The Electric Power System

- Australia-

Basic facts

- Area: 7,741,220 sq km
- Population: 22,751,014
- Number of electricity consumers
  - Residential 9 875 547
  - Business 1 240 301
- 8 TSOs
- 13 DSOs
- Peak load: 33741 MW
- Average interruption of electricity: 8.3 min average across all states (source AER 2014)

Table 3.2 Number of customers at 30 June 2014

Classification of customers	NSW & ACT	VIC	QLD	SA	WA	TAS	NT	TOTAL
Residential	3,189,194	2,377,337	1,857,602	743,918	996,657	235,170	75,669	9,475,547
Business	407,330	321,142	227,379	99,203	129,259	42,356	13,632	1,240,301
Total	**3,596,524**	**2,698,479**	**2,084,981**	**843,121**	**1,125,916**	**277,526**	**89,301**	**10,715,848**

TOTAL			% Change		% Change		% Change		% Change		% Change		% Change		% Change
	2010	3,426,356	0.9	2,562,102	2.2	1,947,328	2.0	817,270	1.2	1,055,861	0.4	279,789	3.8	74,004	2.7	10,162,710	1.5
	2011	3,459,414	1.0	2,585,702	0.9	1,980,752	1.7	825,218	1.0	1,060,269	0.4	275,536	-1.5	76,603	3.5	10,263,494	1.0
	2012	3,499,958 [2]	1.2	2,633,476	1.8	2,022,600	2.1	832,073	0.8	1,086,294	2.5	277,956	0.9	77,708	1.4	10,430,065 [2]	1.6
	2013	3,541,054 [2]	1.2	2,663,871	1.2	2,064,283	2.1	836,365	0.5	1,100,039	1.3	278,756	0.3	82,545	6.2	10,566,913 [2]	1.3
	2014	**3,596,524**	**1.6**	**2,698,479**	**1.3**	**2,084,981**	**1.0**	**843,121**	**0.8**	**1,125,916**	**2.4**	**277,526**	**-0.4**	**89,301**	**8.2**	**10,715,848**	**1.4**

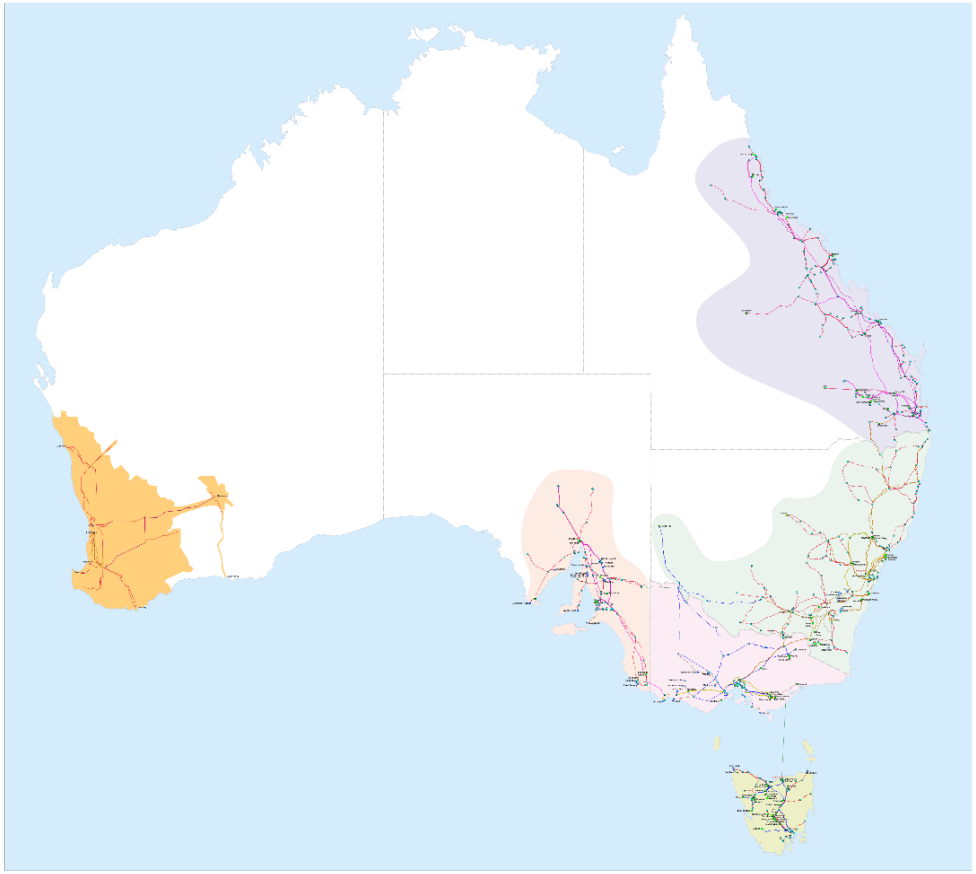
Source: esaa, company annual reports

Structure of the System(s)

