Better connections and developed regional airport infrastructure will enhance regional economics and create jobs in regional areas. The many smaller airports and air strips in WA play an important social and community role in supporting regional cohesion. Nearly all of these smaller airports are owned by local government, with many requiring subsidies for operations and maintenance.

A large part of the state's domestic air travel is to and from Perth from the northern airports serving the mining industry, which employs large numbers of fly-in /fly-out workers. The DEC of these fly-in /fly-out operations to the state's economy was about $0.5 billion in 2011. Passenger numbers at Karratha Airport are forecast[411] to increase to around 1.75 million by 2032, up from 728,000 in 2013/14.

Broome international airport services a growing number of tourists travelling to the northern regions of WA. This market is likely to become more important for these local economies. Passenger numbers at Broome Airport are forecast to increase from 410,000 in 2013–14 to around 820,000 by 2025.[412]

Table 69: Western Australia airport passenger and freight volumes – 2013–14

	Revenue passenger (No.)				International Freight (tonnes)			
Airport	Domestic (incl. Regional) Airlines	International Airlines	Total passengers	Total as % of national total	Inbound	Outbound	Total	Total as % of national total
Perth	8,880,149	4,056,341	12,936,490	8.83%	41,298	38,783	80,081	3.75%
Karratha	727,798	0	727,798	0.50%	0	0	0	0.00%
Port Hedland	504,659	0	504,659	0.34%	0	0	0	0.00%
Broome	410,618	0	410,618	0.28%	0	0	0	0.00%
Newman	408,332	0	408,332	0.28%	0	0	0	0.00%
Kalgoorlie	237,396	0	237,396	0.16%	0	0	0	0.00%
Paraburdoo	209,087	0	209,087	0.14%	0	0	0	0.00%

Source: Bureau of Infrastructure, Transport and Regional Economics (2014i)

410. Perth Airport (2014)
411. Karratha Airport (2013)
412. Broome International Airport (2008)

4.7 Energy

4.7.1 Electricity

The Audit found that, in 2011, WA had an installed electricity generation capacity of 6,224 MW. Transmission peak demand was 3,581 MW and distribution peak demand was 3,696 MW. The utilisation of electricity in WA in 2011 was 18,814 GWh for generation, 17,838 GWh for transmission and 18,270 GWh for distribution.

The DEC from electricity infrastructure in 2011 was $2.3 billion. The Audit forecasts a 31 per cent increase in the use of electricity from 2011 to 2031. This equates to 24,469 GWh for generation, 23,374 GWh for transmission and 24,132 GWh for distribution by 2031. Based on these forecasts, the Audit projects a 121 per cent increase in the DEC of electricity infrastructure to $5.2 billion in 2031.

The Independent Market Operator of WA (IMO) forecast[413] an increase in annual electricity from 17,930 GWh in 2011, and 18,324 GWh in 2013–14, to 21,984 GWh in 2023–24 in the Wholesale Electricity Market (WEM). Although the IMO only forecasts 10 years ahead, this is broadly consistent with Audit projections.

However, the IMO forecast cannot be compared directly with the Audit's projections for DEC. The IMO reports and forecasts unit electricity consumption in gigawatt-hours, whereas DEC is a measure of the value-add provided by electricity infrastructure, expressed in dollar terms. The two are not necessarily perfectly correlated. Nonetheless, unlike most other jurisdictions, both the regulator and the Audit project a rise in electricity consumption in the years ahead as WA's population grows more quickly than elsewhere.

Several new generation assets were built on the basis of the expected growth in demand, such as the Bluewaters power station in WA in 2009. This has led to a surplus of generation capacity, which will lead to higher retailer prices. This is because the WEM, unlike the NEM, is a capacity market where generators are provided with a fixed payment for the provision of capacity.

The Large-scale Renewable Energy Target (and the previous Renewable Energy Target) have led to a substantial increase in the penetration of wind farms across the Australia. This has led to growth in installed wind capacity in WA, including the 206 MW Collgar wind farm, one of the largest wind farms in Australia. At the same time, the Small-scale Renewable Energy Scheme, feed-in tariffs and other solar photovoltaic (PV) subsidies have led to a significant increase in the penetration of solar PV systems in the last five years. In WA, the capacity of installed solar PV has increased from 18 MW at the start of 2010 to 427 MW as of October 2014 and the IMO forecast a rise to around 1,090 MW in 2023–24.

The combination of flattening growth in demand and rising penetration of renewables has led to an ongoing structural change in the wholesale sector.

At the same time, there have been considerable rises in network charges in the WEM. These rising network charges have in turn influenced retail prices, creating an impetus for regulators to investigate options that may diminish, or delay, further expansion of the network. There have been significant changes in WA, including:

- The announcement of a merger of the government-owned entities of Synergy, an electricity retailer, and Verve, a generator. The objective is to facilitate cost savings and encourage private sector investment in the future.
- The government's current electricity market review, which is being undertaken to examine market structure and options for reform that can reduce the cost of supplying electricity and encourage private sector investment in the WEM.

The implications of surplus capacity differ by sector. For the generation sector, surplus capacity and renewable policy settings are likely to lessen the need for new capacity. IMO has assessed that no new capacity will be required through to 2020–21 in the WEM, or through to 2018–19 if Kwinana Stage C is decommissioned, based on existing supply and demand conditions.

For the network sector, the decline in demand has lessened the need for augmentation investment. However, Western Power has foreshadowed the need for a number of network augmentation investments over the next five years.[414]

4.7.2 Gas

In 2011, WA gas transmission pipelines had an annual throughput of 387 petajoules (PJ). Gas distribution pipelines had an annual throughput of 28 PJ.

The main pipelines in WA are the Dampier to Bunbury Pipeline, the Parmelia pipeline and the Goldfields Pipeline. Pipelines delivering natural gas to processing plants from offshore LNG facilities off WA's coastline were not included in the Audit.

The DEC from gas pipelines in WA in 2011 was estimated at $622 million – made up of $528 million from transmission and $94 million from distribution.

413. Independent Market Operator (2014a)
414. Western Power (2015)

The Audit projects an increase of 50 per cent in the DEC of gas pipeline infrastructure to $931 million by 2031. This $308 million increase is made up of $247 million from transmission and $63 million from distribution pipelines. This increase projected in DEC is considerably slower than expected economic growth of 131 per cent for WA over the period.

In its latest *Statement of Opportunities*,[415] the IMO identified an increase in domestic gas demand from 980 terajoules (TJ) per day in 2014 to 1,055 TJ per day in 2024.

As with electricity, there are several reasons why it is difficult to make a direct comparison between the Audit's forecast rise in DEC in the gas sector, and IMO's demand forecast. In particular, the DEC analysis was finalised before the latest IMO gas market forecasts were published. Also, IMO reports and forecasts gas consumption in TJ per day, whereas DEC is a measure of the value-add provided by gas infrastructure, in dollars. The two are not necessarily perfectly correlated.

Unlike eastern Australia, WA has historically exported a significant proportion of its gas production to Asia via LNG terminals. In fact, the North West joint venture located off the north-west coast of Australia is one of the largest LNG producers in the world. The ability to export gas has meant that the gas price in WA has been more aligned with international gas prices than the market in eastern Australia, if not fully so due to a requirement to sell a share to the domestic market.

The domestic and international gas prices are likely to be more aligned in the future as spare capacity in the North West Shelf means that previously domestic-only producers may use the North West Shelf plants to export their gas as LNG.

The WA gas market is self-contained and is not connected with other jurisdictions. WA has the largest source of conventional gas reserves in Australia, with the main gas fields located in the Carnarvon Basin, with 71,855 PJ of proven and probable of conventional gas reserves, and the Browse Basin, with 17,384 PJ of proven and probable of conventional gas reserves.[416]

There is wide acknowledgement of an ongoing structural shift in the gas market as Australia significantly expands its ability to export gas. There is also uncertainty about whether existing gas market and regulatory frameworks are well suited to handle the shift. Within this context, the AEMC recently conducted a gas market scoping study, which recommended Australia conduct a strategic review of the gas sector, including a review of future market developments over the next 10 to 15 years and a review of the short-term trading market and the declared wholesale gas market.

4.7.3 Petroleum

The petroleum industry is broadly split into upstream and downstream petroleum sectors. The upstream sector refers to exploration and production of crude oil while downstream refers to refining of crude oil and the distribution and sale of petroleum products.

In 2011, consumption of petroleum products in WA was 7,952 ML. Total throughput at petroleum terminals was 14,313 ML. The DEC of petroleum terminals was $195 million and is projected to almost double to $383 million in 2031.

The Audit identifies one refinery in WA – BP's facility at Kwinana. In 2011, BP Kwinana had a throughput of 7,960 ML per year.

The Audit projects an increase in throughput of 3.4 per cent per year in WA. This equates to throughput of 28,133 ML per year by 2031 – an increase of 13,820 ML per year.

4.7.3.1 Crude oil production

Australia's total production of crude oil has been steadily declining. Crude oil production peaked in 2000 at 722 kb/day and declined to just over 338 kb/day in 2013.[417] Oil production is forecast to decline at an annual average rate of 4.4 per cent from 2014–15 to 2049–50.[418] The majority of production comes from two major basins: the Carnarvon Basin in WA (77 per cent of production in 2011), and the Gippsland Basin in Victoria (less than 15 per cent of production in 2011). The majority of crude oil production in WA is exported to Asia.

4.7.3.2 Refinery capabilities

In recent years the global oil refining industry has been undergoing significant structural change. Larger, more efficient 'mega-refineries' have been established in Asia, resulting in increased competitive pressures on established refining operations, including those in Australia. As noted above, WA has one refinery, located in Kwinana and operated by BP.

415. Independent Market Operator (2014b)
416. National Australia Bank (2014), p. 4
417. United States Energy Information Administration (2013)
418. Bureau of Resources and Energy Economics (2011)

In 2013–14, 82 per cent of crude oil and other refinery feedstock was imported.[419] It is unlikely there will be any new refinery capacity developed in Australia in the foreseeable future.

4.7.3.3 Petroleum products

Domestic demand for petroleum products grew at an average annual rate of around 1.5 per cent in the decade to 2011–12. It is expected to grow by around one per cent per year through to 2049–50, largely driven by population and economic growth. However, energy intensity (measured by total domestic energy consumption per dollar of gross domestic product) is projected to decline by around 1.7 per cent per year over the same period, compared to a decline of 1.3 per cent from 1989–90 to 2009–10. This indicates accelerating improvement in energy efficiency. The transport sector uses more than 60 per cent of all petroleum consumed in Australia, and is the primary driver of demand growth. In addition, the expansion of the mining sector has contributed significantly to increased demand for diesel.[420]

Imported refined petroleum products account for approximately 40 per cent of total domestic consumption, and this share is forecast to rise. Refined petroleum products are imported from more than 20 countries, but 80 per cent of all such products come from just three: Singapore (53 per cent), South Korea (18 per cent) and Japan (12 per cent).[421]

Demand for petroleum import facilities and the need for additional import infrastructure within WA is expected to grow.

4.8 Telecommunications

The DEC of telecommunications infrastructure in WA is projected to increase from $1.4 billion in 2011 to $3.7 billion in 2031, a 171 per cent rise.

In WA, 91 per cent of premises have access to ADSL, 78 per cent have 3G mobile coverage, 41 per cent have 4G coverage, eight per cent have access to hybrid-fibre co-axial (HFC) and three per cent have access to fibre to the premises.[422] Less than one per cent of premises in WA have National Broadband Network access, although this is likely to increase rapidly.

WA has a higher share of areas with poor access to quality broadband services than most other states, with a significantly higher share of premises receiving either the lowest or second lowest level of service than any of the larger states. In regional WA this poorer access impacts negatively on education services and business, creating barriers to development and difficulties in accessing services.

The Nextgen Group (Nextgen), are currently constructing a North West Cable System which will be Australia's first purpose built subsea fibre optic network for the oil and gas industry. The cable system will connect offshore oil and gas facilities in the Browse, Bonaparte and Carnarvon Basins to onshore locations, including data centres and business headquarters. Specifically the project will deliver:

- 2,100 kilometre (km) of fibre between landing stations in Port Hedland and Darwin;
- branching units and riser cables to the oil and gas platforms; and
- terrestrial optical fibre connectivity to the rest of Australia from competitive points of interconnection in Port Hedland and Darwin.

The subsea cable system will be built, owned and operated by Nextgen, a national telecommunications operator with Australia's second biggest long haul optical fibre network of more than 17,000 km. The North West Cable System is scheduled for completion in the first half of 2016.

WA is also exploring the potential viability of co-investment with private industry for inland fibre optic cable systems in the Pilbara, Midwest and Goldfields.

4.9 Water

The DEC for water and sewerage infrastructure in WA is projected to increase by 96 per cent to $3.1 billion between 2011 and 2031. The Audit identified that 243 GL of water was supplied to Perth in 2011 and 210 GL to other regions. A total of 127 GL of sewage was collected in Great Perth in 2011, and 11 GL in other regions.

The highest projected growth in water and sewerage DEC is in greater Perth, where DEC is projected to grow by $1.3 billion from 2011 to $2.5 billion in 2031. In the regional areas DEC is projected to grow by $260 million to $691 million in 2031.

It is important to note that water and sewerage services have historically been under-priced, particularly in regional areas, and that this has potentially led to an understatement of DEC, which is derived from the National Water Commission data.

In regional areas the under-pricing of water and sewerage services means that the return on the capital base is a long way below the level needed to fund the full replacement cost of assets.

419. Carson, L. (2014), p. 108
420. Bureau of Resources and Energy Economics (2014a)
421. Australian Institute of Petroleum (2013a)
422. Department of Communications (2013)

4.9.1 Greater Perth region

In 2013, total water consumption for the greater Perth region was approximately 470 GL. This comprised about 225 GL of private water supply, 240 GL of public water supply through Water Corporation of Western Australia, and a further 5 GL of recycled water supplied to industry in Kwinana from the Water Corporation's Kwinana Water Recycling Plant. Average domestic water use decreased from 191 kL per person per year in 2001 to 131 kL per person per year in 2013–14.[423] Despite this, Perth remains one of the highest water using cities in Australia. The main source of water supply for Perth is groundwater, with less than a quarter of the total water source coming from surface water. Current supply is sufficient to meet demand under average climatic conditions, and recent construction of desalination plants has increased the resilience of supply in relation to drought. However, further augmentation will be required beyond 2020 to address population growth and address climatic variability. In the Kwinana Industrial Area and the Rockingham Industrial Zone, readily accessible water supplies are not sufficient to meet projected long-term demand for industry. An assessment of alternative water supply options including managed aquifer recharge of treated wastewater will be completed in 2015.

Key drivers of demand are the region's population (which is projected to grow at a rate of 2.5 per cent per year), and changes in climate over several decades. The Water Corporation is operating under medium- and long-term water security plans for Perth, including *Water Forever − Our 10 year Plan for Perth, Water Forever − Our 50 year Plan* and *Water Forever − Water Recycling and Efficiency*. The goals for 2030 under these plans are to:

- reduce water use by 15 per cent − by working with households, businesses and communities;
- increase water recycling to 30 per cent − by increasing the use of recycled water in parks, gardens and industry; and
- develop up to 100 GL of new water sources − desalination, groundwater replenishment and secure groundwater sources are all important sources to secure Perth's future water supply.

In particular, *Water Forever − Our 10 year Plan for Perth* aims to sustainably drought-proof Perth by 2022, by:

- expanding the Southern Seawater Desalination Plant;
- transferring groundwater abstraction to the deeper aquifers to protect the groundwater environment and secure groundwater supplies;
- replenishing deep aquifers with recycled water through a new groundwater replenishment scheme, subject to receiving necessary approvals;
- continuing to make gains in water use efficiency while preserving an outdoor lifestyle and enabling continued growth; and
- using wastewater recycling as a resource for industry, public open spaces and agriculture.

A $4.37 billion investment plan over 10 years has been developed to implement these initiatives.

4.9.2 Wheatbelt region

The Wheatbelt region east of the Darling Scarp is mainly used for dryland agriculture and is located over ancient hard rock which does not hold reliable quantities of freshwater. Towns in this area are serviced by the Goldfields Agricultural Supply Scheme and the Great Southern Towns Water Supply Scheme. Settlement outside the range of these schemes relies on rainwater collection, groundwater, strategic community water supply facilities and non-strategic Agricultural Area Dams.[424]

Large reserves of easily accessible, high-quality groundwater support irrigated agriculture in the portion of the Wheatbelt region that is west of the Darling Scarp. Water is available from the Gingin and Jurien groundwater areas to support growth of towns in this part of the region.

Broadly, the Wheatbelt region's demand for water is adequately supplied. However, when demand nears the current supply capacity of the three systems, only the Goldfields Agricultural Supply Scheme and the groundwater aquifers west of the Darling Scarp have capacity to expand. The Great Southern Towns Water Supply Scheme has limited capacity to expand, mainly due to financial factors.

4.9.3 Kimberley region

The Kimberley region consists of the main townships of Broome, Derby, Fitzroy Crossing, Halls Creek, Kununurra and Wyndham. The total water used from town water supply schemes in 2013 for the region was 8.7 GL, which averages around 220 KL per person per year.

In addition, a major water infrastructure component of the region is the Ord River Irrigation Scheme (the Ord).

423. Water Corporation (2014)
424. Wheatbelt Development Commission (2013)

4.9.4 Pilbara region

The Pilbara region is extremely important to the state's (and the nation's) economy, being home to major industrial projects, mainly in the iron ore and oil and gas sectors. The Pilbara has WA's highest average volume of water supplied per capita, at 480 kL per year, due in part to its high average temperatures. Water supply to the region's towns and ports totals 22.7 GL per year. Recently upgraded water supplies for the West Pilbara and Port Hedland town water supply schemes are sufficient to meet short-term demand. A reduction in the growth outlook for mining is likely to delay the need for further supply augmentation in the short to medium term for these towns. A brackish groundwater source and desalination plant is being developed to meet growth in demand for Onslow. The Water Corporation, under its 2012 *Water Forever Whatever the Weather – A 10-year plan for Western Australia* plans to spend $980 million over the next 10 years to upgrade major water and wastewater systems in the region and to encourage increased use of recycled water to cater for future growth.

A number of studies have been completed by the WA State Government to identify water supply opportunities in the Pilbara to support economic development and diversification in the region. The *Pilbara Integrated Water Supply Pre-Feasibility Study* (Department of Water, WA 2009) identified several water supply options, including the use of surplus mine dewater for irrigated agriculture.

In November 2013, the WA Government approved $12.5 million through the Royalties for Regions for the Pilbara Hinterland Agricultural Development Initiative to investigate the use of surplus mine dewater for irrigated agriculture in the Pilbara, and provide the baseline knowledge to inform future development decisions by government and/or private industry. Pilbara Hinterland Agricultural Development Initiative is being implemented by the Department of Agriculture and Food WA and due for completion in late 2018.

4.9.5 Other regions

Other regions supplied by Water Corporation include:

- Gascoyne − 2.1 GL per year;
- Mid West − 13.2 GL per year;
- Goldfields/Esperance − 14.1 GL per year;
- South West − 13.9 GL per year; and
- Great Southern − 8 GL per year.

Traditional sources, such as dams and groundwater, will continue to underpin water supplies for many WA towns in these regions. Climate independent water sources are used by towns connected to the Perth integrated water supply scheme and are currently accessing water from the Southern Seawater desalination plant (in Binningup) and Perth desalination plant (in Kwinana). These sources are often developed in conjunction with water efficiency programs and new water recycling initiatives. The Water Corporation is also investigating the interconnection of some discrete water schemes to provide greater flexibility in water supply options.

Audit observations – South Australia

5.1 Structure of this chapter

This chapter presents observations from the Audit for the four infrastructure sectors – transport, energy, telecommunications and water – across South Australia (SA). It provides data about the state's population and economy (i.e. the key drivers of demand for infrastructure), and the value-add attributable to SA infrastructure, in 2011. It also outlines growth projections to 2031 for the state's population and economy, and for each of the infrastructure sectors. As noted in the Introduction to this report, these projections are based on economic and demographic analysis set out in two associated studies.[425]

The Audit uses the Direct Economic Contribution (DEC) methodology to quantify both the value-add attributable to infrastructure in 2011, and the projected change in overall demand for infrastructure from 2011 to 2031. When considered in the light of other factors, such as capacity limitations which might constrain economic growth, this approach helps to identify locations and sectors that are likely to warrant further attention in the Australian Infrastructure Plan (the Plan).

This chapter also takes account of other documents, including plans, studies and strategies, prepared by the SA Government and others.

Table 70: Projected population and economic growth for South Australia

	2011	% of National	2031	% of National	Increase % 2011–31
Population (persons)	1,639,614	7.3%	1,971,779	6.5%	20%
Gross State Product ($m)	89,789	6.4%	138,938	5.4%	55%

Source: ACIL Allen Consulting (2014a)[426]

5.2 Drivers of infrastructure demand − population and economy

Both economic and population growth in SA are projected to be slower than for Australia as a whole. As a result, its share of both is projected to decline.

The SA Government's medium level projection for the state's population in 2031 is 2.02 million, approximately two per cent higher than the projection by the Australian Bureau of Statistics.[427]

The SA Government's draft *Integrated Transport and Land Use Plan* for the state (the draft plan) notes that 82 per cent of the state's population lives in greater Adelaide.[428] Both the ABS

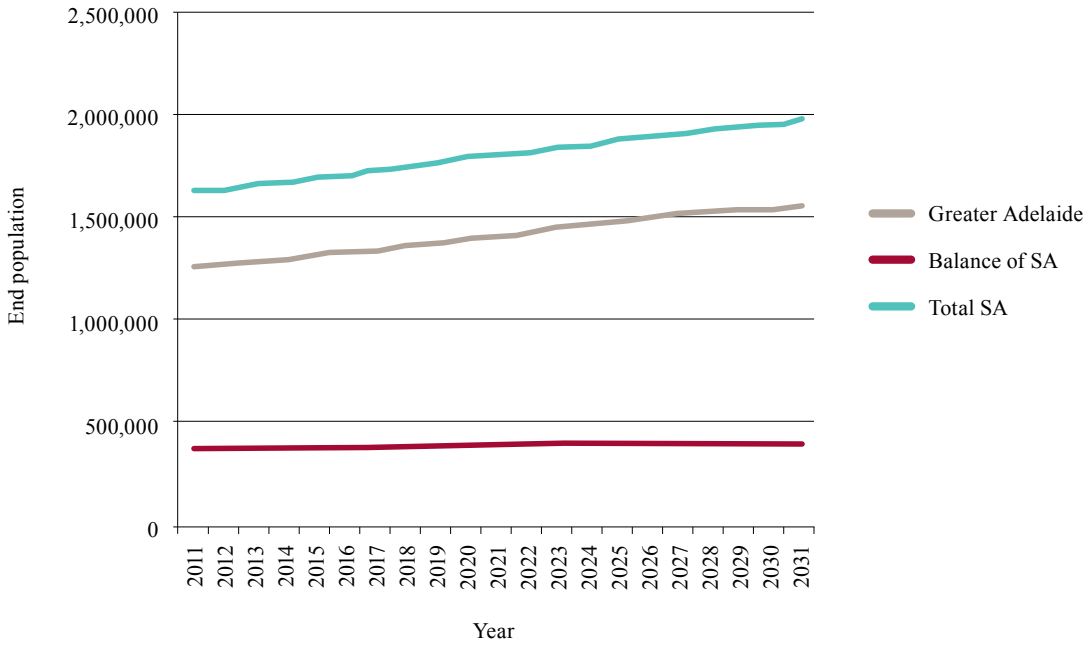
425. ACIL Allen Consulting (2014a) and Infrastructure Australia (2015b)
426. Gross State Product is in 2010–11 prices.
427. The projections were released in December 2010, prior to the 2011 Census.
428. South Australian Department of Planning, Transport and Infrastructure (2013), p. 31

projections and the SA Government's draft plan indicate that population growth will be predominantly in the greater Adelaide region.

Figure 88 shows that Adelaide is projected to account for the majority of SA population growth.

The SA Government's draft plan indicates that in each of six regions outside greater Adelaide, population growth between 2011 and 2036 is typically expected to be around 5,000 people.[429] Further detail is provided in the Audit paper on population estimates and projections.[430]

Figure 88: Population projections for South Australia, 2011–31



Source: Australian Bureau of Statistics (2013c) [431]

429. The SA Government uses these regions for its planning purposes. The expected regional population increases range from around 1,500 on Kangaroo Island to approximately 8,000 in the Far North region.
430. Infrastructure Australia (2015b)
431. Series B (medium level) projections.

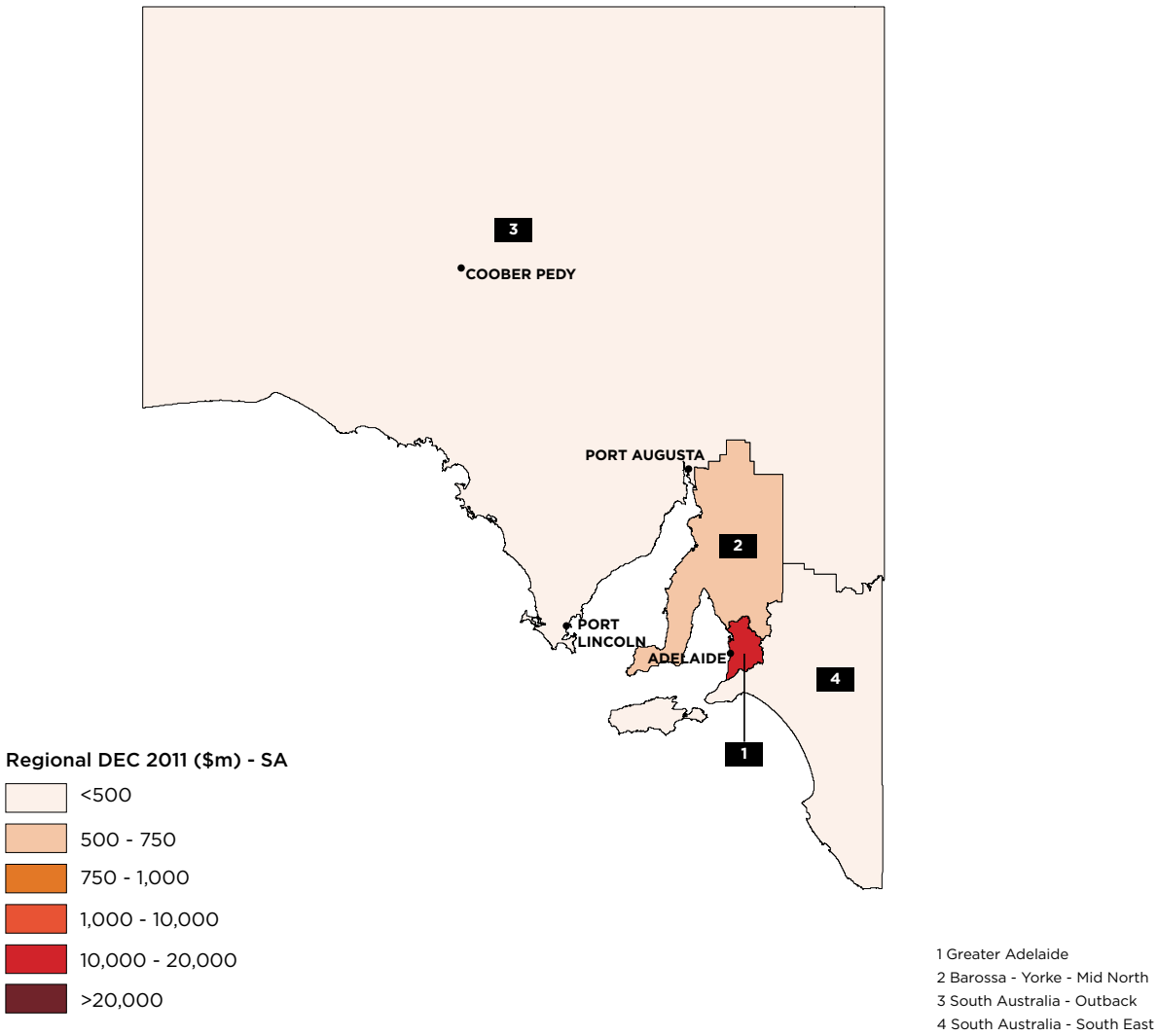
5.3 Summary of South Australia infrastructure from 2011 to 2031

In 2011 the DEC of infrastructure in SA was $14 billion, which was seven per cent of the national figure. Figure 89 shows SA DEC for 2011 in the context of the four regions identified for the Audit (the Audit regions).

By 2031, SA infrastructure DEC is projected to increase by around $10 billion, or 71 per cent, to $23 billion. This would represent six per cent of the national DEC. Figure 90 shows projected SA DEC by Audit region in 2031.

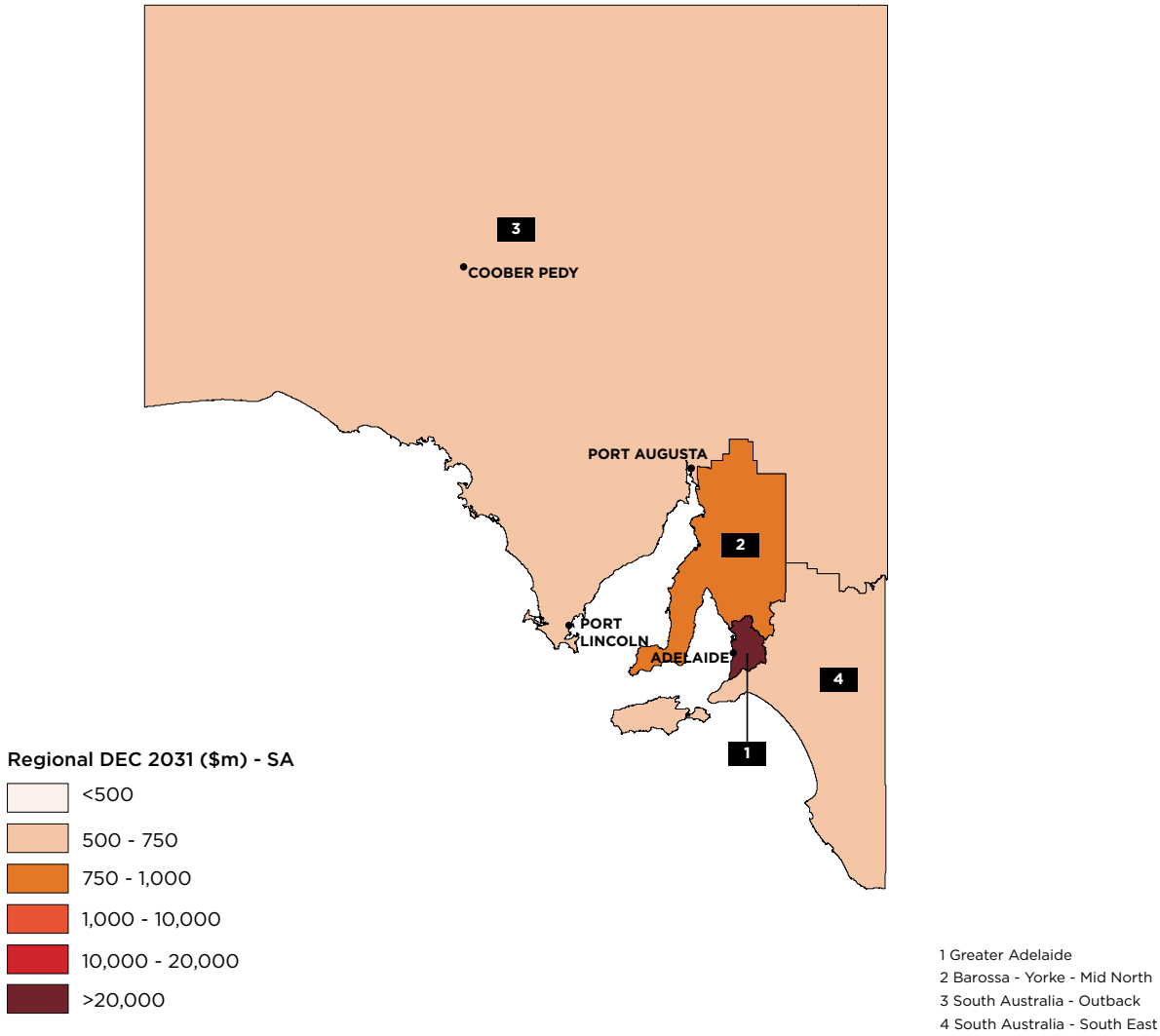
Growth in the DEC of SA infrastructure is projected to be fastest in the greater Adelaide region, where it is projected to grow by 74 per cent from $12 billion to $21 billion over the 2011–31 period.