Click here for an interactive map

Wholesale Electricity Market (WEM):

- WEM commenced operation in **September 2006.**
- The South West Interconnected System (SWIS) incorporates **7,802 km** of transmission lines.
- Total of **$500 million** was transacted in 2014-15.
- There are more than **1 million customers** in the WEM.
- **5,788 MW** – total registered generation capacity. Including 513 MW of Non-Scheduled Generation.



Source: AEMO

National Electricity Market (NEM):

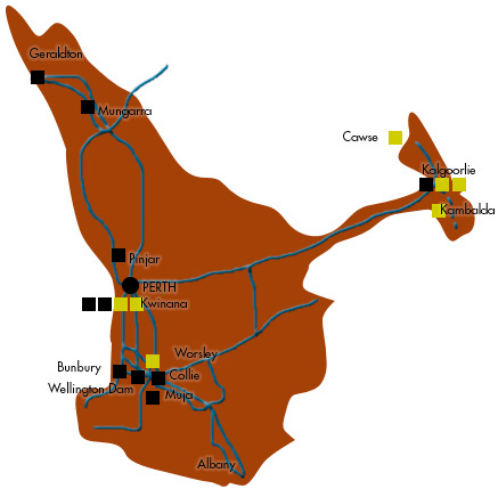
- NEM commenced operation as a wholesale spot market for electricity in **December 1998.**
- Incorporates around **40,000 km** of transmission lines and cables.
- The NEM supplies about **200 terawatt hours** of electricity to businesses and households each year.
- **$7.7 billion** was traded in the NEM in 2014–15.
- Supplies around **9 million** customers.
- **45,000MW** - total electricity generating capacity.