Figure 89: Direct Economic Contribution of infrastructure in South Australia, 2011



Source: ACIL Allen Consulting (2014a)

Figure 90: Projected Direct Economic Contribution of infrastructure in South Australia, 2031



Source: ACIL Allen Consulting (2014a)

Table 71 provides a snapshot of SA economic infrastructure across the four sectors of transport, water, energy and telecommunications. The table notes the capacity of each subsector in general terms and its rate of utilisation in 2011, along with historical (2011) and projected (2031) DEC for each subsector.

Table 71: Overview of South Australian infrastructure

	Subsector	Capacity 2011	% of Nat.	Utilisation 2011	% of Nat.	DEC 2011	% of Nat.	DEC 2031	% of Nat.	Projected % increase in DEC 2011-2031
Transport	Urban Roads	**169,400,000** Car VKT per day	8%	**28,200,000** Car VKT per day	7%	$6,705m	9%	$12,373m	7%	85%
	Urban Public Transport	**10,000,000** Passenger KT per day	4%	**1,700,000** Passenger KT per day	3%					
	National Highways	**3,860** km of nationally significant roads	11%	**68,110** vehicles per day	4%	$511m	5%	$722m	5%	41%
	Freight Rail	n/a	n/a	n/a	n/a	$13m	<1%	$15m	<1%	20%
	Ports	**42** Mt p.a. throughput	3%	**38** Mt p.a. throughput	4%	$1,088m	5%	$1,611m	4%	48%
		0.6 MTEU throughput	5%	**0.3** MTEU throughput	4%					
	Airports	**21** Count of airfields	8%	**7,807,595** Total RPT passenger movements (millions)	6%	$1,687m	8%	$2,854m	7%	69%
Energy	Electricity	**4,438** Installed capacity (MW) of Generation	8%	**12,960** Utilisation of Generation (GWh)	2%	$990m	6%	$1,571m	6%	59%
		3,477 Peak Demand Transmission (MW)	8%	**13,045** Utilisation of Transmission (GWh)						
		3,031 Peak Demand Distribution (MW)	8%	**11,093** Utilisation of Distribution (GWh)						
	Gas	n/a	n/a	**116.57** Transmission throughput (PJ/a)	9%	$86m	8%	$105m	3%	23%
		n/a	n/a	**22.00** Distribution throughput (PJ/a)	6%	$151m	13%	$185m	12%	23%
	Petroleum product terminals	n/a	n/a	**2,928** Annual throughput (ML)	4%	$40m	4%	$52m	3%	32%
Telecommunications		**4.42** Broadband average availability rating (out of 5)	n/a	**452**	n/a	$1,313m	6%	$2,307m	5%	76%
		1.76 Broadband average quality rating (out of 5)	n/a	Total households with broadband internet access at home (‘000)						
Water & Sewerage	Water	**10,357** Length of water mains (km)	5%	**204,215** Water supplied (ML)	3%	$947m	9%	$1,364m	9%	44%
		2,002 Volume of water stored in dams (GL)	3%	**736** Properties served – water (‘000)	9%					
	Sewerage	**100,000** Desalination capacity (ML)	19%	**93,348** Sewage collected (ML)	5%					
		7,700 Length of sewer mains (km)	6%	**591** Properties served – sewerage (‘000)	8%					

Source: ACIL Allen Consulting (2014a)[432]

432. DEC figures are rounded to the nearest $ million, so percentage changes may not tally exactly with rounded estimates in this table. See Glossary for explanation of abbreviations and terms.

5.4 South Australian plans and strategies

South Australia's Strategic Plan[433] is the overarching plan for the state. It provides a comprehensive statement about what SA's private and public sectors and the general community should strive to achieve in terms of social, educational, legal, cultural, economic, business, health, mining, public administration and governance goals and objectives. The SA Premier has also nominated seven priorities for action to focus and guide the government's work in delivering the Strategic Plan.

The *Planning Strategy for South Australia*[434] (incorporating the *30 Year Plan for Greater Adelaide*[435] and plans for regional SA), along with the *Integrated Transport and Land Use Plan*[436] (ITLUP), the *Regional Mining and Infrastructure Plan*[437] and the *Strategic Infrastructure Plan for South Australia Discussion Paper*[438] collectively form a coordinated series of plans for land use, transport and infrastructure planning and investment over the next 30 years.

These plans aim to consolidate both population and employment growth in the established parts of Adelaide.[439]

5.5 Remote Indigenous services in South Australia

As discussed in Section 5.1.3 in Volume 1, infrastructure provision is a critical issue for remote Indigenous communities, with many areas lacking even basic services. Improving the delivery of infrastructure to these areas can bring considerable social benefits in terms of access to services and economic opportunities, and is fundamental to the governments' broader agenda of *Closing the Gap in Indigenous Disadvantage*.

The majority of the remote Indigenous communities in SA are concentrated in the north-west of the state, however there are several smaller communities near the coast in the south. While some of these communities are relatively close to the economic centre of Adelaide, many others are more than 1,000 kilometres from the state's capital. This reinforces the need for considerable investment in essential infrastructure to ensure Indigenous people in these areas have access to services that can support better health, education and employment outcomes in their communities.

5.6 Transport

5.6.1 Urban transport

For the urban transport component of the Audit, the top-down economic analysis used for the other sectors, which is based on national accounts and industry data, was complemented by bottom-up analysis based on detailed transport modelling for the six major capital cities.

This modelling provides detailed information about trips within these cities by origin/destination, and by corridor, in 2011. It takes account of projected population and employment growth and spatial distribution to project demand for trips, also by origin/destination and corridor, in 2031.

For both road and rail corridors the model includes detailed information about capacity, showing where demand is projected to grow in excess of supply. For road corridors it quantifies the cost of delay, showing where interventions will likely provide the biggest economic return. For rail corridors the model assumes minimal delay (i.e. all passengers are able to board the next available train). This is to ensure the model does not displace rail passengers, and thus shows the full extent of demand for the rail corridor.

This analysis facilitates identification of the corridors with the highest levels of economic activity, and the corridors in which capacity constraints and/or delays impose the highest economic cost. Given the absence of rail delay cost from the model, projected delay cost is at best an approximation. However, rail delay cost is unlikely to represent more than a small proportion of total delay cost for most corridors. As such, road delay cost is a reasonable proxy for delay cost for most corridors.

5.6.1.1 Urban transport in greater Adelaide

The DEC for urban transport in greater Adelaide is projected to grow from $7 billion in 2011 to $12 billion in 2031 − a growth rate of 3.1 per cent per year. The cost of delay on Adelaide's urban transport network in 2011 was around $1 billion. In the absence of any additional capacity (other than projects already under construction or funded), the cost of delay is projected to grow to $4 billion in 2031.

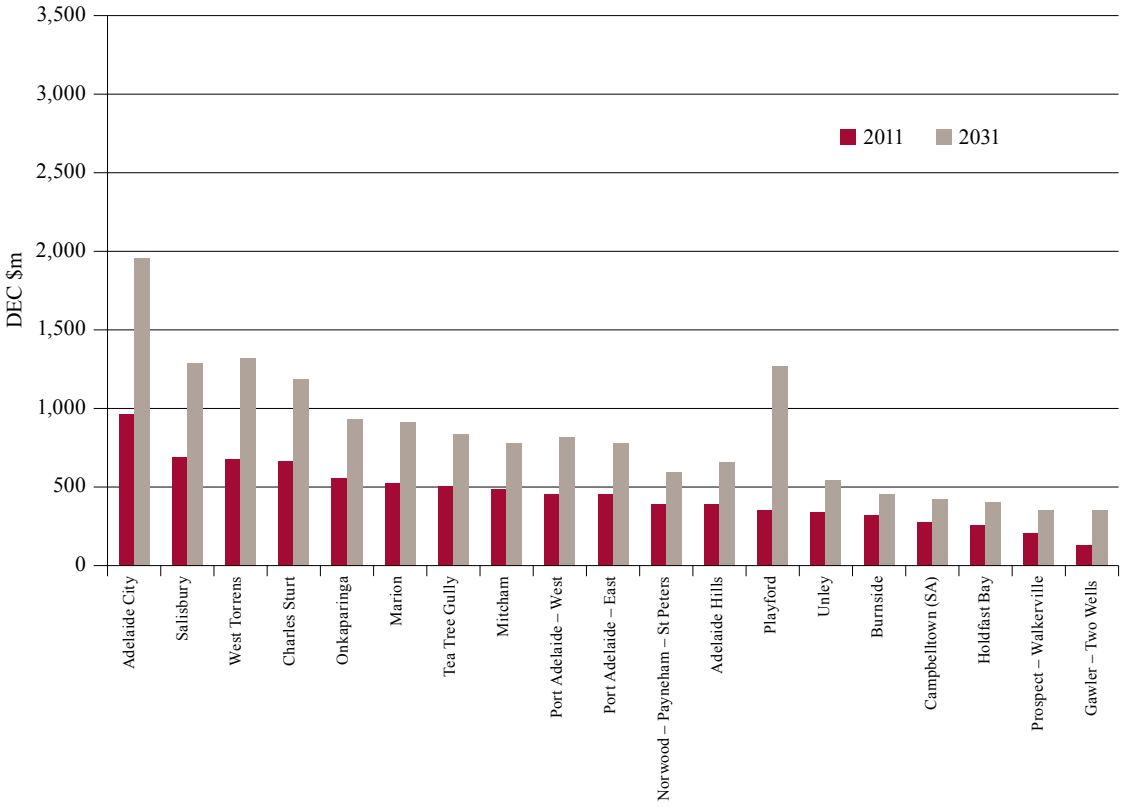
433. South Australian Government (2011)
434. South Australian Department of Planning and Local Government (2010b)
435. South Australian Department of Planning and Local Government (2010a)
436. South Australian Department of Planning, Transport and Infrastructure (2013)
437. South Australian Department of Planning, Transport and Infrastructure (2014)
438. South Australian Department for Transport, Energy and Infrastructure (2010)
439. South Australian Department of Planning, Transport and Infrastructure (2013), p. 32 and p. 36

5.6.1.2 Origins/destinations of trips in greater Adelaide

Figure 91 shows trips in greater Adelaide by origin/destination (O/D), across road and public transport modes, in terms of DEC for 2011 and projected DEC for 2031. The O/D regions used here are SA3 regions as defined by ABS.[440]

This analysis shows that Adelaide City is the largest O/D for trips within greater Adelaide. The model also projects significant growth in O/D trips for the Playford region.

Figure 91: Trips in greater Adelaide by origin/destination for road and public transport in 2011 and 2031, measured by DEC ($ million)



Source: Infrastructure Australia analysis of modelling data ACIL Allen Consulting (2014b)

5.6.1.3 Road corridors in greater Adelaide

The Audit dataset provides a broad range of data about corridors, and there are many ways of analysing this data. Given the focus of the Audit on economic indicators, the analysis in Table 72 and Table 73 focuses on delay cost. This applies a dollar cost to time delays, based on lost productivity, and takes account of the different costs applicable to different vehicle types.

Some users of the Audit dataset may prefer to use more traditional indicators of congestion, such as traffic V/C. This measure is included in the Table 72 and Table 73, as is the DEC measure, which gives insight into the underlying value of activity on the corridor, and the proportion of DEC attributable to delay cost.

These measures are expressed per lane kilometre of road. This normalises the results to facilitate comparison across a wide range of different corridor types − some very long, some consisting of multiple roads, and some relatively short single roads.

The modelling provides one method of measuring and projecting demand for transport infrastructure and the corridors identified in Table 72 and Table 73 reflect this approach. The SA Government may have utilised other data, and different methods of analysis, to inform identification of infrastructure priorities. For further information on the assumptions, included projects and methodology applied in the model, refer to the supporting documentation by Veitch Lister Consulting.

Table 72 shows corridors ranked by delay cost per lane kilometre in 2011, with the equivalent projections for 2031 in Table 73. Taken together, these tables give an indication of which corridors warrant further study, and where interventions are likely to have the biggest economic return.

440. SA3s provide a standardised regional breakup of Australia and generally (although not always) have populations between 30,000 and 130,000 persons.

Table 72: Top 10 road corridors in greater Adelaide area 2011, by delay cost (2011 dollars)

Rank	Road Corridor	State	Delay cost by lane km 2011 ($m)	DEC per lane km 2011 value ($m)	Volume Capacity Ratio 2011 AM Peak (7-9 AM)
1	Goodwood Rd Corridor	SA	1.63	4.05	78%
2	Lower North East Rd/Payneham Rd Corridor	SA	1.55	3.60	78%
3	Anzac Hwy Corridor	SA	1.53	4.63	66%
4	Fullarton Rd Corridor	SA	1.51	3.30	85%
5	Port Road Corridor	SA	1.36	4.27	65%
6	Portrush Road Corridor	SA	1.33	3.64	81%
7	North East Road Corridor	SA	1.25	3.86	63%
8	Marion Rd Corridor	SA	1.01	2.86	70%
9	Magill Road Corridor	SA	0.97	2.48	76%
10	Unley Rd/Belair Rd Corridor	SA	0.95	2.40	70%

Source: Infrastructure Australia analysis of data from ACIL Allen Consulting (2014b) and Veitch Lister Consulting (2014f)

Table 73: Top 15 road corridors in greater Adelaide area 2031, by delay cost (2011 dollars)

Rank	Road Corridor	State	Delay cost by lane km 2031 ($m)	DEC per lane km 2031 ($m)	Volume Capacity Ratio 2031 AM Peak (7–9 AM)
1	Port Road Corridor	SA	3.40	7.57	73%
2	Port Wakefield Rd/Main North Rd Corridor	SA	3.29	5.85	72%
3	Goodwood Rd Corridor	SA	3.26	6.60	85%
4	Anzac Hwy Corridor	SA	2.89	7.20	71%
5	Fullarton Rd Corridor	SA	2.80	5.23	92%
6	Lower North East Rd/Payneham Rd Corridor	SA	2.71	5.43	82%
7	Portrush Road Corridor	SA	2.43	5.54	86%
8	North East Road Corridor	SA	2.39	5.96	68%
9	Outer Main North Rd Corridor	SA	2.34	5.02	74%
10	Marion Rd Corridor	SA	2.14	4.73	78%
11	Salisbury Hwy/Philip Hwy Corridor	SA	2.00	4.65	75%
12	Magill Road Corridor	SA	1.94	3.99	83%
13	Torrens Road Corridor	SA	1.88	4.48	77%
14	Kensington Road Corridor	SA	1.87	3.89	71%
15	Unley Rd/Belair Rd Corridor	SA	1.86	3.86	75%

Source: Infrastructure Australia analysis of data from ACIL Allen Consulting (2014b) and Veitch Lister Consulting (2014f)

Several of the corridors identified above, in particular the Port Wakefield Road/Main North Road corridor and the Salisbury Highway/ Philip Highway corridor, form part of a broader north−south corridor through greater Adelaide. The SA Government has placed a priority on the development of this corridor, to create a free flowing freight 'spine' connecting expanding industrial areas in the north and south, supporting higher freight transport productivity and improving access to freight gateways. The first stages of the corridor have already been completed, and funding is committed for the next two stages.

Figure 92 and Figure 93 show projected road congestion, by V/C, in 2031 for the AM peak hour and daytime inter-peak periods respectively. These show the corridors and locations likely to reach or exceed maximum capacity by 2031 in the absence of any additional capacity.

While network constraints exist during the peak hour, in the inter-peak period there is surplus capacity across most of the network.

Figure 92: Adelaide road network volume/ capacity ratio in 2031 – AM maximum peak hour

Figure 93: Adelaide road network volume/ capacity ratio in 2031 – daytime inter-peak period

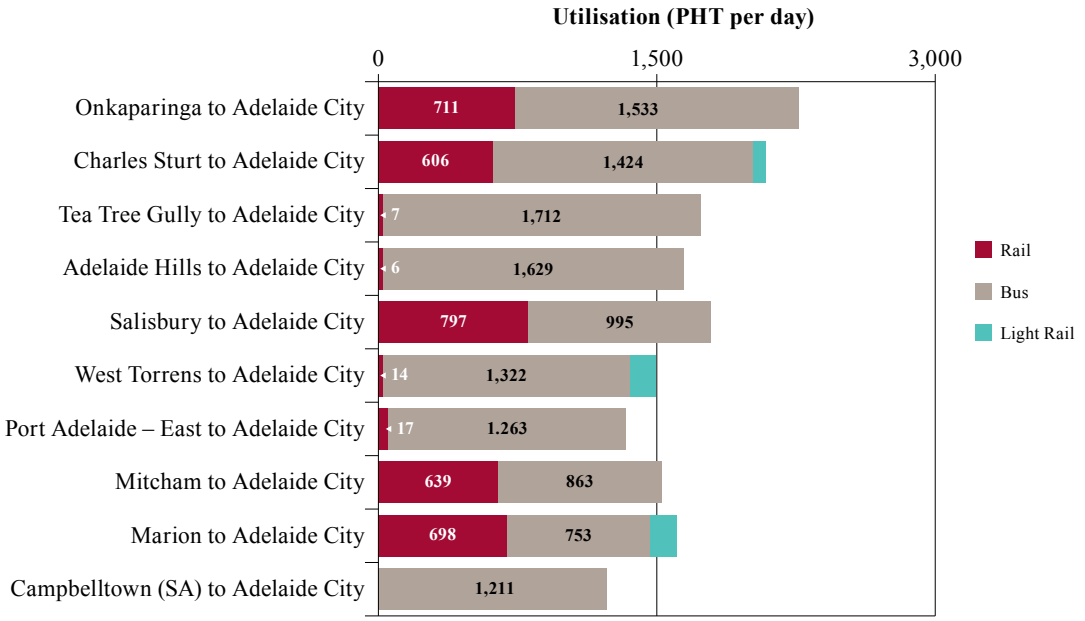
Source: Veitch Lister Consulting (2014f)

The SA Government considers the performance of signalised intersections a more important indicator of network performance than V/C ratios because of Adelaide's extensive at-grade road network. SA Government measures of V/C are significantly different from those in the Audit because of different modelling assumptions. The draft *SA Integrated Transport and Land Use Plan* identifies the need to invest in a series of targeted intersection improvements to improve the performance of the network.

5.6.1.4 Public transport in greater Adelaide

Figure 94 sets out the top 10 public transport O/D pairs in greater Adelaide by passenger hours travelled (PHT), and by public transport mode. Adelaide City features in all 10 O/D pairs, and bus is the dominant mode. There is also a reasonable amount of travel by rail from Onkaparinga, Charles Sturt, Salisbury, Mitcham and Marion to Adelaide City.

Figure 94: Top 10 Adelaide origin/destination pairs by hours travelled for public transport



Source: Infrastructure Australia analysis of data from Veitch Lister Consulting (2014f)

A major thrust of the 30 Year Plan for Greater Adelaide and the draft SA Integrated Transport and Land Use Plan is to strengthen the metropolitan public transport system. SA's approach to land use and transport planning in greater Adelaide is focused on delivering a public transport system to support development within the CBD and inner areas of Adelaide. This approach includes electrification of the train network and the proposed AdeLINK tram network.

Providing residential living close to employment, education and retail opportunities, in conjunction with effective choice in transport mode, supports urban vitality and economic development. This highlights the importance of continued capital investment in infrastructure and operating investment in the provision and expansion of bus, train and tram services in urban areas.

5.6.1.5 Rail trips in greater Adelaide

Table 74 shows the top five destination SA3 regions for rail trips in greater Adelaide. This shows that Adelaide City is the dominant destination for rail trips in the greater Adelaide area.

Table 74: Top destinations in greater Adelaide for rail trips by passenger hours travelled (PHT), 2011 and projected 2031

	Adelaide City	Salisbury	Port Adelaide – West	Playford	Onkaparinga
2011	6,145	982	871	844	818
2031	11,852	1,450	1,280	1,954	1,987

Source: Infrastructure Australia analysis of modelling data from Veitch Lister Consulting (2014f)

Figure 95 and Figure 96 show that passenger loadings on Adelaide's rail corridors are projected to increase over time, reaching or exceeding crush capacity on the inner sections of the Gawler and Seaford lines by 2031.

Figure 95: Adelaide rail network weekday passenger demand relative to crush capacity (2011)

Figure 96: Adelaide rail network weekday passenger demand relative to crush capacity (2031)

Source: Veitch Lister Consulting (2014f)

5.6.1.6 Bus trips in greater Adelaide

Table 75 shows the top five destination SA3 regions for bus trips in greater Adelaide. This shows that Adelaide City is the dominant destination for bus trips in the greater Adelaide region.

Table 75: Top destinations in greater Adelaide for bus trips by passenger hours travelled (PHT), 2011 and projected 2031

	Adelaide City	Onkaparinga	Tea Tree Gully	Charles Sturt	Salisbury
2011	17,923	3,421	2,780	2,747	2,659
2031	26,309	4,192	3,813	4,071	3,525

Source: Infrastructure Australia analysis of data from Veitch Lister Consulting (2014f)

5.6.1.7 Freight movements in greater Adelaide

Table 76 shows the daily vehicle kilometres travelled by vehicle type between major O/D pairs in the greater Adelaide region. This shows freight traffic constitutes a relatively high proportion of traffic for some O/D pairs, in particular for travel between the West Torrens and Adelaide City SA3 regions.

Table 76: Daily VKT by vehicle type between major O/D pairs in the greater Adelaide region

		Utilisation (VKT/day)	Utilisation (VKT/day)	Utilisation (VKT/day)	LCV & HCV as % of daily VKT
From	**To**	**Car**	**LCV**	**HCV**	
West Torrens	Adelaide City	137,333	10,150	8,809	12.1%
Charles Sturt	Adelaide City	151,765	8,573	7,405	9.5%
Port Adelaide – West	Charles Sturt	233,181	11,448	6,915	7.3%
West Torrens	Charles Sturt	187,452	8,543	5,616	7.0%
Salisbury	Playford	301,469	12,097	7,959	6.2%
Salisbury	Port Adelaide – East	180,699	7,065	4,241	5.9%
Tea Tree Gully	Salisbury	313,835	9,092	4,814	4.2%
Onkaparinga	Marion	386,135	9,795	6,448	4.0%
Mitcham	Marion	163,163	4,808	1,939	4.0%
Onkaparinga	Mitcham	235,487	4,894	4,784	3.9%

Source: Infrastructure Australia analysis of data from Veitch Lister Consulting (2014f)

Key freight routes within Adelaide run between the south, north and western parts of the city. This leads to a convergence of freight to the west of central Adelaide to connect with the Port and the north-west. The *SA Integrated Transport and Land Use Plan* prioritises upgrades of the North−South Corridor including the Northern Expressway, Northern Connector and South Road, and separation of freight and passenger rail at Goodwood Junction.

5.6.2 National highways

Of Australia's 34,656 km of national highways (which include the National Land Transport Network highways and other key freight routes) identified in the Audit, 3,860 km are in SA. This includes the following national highway links connecting Australia's capital cities:

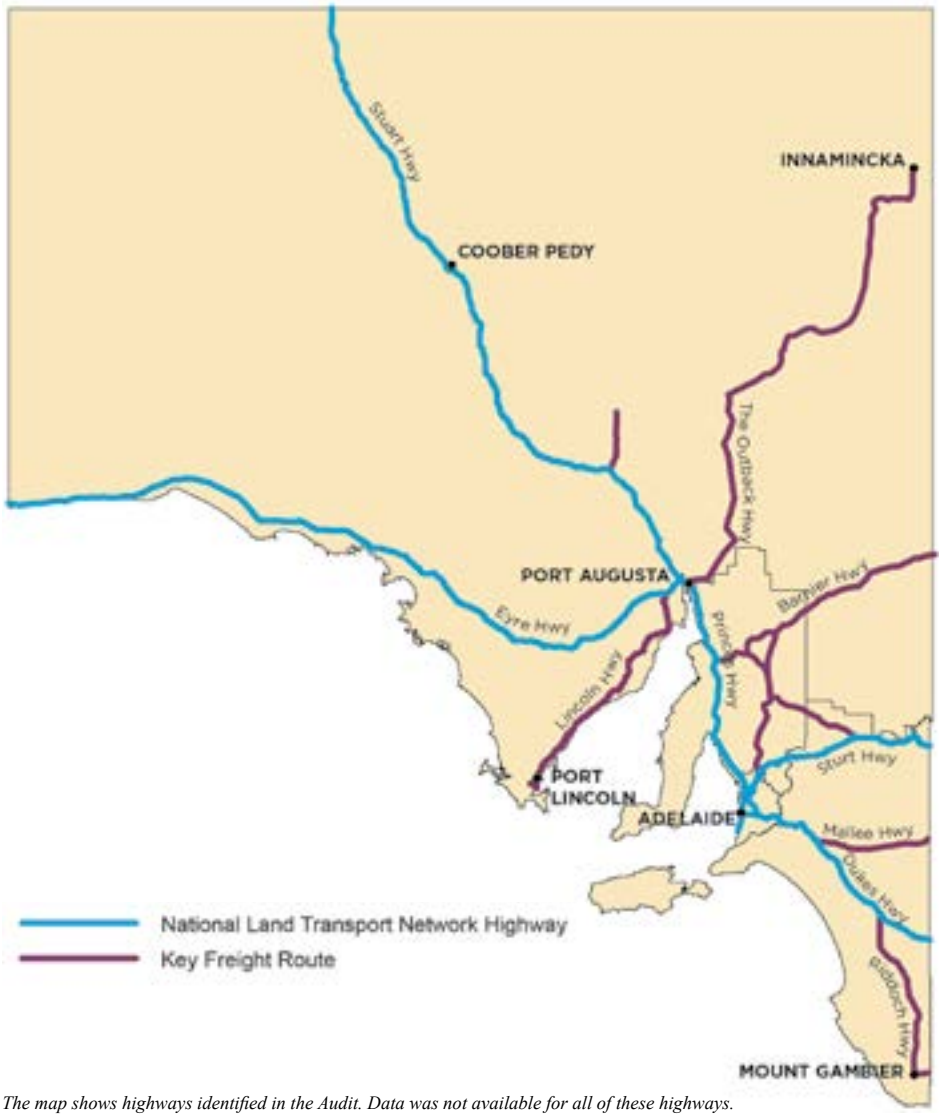
- Adelaide to Perth (Eyre Highway Route 1);
- Adelaide to Darwin (Stuart Highway Route 87);
- Adelaide to Sydney (Sturt Highway Route 20); and
- Adelaide to Melbourne (Dukes highway and Western Highway Route 8).

Key freight routes in SA include roads serving Port Augusta, Whyalla, Port Lincoln, Leigh Creek and Roxby Downs. In 2011, the national highways in SA carried an average of 68,110 vehicles per day.

Figure 97 shows the National Land Transport Network highways and the other key SA freight routes included in the Audit. Together these routes play an important role in facilitating industry and enabling business and community activity.

The DEC of these roads in 2011 was estimated at $511 million. This is projected to increase to $722 million in 2031, an increase of 41 per cent. These are relatively small figures in the national context. The total DEC for national highways and key freight routes in 2011 was $9.5 billion. This is projected to grow to $15.6 billion in 2031.

Figure 97: National Land Transport Network highways and key freight routes South Australia 2011



The map shows highways identified in the Audit. Data was not available for all of these highways.

Source: ACIL Allen Consulting (2014a)

The most economically significant road corridors run north from Adelaide to the mining centres and through to Darwin. The DEC for these roads is projected to increase by 154 per cent to 2031, marginally faster than the projected increase of around 138 per cent for the highways connecting to the east and west coast capital cities.

The SA Government's *Regional Mining and Infrastructure Plan*[441] identifies that increased capacity will be needed to service increased mining sector production. The draft *Integrated Transport and Land Use Plan*[442] articulates the importance of the Strzelecki Track in supporting the expanding gas fields in the Cooper Basin.

5.6.3 Freight rail

The interstate freight rail network in SA comprises links between Adelaide and Perth, Melbourne, Sydney and Darwin (via Tarcoola). The DEC of freight rail in SA is projected to increase from $13 million in 2011 to $15 million in 2031, an increase of around 20 per cent. There is no evidence of capacity constraint.

Interstate rail freight between SA and WA is forecast to double between 2013 and 2030. The key driver of demand in this rail corridor is the rail market share for freight between Melbourne, Sydney, Adelaide and Perth, with Melbourne and Sydney volumes dominating. The Tarcoola to Darwin rail line has strong market share for freight on the Adelaide to Darwin corridor, and supports the development of mines and other resource developments along the corridor.

441. South Australian Department of Planning, Transport and Infrastructure (2014), pp. 36-37
442. South Australian Department of Planning, Transport and Infrastructure (2013)

5.6.4 Ports

On a national scale, SA ports are relatively small, accounting for around two per cent of the country's total imports and exports in 2013 (measured in mass tonnes).

Port Adelaide/Outer Harbor is the largest port in SA. Other regional ports include Thevenard, Port Lincoln, Port Bonython, Port Pirie, Wallaroo, Port Giles, Klein Point and Ardrossan. The regional ports support significant export volumes from SA's agricultural, mining and resource sectors. The expansion of a number of these regional ports, as well as development of new high-capacity ports, could support further significant increases in exports, especially of minerals and resources.

The DEC of SA ports is projected to increase by 48 per cent, from $1.09 billion in 2011 to $1.61 billion in 2031. The Audit shows the Port of Adelaide's bulk terminal facilities are likely to need additional capacity within the 15 year timeframe of the Plan.

Table 77: South Australian port tonnages – 2012–13

	Total Throughput (mass tonnes)				Containerised trade in TEU			
Port	**Imports**	**Exports**	**Total**	**Total as % of national total**	**Imports**	**Exports**	**Total**	**Total as % of national total**
Port Adelaide (Flinders)	6,588,315	8,578,024	15,166,339	1.34%	168,742	170,319	339,061	4.73%
Thevenard (Flinders)	0	2,046,271	2,046,271	0.18%	0	0	0	0.00%
Port Lincoln (Flinders)	256,744	1,636,257	1,893,001	0.17%	0	0	0	0.00%
Klein Point (Flinders)	0	1,758,968	1,758,968	0.16%	0	0	0	0.00%
Wallaroo (Flinders)	0	760,553	760,553	0.07%	0	0	0	0.00%
Port Giles (Flinders)	0	719,159	719,159	0.06%	0	0	0	0.00%
Port Pirie (Flinders)	386,576	217,643	604,219	0.05%	0	0	0	0.00%
South Australia Total	**7,231,635**	**15,716,875**	**22,948,510**	**2.03%**	**168,742**	**170,319**	**339,061**	**4.73%**

Source: Ports Australia (2014a)[443]

The *Regional Mining and Infrastructure Plan* identifies[444] that increased port capacity will be needed to service increased mining sector production.

5.6.4.1 Port Adelaide/Outer Harbor

Port Adelaide and Outer Harbor port facilities operate together to perform a significant role in supporting the import and export trade of the state, in particular the export of agricultural, mining and manufactured goods.

Port Adelaide/Outer Harbor has the greatest throughput in terms of mass tonnes, accounting for 91 per cent of imports and 55 per cent of exports for the state in 2013.[445] Port Adelaide operated at 87 per cent of capacity in 2011.

5.6.5 Airports

Adelaide Airport is the fifth busiest in the country, with over seven million passenger movements per year, and a DEC of about $1.6 billion in 2011. This is projected to increase to $2.7 billion in 2031. The airport's master plan[446] projects growth in passenger movements to more than 13 million by 2029. The airport has sufficient capacity to accommodate this increase. Adelaide Airport passenger traffic contributed $1.94 billion (around 2.1 per cent of Gross State Product) to the SA economy in 2011.[447]

The total DEC of all airports in SA is projected to grow from $1.68 billion in 2011 to $2.85 billion in 2031, a 69 per cent rise.

443. State totals include small ports not specifically listed.
444. Department of Planning, Transport and Infrastructure (2014b), pp. 31-34
445. Ports Australia (2014b)
446. Adelaide Airport (2014a), p. 34
447. Adelaide Airport (2014b)

Table 78: South Australia airport passenger and freight volumes – 2013–14

	Revenue passenger (No.)				International Freight (tonnes)			
Airport	Domestic (incl. Regional) Airlines	International Airlines	Total passengers	Total as % of national total	Inbound	Outbound	Total	Total as % of national total
Adelaide	6,670,866	906,523	7,577,389	5.17%	10,201	9,602	19,083	0.09%
Port Lincoln	187,702	0	187,702	0.13%	0	0	0	0.00%

Source: BITRE (2014)

As with all other states and territories in Australia, regional airports in SA play a vital role in connecting communities and in providing access to Adelaide and regional centres for essential services. These air services and airports play an essential role in the state's resource and mining industry, by providing essential and reliable fly-in/fly-out services to mining and resource companies.

5.7 Energy

5.7.1 Electricity

The Audit found that, in 2011, SA had an installed electricity generation capacity of 4,438 MW. Transmission peak demand was 3,477 MW and distribution peak demand was 3,031 MW. The utilisation of electricity in SA in 2011 was 12,960 GWh for generation, 13,045 GWh for transmission and 11,093 GWh for distribution.

The DEC of electricity infrastructure in 2011 was $990 million. This was made up of $194 million from generation, $246 million from transmission and $550 million from distribution.

The Audit forecasts a 42 per cent increase in the use of electricity from 2011 to 2031. This equates to 18,564 GWh for generation, 18,517 GWh for transmission and 15,642 GWh for distribution by 2031. Based on these forecasts, the Audit projects an increase of $581 million (59 per cent) in the DEC of electricity infrastructure to $1.57 billion. This rise is made up of $117 million from generation, $145 million from transmission and $139 million from distribution.

Conversely, the Australian Energy Market Operator (AEMO) forecasts declining electricity consumption in SA, from 13,725 GWh in 2011 to 12,074 GWh in 2031.[448] AEMO attributes the decline to reduced large industrial consumption, reduced residential and commercial consumption from increased rooftop photovoltaic (PV) output, increasing energy efficiency, and response to high electricity prices.

There are several reasons for caution in directly comparing AEMO's forecasts and the Audit projections for the DEC of electricity infrastructure. The Audit assumes an energy efficiency improvement rate of 1.5 per cent per year (compared to a historic rate of 0.5-1.0 per cent), whereas AEMO assumes much faster rates, exceeding 20 per cent in some years. Consequently the electricity use underlying the Audit's DEC measure is considerably higher than that for AEMO's forecast.

Additionally, AEMO reports and forecasts unit electricity consumption in gigawatt hours (GWh), whereas DEC is a measure of the value-add provided by electricity infrastructure, expressed in dollar terms. The two are not necessarily perfectly correlated.

SA is part of the National Electricity Market (NEM) which also includes NSW, Victoria, Queensland and Tasmania. Electricity consumption and demand has fallen in the NEM in recent years. Annual energy sent out across the NEM fell seven per cent from 194.9 TWh in 2009–10 to 181.2 TWh in 2013–14.[449]

In 2008 and 2009, SA experienced high power prices that exceeded the levels required to support new entry. Coupled with the abundant renewable resources that exist in SA, these high prices supported the entry of large quantities of renewable energy generation in the form of wind farms. Together with falling demand, this has led to a surplus of generation capacity. AEMO has indicated that no new generation capacity is required in SA to maintain supply adequacy over the next 10 years, due to the decline in consumption under high, medium, and low growth scenarios.

The Large-scale Renewable Energy Target (and the previous Renewable Energy Target) have led to a substantial increase in the penetration of wind farms across the NEM. SA has a high wind farm capacity of 1,473 MW.[450] A recent example of new wind farm investment is the Snowtown wind farm expansion, completed in 2014.

448. Australian Energy Market Operator (2014a)
449. Australian Energy Market Operator (2014a)
450. South Australian Department of State Development (2014)

The Small-scale Renewable Energy Scheme, feed-in tariffs, and other solar photovoltaic (PV) subsidies have led to a significant increase in the penetration of solar PV systems in the last five years. In SA, the capacity of installed solar PV has increased from 21 MW at the start of 2010 to 558 MW as of October 2014. In the *National Electricity Forecasting Report*, AEMO forecast an increase in solar PV to 2,425 GWh by 2031.[451]

The combination of an unanticipated decline in demand and rising penetration of renewables has led to an ongoing structural change in the wholesale sector.

At the same time, there have been considerable rises in network charges across the NEM, due to a range of factors. The rising network charges have in turn influenced retail prices, creating an impetus for regulators to investigate options that may diminish, or delay, further expansion of the network. Consequently, the Australian Energy Market Commission (AEMC), on 27 November 2014,[452] made a new rule that establishes a new pricing objective and new pricing principles for electricity distribution businesses that will require that network prices reflect the efficient costs of providing network services. Distribution network prices will reflect the costs of providing the electricity to consumers with different patterns of consumption which has the potential to reduce demand during peak periods, and consequently also reduce future network infrastructure investment.

The implications of surplus capacity differ by sub-sector. For the generation sector, surplus capacity and renewable policy settings are likely to result in the withdrawal of thermal generation assets. Since 2005, significant generation capacity has been 'mothballed' or retired in the NEM. Most recently, SA has seen AGL withdraw the Torrens Island A power station (a 480 MW Open Cycle Gas Turbine plant) from operation, with plans to close it permanently in 2017. In addition, a number of other generators have already changed their operational profile or have been removed from service.

For the network sector, the decline in demand has diminished the need for augmentation investment. Nevertheless, the high penetration of wind farms in SA has created the need to increase inter-connector capacity with Victoria to ensure reliable supply when wind output is low. As a result, the Heywood interconnector upgrade was approved in 2013 with an expected commission date of 2016.

5.7.2 Gas

In 2011, SA gas transmission pipelines had an annual throughput of 117 petajoules (PJ). Gas distribution pipelines had an annual throughput of 22 PJ.

The DEC from gas pipelines in SA in 2011 was estimated to be $237 million, made up of $86 million from transmission and $151 million from distribution.

The main pipelines in SA are the Moomba to Adelaide Pipeline and SEA (Port Campbell to Adelaide) Gas Pipeline.

The Audit projects an increase in the DEC of gas pipeline infrastructure of $54 million to $291 million in 2031, made up of $19 million from transmission and $34 million from distribution. This 23 per cent rise compares to a forecast for the SA's economy to grow by 55 per cent over the same period.

AEMO[453] has forecast a decline in gas consumption in SA, from 104 PJ in 2011 to 81 PJ in 2031 on its medium scenario.

As with electricity, there are several reasons for the apparent inconsistency between the Audit's forecast rise in DEC in the gas sector, and the AEMO's forecast of a fall in demand. In particular, the DEC analysis was finalised before the latest AEMO gas market forecasts were published. Those forecasts were the first to show a break in what had previously been a direct link between economic growth and rising energy consumption. Also, AEMO reports and forecasts gas consumption in petajoules, whereas DEC is a measure of the value-add provided by gas infrastructure, in dollars. The two are not necessarily perfectly correlated.

Although domestic gas consumption is forecast to continue declining, new Liquefied Natural Gas (LNG) plants on the east coast have opened the market to export. Future value-add from gas infrastructure will come from both domestic usage (where demand may continue to fall), and from the export market. The impact of this will largely be in Queensland and the NT.

The SA gas market is connected with NSW, Victoria and (indirectly) Queensland via a number of gas pipelines. SA has considerable conventional gas reserves located in the Cooper Basin. However, the majority of this gas has historically been supplied to NSW via the Moomba to Sydney pipeline, with the rest of Moomba's production supplying Adelaide via the Moomba to Adelaide pipeline. In addition, SA imports gas from Victoria via the South East Australian Gas pipeline.

451. Australian Energy Market Operator (2014a)
452. Australian Energy Market Commission (2014)
453. Australian Energy Market Operator (2014b)

SA also contains unconventional gas reserves in the form of shale gas. There are some plans to develop these resources, although at this stage it is unclear whether their development is commercially viable.

There is wide acknowledgement of an ongoing structural shift in the gas market as Australia significantly expands its ability to export gas. There is also uncertainty about whether existing gas market and regulatory frameworks are well suited to handle the shift. Within this context, the AEMC recently conducted a gas market scoping study, which recommended Australia conduct a strategic review of the gas sector, including a review of future market developments over the next 10 to 15 years and a review of the short-term trading market and the declared wholesale gas market.

5.7.3 Petroleum

The petroleum industry is broadly split into upstream and downstream petroleum sectors. The upstream sector refers to exploration and production of crude oil while downstream refers to refining of crude oil and the distribution and sale of petroleum products.

In 2011, consumption of petroleum products in SA was 3,440 ML. Total throughput at petroleum terminals was 2,928 ML. The DEC of petroleum terminals was $40 million.

The Audit projects an increase in throughput of 1.4 per cent per year in SA. This equates to throughput of 3,851 ML per year by 2031 – an increase of 923 ML per year. This is projected to result in a growth in DEC of $13 million.

5.7.3.1 Crude oil production

Australia's production of crude oil has been steadily declining. Crude oil production peaked in 2000 at 687 kb/day and has since declined to just over 410 kb/day. This downward trend is expected to continue at an average rate of 4.4 per cent per year from 2014–15 to 2049–50.[454] The majority of production comes from two major basins, the Carnarvon Basin in Western Australia (77 per cent of production in 2011), and the Gippsland Basin in Victoria (less than 15 per cent of production in 2011).

5.7.3.2 Refinery capabilities

In recent years the global oil refining industry has been undergoing significant structural change. Larger, more efficient 'mega-refineries' have been established in Asia resulting in increased competitive pressures on established refining operations, including those in Australia.

SA does not currently have any operating refineries.

In 2013–14, 82 per cent of crude oil and other refinery feedstock was imported.[455] New refinery capacity is unlikely to be developed in Australia in the foreseeable future.

5.7.3.3 Petroleum products

Domestic demand for petroleum products grew at an average annual rate of around 1.5 per cent in the decade to 2011–12. It is expected to grow by around 1 per cent per year through to 2049–50, largely driven by population and economic growth. However, energy intensity (measured by total domestic energy consumption per dollar of gross domestic product) is projected to decline by around 1.7 per cent per year over the same period, compared to a decline of 1.3 per cent from 1989–90 to 2009–10. This indicates accelerating improvement in energy efficiency. The transport sector uses more than 40 per cent of all petroleum consumed in Australia, and is the primary driver of demand growth. In addition, the expansion of the mining sector has contributed significantly to increased demand for diesel.[456]

Imported refined petroleum products account for approximately 40 per cent of total domestic consumption, and this share is forecast to rise.[457] Refined petroleum products are imported from more than 20 countries, but 80 per cent of all such products come from just three: Singapore (53 per cent), South Korea (18 per cent) and Japan (12 per cent).[458]

Demand for petroleum import facilities and the need for additional import infrastructure within SA is expected to grow over the 15-year horizon of the Australian Infrastructure Plan.

454. Bureau of Resources and Energy Economics (2014a)
455. Carson, L. (2014), p. 108
456. Bureau of Resources and Energy Economics (2014a), p. 17
457. Bureau of Resources and Energy Economics (2014a), p. 37
458. Australian Institute of Petroleum (2013c), p. 7

5.8 Telecommunications

SA's telecommunications sector DEC is projected to increase from $1.3 billion in 2011 to $2.3 billion in 2031. The 76 per cent forecast rise in DEC is a larger increase than the 55 per cent cumulative growth forecast for the SA's economy over the same period.

Most of the regional areas of SA currently have poor quality fixed broadband services, however, Adelaide and larger towns have good or very good quality broadband services. A relatively large area of Adelaide has access to broadband through hybrid fibre, fibre or fixed wireless networks.

In SA, 86 per cent of premises have access to ADSL, 79 per cent have 3G mobile coverage, 52 per cent have 4G coverage, 23 per cent have access to hybrid-fibre co-axial (HFC) and just one per cent have access to fibre to the premise.[459]

For overall quality of fixed broadband service, SA lags behind the large eastern states.

5.9 Water

The DEC for water and sewerage infrastructure in SA is projected to increase from $947 million in 2011 to $1.4 billion in 2031, an increase of 44 per cent. The Audit identified that 125 GL of water was supplied to Adelaide in 2011 and 79 GL to other regions. In 2011, 90 GL of sewerage was collected in Adelaide and 4 GL in other areas.

The highest projected growth in water and sewerage DEC in SA is in Adelaide, where DEC is projected to grow by 53 per cent, from $681 million in 2011 to $1 billion in 2031. In the regional areas, DEC is projected to grow by 22 per cent over the same period, from $266 million to $324 million.

Water and sewerage services have historically been under-priced, particularly in regional areas. This has potentially led to an understatement of DEC as measured using the National Water Commission data (and as incorporated into the national accounts and GDP numbers).

In regional areas, under-pricing of water and sewerage services means that the income derived from water and sewerage infrastructure falls below the level needed to fund renewal of assets.

5.9.1 Greater Adelaide region

The South Australian Water Corporation reports that greater Adelaide currently uses approximately 140 GL of water each year (averaged over five years) from mains drinking water supply (when not on water restrictions), and that regional SA uses approximately 70 GL each year. These figures are slightly different from those used in the Audit.[460] This water is provided through the metropolitan Adelaide system, which consists of more than 9,000 km of pipeline, more than 120 large storage tanks, 59 pumping stations, nine reservoirs and six water treatment plants.[461] With its relatively low rainfall and long, dry summers, SA depends heavily on water from the River Murray to meet its requirements. In an average year, the River Murray supplies about 40 per cent of the state's urban water needs,[462] while in dry years this can increase to as much as 90 per cent.

For many decades SA relied on using unfiltered water from the River Murray. However, SA Water now provides 98 per cent of the population with high quality filtered water which meets or exceeds the standards of the *Australian Drinking Water Guidelines*.

As part of SA's Water for Good Plan to secure water for the future, the SA Government has built a seawater desalination plant at Port Stanvac, south of Adelaide, to ensure drinking water is available even in times of drought. The plant has the ability to produce up to 100 GL of drinking water per year,[463] or up to half of Adelaide's current drinking water needs.

SA Water collects and treats about 95 GL of wastewater in Adelaide and about 100 GL state-wide every year. SA Water's metropolitan wastewater system serves Adelaide's population through more than 8,700 km of sewer pipes and three major wastewater treatment plants: Bolivar, Glenelg and Christies Beach, and a small plant at Aldinga. It manages 19 of the 20 wastewater treatment plants, with the Victor Harbor plant privately operated under contract. Adelaide's three major metropolitan WWTPs process more than 250 ML of wastewater a day. Since 1997–98, SA Water has more than tripled the percentage of wastewater being recycled across SA.

Under initiatives contained in *Water for Good Plan*, greater Adelaide's water supply for drinking and non-drinking purposes is projected to meet demand beyond 2031. The *Water for Good Plan*

459. Department of Communications (2013), p. 14
460. South Australian Water Corporation (2014), p. 81
461. South Australian Water Corporation (2014), p. 80
462. South Australian Water Corporation (2014), p. 80
463. South Australian Water Corporation (2014), p. 23

contemplates meeting future demand with new water sources, and through the better management of the current water sources (including water saving measures, as distinct from water restrictions). The major contributors to meeting future demand are:

- desalination, especially for small regional townships where water quality is identified as being an issue; and
- stormwater harvesting and the use of recycled wastewater as an important supply source, especially for irrigation and industry.

As part of SA Water's *Long Term Plan for Eyre Peninsula*, investigations are underway regarding the construction of a desalination plant for Eyre Peninsula.

5.9.2 Regional areas

SA currently uses approximately 1,200 GL of water each year for household use, agriculture, business, recreation, and industry. Of this total, regional SA uses approximately 50 GL each year from mains drinking water supply.

Central Irrigation Trust (CIT), a private company located 220 km north-east of Adelaide, is responsible for the management of 12 irrigation districts in the Riverland and Lower Murray region of SA. It manages and administers 12 irrigation trusts (Berri, Cadell, Chaffey, Cobdogla, Golden Heights, Kingston, Loxton, Lyrup, Moorook, Mypolonga, Sunlands and Waikerie) on the River Murray or its anabranches in SA. Each of the 12 irrigation districts is owned by its irrigators, and CIT manages and operates the irrigation systems on behalf of the districts.[464] In 2012–13, the total volume of water supplied by CIT to its customers was120.7 GL. The total area serviced by its supply networks is 15,483 ha, including 13,000 ha of irrigated land.

Groundwater desalination plants have been proposed to supply regional townships where salinity is affecting water quality.

464. Central Irrigation Trust (2014), p. 23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Audit observations – Tasmania

6.1 Structure of this chapter

This chapter presents observations from the Audit for the four infrastructure sectors – transport, energy, communications and water – across Tasmania. It provides data about the state's population and economy (i.e. the key drivers of demand for infrastructure), and the value-add attributable to Tasmanian infrastructure, in 2011. It also outlines growth projections to 2031 for the state's population and economy, and for each of the infrastructure sectors. As noted in the Introduction to this report, these projections are based on economic and demographic analysis set out in two associated studies.[465]

The Audit uses the Direct Economic Contribution (DEC) methodology to quantify both the value-add attributable to infrastructure in 2011, and the projected change in overall demand for infrastructure from 2011 to 2031. When considered in the light of other factors, such as capacity limitations which might constrain economic growth, this approach helps to identify locations and sectors that are likely to warrant further attention in the Australian Infrastructure Plan (the Plan).

This chapter also takes account of other documents, including plans, studies and strategies, prepared by the Tasmanian Government and others.

6.2 Drivers of infrastructure demand − population and economy

Based on medium level projections from the Australian Bureau of Statistics (ABS), the Tasmanian population is projected to reach 560,000 in 2031 − an increase of 48,000 people, or nine per cent, from 2011. The Tasmanian Government[466] projects the same number of people in 2031, but is developing a population strategy, due for release in mid–2015, to identify strategies to achieve a population target of 650,000 by 2050.

The Audit projects slower population and economic growth in Tasmania than for Australia as a whole from 2011 to 2031. This shows as a declining share of the national total in Table 79.

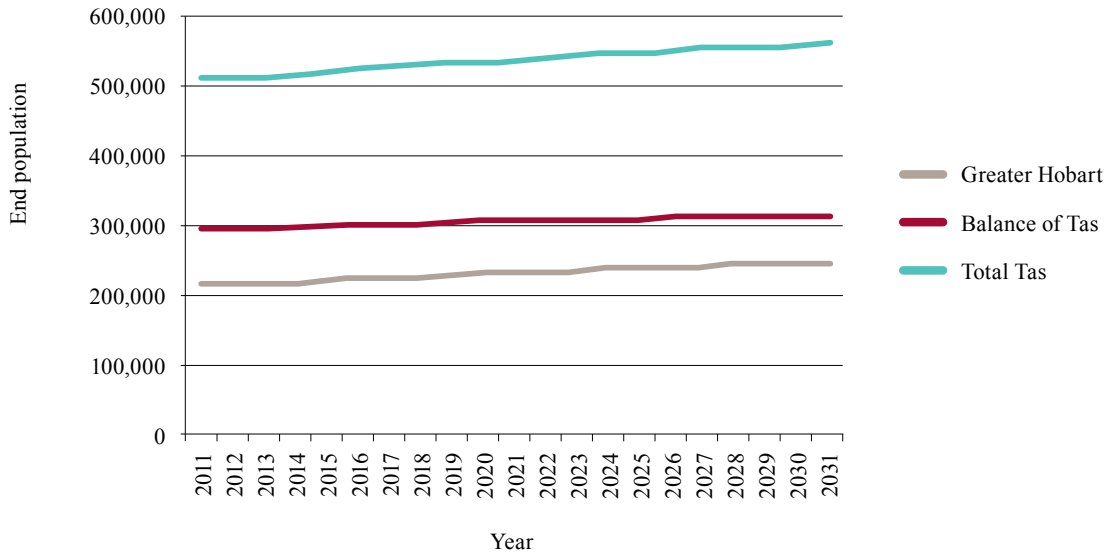
465. ACIL Allen Consulting (2014a) and Infrastructure Australia (2015b)
466. Tasmanian Department of Treasury and Finance (2014)

Table 79: Projected population and economic growth for Tasmania

	2011	% of National	2031	% of National	Increase % 2011–31
Population (persons)	511,483	2.3%	559,706	1.8%	9%
Gross State Product ($m)	24,232	1.7%	34,358	1.3%	42%

Source: ACIL Allen Consulting (2014a)[467]

Figure 98: Population projections for Tasmania – 2011 to 2031



Source: Australian Bureau of Statistics (2013c)[468]

467. Gross State Product is in 2010–11 prices.
468. Series B (medium level) projections.

6.3 Summary of Tasmanian infrastructure from 2011 to 2031

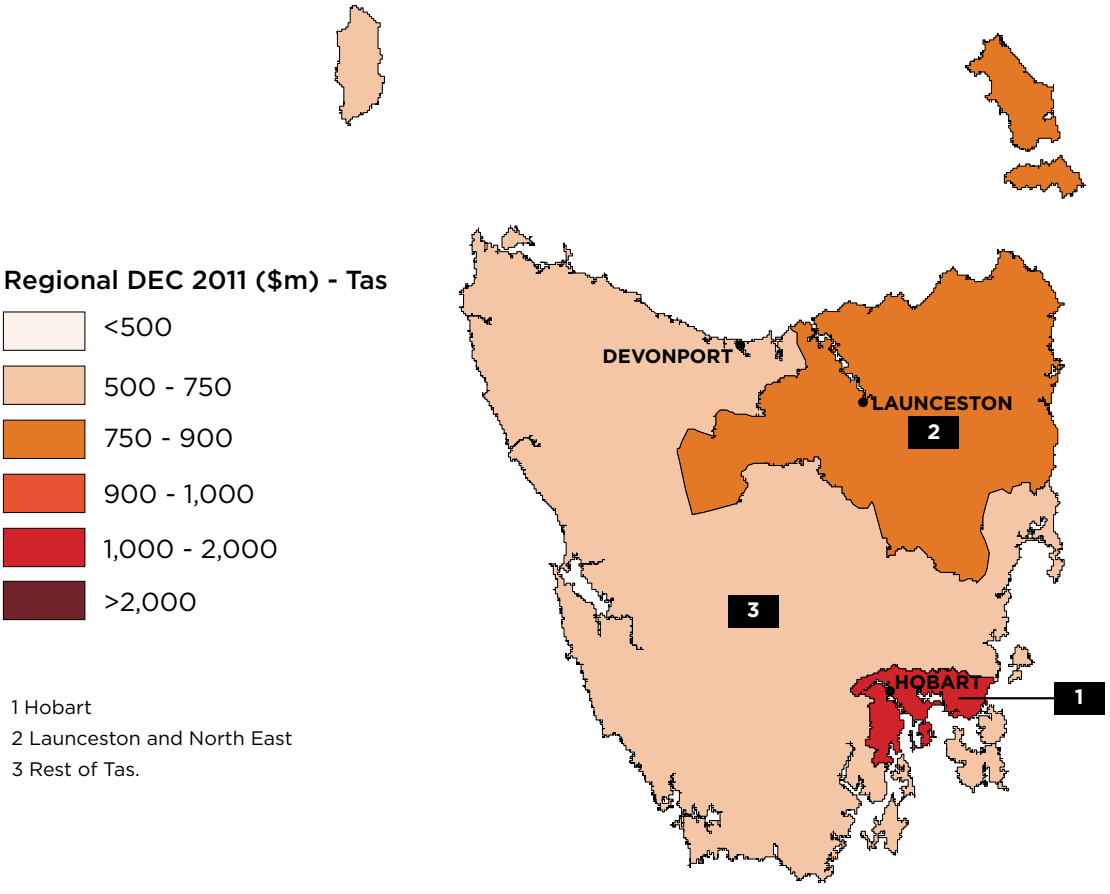
Table 80 provides a snapshot of Tasmania's economic infrastructure across the four sectors of transport, energy, communications, and water. The table notes the capacity of each subsector in general terms and its rate of utilisation in 2011, along with historical (2011) and projected (2031) DEC for each subsector.

In 2011 the DEC of infrastructure in Tasmania was $3.4 billion, which was about two per cent of the national figure. Figure 99 shows Tasmania's DEC by audit region for 2011.

By 2031, Tasmania's infrastructure DEC is projected to increase by 44 per cent, reaching $4.9 billion, which would be 1.3 per cent of national DEC. Figure 100 shows Tasmania's DEC by audit region in 2031.

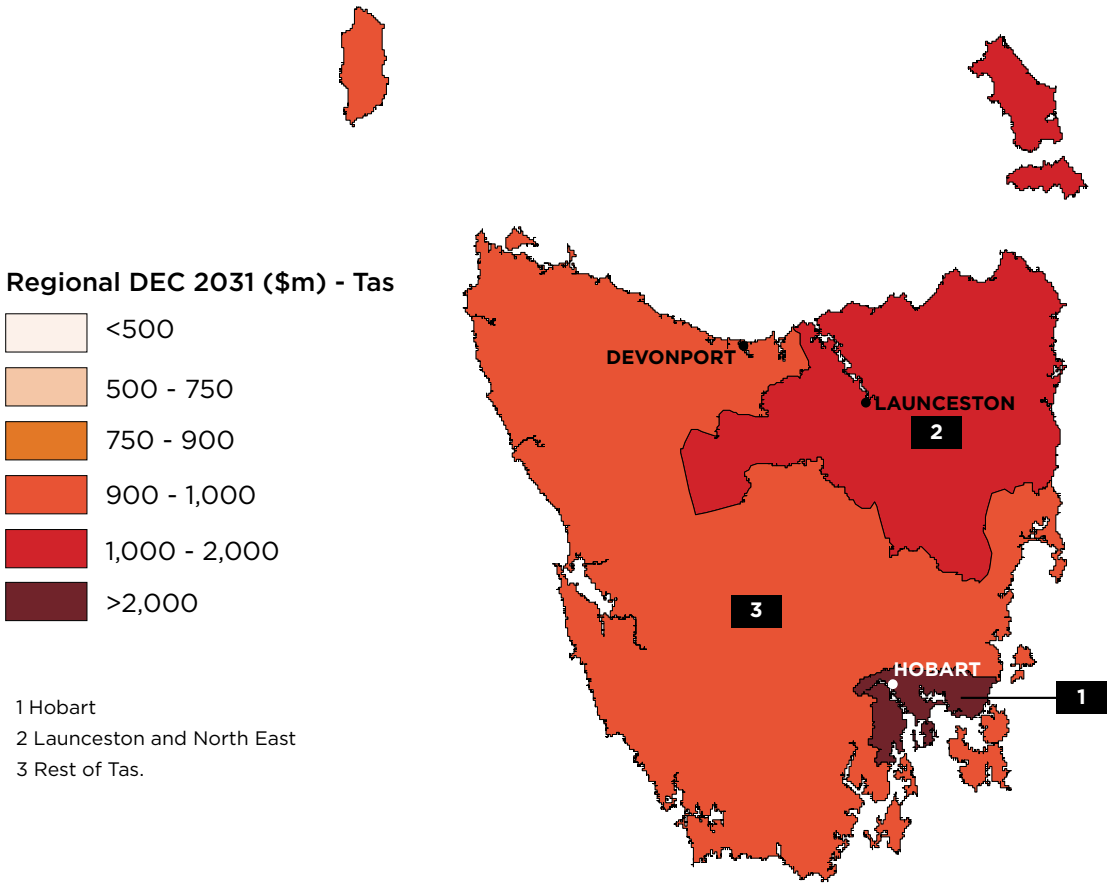
Growth will be fastest in Hobart, where DEC is projected to grow by 59 per cent from $1.8 billion to $2.9 billion during the period.