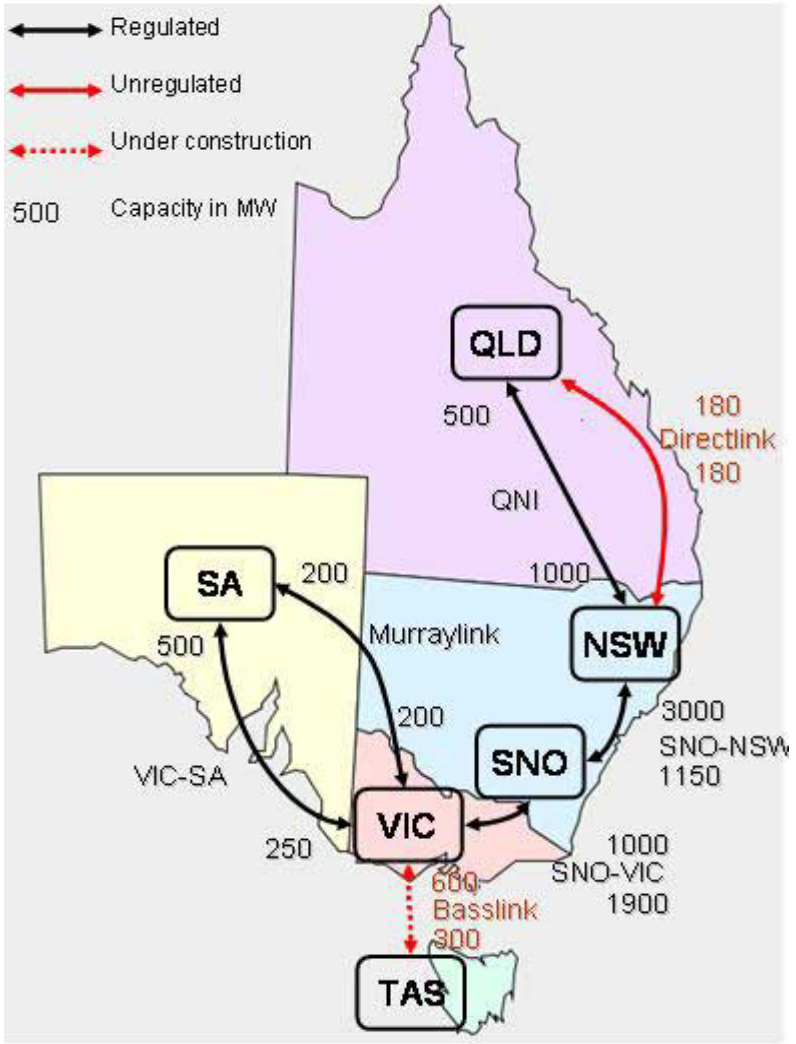
Grid facts and characteristics

- National Electricity Market (NEM)
  - Installed Capacity : approx 47,148 MW
  - 198 terawatt hrs annually
  - Greater than 5000km in transmission length from North Qld to Port Augusta. Longest AC system in the world.
  - 40,000 km of transmission lines and cables
  - Supplies 200TWh to industry and households each year
  - Max demand 32 859MW
- South West Interconnected System (SWIS)
  - Installed Capacity 5500 MW
  - 43,000 customer connection points
  - 96,000 kms of circuit length

The National Market and Interconectors

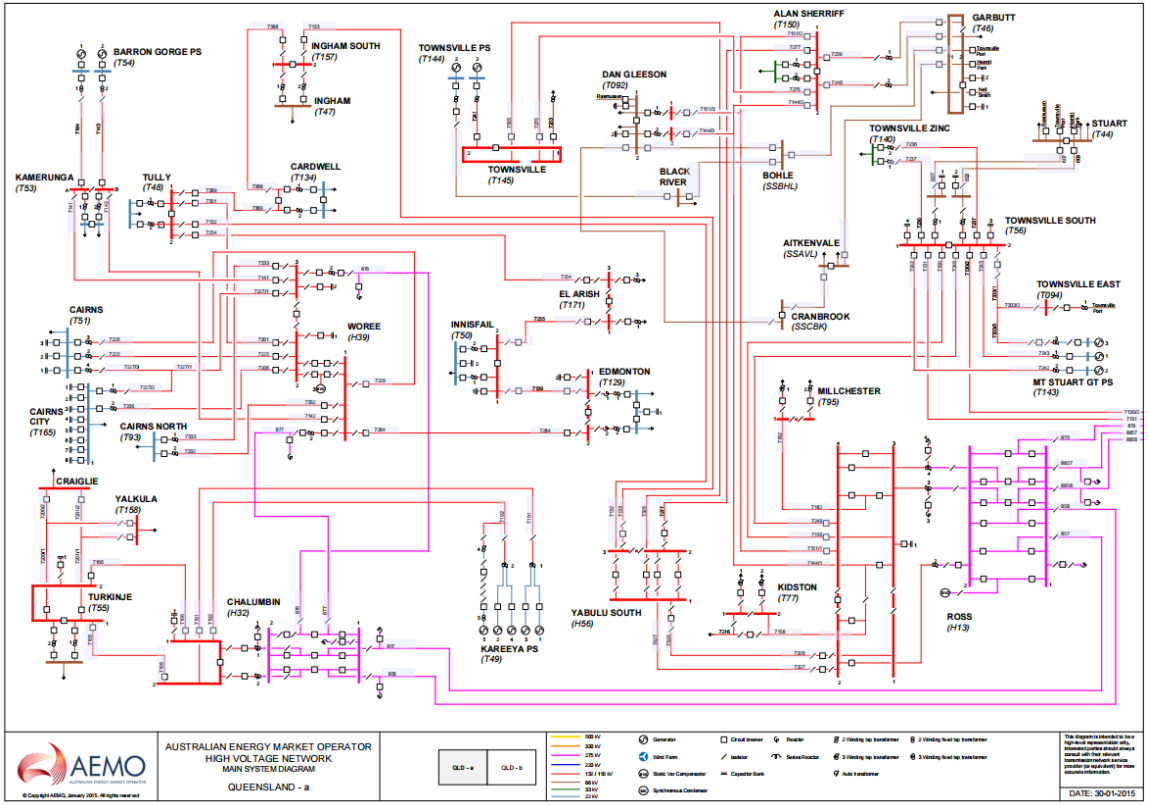
- Australia has two distinct interconnected systems. The Eastern State (NEM – National Electricity Market) at right and the SWIS- South West Interconnected System in Western Australia: below





HV System Diagram

[Click here or on the diagram HV System Diagrams to download detailed HV Network for each Region]



Information on TSOs

Network [Click on name to goto website]	**Circuit Kms**	**Substations & Switchyards**	**Max Demand MW**	**Transmitted TWh**
ElectraNet (SA)	5591	79	3570	13.0
Powerlink (Qld)	13968	114	8836	48.0
SP Ausnet (Vic)	6553		9982	52.3
Transend (TasNetworks) (Tas)[1]	-	57	1770	10.9
TransGrid (NSW)	12657	488	14863	74.2
Western Power (WA)	6792	-	3420	14.5
Power and Water (NT)	730	-	-	-