Figure 99: Tasmania Regional DEC 2011



Source: ACIL Allen Consulting (2014a)

Figure 100: Tasmania Regional DEC 2031



Source: ACIL Allen Consulting (2014a)

Table 80: Overview of Tasmanian infrastructure

	Subsector	Capacity 2011		Utilisation 2011		DEC 2011		DEC 2031		Projected % increase in DEC
			% of Nat.		% of Nat.		% of Nat.		% of Nat.	2011-2031
Transport	Urban Roads	**Not audited**	n/a	**Not audited**	n/a	$835m	1%	$1,483m	2%	78%
	Urban Public Transport	**Not audited**	n/a	**Not audited**	n/a					
	National Highways	**321** km of nationally significant roads	1%	**135,900** vehicles per day	7%	$280m	3%	$406m	3%	45%
	Freight Rail	n/a	n/a	n/a	n/a	$8m	<1%	$8m	<1%	9%
	Ports	**18** Mt p.a. throughput	1%	**16** Mt p.a. throughput	1%	$337m	2%	$437m	1%	30%
		0.5 MTEU throughput	4%	**0.4** MTEU throughput	6%					
	Airports	**9** Count of airfields	3%	**3,316,917** Total RPT passenger movements	3%	$515m	2%	$771m	2%	50%
Energy	Electricity	**2,601** Installed capacity (MW) of Generation	5%	**10,863** Utilisation of Generation (GWh)	2%	$824m	5%	$939m	4%	14%
		1,771 Peak Demand Transmission (MW)	4%	**10,585** Utilisation of Transmission (GWh)						
		1,055 Peak Demand Distribution (MW)	3%	**4,619** Utilisation of Distribution (GWh)						
	Gas	n/a	n/a	**16.35** Transmission throughput (PJ/a)	1%	$15m	1%	$23m	1%	60%
		n/a	n/a	**1.80** Distribution throughput (PJ/a)	1%	$13m	1%	$21m	1%	60%
	Petroleum product terminals	n/a	n/a	**1,042** Annual throughput (ML)	1%	$14m	1%	$17m	1%	21%
Telecommunications		**4.45** Broadband average availability rating (out of 5)	n/a	**136**	n/a	$347m	2%	$557m	1%	61%
		2.14 Broadband average quality rating (out of 5)	n/a	Total households with broadband internet access at home (‘000)						
Water & Sewerage	Water	**6,186** Length of water mains (km)	3%	**76,909** Water supplied (ML)	1%	$239m	2%	$282m	2%	18%
		14,283 Volume of water stored in dams (GL)	24%	**197** Properties served – water (‘000)	2%					
	Sewerage	**0** Desalination capacity (ML)	n/a	**60,378** Sewage collected (ML)	3%					
		4,535 Length of sewer mains (km)	3%	**177** Properties served – sewerage (‘000)	2%					

Source: ACIL Allen Consulting (2014a)[469]

469. DEC figures are rounded to the nearest $ million, so percentage changes may not tally exactly with rounded estimates in this table. See Glossary for explanation of abbreviations and terms.

6.4 Tasmanian Government plans and strategies

The Tasmanian Government has committed to developing an integrated Freight Strategy and a Transport Strategy.[470] The Department of State Growth[471] identified a number of priorities that are likely to feature. These include:

- identifying objectives and principles to guide decision making within the transport system;
- supporting service choice and competition across the Bass Strait;
- efficient freight gateways;
- land freight connections; and
- delivering a single, integrated freight system.

6.5 Transport

6.5.1 Urban transport

The value-add of urban transport in Hobart has been estimated using the top-down economic analysis used for all other sectors, rather than the bottom-up methodology used for urban transport in the six largest capital cities. This is because the detailed transport model used for the six largest capital cities was not available for Hobart.

The estimated DEC of urban transport in Hobart in 2011 was $835 million. This is projected to increase to $1.48 billion in 2031, an increase of 2.9 per cent per year, or 78 per cent in total.

The ABS' method of travel to work data from the 2011 Census provides some insight into travel patterns within Hobart, though it is limited to travel to work on a single day in 2011.

Table 81 illustrates the share of trips made using various means of transport. Passenger vehicles including car, taxi and motorcycle accounted for 84 per cent of trips to work. This is higher than the national average of 79.7 per cent.

Hobart also had a relatively high proportion of active travel, with 7.6 per cent of the population walking or cycling to work. This is higher than the national average of six per cent.

However, Hobart had a lower utilisation of public transport than the other capital cities, with only 5.4 per cent of trips to work made using public transport.[472]

Table 81: Travel to work mode share of Hobart residents

Mode	Share	
	Hobart	Nat. average
Public transport	5.4%	8.9%
Passenger vehicle	84.0%	79.7%
HCV	0.7%	0.7%
Active transport	7.6%	6.0%
Other, Multiple methods	2.3%	4.6%

Source: Australian Bureau of Statistics (2012)

6.5.2 National highways

Of Australia's 34,656 km of national highways identified in the Audit (which include the National Land Transport Network highways and other key freight routes), 321 km[473] are in Tasmania. This includes the Bass and Midland Highways connecting Hobart, Launceston and Burnie. In 2011, 136,000 vehicles used this network each day.

The DEC of Tasmania's national highways and key freight routes is projected to increase to $406 million from 2011 to 2031 − an increase of 45 per cent.

Figure 101 shows the National Land Transport Network highways included in the Audit for Tasmania. These routes play an important role in facilitating the production processes for industry and enabling the activities of business and the community.

Figure 101: National Land Transport Network highways in Tasmania 2011

The map shows highways identified in the Audit. Data was not available for all of these highways.
Source: ACIL Allen Consulting (2014a)

470. Tasmanian Department of State Growth (2013a)
471. Tasmanian Department of State Growth (2013b)
472. Australian Bureau of Statistics (2012)
473. Not all freight routes were included in the Audit due to data being unavailable.

6.5.3 Freight rail

The DEC of freight rail in Tasmania is projected to grow modestly from $7.69 billion in 2011 to $8.41 billion in 2031, an increase of nine per cent.

Despite being relatively small in a national context, freight rail is an important component of Tasmania's freight network, accounting for 329 million tonne kilometres, or 18 per cent of the state's total freight tonne kilometres travelled.[474]

Around three-quarters of freight rail movements take place on the 434 km National Land Transport Network rail line, which links Tasmania's four primary ports with its main urban areas. Freight movements by rail are generally over longer distances than movements by road, and rail plays a key role in connecting the state's north-west, north-east and south.

Tasmania's rail network faces some constraints, including weight restrictions and lack of capacity for large bulk carriers. As a result, the Tasmanian Government plans to invest in rail enhancements.

6.5.4 Ports

The Audit projects that the DEC of ports in Tasmania will rise by 30 per cent to 2031, reaching more than $436 million. This is a slower rate of growth than that expected for the state's economy or for the port sector across the country as a whole.

Four major government-owned ports service Tasmania, with throughput tonnages spread relatively evenly. These are shown in Table 82. In addition, the privately owned Port Latta is used for iron ore exports of around 2 Mtpa.[475]

Table 82: Tasmania port tonnages – 2012–13

	Total Throughput (mass tonnes)				Containerised trade in TEU			
Port	**Imports**	**Exports**	**Total**	**Total as % of national total**	**Imports**	**Exports**	**Total**	**Total as % of national total**
Burnie (TasPorts)	1,264,739	2,371,866	3,636,605	0.32%	115,499	116,170	231,669	3.23%
Devonport (TasPorts)	1,344,913	2,109,885	3,454,798	0.31%	39,203	39,252	78,455	1.09%
Bell Bay (TasPorts)	1,226,602	1,190,123	2,416,725	0.21%	542	3,462	4,004	0.06%
Hobart (TasPorts)	995,750	719,162	1,714,912	0.15%	0	0	0	0.00%
Tasmania Total	**4,832,004**	**6,391,036**	**11,223,040**	**0.99%**	**155,244**	**158,884**	**314,128**	**4.38%**

Source: Ports Australia (2014a)[476]

While Tasmania's four major TasPorts-run facilities have a relatively low level of activity in the national context, they serve as an important link for the state to the mainland.

Tasmania's network of ports is unlike those in other states and territories. The majority of throughput is handled outside the capital city and most of the state's shipping movements are to and from the mainland, rather than international. Additionally, while other states and territories have experienced growth in their ports, Tasmania's total throughput has fallen over the past decade. Total TasPorts ports throughput declined from a peak of 16.7 million tonnes of cargo in 2008 to 11.3 million tonnes in both 2012 and 2013. This was primarily due to a downturn in forest product exports. However, there was an improvement to 12.6 million tonnes in 2014.[477]

The current focus of the Australian and Tasmanian governments, along with TOLL, TasRail and TasPorts, is on enhancing the operations of the port at Burnie, which saw total throughput increase in 2014 for the first time in six years. The Tasmanian Government has committed to supporting the reintroduction of a direct international shipping service as long as it is sustainable in the long-term. Significant investment in dredging, berthing and loading facilities will be required to accommodate larger ships in the future.

6.5.5 Airports

The major airports of Hobart and Launceston operate air services to other capital cities, principally Melbourne and Sydney. The DEC of all Tasmanian airports is projected to increase from $515 million in 2011 to $771 million in 2031, a 50 per cent rise.

In the absence of interstate land transport options, airports are important for the movement of passengers and freight to and from Tasmania. However, passenger and freight throughput are relatively modest at the two largest airports.

474. Tasmanian Department of Infrastructure, Energy and Resources (2013)
475. Bureau of Infrastructure, Transport and Regional Economics (2014g)
476. Port Latta does not appear as it is privately owned.
477. TasPorts (2014)

Table 83: Tasmanian airport passenger numbers – 2013–14[478]

Revenue passenger (No.)				
Airport	Domestic (incl. Regional) Airlines	International Airlines	Total passengers	Total as % of national total
Hobart	2,106,642	0	2,106,642	1.44%
Launceston	1,286,284	0	1,286,284	0.88%
Devonport	131,529	0	131,529	0.09%
Burnie	66,771	0	66,771	0.05%
King Island	33,352	0	33,352	0.02%
Flinders Island	20,359	0	20,359	0.01%

Source: Bureau of Infrastructure, Transport and Regional Economics (2014i)

The *Launceston Airport Master Plan* forecasts that airport passenger numbers will approximately double to 2.5 million in 2035.[479] Hobart Airport forecasts passenger numbers to double, from 2.11 million in 2014 to 4.25 million by 2029.[480] These forecasts are broadly consistent with the Audit's DEC projections for airports in those regions.

6.6 Energy

6.6.1 Electricity

The Audit found that, in 2011, Tasmania had an installed electricity generation capacity of 2,601 MW. Transmission peak demand was 1,771 MW and distribution peak demand was 1,055 MW. The utilisation of electricity in Tasmania in 2011 was 10,863 GWh for generation, 10,585 GWh for transmission and 4,619 GWh for distribution.

The DEC from electricity infrastructure in 2011 was $824 million. This was made up of $393 million from generation, $204 million from transmission and $227 million from distribution.

The Audit forecasts a 14 per cent increase in the use of electricity from 2011 to 2031. This equates to 12,379 GWh for generation, 11,933 GWh for transmission and 5,271 GWh for distribution by 2031. Based on these forecasts, the Audit projects an increase of $115 million (14 per cent) in the DEC of electricity infrastructure – made up of $58 million from generation, $26 million from transmission and $32 million from distribution – to over $939 million in 2031.

The Australian Energy Market Operator[481] (AEMO) forecasts declining electricity consumption in Tasmania, from 10,425 GWh in 2011 to 9,065 GWh in 2031. AEMO attributes the decline to reduced large industrial consumption, reduced residential and commercial consumption from increased rooftop photovoltaic (PV) output, increasing energy efficiency, and response to high electricity prices.

There are several reasons for caution in directly comparing AEMO's forecasts and the Audit projections for the DEC of electricity infrastructure. The Audit assumes an energy efficiency improvement rate of 1.5 per cent per year (compared to a historic rate of 0.5-1.0 per cent), whereas AEMO assumes much faster rates. Consequently the electricity use underlying the Audit's DEC measure is considerably higher than that for AEMO's forecast.

Additionally, AEMO reports and forecasts unit electricity consumption in gigawatt-hours, whereas DEC is a measure of the value-add provided by electricity infrastructure, expressed in dollar terms. The two are not necessarily perfectly correlated.

Tasmania is part of the National Electricity Market (NEM) which also includes NSW, Victoria, Queensland and SA. Electricity consumption and demand has fallen in the NEM in recent years. Annual energy sent out across the NEM fell seven per cent from 194.9 TWh in 2009–10 to 181.2 TWh in 2013–14.

Declining demand has not caused significant disruption in Tasmania, since lower demand growth had been forecast for the state for longer than the other eastern states. Tasmania is reliant on hydro generation plants. The Basslink cable allows Tasmania to export electricity to Victoria when Victorian prices are higher than Tasmanian prices, and to import electricity when Tasmanian prices are higher.

Tasmania currently has sufficient generation assets, both in terms of capacity and energy, but is energy constrained, with hydro generation

478. Tasmanian airports do not currently service international passengers or international freight.
479. Launceston Airport (2015)
480. Hobart International Airport (2009)
481. Australian Energy Market Operator (2014a)

constrained by water availability in storages. However, the presence of Basslink and gas fired generation capabilities means that Tasmanian energy demand can be met. Coupled with the ongoing increase in supply available from renewable sources, there will be little need to build new generation capacity in the foreseeable future, with any electricity shortfalls met by importing from Victoria based on existing supply and demand conditions.

Government policies aimed at reducing carbon emissions, and uncertainty around carbon pricing, have made new investment in emissions intensive assets unviable. Tasmania has ample renewable energy and limited coal resources.

Policies to reduce carbon have increased the relative competiveness of hydro power generation. However, hydroelectric plants are output constrained because their production is a function of water inflows, which are determined by rainfall. Consequently, a carbon price would not influence the output of existing hydroelectric plants in the long-term.

The Large-scale Renewable Energy Target (and the previous Renewable Energy Target) have led to a substantial increase in the penetration of wind farms across the NEM. Tasmania generates around 308 MW of wind power, which represents around 12 per cent of installed capacity. The Musselroe wind farm commenced operation in 2013 and has 168 MW of installed capacity.

The Small-scale Renewable Energy Scheme, feed-in tariffs and other solar PV subsidies led to a significant increase in the penetration of solar PV systems in the last five years. In Tasmania, the capacity of installed solar PV has increased from 2 MW at the start of 2010 to 78 MW as of October 2014. In its latest forecasts, AEMO predicted an increase in solar PV to 473 GWh by 2031.

Renewable energy is now able to supply the majority of generation in Tasmania. In 2013, thermal generation accounted for 13 per cent of installed capacity, but it is mostly used as a contingency.[482]

The combination of an unanticipated decline in demand and rising penetration of renewables has led to an ongoing structural change in the wholesale sector.

The Tasmanian Government is developing an Energy Strategy to identify ways in which energy can be used as a key economic driver for Tasmania. Its *Draft Tasmanian Energy Strategy*,[483] which has an overarching vision of restoring Tasmania's energy advantage, has three key themes:

- making energy work for people;
- reducing the cost of delivering energy; and
- positioning Tasmania for the future.

Underpinning this are a suite of action items, which outline how the Tasmanian Government will respond in the short to medium term to deliver on these three themes.

The implications of surplus capacity differ by sector. For the generation sector, surplus capacity and renewable policy settings are likely to result in the withdrawal of thermal generation assets. Since 2005, a substantial amount of capacity has been 'mothballed' or retired in the NEM.

For the network sector, the decline in demand has diminished the need for augmentation investment. There is likely to be little need for significant network upgrades in Tasmania in the near future.

6.6.2 Gas

In 2011, Tasmanian gas transmission pipelines had an annual throughput of 16 petajoules (PJ). Gas distribution networks had an annual throughput of 2 PJ.

The main pipeline is the Tasmanian Gas Pipeline, which transports gas from Longford in Victoria to Bell Bay. There is significant capacity available and therefore little need to upgrade it in the foreseeable future.

The DEC from gas pipelines in Tasmania in 2011 was estimated to be $28 million, made up of $15 million for transmission and $13 million for distribution.

The Audit projects an increase in the DEC of gas pipeline infrastructure in Tasmania of $17 million (a 60 per cent rise) to $44 million between 2011 and 2031. This increase is made up of $9 million from transmission and $8 million from distribution. The state's economy is expected to grow by 48 per cent over the same period.

AEMO[484] forecast a decline in gas consumption in Tasmania, from 12 PJ in 2014 to 8 PJ in 2031. As with electricity, there are several reasons for the inconsistency between the Audit's forecasts and AEMOs. The DEC analysis was finalised before the latest AEMO gas market forecasts were published. Those forecasts were the first to show a break in what had previously been a direct link between economic growth and rising energy consumption. Also, AEMO reports and forecasts gas consumption in petajoules, whereas DEC is a measure of the value-add provided by gas infrastructure, in dollars. The two are not necessarily perfectly correlated.

482. Office of the Tasmanian Economic Regulator (2014)
483. Tasmanian Department of State Growth (2014)
484. Australian Energy Market Operator (2014b)

Although domestic gas consumption is forecast to continue declining, new Liquefied Natural Gas (LNG) plants on the east coast have opened the market to export. Value-add from gas infrastructure in future will come from both domestic usage (where demand may continue to fall), and from the export market. The impact of this will largely be in Queensland and the NT.

Tasmania does not have any significant conventional or non-conventional gas reserves.

6.6.3 Petroleum

The petroleum industry is broadly split into upstream and downstream petroleum sectors. The upstream sector refers to exploration and production of crude oil while downstream refers to refining of crude oil and the distribution and sale of petroleum products.

The Audit estimated total throughput at petroleum terminals in Tasmania of 1,042 ML in 2011. The DEC of petroleum terminals was $14 million.

The Audit projects an increase in throughput of 0.9 per cent per year, equating to throughput of 1,255 ML per year by 2031 – a difference of 213 ML per year. This is projected to lead to a DEC of $17 million in 2031, an increase of $3 million.

6.6.3.1 Crude oil production

Australia's total production of crude oil has been steadily declining. Crude oil production peaked in 2000 at 722 kb/day and declined to just over 338 kb/day in 2013.[485] Oil production is forecast to decline at an annual average rate of 4.4 per cent from 2014–15 to 2049–50.[486] The majority of production comes from two major basins: the Carnarvon Basin in Western Australia (77 per cent of production in 2011), and the Gippsland Basin in Victoria (less than 15 per cent of production in 2011).

6.6.3.2 Refinery capabilities

In recent years the global oil refining industry has been undergoing significant structural change. Larger, more efficient 'mega-refineries' have been established in Asia, resulting in increased competitive pressures on established refining operations, including those in Australia. There are no refineries in operation in Tasmania.

6.6.3.3 Petroleum products

Domestic demand for petroleum products grew at an average annual rate of around 1.5 per cent in the decade to 2011–12. It is expected to grow by around one per cent per year through to 2049–50, largely driven by population and economic growth. However, energy intensity (measured by total domestic energy consumption per dollar of gross domestic product) is projected to decline by around 1.7 per cent per year over the same period, compared to a decline of 1.3 per cent from 1989–90 to 2009–10. This decline indicates an accelerating improvement in energy efficiency. The transport sector uses more than 60 per cent of all petroleum consumed in Australia, and is the primary driver of demand growth. In addition, the expansion of the mining sector has contributed significantly to increased demand for diesel.[487]

Imported refined petroleum products account for approximately 40 per cent of total domestic consumption, and this share is forecast to rise. Refined petroleum products are imported from more than 20 countries, but 80 per cent of all such products come from just three: Singapore (53 per cent), South Korea (18 per cent) and Japan (12 per cent).[488]

Demand for petroleum import facilities and the need for additional import infrastructure within Tasmania is expected to grow within the life of the Australian Infrastructure Plan.

6.7 Telecommunications

Tasmania was a priority area for the rollout of the National Broadband Network (NBN), and it is expected that increases in DEC will be realised through the NBN and private communications operators. DEC is projected to rise from $347 million in 2011 and $557 million in 2031. This 61 per cent rise is a faster rate of increase than the projected broader economic growth of 42 per cent over the period.

Tasmania has the lowest level of ADSL availability in Australia, and has more areas with poor access to quality broadband services than other states. Low broadband availability rates in Tasmania are driven by the distance from exchanges − 7.5 per cent of premises in Tasmania are more than five kilometres from the closest exchange, which means ADSL is not accessible for these premises.

In Tasmania, 84 per cent of premises have access to ADSL, 68 per cent have 3G mobile coverage, 36 per cent have 4G coverage, 10 per cent have access to fibre to the premises and four per cent have NBN Co fixed wireless services.[489] There is no hybrid-fibre co-axial (HFC) or fibre to the node in the state.

485. United States Energy Information Administration (2013)
486. Bureau of Resources and Energy Economics (2011)
487. Bureau of Resources and Energy Economics (2014a)
488. Australian Institute of Petroleum (2013a)
489. Department of Communications (2013)

For overall quality of fixed broadband service, while Tasmania has a relatively high share of premises that receive the highest level of service, only the NT has a larger share of premises that receive the lowest two categories of service. Around 70 per cent of premises in Tasmania can only access the lowest rated level of service.

6.8 Water

The DEC for water and sewerage infrastructure in Tasmania is projected to increase by 18 per cent to $283 million between 2011 and 2031. The Audit identified that 34 GL of water was supplied to Hobart in 2011 and 43 GL to other regions. This does not cover rural water supplies or water supplied for hydroelectric generation, because it was not included in data extracted from the National Water Commission data set. Sewage collected in 2011 comprised 20 GL in Hobart and 41 GL in other regions.

The highest projected growth in water and sewerage DEC in Tasmania is in Hobart, where DEC is projected to grow by $25 million from 2011 to $135 million in 2031. DEC is projected to grow by $18 million to $148 million in 2031 in regional areas.

Water and sewerage services have historically been under-priced, particularly in regional areas. This has potentially led to an understatement of DEC, which is derived from National Water Commission data.

In regional areas, under-pricing of water and sewerage services means that the income derived from that infrastructure falls below the level needed to fund renewal of assets.

6.8.1 TasWater

Tasmania consumes around 60 GL of drinking water per year.[490] Household drinking water represents approximately 15 per cent of all water use in Tasmania. Demand is met by TasWater, a state wide vertically integrated urban water and sewerage provider.

TasWater is the only provider of drinking water and sewerage services in Tasmania. It was formed from the merger of three former regional water and sewerage corporations, and is owned by Tasmania's 29 councils.

The company owns and manages 6,380 km of water mains and 60 water treatment plants and dosing stations. It treats and removes approximately 50 GL of sewage annually through its network, comprising 4,288 km of gravity and 380 km of pressure mains, 728 sewer pump stations and 33 level one sewage treatments plants and 79 level two sewage treatment plants. Water services are provided to 200,000 connections and sewerage to 178,000 connections. TasWater also provides stormwater transfer and treatment services to the Launceston combined drainage area.

Problems in Tasmania's sewerage infrastructure are generally concentrated around Hobart, largely due to the age of the infrastructure, and in the north of the island. Significant investment will be required in the period to 2031, especially for plants discharging into the Tamar and Derwent rivers.[491]

TasWater has forecast population growth for Tasmania of around 0.5 per cent per year,[492] focused in small pockets around Brighton, Clarence and Kingston in the south, Newnham, Kings Meadows and Legana in the north, and Port Sorell in the north western regions of Tasmania. This is in line with the Audit's projections. These areas will likely account for the majority of new demand in the coming years.

Table 84 details projected water and sewage treatment demand through to 2018 for residential and some non-residential water users. While there is no long-term water supply plan extending to 2031, Tasmania's urban water supply arrangements appear to be secure for the next 15 years, given the low projected increases in population. However, climatic variability and change are important risk factors which need to be addressed in future water supply planning.

Table 84: Predicted water and sewage treatment demand 2015–16 to 2017–18 for 20 mm connections

	2015/16	2016/17	2017/18
ML water supplied	57 964	58 817	59 683
ML sewage (inc infiltration)	49 944	50 431	50 925

Source: TasWater (2014b)

490. Office of the Tasmanian Economic Regulator (2015)
491. TasWater (2014b)
492. Office of the Tasmanian Economic Regulator (2015)

6.8.2 Tasmanian Irrigation

Tasmanian Irrigation is a state-owned company funded by a combination of public and private investment. Its primary aim is to develop and enhance productive capacity in Tasmania's agricultural industry.

Public funding is provided by the Tasmanian and Australian governments. Private investment is made through tradable water entitlement purchases. Operating costs and asset renewals will be funded through annual charges levied on water entitlement holders, and will not require additional subsidies.

In 2013–14, Tasmanian Irrigation delivered 16,000 ML of water − 3,000 less than in the previous year, reflecting a wetter season in 2013–14.[493] There are currently 11 irrigation schemes operated by Tasmanian Irrigation across the state, operating with 115 GL of water entitlements. A further three schemes are under construction, representing more than 11.5 GL of water entitlements. Five more schemes have been identified and $60 million of federal funding has been announced, representing a potential 40 GL of water entitlements.

6.8.3 Hydro Tasmania

Hydro Tasmania is Australia's largest water manager, with an annual average of 15,364 GL of water flowing through its power stations.[494]

The power system in Tasmania uses water from six major river catchments. This use is authorised under a Special Water Licence Agreement. Water management guidelines apply to managing the system as a whole. These guidelines include establishing long-term storage targets, following storage operating rules, managing storage risks and protocols for communication with stakeholders.

Long-term storage targets are established using system modelling. Hydro Tasmania uses this to manage the volatility in inflows, balancing the risk of shortfall against the risk of spill. The modelling incorporates the latest climate change predictions from CSIRO.

493. Tasmanian Irrigation (2014)
494. Hydro Tasmania (2015)

Audit observations – Australian Capital Territory

7.1 Structure of this chapter

This chapter presents observations from the Audit for the four infrastructure sectors – transport, energy, water and communications – across the ACT. It provides data about the territory's population and economy (i.e. the key drivers of demand for infrastructure), and the value-add attributable to ACT infrastructure, in 2011. It also outlines growth projections to 2031 for the territory's population and economy, and for each of the infrastructure sectors. As noted in the Introduction to this report, these projections are based on economic and demographic analysis set out in two associated studies.[495]

The Audit uses the Direct Economic Contribution (DEC) methodology to quantify both the value-add attributable to infrastructure in 2011, and the projected change in overall demand for infrastructure from 2011 to 2031. When considered in the light of other factors, such as capacity limitations which might constrain economic growth, this approach helps to identify locations and sectors that are likely to warrant further attention in the Australian Infrastructure Plan (the Plan).

This chapter also takes account of other documents, including plans, studies and strategies, prepared by the ACT Government and others.

7.2 Drivers of infrastructure demand − population and economy

Based on medium level projections from the Australian Bureau of Statistics (ABS), shown in Table 85, the ACT's population is projected to reach 520,000 by 2031 − an increase of 152,000 people, or 41 per cent, from 2011. The ACT Government[496] projects a slower rate of growth, forecasting a population of 499,000 people in 2032.[497]

From 2011, the ACT's economy will grow at a slightly slower rate than Australia as a whole, although the difference will be small and the ACT will broadly maintain its share of the national economy. The projected population growth is faster than the country as a whole. This implies that the ACT will see slower growth on a per capita basis, although Gross State Product per capita will remain above the national average.

495. ACIL Allen Consulting (2014a) and Infrastructure Australia (2015b)
496. Australian Capital Territory Government Chief Minister and Treasury Directorate (2013)
497. The ACT only provides data for each five year interval, hence a 2032 projection rather than 2031.

Table 85: Projected population and economic growth for the Australian Capital Territory

	2011	% of National	2031	% of National	Increase % 2011–31
Population (persons)	367,985	1.6%	520,412	1.7%	41%
Gross State Product ($m)	31,323	2.2%	56,194	2.2%	79%

Source: ACIL Allen Consulting (2014a)[498]

Higher growth is forecast from 2011 to 2031 in North Canberra, South Canberra, Belconnen, Gungahlin and Cotter-Namadgi. Tuggeranong and Woden SA3 regions are expected to see more modest growth.

7.3 Summary of Australian Capital Territory infrastructure from 2011 to 2031

Table 86 provides a snapshot of the ACT's economic infrastructure across the four sectors of transport, water, energy and communications.

The table notes the capacity of each subsector and its rate of utilisation in 2011, along with historic (2011) and projected (2031) DEC for each subsector.

Given the ACT's size, there is only the one Audit region for the territory. In 2011, the DEC of infrastructure in the ACT was $3.5 billion, which was around two per cent of the national figure.

In 2031, ACT infrastructure DEC is projected to increase by around $3.3 billion, or 96 per cent, reaching $6.8 billion (1.8 per cent of national DEC).

498. Gross State Product is in 2010–11 prices.

Table 86: Overview of ACT infrastructure

	Subsector	Capacity 2011		Utilisation 2011		DEC 2011		DEC 2031		Projected increase in DEC
			% of Nat.		% of Nat.		% of Nat.		% of Nat.	2011-2031
Transport	Urban Roads	**84,200,000** Car VKT per day	4%	**9,900,000** Car VKT per day	2%	$1,824m	2%	$3,577m	2%	96%
	Urban Public Transport	**3,400,000** Passenger KT per day	1%	**700,000** Passenger KT per day	1%					
	National Highways	**0** km of nationally significant roads	n/a	**0** vehicles per day	n/a	$0m	n/a	$0m	n/a	n/a
	Freight Rail	n/a	n/a	n/a	n/a	$0m	n/a	$0m	n/a	-16%
	Ports	**0** Mt p.a. throughput	n/a	**0** Mt p.a. throughput	n/a	$0m	n/a	$0m	n/a	n/a
		0.0 MTEU throughput	n/a	**0.0** MTEU throughput						
	Airports	**1** Count of airfields	0%	**3,240,848** Total RPT passenger movements	2%	$900m	4%	$1,943m	5%	116%
Energy	Electricity	**0** Installed capacity (MW) of Generation	n/a	**0** Utilisation of Generation (GWh)	<1%	$168m	1%	$246m	1%	47%
		620 Peak Demand Transmission (MW)	2%	**3,062** Utilisation of Transmission (GWh)						
		620 Peak Demand Distribution (MW)	2%	**3,062** Utilisation of Distribution (GWh)						
	Gas	n/a	n/a	**0.00** Transmission throughput (PJ/a)	n/a	$0m	n/a	$0m	n/a	n/a
		n/a	n/a	**7.05** Distribution throughput (PJ/a)	2%	$39m	3%	$22m	1%	-44%
	Petroleum product terminals	n/a	n/a	**0** Annual throughput (ML)	n/a	$0m	n/a	$0m	n/a	n/a
Telecommunications		**4.85** Broadband average availability rating (out of 5)	n/a	**115**	n/a	$316m	2%	$656m	2%	108%
		2.70 Broadband average quality rating (out of 5)	n/a	Total households with broadband internet access at home (‘000)						
Water & Sewerage	Water	**3,134** Length of water mains (km)	1%	**33,650** Water supplied (ML)	<1%	$209m	2%	$316m	2%	51%
		56 Volume of water stored in dams (GL)	<1%	**150** Properties served – water (‘000)	2%					
	Sewerage	**0** Desalination capacity (ML)	n/a	**35,441** Sewage collected (ML)	2%					
		3,134 Length of sewer mains (km)	2%	**149** Properties served – sewerage (‘000)	2%					

Source: ACIL Allen Consulting (2014a)[499]

499. DEC figures are rounded to the nearest $ million, so percentage changes may not tally exactly with rounded estimates in this table. See Glossary for explanation of abbreviations and terms.

7.4 Australian Capital Territory Government plans and strategies

A number of documents underlie the strategic planning process in the ACT, including:

- the *National Capital Plan*,[500] which is the strategic plan for Canberra. It sets out the broad planning principles and policies for Canberra and the ACT, and detailed conditions of planning, design and development for the 'Designated Areas'.
- the *Transport for Canberra Plan*[501] sets out a range of actions in transport to 'help create a more sustainable city'. Among these is a plan for mass public transport (either bus rapid transit or light rail), which involves the ACT working with Queanbeyan City Council and the NSW Government to create a public transport corridor between Queanbeyan and the ACT via Canberra Avenue, and completing Majura Parkway.
- *Planning for a sustainable city*[502] sets out high level strategies and actions for how Canberra will meet its aspirations through to 2030 and 2060.

7.5 Transport

7.5.1 Urban transport

For the urban transport component of the Audit, the top-down economic analysis used for the other sectors, which is based on national accounts and industry data, was complemented by bottom-up analysis based on detailed transport modelling for the six major capital cities.

This modelling provides detailed information about trips within these cities by origin/destination, and by corridor, in 2011. It takes account of projected population and employment growth and spatial distribution to project demand for trips, also by origin/destination and corridor, in 2031.

The model includes detailed information about capacity, showing where demand is projected to grow in excess of supply. For road corridors it quantifies the cost of delay, showing where interventions will likely provide the biggest economic return and serves as a useful indicator of which corridors warrant further study.

7.5.1.1 Urban transport in greater Canberra

In 2011 the DEC of urban transport in the Canberra-Goulburn-Yass conurbation was $1.8 billion, with cars accounting for $1.5 billion, heavy commercial vehicles (HCV) $0.2 billion and bus transport $0.1 billion. By 2031 DEC is forecast to double to $3.6 billion, with cars accounting for $2.9 billion, HCV $0.3 billion and buses $0.2 billion.

Road utilisation (measured in vehicle kilometres travelled daily) was 9.9 million in 2011.

The cost of delay on greater Canberra's urban transport network in 2011 was around $0.2 billion. In the absence of any additional capacity (other than projects already under construction or funded), the cost of delay is projected to grow to around $0.7 billion in 2031.

The cost of delay in Canberra is low compared to other Australian cities, although the private car is the dominant mode of transport. The ACT Government's stated intention is to increase the proportion of workers using public and active transport in order to support population growth, respond to climate change and improve accessibility to the city centre for an ageing population.

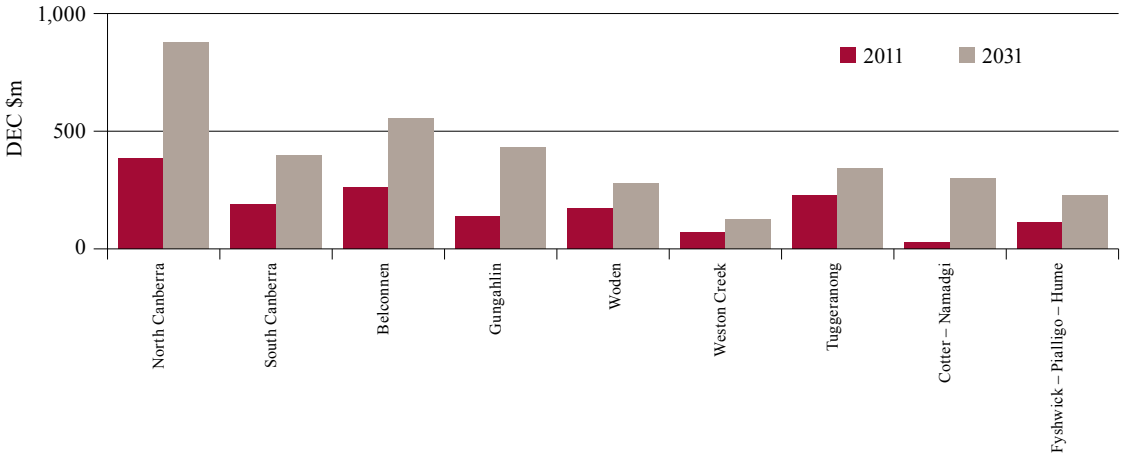
Origins/destinations of trips in greater Canberra

Figure 102 shows trips in greater Canberra by origin/destination (O/D), as measured by DEC in 2011 and projected DEC for 2031. The O/D regions used here are SA3 regions as defined by the ABS.[503]

This analysis shows that the North Canberra region is the largest O/D for trips within greater Canberra, followed by Belconnen and Tuggeranong. Gungahlin is projected to grow to become the second largest O/D for trips by 2031.

500. National Capital Authority (2014)
501. Australian Capital Territory Government Environment and Sustainable Development Directorate (2012a)
502. Australian Capital Territory Government Environment and Sustainable Development Directorate (2012b)
503. SA3s provide a standardised regional breakup of Australia and generally (although not always) have populations between 30,000 and 130,000 persons.

Figure 102: Trips in Canberra by origin/ destination for roads and public transport in 2011 and 2031, measured by DEC ($ million)



Source: Infrastructure Australia analysis of data from ACIL Allen Consulting (2014b) and Veitch Lister Consulting (2014g)

7.5.1.2 Road corridors in greater Canberra

The Audit dataset provides a broad range of data about corridors, and there are many ways of analysing it. Given the focus of the Audit on economic indicators, the analysis in Table 87 and Table 88 focuses on delay cost. This applies a dollar cost to time delays, based on lost productivity, and takes account of the different costs applicable to different vehicle types.

Some users of the Audit dataset may prefer to use more traditional indicators of congestion such as traffic volume compared to capacity (V/C). This measure is included in Table 87 and Table 88, as is the DEC measure, which gives insight into the underlying value of activity on the corridor, and the proportion of DEC attributable to delay cost.

These measures are expressed per lane kilometre of road. This normalises the results to facilitate comparison across a wide range of corridor types − some very long, some consisting of multiple roads, and some relatively short single roads.

The modelling provides one method of measuring and projecting demand for transport infrastructure and the corridors identified in Table 87 and Table 88 reflect this approach. The ACT Government may have utilised other data, and different methods of analysis, to inform identification of infrastructure priorities. For further information on the assumptions, included projects and methodology applied in the model, refer to the supporting documentation by Veitch Lister Consulting.

Table 87 shows corridors ranked by delay cost per lane kilometre in 2011, with the equivalent projections for 2031 in Table 88. Taken together, these tables give an indication of which corridors warrant further study, and where interventions are likely to have the biggest economic return.

Table 87: Top 10 road corridors in greater Canberra 2011, by delay cost (2011 dollars)

Rank	Road Corridor	State	Delay cost by lane km 2011 ($m)	DEC per lane km 2011 value ($m)	Volume Capacity Ratio 2011 AM Peak (7-9 AM)
1	Barton Hwy/Northbourne Ave Corridor	ACT	0.43	2.16	54%
2	Canberra Avenue Corridor	ACT	0.38	1.85	57%
3	Belconnen Way/Barry Dve Corridor	ACT	0.35	1.82	52%
4	Canberra Airport to Civic Corridor	ACT	0.32	1.62	60%
5	Tuggeranong Pky Corridor	ACT	0.28	1.58	58%
6	Macarthur Ave/Limestone Ave/Fairbairn Ave Corridor	ACT	0.20	1.37	52%
7	William Slim Dve/Coulter Dve Corridor	ACT	0.20	1.04	61%
8	Erindale Dve/Yamba Dve Corridor	ACT	0.18	1.03	52%
9	Ginninderra Dve Corridor	ACT	0.18	1.16	55%
10	East-West Corridors	ACT	0.16	1.12	56%

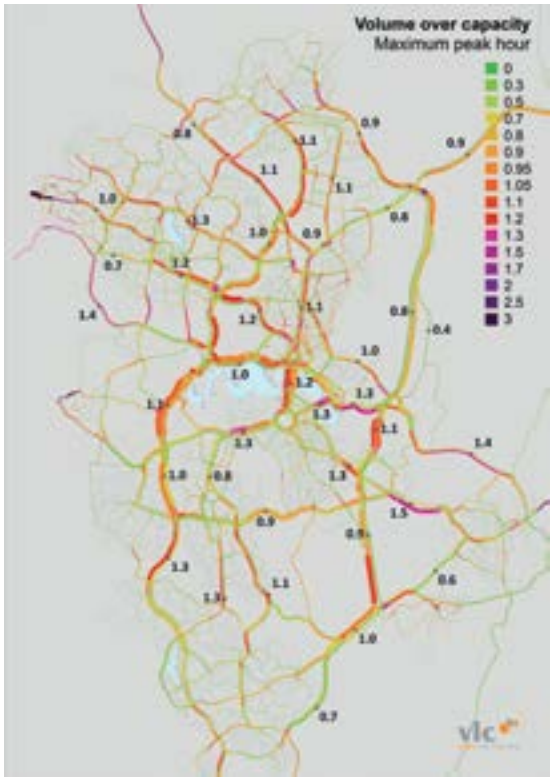
Source: Infrastructure Australia analysis of modelling data by Veitch Lister Consulting (2014g)

Table 88: Top 10 road corridors in greater Canberra 2031, by delay cost (2011 dollars)

Rank	Road Corridor	State	Delay cost by lane km 2031 ($m)	DEC per lane km 2031 ($m)	Volume Capacity Ratio 2031 AM Peak (7–9 AM)
1	Canberra Avenue Corridor	ACT	1.22	3.69	72%
2	Barton Hwy/Northbourne Ave Corridor	ACT	1.18	3.82	68%
3	Belconnen Way/Barry Dve Corridor	ACT	1.15	3.54	67%
4	Canberra Airport to Civic Corridor	ACT	1.11	3.32	79%
5	Gungahlin Dve Corridor	ACT	0.76	2.98	68%
6	Macarthur Ave/Limestone Ave/Fairbairn Ave Corridor	ACT	0.68	2.55	68%
7	William Slim Dve/Coulter Dve Corridor	ACT	0.63	1.96	72%
8	Tuggeranong Pky Corridor	ACT	0.60	2.53	64%
9	Monaro Hwy Corridor	ACT	0.59	2.98	57%
10	Gundaroo Dve/Horse Park Dve Corridor	ACT	0.58	2.06	66%

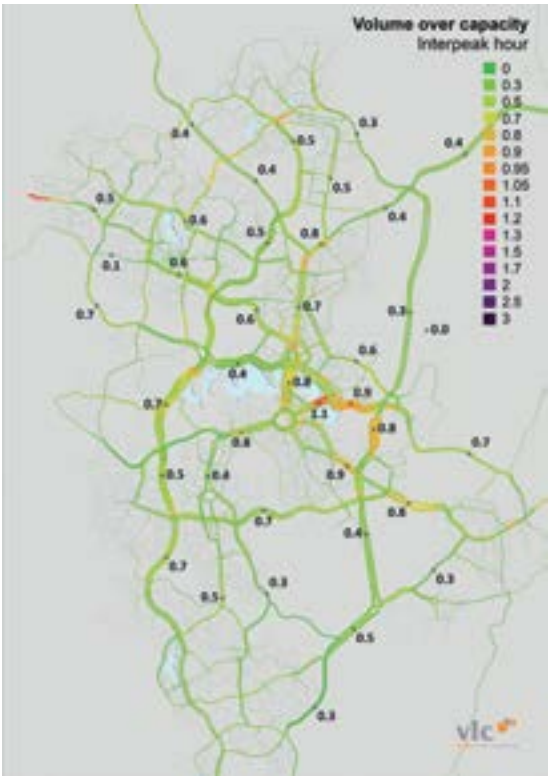
Source: Infrastructure Australia analysis of modelling data by Veitch Lister Consulting (2014g)

Figure 103: Canberra road network volume/capacity ratio in 2031 – AM maximum peak hour



Source: Veitch Lister Consulting (2014g)

Figure 104: Canberra road network volume/capacity ratio in 2031 – daytime inter-peak period



Source: Veitch Lister Consulting (2014g)

The light rail project being developed for the Northbourne Avenue corridor is aligned with the Barton Highway/Northbourne Avenue corridor.

Figure 103 and Figure 104 show projected road congestion in 2031 in the AM peak and daytime inter-peak period, respectively. These show the corridors and locations likely to reach or exceed maximum capacity by 2031, based on current capacity, including projects under construction. While some network constraints exist during the AM peak hour, there remains surplus capacity across the network during the inter-peak period.

7.5.1.3 Public transport in greater Canberra

Figure 105 and Figure 106 show the projected change in passenger loadings on Canberra's bus network, currently the only mode of public transport in Canberra. Passenger loadings on Northbourne Avenue, in particular, are projected to rise substantially through to 2031.

In line with the *Canberra Plan and Light Rail Master Plan*,[504] a light rail line between Gungahlin and the City[505] is currently being developed. The ACT Government is considering an option to extend this to Russell.

504. The ACT Government is currently preparing an updated light rail master plan to succeed an earlier 2008 version of the document. It will examine options for a future light rail network across Canberra.
505. Australian Capital Territory Government Capital Metro (2014)

Figure 105: Canberra bus weekday passenger demand relative to crush capacity (2011)

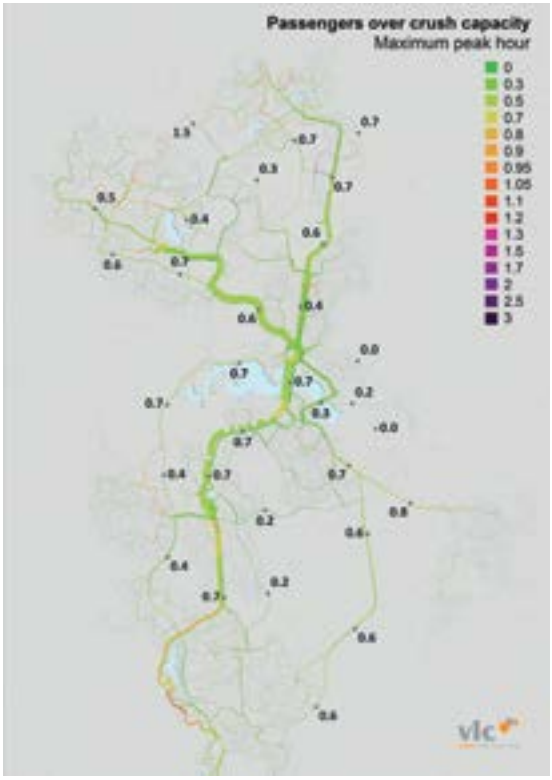
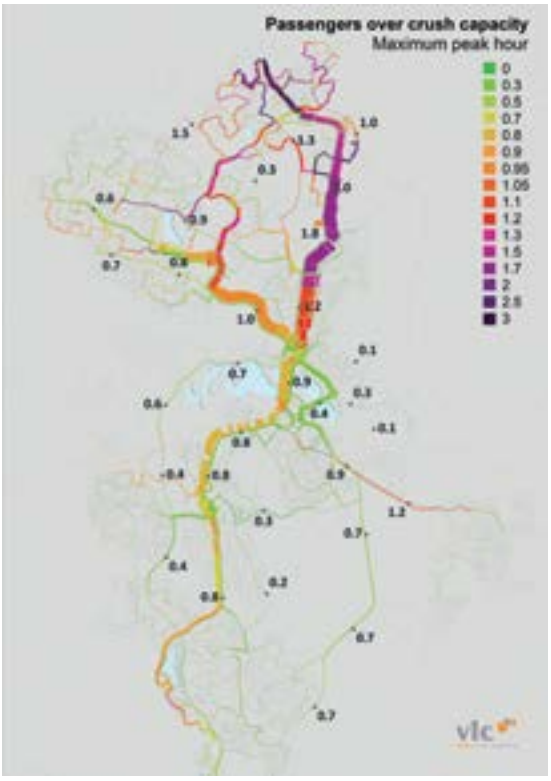


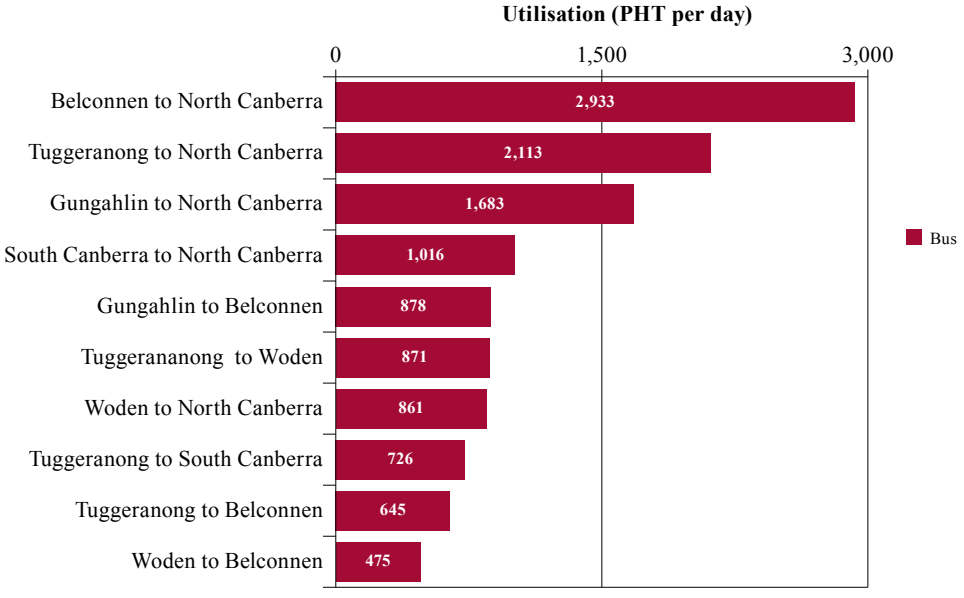
Figure 106: Canberra bus weekday passenger demand relative to crush capacity (2031)



Source: Veitch Lister Consulting (2014g)

Figure 107 sets out the top 10 public transport O/D pairs in Canberra by passenger hours travelled (PHT). North Canberra features in five of the top 10 O/D pairs. The spread of PHT across Canberra is more even than for other cities, reflecting the more even spread of employment, retail and entertainment centres across the city.

Figure 107: Top 10 Canberra origin/destination pairs by passenger hours travelled (PHT) for public transport 2011



Source: Veitch Lister Consulting (2014g)

7.5.1.4 Bus trips in greater Canberra

Table 89 shows the top five destination SA3 regions for passenger hours travelled across the bus network in Canberra. North Canberra is the largest single destination and is projected to remain so. Gungahlin is projected to have fastest growth through to 2031, followed by North Canberra, Belconnen and South Canberra.

Table 89: Top five destinations in greater Canberra for bus trips by passenger hours travelled (PHT), 2011 and projected 2031

	North Canberra	Belconnen	Tuggeranong	Gungahlin	South Canberra
2011	14,408	10,535	8,915	4,472	4,089
2031	27,066	18,061	9,180	18,862	6,770

Source: Veitch Lister Consulting (2014g)

7.5.1.5 Freight movements in greater Canberra

Table 90 shows the proportion of daily vehicle kilometres travelled (VKT) by cars, light commercial vehicles, and heavy commercial vehicles between major origins and destinations in the greater Canberra region.

Table 90: Daily vehicle kilometres travelled by vehicle type 2011

		Utilisation (VKT/day)	Utilisation (VKT/day)	Utilisation (VKT/day)	LCV & HCV as % of daily VKT
From	**To**	**Car**	**LCV**	**HCV**	
Fyshwick-Pialligo-Hume	Tuggeranong	119,419	3,718	2,766	5.2%
Woden	North Canberra	94,715	2,922	1,701	4.7%
Gungahlin	Belconnen	190,689	4,346	1,804	3.1%
South Canberra	North Canberra	157,276	3,164	1,578	2.9%
Tuggeranong	Belconnen	157,724	2,554	1,905	2.7%
Tuggeranong	Woden	170,555	3,480	1,265	2.7%
Tuggeranong	North Canberra	222,314	4,088	1,872	2.6%
Belconnen	North Canberra	326,676	5,868	2,454	2.5%
Belconnen	South Canberra	130,157	1,981	1,195	2.4%
Tuggeranong	South Canberra	145,662	2,050	867	2.0%

Source: Infrastructure Australia analysis of data from Veitch Lister Consulting (2014g)

7.5.2 Airports

Canberra Airport serves the ACT and surrounding regions, linking Canberra with all other states and territories. The airport does not currently serve any regularly scheduled international flights, however, the airport operator has provided for introduction of international flights in future.[506] Passenger numbers are forecast to increase from around 2.85 million in 2013–14 to over nine million by 2033–34.

The airport operator has undertaken significant upgrades in passenger terminal capacity over the last five years. The airport handled 2.86 million passengers in 2013–14, slightly below the range of 3.01 to 3.26 million passengers per year handled between 2008–09 and 2012–13.[507] In 2011, the estimated DEC for Canberra Airport was $900 million. This is predicted to grow to $1.94 billion by 2031, a 116 per cent increase.

The recent terminal infrastructure upgrades provide capacity for future growth and it is likely that the projected increase in activity to 2031 can be serviced within current capacity.

506. Canberra Airport (2014)
507. The 2013–14 figure is provisional.

7.6 Energy

7.6.1 Electricity

The Audit found that, in 2011, the ACT did not have any installed electricity generation capacity. Transmission and distribution peak demands were 620 MW. The utilisation of electricity in the ACT in 2011 was 3,062 GWh for transmission and distribution.

The DEC from electricity infrastructure in 2011 was $168 million. This was made up of $28 million from transmission and $140 million from distribution.

The Audit forecasts a 38 per cent increase in the use of electricity from 2011 to 2031. This equates to 4,231 GWh for transmission and distribution by 2031. Based on these forecasts, the Audit projects a 47 per cent increase in the DEC of electricity infrastructure to $246 million. The $78 million increase is made up of $13 million from transmission and $65 million from distribution.

The ACT is part of the NSW region in the national electricity market (NEM). Declining electricity demand has been an ongoing feature of the NEM in recent years. Annual energy sent out across the NEM fell seven per cent from 194.9 TWh in 2009–10, to 181.2 TWh in 2013–14.

There are several reasons for caution in directly comparing AEMO's forecasts and the Audit projections for the DEC of electricity infrastructure. The Audit assumes an energy efficiency improvement rate of 1.5 per cent per year (compared to a historic rate of 0.5-1.0 per cent), whereas AEMO assumes much faster rates, exceeding 20 per cent in some years. Consequently the electricity use underlying the Audit's DEC measure is considerably higher than that for AEMO's forecast. Additionally, AEMO reports and forecasts unit electricity consumption in gigawatt-hours, whereas DEC is a measure of the value-add provided by electricity infrastructure, expressed in dollar terms. The two are not necessarily perfectly correlated.

The Large-scale Renewable Energy Target (and the previous Renewable Energy Target), and the Small-scale Renewable Energy Scheme, feed-in tariffs, and other solar photovoltaic (PV) subsidies, have led to a significant increase in the penetration of wind farms and solar PV systems in the last five years in the NEM. In 2013,[508] the ACT Government legislated a 90 per cent renewable energy target by 2020,[509] mainly though solar and wind generation, although much of this will be purchased from other jurisdictions in the NEM.

In 2012, the ACT Government commissioned 40 MW of large-scale solar generation capacity. A 20 MW solar farm opened in 2014[510] and by 2031 there is expected to be 90 MW of large scale solar generation. Additionally there is an estimated 40 MW of roof-top generation. The surplus in capacity in the NSW NEM region means there is little need for additional investment in capacity over the next 15 years based on existing demand and supply conditions.

The combination of an unanticipated decline in demand and rising penetration of renewables has led to an ongoing structural change in the wholesale sector.

At the same time, there have been considerable rises in network charges across the NEM, due to a range of factors. The rising network charges have in turn influenced retail prices, creating an impetus for regulators to investigate options that may diminish, or delay, further expansion of the network. Consequently, the Australian Energy Market Commission (AEMC), on 27 November 2014,[511] made a new rule that establishes a new pricing objective and new pricing principles for electricity distribution businesses that will require that network prices reflect the efficient costs of providing network services. Distribution network prices will reflect the costs of providing the electricity to consumers with different patterns of consumption which has the potential to reduce demand during peak periods, and consequently also reduce future network infrastructure investment.

The implications of surplus capacity differ by sector. For the generation sector, surplus capacity and renewable policy settings are likely to result in the withdrawal of thermal generation assets. However, the majority of thermal generation in the NSW NEM region is not located within the ACT area.

For the network sector, the decline in demand has diminished the need for augmentation investment. Indeed, the AEMO has pointed out that several transmission network service providers have delayed or cancelled a number of proposed major network upgrades.

Lower levels of demand growth could also be expected to reduce the need for expenditure to replace existing assets, although this depends on the profile of demand within a distribution network. Under the current regulatory framework, network companies are not required to seek AER approval to undertake investment in replacement assets. Network businesses therefore currently have an incentive to undertake investment, regardless of whether a replacement is justified.

508. Australian Capital Territory Government Legislation Register (2013)
509. Australian Capital Territory Government Environment and Sustainable Development Directorate (2013)
510. Australian Capital Territory Government Environment and Planning Directorate (2014a)
511. Australian Energy Market Commission (2014)

7.6.2 Gas

In 2011, ACT gas distribution pipelines had an annual throughput of 7 petajoules (PJ). The Audit did not identify any major pipelines in the ACT.

The DEC from gas pipelines in the ACT in 2011 was estimated at $39 million. The Audit projects a fall in the DEC of gas pipeline infrastructure of $17 million, or 44 per cent, to $22 million in 2031. This compares to projected economic growth for the ACT of 79 per cent.

The ACT is included within NSW in AEMO's forecasts,[512] which predict a decline in gas consumption across the broader region. Gas consumption in NSW[513] is now forecast to fall from 133 PJ in 2014 to 131 PJ in 2031, including a brief drop below 120 PJ per year early in the next decade.

As with electricity, there are several reasons the Audit's forecast rise in DEC in the gas sector, and AEMO's forecast of a fall in demand, may not be directly comparable. In particular, the DEC analysis was finalised before the latest AEMO gas market forecasts were published. Those forecasts were the first to show a break in what had previously been a direct link between economic growth and rising energy consumption. Also, AEMO reports and forecasts gas consumption in petajoules, whereas DEC is a measure of the value-add provided by gas infrastructure, in dollars. The two are not necessarily perfectly correlated.

Although domestic gas consumption has declined, and is forecast to continue to do so, new Liquefied Natural Gas (LNG) plants on the east coast have opened up the market to export. Value-add from gas infrastructure in future will come from both domestic usage (where demand may continue to fall), and from the export market. The impact of this will largely be in Queensland and the NT.

The ACT gas market is connected with NSW, Victoria, SA and (indirectly) to Queensland via two main gas pipelines, the Moomba to Sydney pipeline and the Eastern Gas pipeline.

7.6.3 Petroleum

Domestic demand for petroleum products grew at an average annual rate of around 1.5 per cent in the decade to 2011–12. It is expected to grow by around one per cent per year through to 2049–50, largely driven by population and economic growth. However, energy intensity (measured by total domestic energy consumption per dollar of gross domestic product) is projected to decline by around 1.7 per cent per year over the same period, compared to a decline of 1.3 per cent from 1989–90 to 2009–10. This decline indicates an accelerating improvement in energy efficiency. The transport sector uses more than 60 per cent of all petroleum consumed in Australia, and is the primary driver of demand growth. In addition, the expansion of the mining sector has contributed significantly to increased demand for diesel.[514]

Imported refined petroleum products account for approximately 40 per cent of total domestic consumption, and this share is forecast to rise. Refined petroleum products are imported from more than 20 countries, but 80 per cent of all such products come from just three: Singapore (53 per cent), South Korea (18 per cent) and Japan (12 per cent).[515]

There are no petroleum product terminals in the ACT.

7.7 Telecommunications

The DEC of telecommunications infrastructure in Canberra is projected to increase from $316 million in 2011 to $656 million in 2031, reflecting Canberra's importance as a government and services hub.

In the ACT, 94 per cent of premises have access to ADSL, 95 per cent have 3G mobile coverage, 66 per cent have 4G coverage, 32 per cent have access to fibre to the node and 13 per cent have access to fibre to the premises.

For overall quality of fixed broadband service, the ACT has the largest share of premises receiving the highest level of broadband service of any jurisdiction.

512. Australian Energy Market Operator (2014b)
513. Australian Energy Market Operator (2014b)
514. Bureau of Resources and Energy Economics (2014a)
515. Australian Institute of Petroleum (2013a)

7.8 Water

Water and sewerage infrastructure accounts for approximately three per cent of projected growth in total DEC in the ACT between 2011 and 2031. The Audit identified that 34 GL of water was supplied to the ACT in 2011, and 35 GL of sewage was collected.

The DEC for water and sewerage infrastructure in≈the ACT is projected to grow from $209 million in 2011 to $316 million in 2031, a 51 per cent increase.

It is important to note that water and sewerage services have historically been under-priced and that this has potentially led to an understatement of DEC as measured by the National Water Commission data (and as incorporated into the national accounts and GDP numbers).

Over 80 per cent of water used in the ACT is for residential and industrial use.[516] There is very little water used for irrigation.

Since 2003, water use per capita has been declining, due to a combination of demand management strategies and increased awareness of water scarcity. Between 2001 and 2013, annual water use per capita halved, falling from approximately 90 kilolitres per person per year in 2001 to just over 40 kilolitres per person per year in 2013.

The ACT enlarged the Cotter Dam in 2013, from 4 GL to 78 GL, and constructed the Murrumbidgee to Googong Transfer Pipeline in 2012. The pipeline carries up to 100 ML of water per day from the Murrumbidgee River to Googong Dam. As a result of these projects, the *ACT Government Water Strategy*[517] notes that water supply in the ACT is secure through to 2035, even under a high population growth scenario.

When demand exceeds supply, the ACT Government has stated[518] that it will consider buying water entitlements from the Murrumbidgee River catchment or reducing demand through water restrictions or other demand management options. The Murray Darling Basin Authority will establish protocols for ACT interstate water trading under the Murray Darling Basin Agreement.

516. Australian Capital Territory Government Environment and Planning Directorate (2014b)
517. Australian Capital Territory Government Environment and Planning Directorate (2014b)
518. Australian Capital Territory Government Environment and Planning Directorate (2014b)

Audit observations – Northern Territory

8.1 Structure of this chapter

This chapter presents observations from the Audit for the four infrastructure sectors – transport, water, energy and communications – across the NT. It provides data on the territory's population and economy (i.e. the key drivers of demand for infrastructure), and the value-add attributable to NT infrastructure, in 2011. It also outlines growth projections to 2031 for the territory's population and economy, and for each of the infrastructure sectors. As noted in the Introduction to this report, these projections are based on economic and demographic analysis set out in two associated studies.[519]

The Audit uses the Direct Economic Contribution (DEC) methodology to quantify both the value-add attributable to infrastructure in 2011, and the projected change in demand for infrastructure from 2011 to 2031. When considered in the light of other factors, such as capacity limitations which might constrain economic growth, this assists in the identification of locations and sectors that are likely to warrant further attention in the Australian Infrastructure Plan.

This chapter also takes account of other documents, including plans, studies and strategies, prepared by the NT Government and others.

8.2 Drivers of infrastructure demand – population and economy

As shown in Table 91, the Australian Bureau of Statistics (ABS) projects that the NT population will reach approximately 316,700 in 2031 based on a medium level projection (Series B) – an increase of 85,400 people, or 37 per cent, from 2011. The NT Government's projection of 320,000 is broadly in line with the ABS forecast.[520]

Gross State Product (GSP) is projected to increase from $17.4 billion to $34.8 billion (in 2011 dollars), an increase of approximately 100 per cent, from 2011 to 2031. This represents an average annual growth rate of 3.52 per cent per year. The NT's share of total Gross Domestic Product (GDP) will rise slightly.

Table 91: Projected population and economic growth for Northern Territory

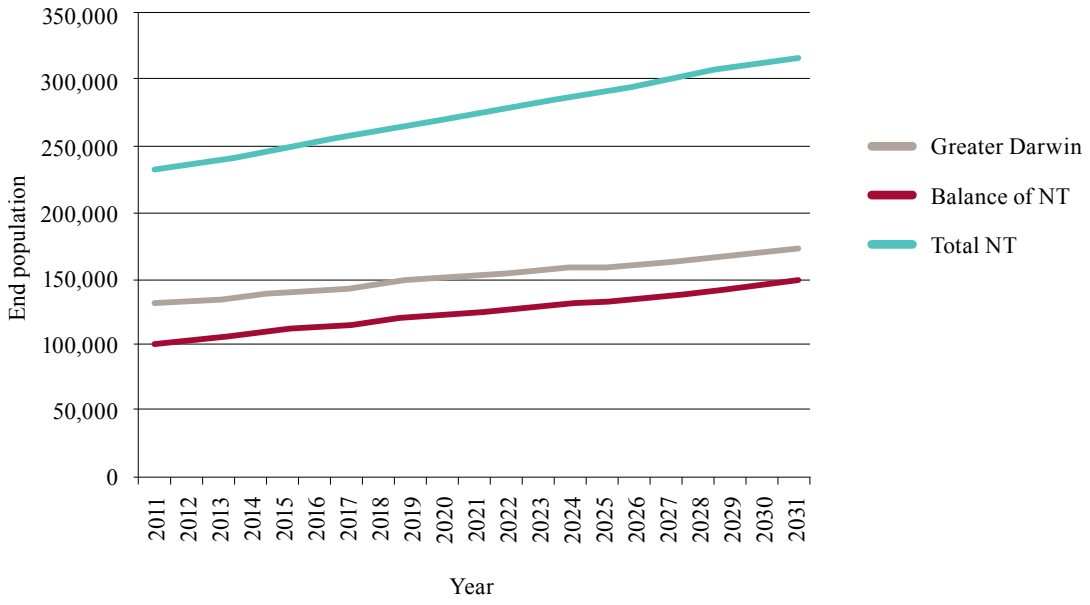
	2011	% of National	2031	% of National	Increase % 2011–31
Population (persons)	231,292	1.0%	316,657	1.0%	37%
Gross State Product ($m)	17,449	1.2%	34,833	1.3%	100%

Source: ACIL Allen Consulting (2014a)[521]

519. ACIL Allen Consulting (2014a) and Infrastructure Australia (2015b)
520. Northern Territory Department of Treasury and Finance (2014)
521. Gross State Product is in 2010–11 prices.

As shown in Figure 108, the NT population outside Darwin is projected to grow slightly faster than Darwin. Darwin is projected to grow by 32 per cent between 2011 and 2031, to a population of 170,200 by 2031, while the balance of the NT is forecast to grow by 43 per cent in the same period, to a population of 146,500.[522]

Figure 108: Population projections for the Northern Territory – 2011 to 2031



Source: Australian Bureau of Statistics (2013c)[523]

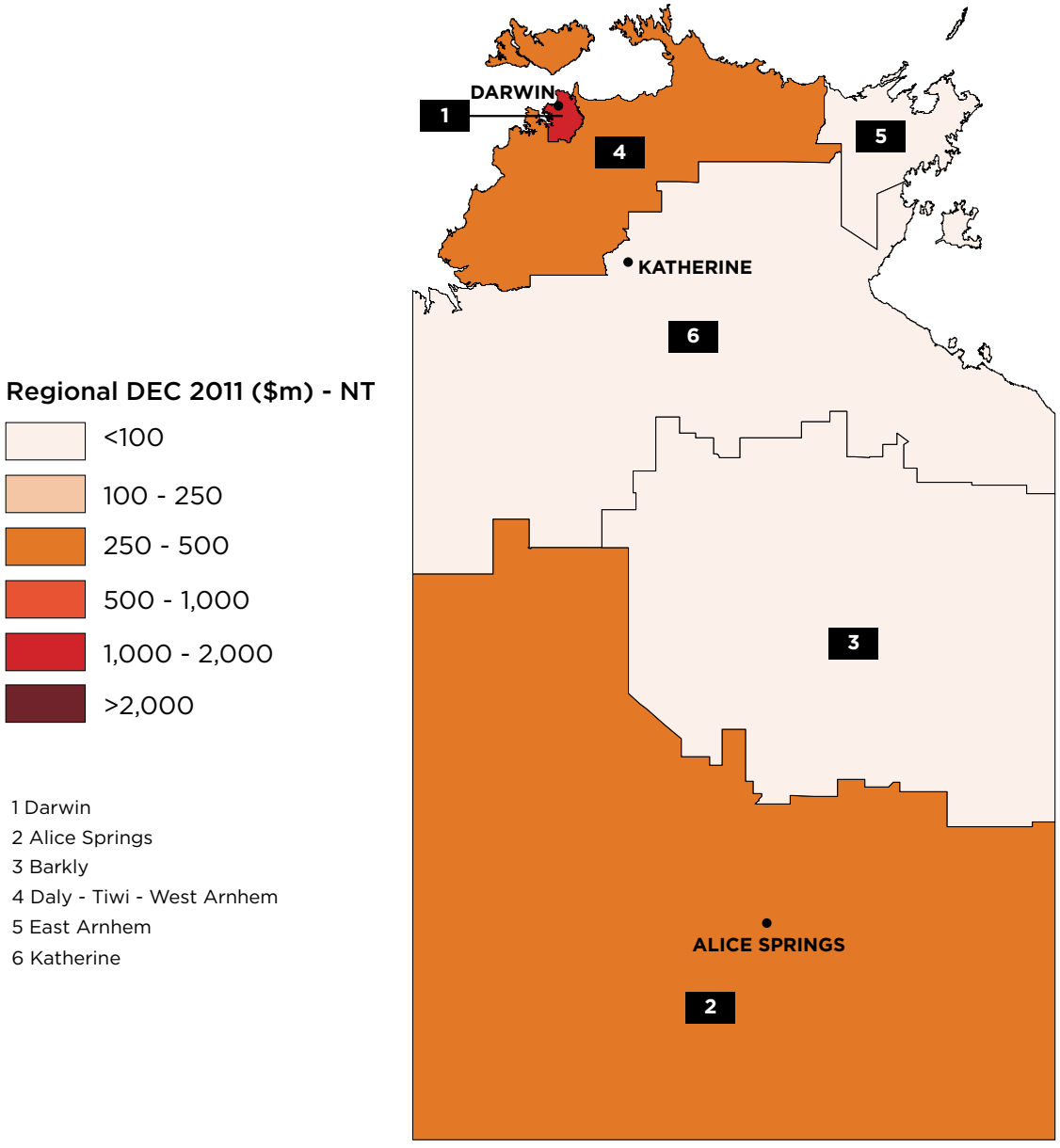
522. Australian Bureau of Statistics (2013c)
523. Series B (medium level) projections.

8.3 Summary of Northern Territory infrastructure from 2011 to 2031

In 2011, the DEC of infrastructure in the NT was $2.1 billion, which was about one per cent of the national figure. In 2031, the NT infrastructure DEC is projected to increase by around $2.2 billion, or 107 per cent, reaching approximately $4.3 billion (1.1 per cent of national DEC). This constitutes an average annual growth rate of 3.7 per cent over the 20 years to 2031.

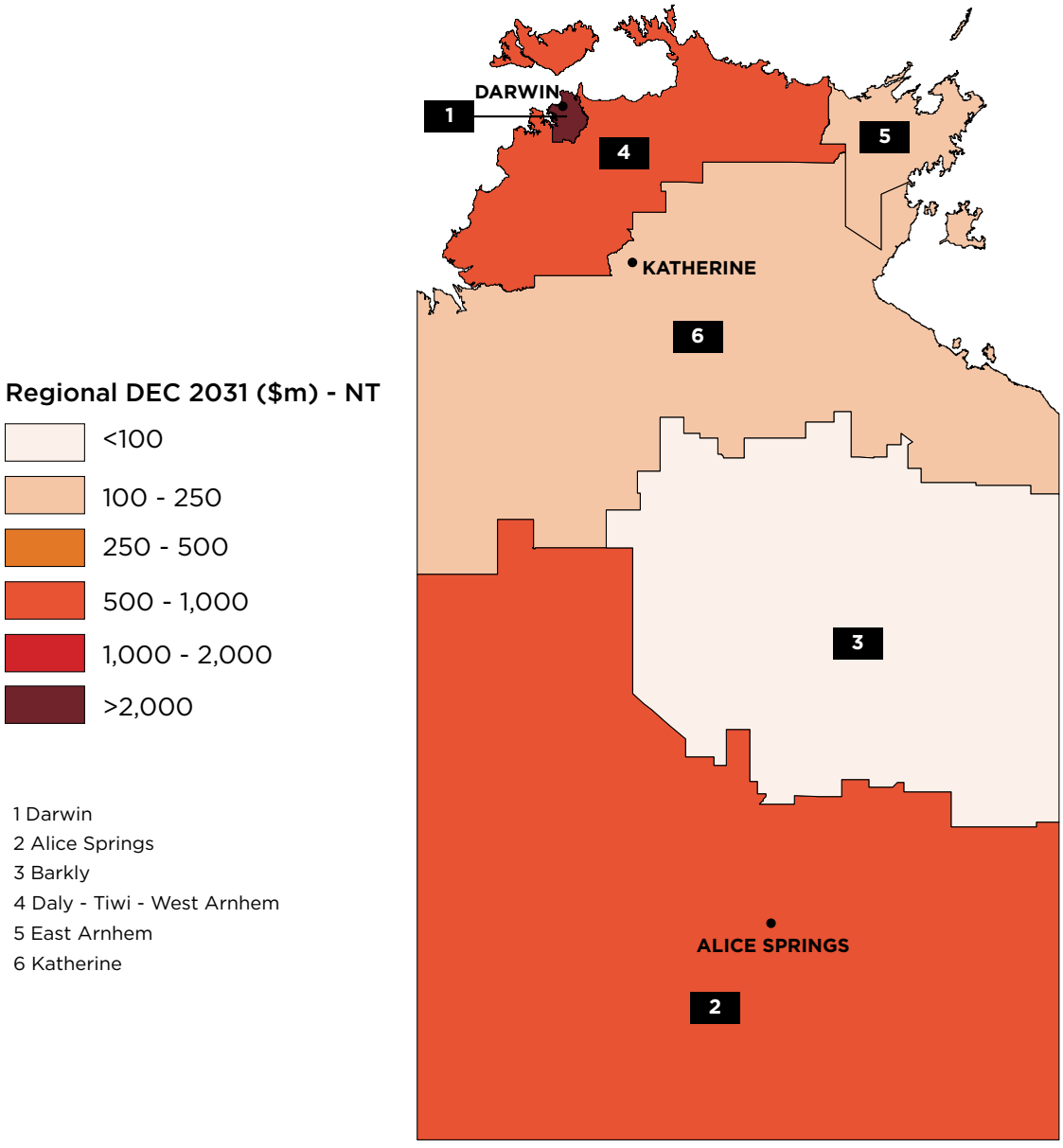
Figure 109 and Figure 110 highlight the spread of infrastructure's economic contribution across the six Audit regions in the NT. DEC growth is projected to be fastest in the Darwin region, increasing by 116 per cent from $1.2 billion to $2.7 billion during the 2011 to 2031 period.

Figure 109: Direct Economic Contribution of infrastructure in the Northern Territory in 2011



Source: ACIL Allen Consulting (2014a)

Figure 110: Projected Direct Economic Contribution of infrastructure in the Northern Territory in 2031



Source: ACIL Allen Consulting (2014a)

Table 92 provides a snapshot of the NT's economic infrastructure across the four sectors of transport, water, energy and communications. The table notes the capacity of each subsector in general terms, and its rate of utilisation in 2011, along with the historical (2011) and projected (2031) DEC for each subsector.

Table 92: Overview of Northern Territory infrastructure

	Subsector	Capacity 2011	% of Nat.	Utilisation 2011	% of Nat.	DEC 2011	% of Nat.	DEC 2031	% of Nat.	Projected % increase in DEC 2011-2031
Transport	Urban Roads	**Not audited**	n/a	**Not audited**	n/a	$600m	1%	$1,431m	1%	139%
	Urban Public Transport	**Not audited**	n/a	**Not audited**	n/a					
	National Highways	**4,517** km of nationally significant roads	13%	**8,150** vehicles per day	<1%	$502m	5%	$1,009m	6%	101%
	Freight Rail	n/a	n/a	n/a	n/a	$2m	<1%	$3m	<1%	43%
	Ports	**26** Mt p.a. throughput	2%	**16** Mt p.a. throughput	2%	$112m	1%	$204m	<1%	83%
		0.2 MTEU throughput	1%	**0.0** MTEU throughput	<1%					
	Airports	**9** Count of airfields	3%	**1,137,972** Total RPT passenger movements	1%	$519m	3%	$997m	2%	92%
Energy	Electricity	**686** Installed capacity (MW) of Generation	1%	**3,293** Utilisation of Generation (GWh)	1%	$119m	1%	$171m	1%	44%
		0 Peak Demand Transmission (MW)	0%	**0** Utilisation of Transmission (GWh)						
		577 Peak Demand Distribution (MW)	2%	**3,293** Utilisation of Distribution (GWh)						
	Gas	n/a	n/a	**43.13** Transmission throughput (PJ/a)	3%	$28m	2%	$70m	2%	153%
		n/a	n/a	**0.30** Distribution throughput (PJ/a)	<1%	$4m	<1%	$11m	1%	153%
	Petroleum product terminals	n/a	n/a	**1,388** Annual throughput (ML)	2%	$19m	2%	$32m	2%	70%
Telecommunications		**3.79** Broadband average availability rating (out of 5)	n/a	**47**	n/a	$105m	<1%	$225m	1%	114%
		1.20 Broadband average quality rating (out of 5)	n/a	Total households with broadband internet access at home ('000)						
Water & Sewerage	Water	**1,706** Length of water mains (km)	1%	**38,830** Water supplied (ML)	1%	$50m	<1%	$115m	1%	132%
		228 Volume of water stored in dams (GL)	<1%	**62** Properties served – water ('000)	1%					
	Sewerage	**0** Desalination capacity (ML)	n/a	**23,499** Sewage collected (ML)	1%					
		954 Length of sewer mains (km)	1%	**57** Properties served – sewerage ('000)	1%					

Source: ACIL Allen Consulting (2014a)[524]

524. DEC figures are rounded to the nearest $ million, so percentage changes may not tally exactly with rounded estimates in this table. See Glossary for explanation of abbreviations and terms.

8.4 Northern Territory Government Plans and Strategies

There are a number of documents published by the NT Government which set out strategic directions for the future of the territory, focusing on the issues of planning, infrastructure provision and development.

The NT Department of Lands and Planning released the *Building the Future: Northern Territory Government 10 Year Infrastructure Strategy* in 2011. This provides a strategic overview of the infrastructure targets that can deliver the greatest economic value to the NT. It sets priorities and objectives across the medium and long-term.[525]

The NT Government's *Territory 2030 Strategic Plan*, released in 2009, sets out objectives across a range of public policy issues, with a commitment to maintain public spending on targeted infrastructure projects.[526]

The NT Government has committed to release a number of additional plans and strategies with direct relevance to its infrastructure priorities, including the *Regional Infrastructure Study* and the *Integrated Transport Planning and Investment Roadmap*. The NT is also participating in the process to develop a National Remote and Regional Transport Strategy through the Transport and Infrastructure Council.

The Australian Government has commissioned a *White Paper on Developing Northern Australia*, which is due for release in 2015. Focusing on the area of Australia north of the Tropic of Capricorn, across the NT, WA and Queensland, the White Paper will discuss the most effective policies and projects to develop the region's future prospects and influence major decisions on infrastructure and planning over the next 20 years.[527]

A key concern in the NT is that many strategic objectives and planned projects rely upon continued development within the mining and resources sector. The withdrawal or suspension of operations by commercial firms, such as Rio Tinto's decision to suspend alumina refinement at its Gove refinery in 2014,[528] can have dramatic impacts on the broad social and economic factors supporting local communities. It is essential that, wherever possible, the NT Government work with major commercial firms to ensure that long-term infrastructure needs and objectives are resilient to shocks in the shorter term.

8.5 Remote Indigenous services in the Northern Territory

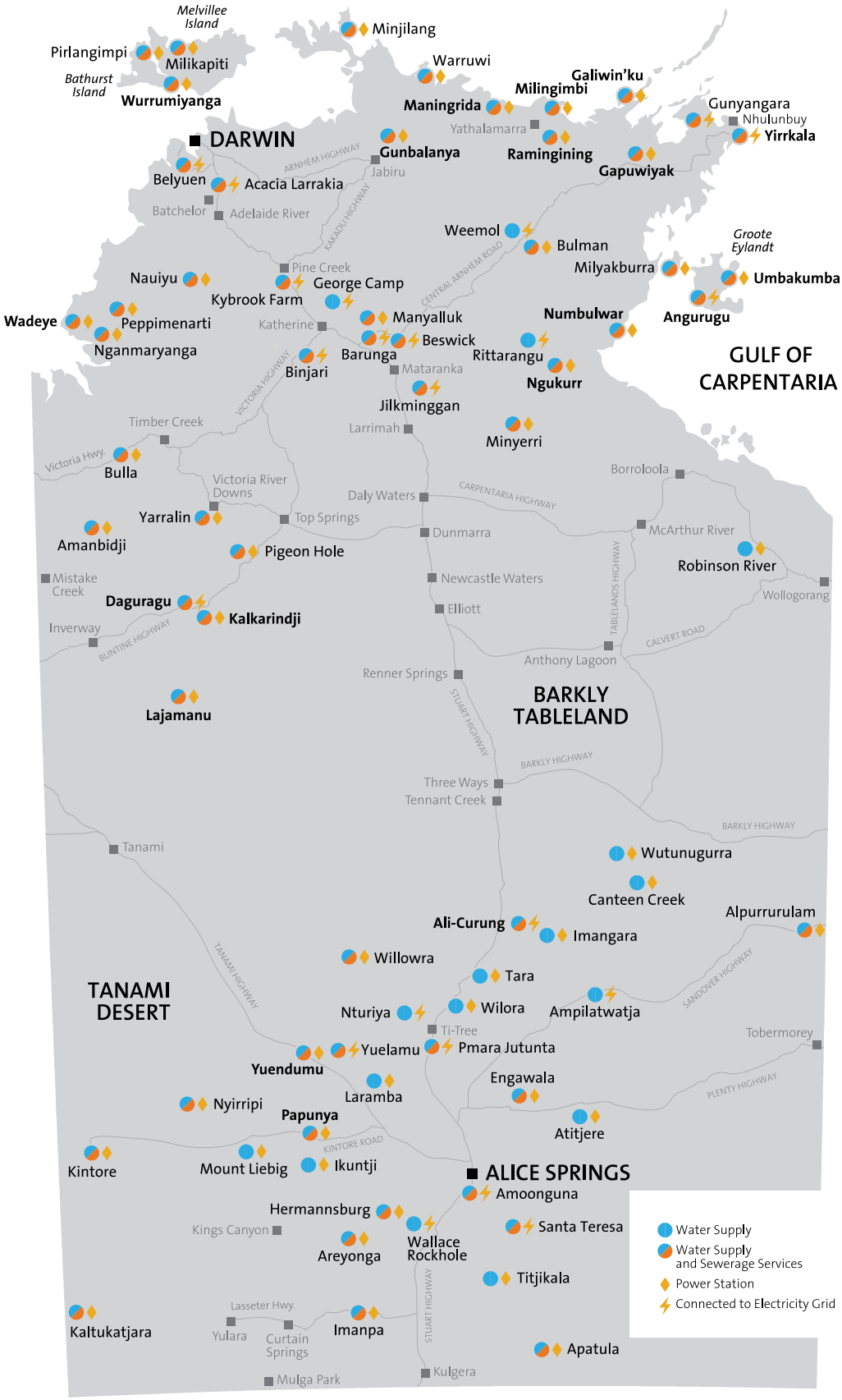
As discussed in Section 5.1.3 in Volume 1, infrastructure provision is a critical issue for remote Indigenous communities, with many areas lacking even basic services. Improving the delivery of infrastructure to these areas can bring considerable social benefits in terms of access to services and economic opportunities, and is fundamental to the governments' broader agenda of *Closing the Gap in Indigenous Disadvantage*.

The NT has hundreds of remote Indigenous communities across the territory, many in very isolated locations and without reasonable transport access to the economic centres of Darwin or Alice Springs. This reinforces the need for considerable investment in essential infrastructure to ensure Indigenous people in these areas have access to services that can support better health, education and employment outcomes in their communities.

NT Power and Water Corporation's not-for-profit subsidiary, Indigenous Essential Services, currently provides electricity, water and sewerage services to 72 remote communities and 66 outstations (as shown in Section 5.1.3 in Volume 1). Provision of services to these geographically isolated communities, in both tropical and arid environments, requires design service levels equal to similar-sized urban centres, with resilience and adaptability to the changing climate. Eighty-five per cent of potable water is sourced from groundwater, from 250 production bores through 160 water storage tanks and 650 km of reticulation. A multi-barrier approach is taken to providing drinking water consistent with Australian Drinking Water Guidelines. Chlorination and ultraviolet systems are used as appropriate. Fifty-six towns and communities have full water-borne sewage disposal systems with waste stabilisation ponds. The remainder have individual onsite systems maintained by the community.

525. Northern Territory Department of Lands and Planning (2011)
526. Northern Territory Department of the Chief Minister (2009)
527. Department of the Prime Minister and Cabinet (2015a)
528. Rio Tinto (2013)

Figure 111: Map of Indigenous community electrical, water and sewerage services in Northern Territory



Source: Northern Territory Power and Water Corporation (2014)

8.6 Transport

8.6.1 Urban transport

The value-add of urban transport in Darwin has been estimated using the top-down economic analysis used for all other sectors, rather than the bottom-up methodology used for urban transport in the six largest capital cities. This is because the detailed transport model used for the six largest capital cities was not available for Darwin.

For 2011, the DEC for urban transport in Darwin was estimated to be $600 million. This is projected to increase to $1.43 billion in 2031, an increase of 4.4 per cent per year, or 139 per cent in total.

The ABS method of travel to work data from the 2011 Census provides some insight into travel patterns within Darwin, though it is limited to travel to work on a single day in 2011.

Table 93 illustrates the high proportion of trips made using passenger vehicles, with 84.3 per cent of trips to work made using car, taxi or motorcycle. This is higher than other capital cities, and higher than the national average of 79.7 per cent for this measure.

Darwin also had the highest proportion of active travel of Australian capital cities, with nine per cent of the population walking or cycling to work. This is higher than the national average of six per cent.[529]

However, Darwin also had the lowest utilisation of public transport of all capital cities, with only 3.4 per cent of trips to work made using public transport.[530]

Table 93: Travel to work mode share of Darwin residents

Mode	Share	
	Darwin	Nat. average
Public transport	3.4%	8.9%
Passenger vehicle	84.3%	79.7%
HCV	0.6%	0.7%
Active transport	9.0%	6.0%
Other, Multiple methods	2.6%	4.6%

Source: Australian Bureau of Statistics (2012)

The *Draft Darwin City Centre Master Plan*, released in February 2014, outlines a set of potential projects and design principles for development of the city. The Plan briefly outlines a potential future light rail corridor that would connect Darwin's CBD to Casuarina and Palmerston, and proposes development of an integrated public transport plan.

8.6.2 National highways

Of Australia's 34,656 km of national highways (which include the National Land Transport Network highways and other key freight routes), 4,517 km are in the NT. This includes the following national highway links connecting the capital cities:

- Darwin to Adelaide (Stuart Highway Routes 1 and 87);
- Darwin to Brisbane (Stuart Highway, Barkly Highway Routes 1, 87 and 66); and
- Darwin to Perth (Stuart Highway and Victoria Highway Routes 1 and 95).

In 2011, the national highway routes in the NT were used by 8,150 vehicles each day. Figure 112 shows the National Land Transport Network highways and other key NT freight routes included in the Audit. Together these routes play an important role in facilitating the production processes for industry and enabling the activities of business and the community.

The DEC of the NT's national highways is projected to double from $502 million in 2011 to $1.01 billion in 2031, or 6.5 per cent of the projected national total DEC for national highways of $15.6 billion. This represents an annual growth rate of 3.6 per cent, which is higher than the projected national average of 2.5 per cent.

The NT has on average a lower quality national highway network than other states, due to the sparse population and long distances, extreme weather events, and relatively low levels of road utilisation.

529. Australian Bureau of Statistics (2012)
530. Australian Bureau of Statistics (2012)

Figure 112: National Land Transport Network highways and key freight routes in the Northern Territory 2011

The map shows highways identified in the Audit. Data was not available for all of these highways.

Source: ACIL Allen Consulting (2014a)

8.6.3 Freight rail

The DEC of freight rail in the NT is projected to rise by 43 per cent, from around $2 million in 2011 to $3 million in 2031. The NT share of the bulk rail freight task in 2012–13 was 2.4 million net tonnes, 0.2 per cent of the total national task.[531]

The NT is connected to the interstate rail network by the 2,244 km standard gauge railway from Darwin to Tarcoola in SA. Construction of the 1,420 km section between Alice Springs and Darwin was completed in 2004. The railway is operated by Genesee and Wyoming Australia. Utilisation of the railway is limited, with six intermodal services per week in each direction from Darwin to Tarcoola to Adelaide. There is ample capacity for increased services on this line.[532]

8.6.4 Ports

Darwin Port is the major port in the NT. The port is currently owned by the NT Government and operated by the Darwin Port Corporation under the *Darwin Port Corporation Act*.[533]

Darwin Port accounted for less than one per cent of Australia's total port throughput (by mass tonnes) for 2012–13. However, this represents a more than four-fold increase over the preceding 10 years, reflecting the role the rail connection to SA has played in the expansion of the port's overall freight task.[534] A major factor in the strong growth of the port has been the increase in its livestock exports. The port has become a key component of the beef supply chain.

The DEC of ports in the NT is projected to rise by 84 per cent from $111 million in 2011 to $205 million in 2031.

Table 94: Northern Territory port tonnages – 2012–13

	Total Throughput (mass tonnes)				Containerised trade in TEU			
Port	Imports	Exports	Total	Total as % of national total	Imports	Exports	Total	Total as % of national total
Darwin Port Corporation	1,498,601	2,800,407	4,299,008	0.38%	0	0	0	0.00%

Source: Ports Australia (2014a)[535]

531. Bureau of Infrastructure, Transport and Regional Economics (2014h)
532. Genesee and Wyoming Inc. (2014)
533. Darwin Port Corporation (2014)
534. Ports Australia (2014b)
535. State totals include small ports not specifically listed.

8.6.5 Airports

The major airports in the NT are Darwin and Alice Springs, which serve local communities and industries as well as a thriving tourist industry. Darwin is the tenth busiest airport in the country and Alice Springs airport is the eighteenth busiest.[536] The total DEC for all the airports in the NT is projected to grow from $519 million in 2011 to $997 million in 2031, representing an average annual growth rate of 3.3 per cent.

Table 95: Northern Territory airport passenger and freight volumes – 2013–14

	Revenue passenger (No.)				International Freight (tonnes)			
Airport	Domestic (incl. Regional) Airlines	International Airlines	Total passengers	Total as % of national total	Inbound	Outbound	Total	Total as % of national total
Darwin	1,705,830	338,826	2,044,656	1.40%	355	46	401	0.01%
Alice Springs	677,533	0	677,533	0.46%	0	0	0	0.00%
Ayers Rock	236,837	0	236,837	0.16%	0	0	0	0.00%

Source: Bureau of Infrastructure, Transport and Regional Economics (2014i)

Remote regions in the NT are dependent on air travel to access the main centres. The operation and maintenance of regional airports and airstrips is largely dependent on government funding.

Darwin Airport is both a military and commercial airport. Its commercial operations are privately owned and managed. The 2010 Darwin Airport Master Plan forecasts that passenger numbers will increase to around four million by 2030, compared to two million in 2013–14.[537] International freight is expected to increase dramatically from 298 tonnes per year (combined inwards and outwards freight) to around 1,400 tonnes per year by 2030.[538]

Alice Springs Airport is forecasting growth in annual passenger numbers of approximately 29 per cent to 2030, from 670,000 per year in 2013/14[539] to 940,000 in 2030.[540]

8.7 Energy

8.7.1 Electricity

In 2011, the NT had an installed electricity generation capacity of 686 MW. Distribution peak demand was 577 MW. The utilisation of electricity in 2011 was 3,293 GWh for both generation and distribution, as the NT has an independent electricity network.

The DEC from electricity infrastructure in 2011 was $119 million. This was made up of $34 million from generation and $85 million from distribution.

The Audit forecasts a 26 per cent increase in the use of electricity from 2011 to 2031. This equates to 4,150 GWh for generation and distribution by 2031. Based on these forecasts, the Audit projects a 44 per cent increase in the DEC of electricity infrastructure from $119 million to $170 million. The $52 million increase is made up of $14 million from generation and $38 million from distribution.

The main electricity network in the NT is the Darwin-Katherine system. Growth in electricity demand in this system has been strong relative to other jurisdictions in recent years.

Demand growth and other factors have led to investment in new generation assets, for example the expansion of the Channel Island power station by 100 MW in 2011.

In its 2012–13 *Power System Review*, the NT Utilities Commission concluded that there is a high level of generation capacity over the next 10 years, but there may be issues with reliability. In addition, there is also sufficient network capacity to meet future demand for the 10-year period, but there are concerns about the reliability of certain network assets.

The Large-scale Renewable Energy Target (and the previous Renewable Energy Target) have led to a substantial increase in the penetration of wind farms across Australia, although there are currently no large scale wind farms operating in the NT.

The Small-scale Renewable Energy Scheme, feed-in tariffs, and other solar photovoltaic (PV) subsidies have led to a significant increase in the penetration of solar PV systems in the last five years. In the NT, the capacity of installed solar PV has increased from 1.6 MW at the start of 2010 to 16.4 MW as of October 2014.

536. Bureau of Infrastructure, Transport and Regional Economics (2014i)
537. Bureau of Infrastructure, Transport and Regional Economics (2014i)
538. Darwin International Airport (2010)
539. Bureau of Infrastructure, Transport and Regional Economics (2014i)
540. Alice Springs Airport (2010)

8.7.2 Gas

In 2011, NT gas transmission pipelines had an annual throughput of 43 petajoules (PJ). The main pipelines in the NT are the Bonaparte Pipeline, Darwin to Amadeus Basin, Daly Waters to McArthur River Pipeline and the Palm Valley to Alice Springs Pipeline. Pipelines delivering natural gas to processing plants from offshore Liquefied Natural Gas (LNG) facilities off the NT coastline were not included in the Audit.

The DEC from gas pipelines in the NT in 2011 was estimated to be $32 million.

The Audit projects an increase of $49 million in the DEC of gas pipeline infrastructure to $81 million in 2031, a rise of more than 150 per cent. Only Queensland and the NT are forecast to see DEC in the gas sector rise at a faster rate than economic growth.

The forecast high international demand for gas is expected to result in a structural shift in the Australian gas market. Australia's gas exports are predicted to increase from 56 billion cubic metres (BCM) in 2012 to 130 BCM in 2020, driven mostly by the start of a number of LNG export terminals, particularly in Queensland. The majority of NT's gas production is currently exported via the ConocoPhillips Darwin LNG plant, although the Ichthys LNG terminal in Darwin will take the lead role when exports through it commence in late 2016.

The NT gas pipelines are not currently connected to any other network. However, there are proposals to connect the NT gas pipelines with the eastern Australia gas network. The NT has considerable conventional gas reserves in the Amadeus Basin (138 PJ) and the Bonaparte Basin (1,054 PJ).[541] Exploration activities have also shown high prospectivity for unconventional gas in the McArthur, Beetaloo, and Georgina Basins.

8.7.3 Petroleum

The petroleum industry is broadly split into upstream and downstream petroleum sectors. The upstream sector refers to exploration and production of crude oil while downstream refers to refining of crude oil and the distribution and sale of petroleum products.

In 2011, total throughput at petroleum terminals was 1,388 ML. The DEC of petroleum terminals was $19 million.

The Audit projects an increase in throughput of 2,355 ML per year by 2031 – an increase of 2.7 per cent per year. This is projected to result in a growth in DEC of $13 million (70 per cent) to $32 million.

8.7.3.1 Crude oil production

Australia's total production of crude oil has been steadily declining. Crude oil production peaked in 2000 at 722 kb/day and declined to just over 338 kb/day in 2013.[542] Oil production is forecast to decline at an annual average rate of 4.4 per cent from 2014–15 to 2049–50.[543] The majority of production comes from two major basins: the Carnarvon Basin in Western Australia (77 per cent of production in 2011), and the Gippsland Basin in Victoria (less than 15 per cent of production in 2011). NT has crude oil reserves in the Bonaparte Basin 1054 PJ still remaining), which crosses WA and NT.

8.7.3.2 Refinery capabilities

In recent years the global oil refining industry has been undergoing significant structural change. Larger, more efficient 'mega-refineries' have been established in Asia resulting in increased competitive pressures on established refining operations, including those in Australia. There are no existing refineries currently operating in NT.

In 2013–14, 82 per cent of crude oil and other refinery feedstock was imported.[544] New refinery capacity is unlikely to be developed in Australia in the foreseeable future.

8.7.3.3 Petroleum products

Domestic demand for petroleum products grew at an average annual rate of around 1.5 per cent in the decade to 2011–12. It is expected to grow by around one per cent per year through to 2049–50, largely driven by population and economic growth. However, energy intensity (measured by total domestic energy consumption per dollar of gross domestic product) is projected to decline by around 1.7 per cent per year over the same period, compared to a decline of 1.3 per cent from 1989–90 to 2009–10. This decline indicates an accelerating improvement in energy efficiency. The transport sector uses more than 60 per cent of all petroleum consumed in Australia, and is the primary driver of demand growth. In addition, the expansion of the mining sector has contributed significantly to increased demand for diesel.[545]

Imported refined petroleum products account for approximately 40 per cent of total domestic consumption, and this share is forecast to rise. Refined petroleum products are imported from

541. APA Group (2013), p. 24
542. United States Energy Information Administration (2013)
543. Bureau of Resources and Energy Economics (2011), p. 38
544. Carson, L. (2014), p. 108
545. Bureau of Resources and Energy Economics (2014a)

more than 20 countries, but 80 per cent of all such products come from just three: Singapore (53 per cent), South Korea (18 per cent) and Japan (12 per cent).[546]

Demand for petroleum import facilities and the need for additional import infrastructure within the NT is expected to grow.

8.8 Telecommunications

The DEC of telecommunications infrastructure in the NT is projected to rise by 114 per cent from $105 million in 2011 to $225 million in 2031.

Most of this growth is projected to occur in Darwin. This is broadly in line with the rate of growth forecast for the NT economy at large. The wider challenge is ensuring efficient delivery of high quality services to regional and remote communities.

The Department of Communications reported in December 2013 that 88 per cent of premises had access to ADSL, 56 per cent had 3G mobile coverage and 34 per cent had 4G coverage.[547] The NT has the lowest coverage of the states and territories for fixed and mobile broadband services.

Remote communities in the NT lack contemporary communications infrastructure. As of June 2014, 41 per cent of these communities lack access to traditional fixed-line telephone services, 91 per cent lack have access to DSL, and 52 per cent lack access to mobile networks.

Overall, there are 44 remote communities that do not have access to even basic fixed and mobile services.

8.9 Water

The Audit identified that 32 GL of water was supplied to Darwin in 2011 and 7 GL to other regions. Sewage collected in 2011 comprised 20 GL in Darwin and 3GL in other regions. The DEC of the water and sewerage sector in the NT is projected to increase by 132 per cent, from $49 million in 2011 to $116 million in 2031.

The highest projected growth in water and sewerage DEC is in Darwin, where DEC is projected to grow by $63 million from $42 million in 2011 to $105 million in 2031. In the regional areas DEC is projected to grow by $4 million to $11 million 2031.

It is important to note that water and sewerage services have historically been under-priced, particularly in regional areas, and that this has potentially led to an understatement of DEC as measured by National Water Commission data (and as incorporated into the national accounts and GDP numbers). In regional areas the under-pricing of water and sewerage services means that the return on the capital base is a long way below the level needed to fund the full replacement cost of assets.

The NT Power and Water Corporation provides water and sewerage services in the NT's five major centres and five other minor centres. The company provides sewerage services only to an additional five minor centres.[548]

8.9.1 Greater Darwin region

Water usage in greater Darwin varies widely between the wet and dry seasons. During the dry season, the region typically uses 160 ML per day, while during the wet season this amount reduces to about 80 ML per day. Over half of the water consumed in the greater Darwin region is used in the residential sector (three-quarters of which is used outdoors), followed by non-residential commercial and government sectors. Household outdoor water use can increase as much as 10 times in the dry season. Annual water demand has grown at an average of 2.3 per cent over the 30 year period from 1980 to 2010. Variable annual rainfall and wet seasons frequently lead to annual fluctuations in demand of more than 10 per cent per year.

While most centres in the NT rely on groundwater, Darwin's main water supply is the Darwin River Dam. NT Power and Water Corporation currently extracts around 37 GL a year from the dam, and is licenced to extract 8.4 GL per year from the six production bores in the McMinns and Howard East borefields. However, operational constraints such as the need for routine maintenance mean that extraction from the borefields is usually limited to 6 GL per year, which is about 15 per cent of Darwin's annual supply.

546. Australian Institute of Petroleum (2013a)
547. Department of Communications (2013)
548. Northern Territory Power and Water Corporation (2014)

The current *Darwin Region Water Supply Strategy*[549] notes that NT Power and Water Corporation has undertaken water demand assessments based on a range of climate change scenarios, and has adopted a mid-range emissions scenario developed by CSIRO for its water supply planning. Modelling of this scenario suggests that there would be a significant impact on the yields available from the current Manton Dam and Darwin River Dam.

In the short term, NT Power and Water Corporation has designed demand-side actions under the five-year Living Water Smart program, which is aimed at helping the Darwin region reduce water use by 10 GL per year, or about a quarter of the current Darwin region water demand. Additional recycling opportunities are also being explored.

The NT Government has identified a number of priority water infrastructure projects that would secure long-term water supply for Darwin's growth and provide opportunity for growth in irrigated agriculture.

8.9.2 Regional areas

With the exception of Darwin, Pine Creek and Katherine, most centres in the NT rely wholly on groundwater. Water is pumped through 2,265 km of mains across 18 major and minor centres. Sewer mains in the eight centres cover 1,157 km.[550] Sewage is mostly treated via waste stabilisation ponds. The Alice Springs Water Reuse Project recycles water for use in horticulture and irrigation. Producing 600 ML a year, it is the first project of its kind in Australia.

549. Northern Territory Power and Water Corporation (2013)
550. Northern Territory Power and Water Corporation (2014)

Appendices and Tables

Appendix 1
Direct Economic Contribution (DEC)

1.1 Overview

The Australian Infrastructure Audit uses, as one of its inputs, a methodology known as Direct Economic Contribution (DEC) to measure the 'value-add' of the services delivered to the economy by Australia's infrastructure networks.

Put simply, DEC is a measure, in dollar terms, of the direct value that households, individuals and businesses derive from our infrastructure. DEC measures this value by measuring what we actually pay to use infrastructure, whether through direct user charges, or through other indirect forms of payment. In this sense, DEC also measures the direct cost associated with the use of infrastructure.

DEC does not measure the additional value we might place on use of infrastructure above what we actually pay (i.e. the economic concept of 'consumer surplus'). An explanation of how DEC is calculated is presented at section 1.2.

At a household or individual level, each one of us spends money on infrastructure-related services every day. For example:

- we buy electricity to power the appliances in our homes;
- we purchase mobile phone and data services to communicate with family, friends and the businesses that we deal with;
- we purchase water for use at home;
- we purchase tickets for air travel (which include an amount for airport-related charges) and pay tolls for use of some roads and bridges; and
- we pay through taxes for the infrastructure supporting many of our transport services, e.g. the cost of providing and maintaining the roads we drive on and the rail tracks on which our trains run.

Businesses do much the same. They buy or pay for services provided by our infrastructure networks – gas to power their equipment, electricity for use in offices, water for agriculture, and several forms of transport such as rail and road freight, the use of major ports, and the use of airports for business travel and the movement of high value goods.

Each time we buy a product such as a piece of furniture, or a service such as a meal in a café, some of the cost (and value) of that product or service is attributable to the infrastructure required to make the product or service available in the location in which it is provided.

Although it costs us money each time we use our infrastructure, we also derive benefit from the infrastructure. For example, we benefit from the comfort from heating and cooling our homes, and the ability to use communications services to converse with friends and access information from across the world.

When added up, the cost of the infrastructure services consumed by each household and business equals the overall DEC of infrastructure services within the Australian economy. Analysis for the Australian Infrastructure Audit shows that the DEC of our infrastructure was around $187 billion in 2011, which is about 13 per cent of the Australian economy, or Gross Domestic Product.

Without these services, we couldn't pursue the lives that we lead, or that we aspire to. These services are integral to our way of life, and our economy.

As the Australian population grows and as the economy grows, so the value of the infrastructure-related services we collectively use will also grow. There will be more of us seeking the same services we enjoy now, or better services. There will be more businesses needing infrastructure services to support their contribution to Australian life. Put simply, the demand for infrastructure services will rise.

As a result, we will need to make greater and better use of our current infrastructure and associated services, and, when current infrastructure can no longer meet increasing demand, we will need to expand supply by building new infrastructure.

At a national level, if we cannot ensure the capacity of our infrastructure at least broadly matches growing demand, we may constrain our economy's capacity to grow. On average, each one of us would be less well off as a result.

In addition, without adequate infrastructure capacity, the increased demand for infrastructure would probably drive up costs above what they might otherwise be. These higher costs would flow through to businesses and, in turn, to households. But, where we need additional infrastructure capacity, we have to pay for it. The additional services provided by additional capacity cannot be secured without some cost.

So the increase in the demand for, and supply of, infrastructure services in the future will mean that DEC will in future be larger than it is at present. Analysis for the Australian Infrastructure Audit projects the DEC of our infrastructure will grow (on 'base case assumptions') to around $370 billion by 2031, by which time Australia's economy would be some 84 per cent larger than it is at present.

But DEC need not grow precisely in proportion with the expected growth in the population or the economy. In fact, if we can make better or more efficient use of our infrastructure, we can meet our need for infrastructure services at a lower cost, and the future increase in DEC need not be as high as it would be if we continue to use infrastructure the way we do now.

At an individual level, we are often looking for ways of reducing costs. For example, we:

- choose between suppliers of a particular service, e.g. obtaining quotes for maintenance work on our homes, or when assessing the cost and value of eating out at different cafés or restaurants; and
- economise on our use of a particular service, e.g. buying less of an expensive item.

The money we have saved from these choices is then available to us to spend on other items or to save for other purposes. The infrastructure services we consume are also part of this process. We see this process of searching for better value and reducing cost when making decisions to:

- put on an additional layer of clothing and turn down heaters (i.e. we are still warm but at a lower cost);
- install a 'low flow' showerhead and consume less water (i.e. we are still clean but have used less water);
- switch mobile phone carriers (i.e. we are still consuming the same or greater quantity of communications services, but at a lower cost); and
- travel to work outside of peak hours where possible and avoid congestion (i.e. we are still getting to work but spending less time travelling).

Businesses do the same − they search for ways of reducing costs. This is part of how they add value to their customers and stay in business.

So it is with infrastructure overall at a national level. If we can meet our need for infrastructure services more efficiently, i.e. at a lower cost, then the money we would have paid for those services is freed up to spend on other items or to invest in future income producing enterprises which may make a greater contribution to GDP and as a result increase personal wealth.

In short, the value we get from infrastructure will need to increase to support growth in the Australian economy. We can increase this value by getting more and better services from our existing infrastructure (increasing productivity), or by building new infrastructure (increasing supply). If our infrastructure DEC does not increase in one of these ways, our economy is likely to be smaller than it would otherwise be, and we will probably be poorer as a result.

1.2 Methodology

This section provides a brief summary of the methodology applied to the modelling of infrastructure's value-add (which is also its contribution to Gross Domestic Product). A complete description can be found in the National Economic Analysis report prepared by ACIL Allen Consulting.[551]

1.2.1 Audit regions

The Audit divides Australia into 73 regions, with boundaries based on the Australian Bureau of Statistics (ABS) 'statistical geography', a hierarchy of statistical areas used by the ABS for its data.

A decision had to be taken about the number of regions to be used in the Audit. Given the scale of the economic modelling, a balance needed to be struck between:

- having enough regions to plausibly represent the diversity of Australia's demography and economy; and
- keeping the number of regions at a level that would allow the economic model to be developed and run in a reasonable period.

1.2.2 Demographic inputs

Population projections prepared by governments all vary to some degree. Although most governments use national projections prepared by the ABS as a starting point, they then apply their own assumptions within their jurisdictions. In the Audit, ABS projections were used as a starting point for all regions to ensure a nationally consistent approach to the modelling.

The economic analysis used population data from 2011 (which was the most recent national census year) and projections to 2031 prepared by the ABS. The year 2031 was chosen to align with the national census cycle and five yearly population projections commonly used by governments, and to provide data to underpin development of the 15 year Australian Infrastructure Plan.

The baseline scenario was built on ABS medium level projections. In the base case, Australia's population grows by 36.5 per cent from 22.3 million in 2011 to 30.5 million in 2031. The Bureau's high population growth projection was used to model a high population growth scenario. On that projection, Australia's population would grow to 31.9 million in 2031.

Within the national projections, the Audit also used ABS projections for each state and territory, and the capital cities (the Greater Capital City Statistical Area) as 'control totals'. The difference in population between ABS projections for each state/territory and its respective capital city was then distributed between the other Audit regions in each jurisdiction. This method took account of the base year population in each region, and also of the economic structure of the region (e.g. whether particular industries are likely to be growing or declining, either in absolute terms or in that particular region).

551. ACIL Allen Consulting (2014a)

1.2.3 Economic inputs

The macro-economic model used in the Audit is a computable generalised equilibrium (CGE) model that explicitly takes account of the Australian economy in a global context. For a country such as Australia, with large trade flows with the rest of the world, this is an important consideration.

The CGE model covers 70 sectors in the Australian economy. The various infrastructure sectors (and sub-sectors) considered in the Audit are included in the model:

- transport is covered by five sectors in the model;
- oil and gas are covered by six sectors;
- electricity is covered by two sectors; and
- water and telecommunications are each represented as single sectors in the model.

Interactions between the 70 sectors are incorporated in the model using, among other things, input-output tables prepared by the ABS. In other words, an input to one sector is an output from another sector. For example, the electricity used as an input in the manufacturing sector is an output from the electricity sector. The sectors in the economy are then represented geographically using the 73 audit regions.

Further detail on the modelling can be found in the ACIL Allen National Economic Analysis report.[552]

The modelling also used a conventional 'Public Private Partnership (PPP) approach', used by the Australian Treasury and others, in preparing the projections of the Australian economy. This approach considers three factors – Population change, labour force Participation rates, and assumptions about Productivity (PPP) – to arrive at the projections of growth in the overall Australian economy.

In the modelling, the labour force participation rate is projected to fall from around 65 per cent to 63 per cent by 2031. Consistent with projections prepared by others, the growth in labour force productivity is projected to be lower than over the last 30 to 40 years. In the modelling, labour force productivity is projected to grow at approximately 1.5 per cent per year to 2031.

1.2.4 Projections

Projections of the economy, nationally and regionally, were made having regard to:

- projections of the global economy, including the principal countries/regions that Australia trades with, e.g. China, Japan, United States, India, Korea and Europe. Growth in real global GDP is projected to slow from 4.1 to 4.4 per cent per year over the period to 2019, to 3.7 per cent by 2031.
- domestic demographic and economic data (outlined above); and
- the distribution of population and industries across the 73 regions.

In the base case scenario, GDP is projected to grow by 84 per cent from $1,406 billion in 2011 to $2,583 billion in 2031.

1.2.5 Calculation of the infrastructure sector's Direct Economic Contribution (DEC)

The modelling of DEC is based on calculations for each part of the infrastructure sector at the national and regional levels. These calculations consider:

- the quantity of infrastructure services consumed (Q);
- the price paid by users for those services (P); and
- the input costs associated with the provision of the services (I).

The DEC of the infrastructure in question is then calculated using the formula DEC = Q x P – I, where:

- Q = the quantity of infrastructure services consumed (essentially demand for the service);
- P = the price paid for the service; and
- I = the input cost of providing service, i.e. what is it costing to provide the infrastructure itself.

This approach is akin to calculations of the 'value-add' commonly used in economic analysis for other industries.

In sectors where the cost of providing the infrastructure service is not priced at all, or not fully priced, e.g. in much of the transport sector, and parts of the water sector, the calculations estimate government outlays associated with providing the infrastructure. This is treated as a proxy for the prices that might otherwise be paid if the services were being charged for in a more conventional manner.

552. ACIL Allen (2014a). Appendix C in the report provides further detail.

1.2.5.1 Particular considerations for urban transport

In the case of urban transport, the 'top down' economic modelling applied to all infrastructure sectors was supplemented with 'bottom up' conventional transport modelling of the six largest Australian capital cities. This modelling allowed more detailed assessment of the DEC and transport delay costs in different parts of the six cities. It also enabled a detailed assessment of the capacity of the networks. The modelling was undertaken using a consistent process, to enable comparison of results across capital cities.

Results at an aggregate level for the two smaller capital cities, Hobart and Darwin, were estimated using top-down economic analysis, having regard to the local demographic and economic conditions in the two cities.

The DEC of urban transport is calculated on the basis that DEC = shadow toll (ST) minus input costs (I), where

- ST is an estimate of the value a user derives from the use of transport infrastructure. This value is estimated through the cost a user is willing to incur to use a service. For roads, the shadow toll takes into account the value of travel time, tolls and vehicle operating costs. For public transport, the shadow toll takes into account the value of travel time and fares paid.
- I = the input cost of providing the service. In the case of roads, this represents the cost of road maintenance plus vehicle operating cost. (In practical terms, this means that the vehicle operating costs cancel out.) In the case of public transport, the input cost equals operating expenses excluding labour costs.

The shadow toll includes a measure of the cost of delays due to congestion. The delay cost is measured as the difference between the time it takes to travel on a road link under congested conditions and uncongested conditions. This approach recognises that, although congestion and delay are undesirable, drivers nevertheless use the road in question, knowing that there is likely to be a delay. In other words, even though there may not be an uncongested choice, drivers are making a choice to use the road.

In the case of public transport, the modelling framework does not allow for the cost of public transport delays, e.g. delays resulting from being unable to board an overcrowded bus or train. This approach was adopted so that the model would show projected demand for these services. As a result, the estimates of DEC for public transport are conservative.

1.2.6 What is not included in DEC

The calculation of DEC used in the Audit does not assess the following economic concepts that are more commonly considered in detailed project evaluations:

- Consumer surplus – this is not counted in national accounts data, which forms the basis for much of the modelling in the Audit. The concept is more appropriately applied and measured as part of individual project assessments.
- Externalities – infrastructure can generate so-called externalities (both positive and negative) that are non-priced or under-priced impacts on third parties. Although these are an important consideration in individual project assessments, it was not practical to address these impacts for all items of infrastructure identified in the Audit.
- Taxes − taxes are removed in traditional cost-benefit analysis, and are removed from the DEC calculations.
- Indirect and flow-on impacts – although these benefits and impacts are often claimed by project proponents and others, these concepts were not included in the assessment for the following reasons.
- Measurements of indirect impacts can lead to double counting the benefits.
- Even where the approach to measuring indirect impacts is well founded, it is more appropriately applied at a project level.

Appendix 2
Tables showing Direct Economic Contribution by geographic area and sector

Table A2-1: DEC by audit region, 2011 ($ million in 2011 dollars)

Audit Region	Urban transport	National Highways	Ports	Airports	Rail	Electricity	Gas	Petroleum	Water & Sewerage	Tele-communications	Total
Greater Sydney	20,413	96	4,641	5,134	43	2,416	349	202	1,808	7,654	42,756
Capital Region	0	351	0	15	0	168	28	0	54	64	680
Central West	0	396	0	45	188	387	14	0	62	75	1,167
Coffs Harbour – Grafton	0	164	6	60	4	98	0	0	44	68	444
Far West and Orana	0	5	0	10	4	85	11	0	81	28	224
Hunter Valley exc Newcastle	2,082	270	0	0	423	711	0	0	74	47	3,607
Illawarra	1,914	552	147	0	2	161	14	0	187	111	3,088
Mid North Coast	0	453	0	40	8	151	0	0	93	50	795
Murray	0	271	0	45	1	89	5	0	89	40	540
New England and North West	0	160	0	45	26	133	1	0	46	65	476
Newcastle and Lake Macquarie	3,096	0	420	181	150	400	22	37	173	246	4,725
Richmond – Tweed	0	240	0	55	2	171	0	0	71	105	644
Riverina	0	230	0	45	7	243	23	0	127	43	718
Southern Highlands and Shoalhaven	0	410	46	0	4	66	10	0	63	34	633
Greater Melbourne	19,050	0	4,457	4,031	18	923	531	196	1,367	5,800	36,373
Ballarat	0	115	0	0	0	74	5	0	55	104	353
Bendigo	0	157	0	0	0	71	0	0	66	76	370
Geelong	958	128	142	0	0	175	8	86	106	67	1,670
Hume	0	340	0	0	3	367	2	0	29	28	769
Latrobe – Gippsland	0	237	65	0	2	1,216	46	0	190	53	1,809
North West	0	457	0	30	3	75	7	0	108	35	715
Shepparton	0	46	0	0	1	63	5	0	171	29	315
Warrnambool and South West	0	13	55	0	1	110	23	0	59	28	289
Greater Brisbane	10,316	55	2,742	3,005	365	1,016	78	236	1,151	1,859	20,823
Cairns N+S	0	32	121	600	6	118	0	9	51	50	987
Cairns Hinterland	0	51	15	0	2	91	0	0	23	21	203
Darling Downs – Maranoa	0	258	0	10	4	330	50	0	28	26	706
Far North	0	0	107	25	0	-32	0	1	6	3	110
Outback-North	0	57	28	40	8	23	49	0	6	10	221
SWQld_NA	0	18	0	5	5	8	0	0	4	2	42
SWQld	0	16	0	0	2	5	36	0	1	2	62
Sunshine Coast	1,264	111	0	140	3	150	0	0	248	81	1,997
Central Highlands (Qld)	0	96	0	25	362	25	0	0	8	8	524
Gladstone – Biloela	0	71	0	40	107	122	0	0	14	2	356
Gladstone – Biloela_NA	0	7	615	0	39	204	50	14	36	6	971
Rockhampton	0	81	27	110	38	167	0	0	52	36	511

Key

>1 | 1–250 | 251–500 | 501–1,500 | 1,501–2,500 | 2,501–3,500 | 3,501–4,500 | 4,501–6,000 | 6,001–10,000 | 10,001–20,000 | 20,000 +

Table A2-1: (continued)

Audit Region	Urban transport	National Highways	Ports	Airports	Rail	Electricity	Gas	Petroleum	Water & Sewerage	Tele-communications	Total
Gold Coast	1,495	679	0	855	9	250	9	0	367	270	3,934
Bowen Basin – North	0	138	67	5	728	27	0	0	16	7	988
Mackay	0	174	398	165	34	93	0	13	65	36	978
Whitsunday	0	0	0	100	1	15	0	0	2	7	125
Toowoomba	0	193	0	0	17	114	4	0	113	74	515
Charters Towers – Ayr – Ingham	0	121	2	5	3	35	0	0	27	5	198
Townsville	0	27	127	255	26	122	8	15	123	168	871
Bundaberg	0	45	23	20	3	69	0	0	26	22	208
Wide Bay	0	163	17	0	5	276	0	0	26	61	548
Hervey Bay	0	0	0	25	0	43	0	0	45	7	120
Greater Adelaide	6,705	0	942	1,612	5	652	199	38	681	1,234	12,068
Barossa – Yorke – Mid North	0	196	75	0	0	102	26	0	155	22	576
South Australia – Outback	0	127	71	53	7	145	3	2	32	22	462
South Australia – South East	0	189	0	22	0	90	9	0	79	35	424
Greater Perth	9,134	0	2,653	1,489	7	1,268	388	164	1,174	1,213	17,490
Augusta – Margaret River – Busselton	0	60	0	0	0	22	0	0	28	7	117
Bunbury	0	179	45	0	8	457	65	0	105	28	887
Manjimup	0	28	0	0	0	11	0	0	10	3	52
Esperance	0	12	83	5	5	29	4	7	4	4	153
Gascoyne	0	5	13	5	0	22	1	0	9	1	56
Goldfields	0	58	0	45	6	44	21	0	54	14	242
Kimberley	0	45	53	85	0	97	0	2	26	15	323
Mid West	0	140	100	15	4	66	40	3	33	19	420
Pilbara	0	66	1,846	235	2,706	206	103	17	37	24	5,240
Albany	0	5	60	10	1	33	0	1	42	13	165
Wheat Belt – North	0	128	0	0	6	66	1	0	68	12	281
Wheat Belt – South	0	0	0	0	1	17	0	0	15	3	36
Hobart	835	0	102	295	1	172	13	6	109	276	1,809
Launceston and North East	0	182	131	185	5	259	11	1	59	53	886
Rest of Tas.	0	97	103	35	1	393	4	8	70	18	729
Darwin	600	0	54	344	1	65	24	11	42	83	1,224
Alice Springs	0	169	0	150	1	17	4	0	6	13	360
Barkly	0	26	0	0	0	5	0	0	0	1	32
Daly – Tiwi – West Arnhem	0	266	0	5	0	8	0	0	0	0	279
East Arnhem	0	0	53	20	0	14	0	8	0	2	97
Katherine	0	41	4	0	0	9	4	0	1	6	65
Australian Capital Territory	1,824	0	0	900	0	168	39	0	209	316	3,456
Australia	**79,686**	**9,503**	**20,656**	**20,676**	**5,422**	**16,061**	**2,347**	**1,077**	**10,609**	**21,050**	**187,087**

Source: ACIL Allen Consulting (2014a)

Key

>1 | 1–250 | 251–500 | 501–1,500 | 1,501–2,500 | 2,501–3,500 | 3,501–4,500 | 4,501–6,000 | 6,001–10,000 | 10,001–20,000 | 20,000 +

Table A2-2: DEC by audit region, 2031, baseline scenario ($ million in 2011 dollars)

Audit Region	Urban transport	National Highways	Ports	Airports	Rail	Electricity	Gas	Petroleum	Water & Sewerage	Tele-communications	Total
Greater Sydney	41,452	143	7,566	9,445	61	3,762	490	286	2,019	14,610	79,834
Capital Region	0	520	0	22	0	262	40	0	67	98	1,009
Central West	0	612	0	72	307	584	19	0	74	124	1,792
Coffs Harbour – Grafton	0	229	8	89	4	159	0	0	52	102	643
Far West and Orana	0	9	0	16	5	133	15	0	102	47	327
Hunter Valley exc Newcastle	3,741	442	0	0	640	1,118	0	0	115	78	6,134
Illawarra	3,073	854	206	0	4	254	20	0	197	182	4,790
Mid North Coast	0	621	0	58	9	244	0	0	108	73	1,113
Murray	0	390	0	68	1	129	6	0	99	63	756
New England and North West	0	234	0	71	44	192	1	0	52	107	701
Newcastle and Lake Macquarie	5,369	0	577	284	185	635	31	52	213	395	7,741
Richmond – Tweed	0	328	0	80	2	268	0	0	80	158	916
Riverina	0	345	0	73	9	356	32	0	151	73	1,039
Southern Highlands and Shoalhaven	0	569	60	0	4	105	14	0	75	52	879
Greater Melbourne	38,966	0	7,796	8,016	27	1,397	585	293	2,192	11,949	71,221
Ballarat	0	176	0	0	0	116	5	0	72	173	542
Bendigo	0	241	0	0	1	110	0	0	85	126	563
Geelong	1,830	194	200	0	0	265	9	128	182	111	2,919
Hume	0	501	0	0	3	566	3	0	52	45	1,170
Latrobe – Gippsland	0	354	88	0	2	1,887	51	0	241	85	2,708
North West	0	692	0	48	4	108	7	0	132	58	1,049
Shepparton	0	71	0	0	1	95	6	0	221	49	443
Warrnambool and South West	0	21	77	0	1	164	25	0	74	45	407
Greater Brisbane	25,158	99	4,969	6,151	559	1,508	97	391	1,775	4,130	44,837
Cairns N+S	0	61	215	1,219	9	180	0	15	90	108	1,897
Cairns Hinterland	0	85	24	0	2	128	0	0	36	41	316
Darling Downs – Maranoa	0	467	0	19	5	457	62	0	42	54	1,106
Far North	0	0	207	55	0	-54	0	2	11	7	228
Outback-North	0	130	52	86	20	43	61	0	10	25	427
SWQld_NA	0	39	0	10	8	11	0	0	6	5	79
SWQld	0	29	0	0	3	7	45	0	1	4	89
Sunshine Coast	2,785	186	0	255	3	225	0	0	382	158	3,994
Central Highlands (Qld)	0	206	0	50	520	34	0	0	14	19	843
Gladstone – Biloela	0	129	0	74	152	164	0	0	19	4	542
Gladstone – Biloela_NA	0	12	1,115	0	78	654	1,667	23	190	14	3,753
Rockhampton	0	165	47	217	61	252	1	1	91	77	912
Gold Coast	3,168	1,270	0	1,659	12	371	11	0	653	563	7,707
Bowen Basin – North	0	286	121	10	1,047	37	0	0	25	16	1,542
Mackay	0	348	696	325	53	139	0	22	99	76	1,758
Whitsunday	0	0	0	188	1	22	0	0	4	13	228

Key

>1 | 1–250 | 251–500 | 501–1,500 | 1,501–2,500 | 2,501–3,500 | 3,501–4,500 | 4,501–6,000 | 6,001–10,000 | 10,001–20,000 | 20,000 +

Table A2-2: (continued)

Audit Region	Urban transport	National Highways	Ports	Airports	Rail	Electricity	Gas	Petroleum	Water & Sewerage	Tele-communications	Total
Toowoomba	0	356	0	0	25	173	5	0	199	162	920
Charters Towers – Ayr – Ingham	0	207	3	9	4	47	0	0	37	11	318
Townsville	0	53	232	530	41	190	10	24	232	375	1,687
Bundaberg	0	74	36	37	4	101	0	0	38	45	335
Wide Bay	0	266	26	0	7	395	0	0	41	118	853
Hervey Bay	0	0	0	46	0	66	0	0	68	15	195
Greater Adelaide	12,373	0	1,419	2,738	7	1,032	244	50	1,039	2,188	21,090
Barossa – Yorke – Mid North	0	270	95	0	0	159	32	0	196	32	784
South Australia – Outback	0	196	97	84	8	242	4	3	38	35	707
South Australia – South East	0	257	0	32	0	138	11	0	90	52	580
Greater Perth	33,619	0	6,364	4,112	12	3,001	648	323	2,452	3,343	53,874
Augusta – Margaret River – Busselton	0	107	0	0	0	50	0	0	41	15	213
Bunbury	0	332	83	0	11	1,049	108	0	161	61	1,805
Manjimup	0	53	0	0	0	24	0	0	13	6	96
Esperance	0	27	154	10	7	56	7	15	6	8	290
Gascoyne	0	11	27	11	0	47	1	0	13	3	113
Goldfields	0	134	0	102	10	101	35	0	66	31	479
Kimberley	0	94	120	206	0	213	0	4	45	40	722
Mid West	0	280	182	16	6	151	67	7	49	39	797
Pilbara	0	148	8,279	604	5,457	240	64	33	139	71	15,035
Albany	0	12	105	20	1	68	0	1	55	27	289
Wheat Belt – North	0	218	0	0	8	136	2	0	85	24	473
Wheat Belt – South	0	0	0	0	1	32	0	0	18	5	56
Hobart	1,484	0	137	452	1	198	20	7	135	448	2,882
Launceston and North East	0	264	169	268	6	283	18	1	66	82	1,157
Rest of Tas.	0	142	130	51	1	458	6	10	82	27	907
Darwin	1,432	0	93	667	2	93	61	19	105	178	2,650
Alice Springs	0	348	0	280	1	26	9	0	8	27	699
Barkly	0	51	0	0	0	8	1	0	0	2	62
Daly – Tiwi – West Arnhem	0	531	0	10	0	12	0	0	1	0	554
East Arnhem	0	0	104	40	0	18	0	13	0	5	180
Katherine	0	79	8	0	0	13	10	0	2	13	125
Australian Capital Territory	3,577	0	0	1,943	0	246	22	0	316	656	6,760
Australia	**178,027**	**15,568**	**41,887**	**40,928**	**9,467**	**26,153**	**4,688**	**1,723**	**15,939**	**42,261**	**376,641**

Source: ACIL Allen Consulting (2014a)

Key

>1 | 1–250 | 251–500 | 501–1,500 | 1,501–2,500 | 2,501–3,500 | 3,501–4,500 | 4,501–6,000 | 6,001–10,000 | 10,001–20,000 | 20,000 +

Table A2-3: Increase in DEC by audit region, 2011 to 2031, baseline scenario ($ million in 2011 dollars)

Audit Region	Urban transport	National Highways	Ports	Airports	Rail	Electricity	Gas	Petroleum	Water & Sewerage	Tele-communications	Total
Greater Sydney	21,039	47	2,925	4,311	18	1,346	141	84	211	6,956	37,078
Capital Region	0	169	0	7	0	94	12	0	13	34	329
Central West	0	216	0	27	119	197	5	0	12	49	625
Coffs Harbour – Grafton	0	65	2	29	0	61	0	0	8	34	199
Far West and Orana	0	4	0	6	1	48	4	0	21	19	103
Hunter Valley exc Newcastle	1,659	172	0	0	217	407	0	0	41	31	2,527
Illawarra	1,159	302	59	0	2	93	6	0	10	71	1,702
Mid North Coast	0	168	0	18	1	93	0	0	15	23	318
Murray	0	119	0	23	0	40	1	0	10	23	216
New England and North West	0	74	0	26	18	59	0	0	6	42	225
Newcastle and Lake Macquarie	2,273	0	157	103	35	235	9	15	40	149	3,016
Richmond – Tweed	0	88	0	25	0	97	0	0	9	53	272
Riverina	0	115	0	28	2	113	9	0	24	30	321
Southern Highlands and Shoalhaven	0	159	14	0	0	39	4	0	12	18	246
Greater Melbourne	19,916	0	3,339	3,985	9	474	54	97	825	6,149	34,848
Ballarat	0	61	0	0	0	42	0	0	17	69	189
Bendigo	0	84	0	0	1	39	0	0	19	50	193
Geelong	872	66	58	0	0	90	1	42	76	44	1,249
Hume	0	161	0	0	0	199	1	0	23	17	401
Latrobe – Gippsland	0	117	23	0	0	671	5	0	51	32	899
North West	0	235	0	18	1	33	0	0	24	23	334
Shepparton	0	25	0	0	0	32	1	0	50	20	128
Warrnambool and South West	0	8	22	0	0	54	2	0	15	17	118
Greater Brisbane	14,842	44	2,227	3,146	194	492	19	155	624	2,271	24,014
Cairns N+S	0	29	94	619	3	62	0	6	39	58	910
Cairns Hinterland	0	34	9	0	0	37	0	0	13	20	113
Darling Downs – Maranoa	0	209	0	9	1	127	12	0	14	28	400
Far North	0	0	100	30	0	-22	0	1	5	4	118
Outback-North	0	73	24	46	12	20	12	0	4	15	206
SWQld_NA	0	21	0	5	3	3	0	0	2	3	37
SWQld	0	13	0	0	1	2	9	0	0	2	27
Sunshine Coast	1,521	75	0	115	0	75	0	0	134	77	1,997
Central Highlands (Qld)	0	110	0	25	158	9	0	0	6	11	319
Gladstone – Biloela	0	58	0	34	45	42	0	0	5	2	186
Gladstone – Biloela_NA	0	5	500	0	39	450	1,617	9	154	8	2,782
Rockhampton	0	84	20	107	23	85	1	1	39	41	401
Gold Coast	1,673	591	0	804	3	121	2	0	286	293	3,773
Bowen Basin – North	0	148	54	5	319	10	0	0	9	9	554
Mackay	0	174	298	160	19	46	0	9	34	40	780
Whitsunday	0	0	0	88	0	7	0	0	2	6	103

Key

>1 | 1–250 | 251–500 | 501–1,500 | 1,501–2,500 | 2,501–3,500 | 3,501–4,500 | 4,501–6,000 | 6,001–10,000 | 10,001–20,000 | 20,000 +

Table A2-3: (continued)

Audit Region	Urban transport	National Highways	Ports	Airports	Rail	Electricity	Gas	Petroleum	Water & Sewerage	Tele-communications	Total
Toowoomba	0	163	0	0	8	59	1	0	86	88	405
Charters Towers – Ayr – Ingham	0	86	1	4	1	12	0	0	10	6	120
Townsville	0	26	105	275	15	68	2	9	109	207	816
Bundaberg	0	29	13	17	1	32	0	0	12	23	127
Wide Bay	0	103	9	0	2	119	0	0	15	57	305
Hervey Bay	0	0	0	21	0	23	0	0	23	8	75
Greater Adelaide	5,668	0	477	1,126	2	380	45	12	358	954	9,022
Barossa – Yorke – Mid North	0	74	20	0	0	57	6	0	41	10	208
South Australia – Outback	0	69	26	31	1	97	1	1	6	13	245
South Australia – South East	0	68	0	10	0	48	2	0	11	17	156
Greater Perth	24,485	0	3,711	2,623	5	1,733	260	159	1,278	2,130	36,384
Augusta – Margaret River – Busselton	0	47	0	0	0	28	0	0	13	8	96
Bunbury	0	153	38	0	3	592	43	0	56	33	918
Manjimup	0	25	0	0	0	13	0	0	3	3	44
Esperance	0	15	71	5	2	27	3	8	2	4	137
Gascoyne	0	6	14	6	0	25	0	0	4	2	57
Goldfields	0	76	0	57	4	57	14	0	12	17	237
Kimberley	0	49	67	121	0	116	0	2	19	25	399
Mid West	0	140	82	1	2	85	27	4	16	20	377
Pilbara	0	82	6,433	369	2,751	34	-39	16	102	47	9,795
Albany	0	7	45	10	0	35	0	0	13	14	124
Wheat Belt – North	0	90	0	0	2	70	1	0	17	12	192
Wheat Belt – South	0	0	0	0	0	15	0	0	3	2	20
Hobart	649	0	35	157	0	26	7	1	26	172	1,073
Launceston and North East	0	82	38	83	1	24	7	0	7	29	271
Rest of Tas.	0	45	27	16	0	65	2	2	12	9	178
Darwin	832	0	39	323	1	28	37	8	63	95	1,426
Alice Springs	0	179	0	130	0	9	5	0	2	14	339
Barkly	0	25	0	0	0	3	1	0	0	1	30
Daly – Tiwi – West Arnhem	0	265	0	5	0	4	0	0	1	0	275
East Arnhem	0	0	51	20	0	4	0	5	0	3	83
Katherine	0	38	4	0	0	4	6	0	1	7	60
Australian Capital Territory	1,753	0	0	1,043	0	78	-17	0	107	340	
Australia	**98,341**	**6,065**	**21,231**	**20,252**	**4,045**	**10,092**	**2,341**	**646**	**5,330**	**21,211**	**189,554**

Source: ACIL Allen Consulting (2014a)

Key

>1 | 1–250 | 251–500 | 501–1,500 | 1,501–2,500 | 2,501–3,500 | 3,501–4,500 | 4,501–6,000 | 6,001–10,000 | 10,001–20,000 | 20,000 +

Table A2-4: New South Wales DEC by audit region and sector, 2011 and 2031 ($ million)

	Greater Sydney	Capital Region	Central West	Coffs Harbour – Grafton	Far West and Orana	Hunter Valley exc Newcastle	Illawarra	Mid North Coast	Murray	New England and North West	Newcastle and Lake Macquarie	Richmond – Tweed	Riverina	Southern Highlands and Shoalhaven	Total for NSW
Total DEC in 2011	42,756	680	1,167	444	224	3,607	3,088	795	540	476	4,725	644	718	633	60,497
Total DEC as % of Total National DEC in 2011	22.9%	0.4%	0.6%	0.2%	0.1%	1.9%	1.7%	0.4%	0.3%	0.3%	2.5%	0.3%	0.4%	0.3%	32.3%
Change in DEC: 2011 to 2031															
Urban transport	21,039	0	0	0	0	1,659	1,159	0	0	0	2,273	0	0	0	26,130
National Highways	47	169	216	65	4	172	302	168	119	74	0	88	115	159	1,698
Ports	2,925	0	0	2	0	0	59	0	0	0	157	0	0	14	3,157
Airports	4,311	7	27	29	6	0	0	18	23	26	103	25	28	0	4,603
Rail	18	0	119	0	1	217	2	1	0	18	35	0	2	0	413
Electricity	1,346	94	197	61	48	407	93	93	40	59	235	97	113	39	2,922
Gas pipelines	141	12	5	0	4	0	6	0	1	0	9	0	9	4	191
Petroleum terminals	84	0	0	0	0	0	0	0	0	0	15	0	0	0	99
Water and sewerage	211	13	12	8	21	41	10	15	10	6	40	9	24	12	432
Telecommunications	6,956	34	49	34	19	31	71	23	23	42	149	53	30	18	7,532
Total	37,078	329	625	199	103	2,527	1,702	318	216	225	3,016	272	321	246	47,177
Total DEC (all sectors) in 2031	79,834	1,009	1,792	643	327	6,134	4,790	1,113	756	701	7,741	916	1,039	879	107,674
DEC Index (2011=1.00)	1.87	1.48	1.54	1.45	1.46	1.70	1.55	1.40	1.40	1.47	1.64	1.42	1.45	1.39	1.78
Total DEC as % of Total National DEC in 2031	21.2%	0.3%	0.5%	0.2%	0.1%	1.6%	1.3%	0.3%	0.2%	0.2%	2.1%	0.2%	0.3%	0.2%	28.6%

Source: Adapted from ACIL Allen Consulting (2014a)

Key

>1 | 1–250 | 251–500 | 501–1,500 | 1,501–2,500 | 2,501–3,500 | 3,501–4,500 | 4,501–6,000 | 6,001–10,000 | 10,001–20,000 | 20,000 +

Table A2-5: Victoria DEC by audit region and sector, 2011 and 2031 ($ million)

	Greater Melbourne	Ballarat	Bendigo	Geelong	Hume	Latrobe – Gippsland	North West	Shepparton	Warrnambool and South West	Total for Vic
Total DEC in 2011	36,373	353	370	1670	769	1,809	715	315	289	42,663
Total DEC as % of Total National DEC in 2011	19.4%	0.2%	0.2%	0.9%	0.4%	1.0%	0.4%	0.2%	0.2%	22.8%
Change in DEC: 2011 to 2031										
Urban transport	19,916	0	0	872	0	0	0	0	0	20,788
National Highways	0	61	84	66	161	117	235	25	8	757
Ports	3,339	0	0	58	0	23	0	0	22	3,442
Airports	3,985	0	0	0	0	0	18	0	0	4,003
Rail	9	0	1	0	0	0	1	0	0	11
Electricity	474	42	39	90	199	671	33	32	54	1,634
Gas pipelines	54	0	0	1	1	5	0	1	2	64
Petroleum terminals	97	0	0	42	0	0	0	0	0	139
Water and sewerage	825	17	19	76	23	51	24	50	15	1,100
Telecommunications	6,149	69	50	44	17	32	23	20	17	6,421
Total	34,848	189	193	1,249	401	899	334	128	118	38,359
Total DEC (all sectors) in 2031	71,221	542	563	2,919	1,170	2,708	1,049	443	407	81,022
DEC Index (2011=1.00)	1.96	1.54	1.52	1.75	1.52	1.50	1.47	1.41	1.41	1.90
Total DEC as % of Total National DEC in 2031	18.9%	0.1%	0.1%	0.8%	0.3%	0.7%	0.3%	0.1%	0.1%	21.5%

Source: Adapted from ACIL Allen Consulting (2014a)

Key

>1 | 1–250 | 251–500 | 501–1,500 | 1,501–2,500 | 2,501–3,500 | 3,501–4,500 | 4,501–6,000 | 6,001–10,000 | 10,001–20,000 | 20,000 +

Table A2-6: Queensland DEC by audit region and sector, 2011 and 2031 ($ million)

	Greater Brisbane	Cairns N+S	Cairns Hinterland	Darling Downs – Maranoa	Far North	Outback-North	SWQld_NA	SWQld	Sunshine Coast	Central Highlands (Qld)	Gladstone – Biloela	Gladstone – Biloela_NA	Rockhampton	Gold Coast	Bowen Basin – North	Mackay	Whitsunday	Toowoomba	Charters Towers – Ayr – Ingham	Townsville	Bundaberg	Wide Bay	Hervey Bay	Total for Qld
Total DEC in 2011	20,823	987	203	706	110	221	42	62	1,997	524	356	971	511	3,934	988	978	125	515	198	871	208	548	120	35,998
Total DEC as % of Total National DEC in 2011	11.1%	0.5%	0.1%	0.4%	0.1%	0.1%	0.0%	0.0%	1.1%	0.3%	0.2%	0.5%	0.3%	2.1%	0.5%	0.5%	0.1%	0.3%	0.1%	0.5%	0.1%	0.3%	0.1%	19.2%
Change in DEC: 2011 to 2031																								
Urban transport	14,842	0	0	0	0	0	0	0	1,521	0	0	0	0	1,673	0	0	0	0	0	0	0	0	0	18,036
National Highways	44	29	34	209	0	73	21	13	75	110	58	5	84	591	148	174	0	163	86	26	29	103	0	2,075
Ports	2,227	94	9	0	100	24	0	0	0	0	0	500	20	0	54	298	0	0	1	105	13	9	0	3,454
Airports	3,146	619	0	9	30	46	5	0	115	25	34	0	107	804	5	160	88	0	4	275	17	0	21	5,510
Rail	194	3	0	1	0	12	3	1	0	158	45	39	23	3	319	19	0	8	1	15	1	2	0	847
Electricity	492	62	37	127	-22	20	3	2	75	9	42	450	85	121	10	46	7	59	12	68	32	119	23	1,879
Gas pipelines	19	0	0	12	0	12	0	9	0	0	0	1,617	1	2	0	0	0	1	0	2	0	0	0	1,675
Petroleum terminals	155	6	0	0	1	0	0	0	0	0	0	9	1	0	0	9	0	0	0	9	0	0	0	190
Water and sewerage	624	39	13	14	5	4	2	0	134	6	5	154	39	286	9	34	2	86	10	109	12	15	23	1,625
Telecommunications	2,271	58	20	28	4	15	3	2	77	11	2	8	41	293	9	40	6	88	6	207	23	57	8	3,277
Total	24,014	910	113	400	118	206	37	27	1,997	319	186	2,782	401	3,773	554	780	103	405	120	816	127	305	75	38,568
Total DEC (all sectors) in 2031	44,837	1,897	316	1,106	228	427	79	89	3,994	843	542	3,753	912	7,707	1,542	1,758	228	920	318	1,687	335	853	195	74,566
DEC Index (2011=1.00)	2.15	1.92	1.56	1.57	2.07	1.93	1.88	1.44	2.00	1.61	1.52	3.87	1.78	1.96	1.56	1.80	1.82	1.79	1.61	1.94	1.61	1.56	1.63	2.07
Total DEC as % of Total National DEC in 2031	11.9%	0.5%	0.1%	0.3%	0.1%	0.1%	0.0%	0.0%	1.1%	0.2%	0.1%	1.0%	0.2%	2.0%	0.4%	0.5%	0.1%	0.2%	0.1%	0.4%	0.1%	0.2%	0.1%	19.8%

Source: Adapted from ACIL Allen Consulting (2014a)

Key

>1 | 1–250 | 251–500 | 501–1,500 | 1,501–2,500 | 2,501–3,500 | 3,501–4,500 | 4,501–6,000 | 6,001–10,000 | 10,001–20,000 | 20,000 +

Table A2-7: Western Australia DEC by audit region and sector, 2011 and 2031 ($ million)

	Greater Perth	Augusta – Margaret River – Busselton	Bunbury	Manjimup	Esperance	Gascoyne	Goldfields	Kimberley	Mid West	Pilbara	Albany	Wheat Belt – North	Wheat Belt – South	Total for WA
Total DEC in 2011	17,490	117	887	52	153	56	242	323	420	5,240	165	281	36	25,462
Total DEC as % of Total National DEC in 2011	9.3%	0.1%	0.5%	0.0%	0.1%	0.0%	0.1%	0.2%	0.2%	2.8%	0.1%	0.2%	0.0%	13.6%
Change in DEC: 2011 to 2031														
Urban transport	24,485	0	0	0	0	0	0	0	0	0	0	0	0	24,485
National Highways	0	47	153	25	15	6	76	49	140	82	7	90	0	690
Ports	3,711	0	38	0	71	14	0	67	82	6,433	45	0	0	10,461
Airports	2,623	0	0	0	5	6	57	121	1	369	10	0	0	3,192
Rail	5	0	3	0	2	0	4	0	2	2,751	0	2	0	2,769
Electricity	1,733	28	592	13	27	25	57	116	85	34	35	70	15	2,830
Gas pipelines	260	0	43	0	3	0	14	0	27	-39	0	1	0	309
Petroleum terminals	159	0	0	0	8	0	0	2	4	16	0	0	0	189
Water and sewerage	1,278	13	56	3	2	4	12	19	16	102	13	17	3	1,538
Telecommunications	2,130	8	33	3	4	2	17	25	20	47	14	12	2	2,317
Total	36,384	96	918	44	137	57	237	399	377	9,795	124	192	20	48,780
Total DEC (all sectors) in 2031	53,874	213	1,805	96	290	113	479	722	797	15,035	289	473	56	74,242
DEC Index (2011=1.00)	3.08	1.82	2.03	1.85	1.90	2.02	1.98	2.24	1.90	2.87	1.75	1.68	1.56	2.92
Total DEC as % of Total National DEC in 2031	14.3%	0.1%	0.5%	0.0%	0.1%	0.0%	0.1%	0.2%	0.2%	4.0%	0.1%	0.1%	0.0%	19.7%

Source: Adapted from ACIL Allen Consulting (2014a)

Key

>1 | 1–250 | 251–500 | 501–1,500 | 1,501–2,500 | 2,501–3,500 | 3,501–4,500 | 4,501–6,000 | 6,001–10,000 | 10,001–20,000 | 20,000 +

Table A2-8: South Australia DEC by audit region and sector, 2011 and 2031 ($ million)

	Greater Adelaide	Barossa – Yorke – Mid North	South Australia – Outback	South Australia – South East	Total for SA
Total DEC in 2011	12,068	576	462	424	13,530
Total DEC as % of Total National DEC in 2011	6.5%	0.3%	0.2%	0.2%	7.2%
Change in DEC: 2011 to 2031					
Urban transport	5,668	0	0	0	5,668
National Highways	0	74	69	68	211
Ports	477	20	26	0	523
Airports	1,126	0	31	10	1,167
Rail	2	0	1	0	3
Electricity	380	57	97	48	582
Gas pipelines	45	6	1	2	54
Petroleum terminals	12	0	1	0	13
Water and sewerage	358	41	6	11	416
Telecommunications	954	10	13	17	994
Total	9,022	208	245	156	9,631
Total DEC (all sectors) in 2031	21,090	784	707	580	23,161
DEC Index (2011=1.00)	1.75	1.36	1.53	1.37	1.71
Total DEC as % of Total National DEC in 2031	5.6%	0.2%	0.2%	0.2%	6.1%

Source: Adapted from ACIL Allen Consulting (2014a)

Key

>1 | 1–250 | 251–500 | 501–1,500 | 1,501–2,500 | 2,501–3,500 | 3,501–4,500 | 4,501–6,000 | 6,001–10,000 | 10,001–20,000 | 20,000 +

Table A2-9: Tasmania DEC by audit region and sector, 2011 and 2031 ($ million)

	Hobart	Launceston and North East	Rest of Tas.	Total for Tas.
Total DEC in 2011	1,809	886	729	3,424
Total DEC as % of Total National DEC in 2011	1.0%	0.5%	0.4%	1.8%
Change in DEC: 2011 to 2031				
Urban transport	649	0	0	649
National Highways	0	82	45	127
Ports	35	38	27	100
Airports	157	83	16	256
Rail	0	1	0	1
Electricity	26	24	65	115
Gas pipelines	7	7	2	16
Petroleum terminals	1	0	2	3
Water and sewerage	26	7	12	45
Telecommunications	172	29	9	210
Total	1,073	271	178	1,522
Total DEC (all sectors) in 2031	2,882	1,157	907	4,946
DEC Index (2011=1.00)	1.59	1.31	1.24	1.44
Total DEC as % of Total National DEC in 2031	0.8%	0.3%	0.2%	1.3%

Source: Adapted from ACIL Allen Consulting (2014a)

Table A2-10: Australian Capital Territory DEC by sector, 2011 and 2031 ($ million)

	Australian Capital Territory
Total DEC in 2011	3,456
Total DEC as % of Total National DEC in 2011	1.8%
Change in DEC: 2011 to 2031	
Urban transport	1,753
National Highways	0
Ports	0
Airports	1,043
Rail	0
Electricity	78
Gas pipelines	-17
Petroleum terminals	0
Water and sewerage	107
Telecommunications	340
Total	3,304
Total DEC (all sectors) in 2031	6,760
DEC Index (2011=1.00)	1.96
Total DEC as % of Total National DEC in 2031	1.8%

Source: Adapted from ACIL Allen Consulting (2014a)

Key

>1 1–250 251–500 501–1,500 1,501–2,500 2,501–3,500 3,501–4,500
4,501–6,000 6,001–10,000 10,001–20,000 20,000 +

Table A2-11: Northern Territory DEC by audit region and sector, 2011 and 2031 ($ million)

	Darwin	Alice Springs	Barkly	Daly - Tiwi - West Arnhem	East Arnhem	Katherine	Total for NT
Total DEC in 2011	1,224	360	32	279	97	65	2,057
Total DEC as % of Total National DEC in 2011	0.7%	0.2%	0.0%	0.1%	0.1%	0.0%	1.1%
Change in DEC: 2011 to 2031							
Urban transport	832	0	0	0	0	0	832
National highways	0	179	25	265	0	38	507
Ports	39	0	0	0	51	4	94
Airports	323	130	0	5	20	0	478
Rail	1	0	0	0	0	0	1
Electricity	28	9	3	4	4	4	52
Gas pipelines	37	5	1	0	0	6	49
Petroleum terminals	8	0	0	0	5	0	13
Water and sewerage	63	2	0	1	0	1	67
Telecommunications	95	14	1	0	3	7	120
Total	1,426	339	30	275	83	60	2,213
Total DEC (all sectors) in 2031		699	62	554	180	125	4,270
DEC Index (2011=1.00)	2.17	1.94	1.94	1.99	1.86	1.92	2.08
Total DEC as % of Total National DEC in 2031	0.7%	0.2%	0.0%	0.1%	0.0%	0.0%	1.1%

Source: Adapted from ACIL Allen Consulting (2014a)

Key

>1 1–250 251–500 501–1,500 1,501–2,500 2,501–3,500 3,501–4,500 4,501–6,000 6,001–10,000 10,001–20,000 20,000 +

Appendix 3
Glossary

Term	Definition
Audit region	Audit regions are geographic areas defined by the Australian Statistical Geography Standard (ASGS) and used by the Australian Bureau of Statistics to collect and report population, demographic and related information for Australia. Further information on how audit regions are defined is contained in the National Economic Analysis report prepared by ACIL Allen Consulting (see bibliography).
Compound Annual Growth Rate	The average year-on-year growth rate over a specified period of time.
Consumer Price Index	A consumer price index (CPI) measures changes over time in the price level of consumer goods and services in the economy.
Cost-benefit analysis	An analytical tool that can be used to assess the costs and benefits of a proposal.
Governance	Processes implemented to provide management oversight, guidance and compliance with policy and procedures.
Gross Domestic Product (GDP)	The market value of all final goods and services produced within a country in a given period.
Gross State Product (GSP)	The market value of all final goods and services produced within a state or territory in a given period.
Gross Regional Product (GRP)	The market value of all final goods and services produced within a region in a given period.
Initiative	This includes potential infrastructure investments, governance arrangements or policy measures intended to increase productivity or economic activity, or otherwise support national aspirations.
Metropolitan area	An urban area extending across local government and sometimes state/territory boundaries, which forms a geographically contiguous area of relatively high population and economic activity.
Peak oil	The point in time when the maximum rate of oil extraction is reached, after which the world's oil supplies go into irreversible decline.
Program	Suite of appraised projects which may be delivered within a specified timeframe and sequence.
Value capture	Refers to a type of public financing where increases in private land values generated by public investments are all or in part "captured" or recouped by the public sector.

Appendix 4
Acronyms

Acronym	Definition
ABS	Australian Bureau of Statistics
ACCC	Australian Competition and Consumer Commission
ACT	Australian Capital Territory
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
BCA	Business Council of Australia
BITRE	Bureau of Infrastructure, Transport and Regional Economics
CAGR	compound annual growth rate
COAG	Council of Australian Governments
CSG	coal seam gas
DEC	Direct Economic Contribution
DEWS	Queensland Department of Energy and Water Supply
GDP	Gross Domestic Product
GL	gigalitres
GWh	gigawatt hours
GRP	Gross Regional Product
GSP	Gross State Product
HCV	heavy commercial vehicle
HFC	hybrid-fibre co-axial
ICT	information and communications technology
IMO	Independent Market Operator
ISDN	Integrated Services for Digital Network
KT	kilometres travelled
LCV	light commercial vehicle
LNG	liquefied natural gas
Mbps	megabits per second
MFP	multi factor productivity
ML	megalitres
Mtpa	megatonnes per year
NBN	National Broadband Network
NEM	National Electricity Market
NSW	New South Wales
NT	Northern Territory
O/D	origin/destination
OECD	Organisation for Economic Cooperation and Development
PHT	passenger hours travelled
PJ	petajoules
PKT	passenger kilometres travelled
PPP	Public Private Partnership
PV	photovoltaic
Qld	Queensland
SA	South Australia
SEQ	South East Queensland
SWIS	South West Interconnected System
Tas	Tasmania
TEU	twenty-foot equivalent unit
TJ	terajoule
V/C	volume compared to capacity
Vic	Victoria
VKT	vehicle kilometres travelled
WA	Western Australia
WEM	Wholesale Electricity Market

Appendix 5
Lists of Figures and Tables

Figures

Tables

Appendix 6
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