1 Transend merged with the distribution division of Aurora Energy to form the combined network business TasNetworks in 2014. Reports prior to 2014 will refer to Transend, post 2014 will refer to TasNetorks

Installed capacity and output with reference to primary resources

Generation capacity and output by fuel source

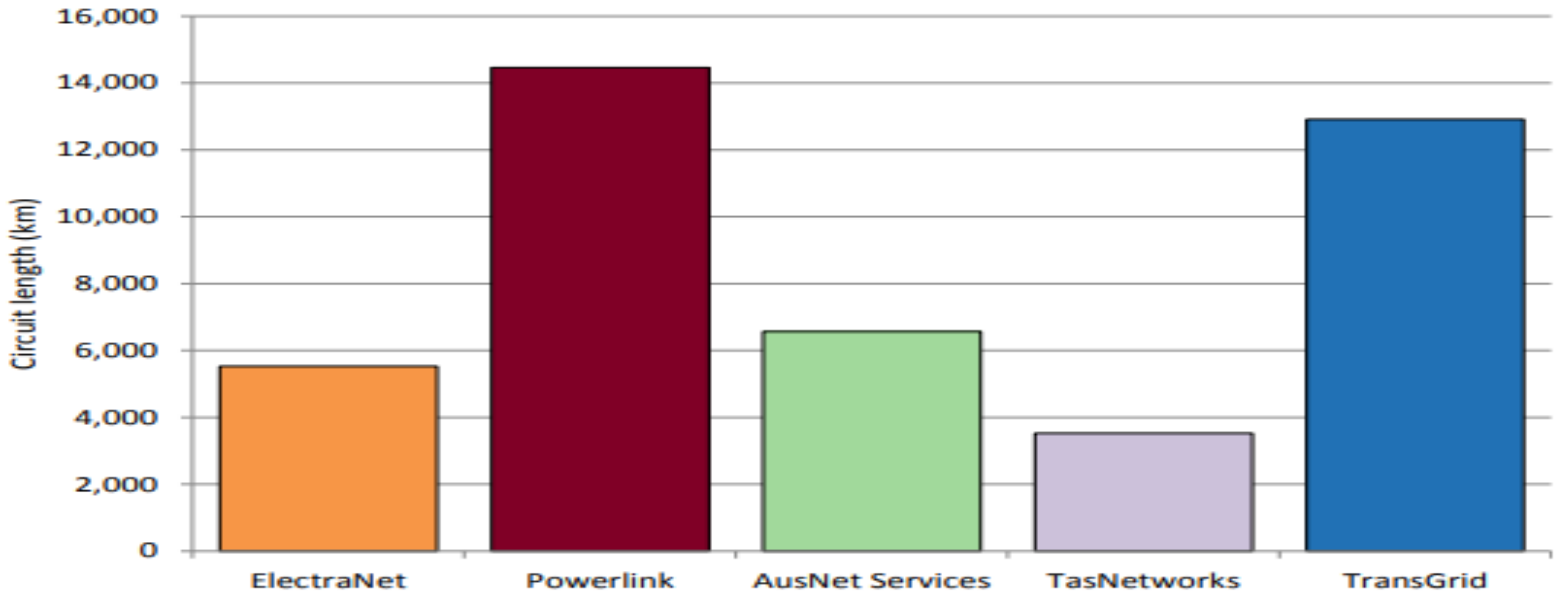
Graph | **Data** | Information

Fuel	Capacity (Percent of total generation)	Output (Percent of total generation)
Black coal	38.1	56.3
Brown coal	9.8	18.4
Gas	20.4	9.8
Hydro	17.0	7.8
Wind	8.9	6.5
Liquid	2.3	0.0
Solar	0.6	0.3
Other	2.7	0.8

2017/18 – source AER

TNSP by Line Kilometre length

Figure B.1 Five year average circuit length by TNSP (2012 to 2016)



B.1.2 Energy transported

Energy transported is the total volume of electricity throughput over time through the transmission network, measured in gigawatt hours (GWh). We use it because energy throughput is the TNSP service directly consumed by end–customers. Therefore, it reflects services provided to customers. However, if there is sufficient capacity to meet current energy throughput levels, changes in throughput are unlikely to have a significant impact on a TNSP's costs. Figure B.2 shows each TNSP's energy transported in 2016.

TNSP by Regulated Asset Base Value

Figure 5.3 Size of TNSPs, by average RAB

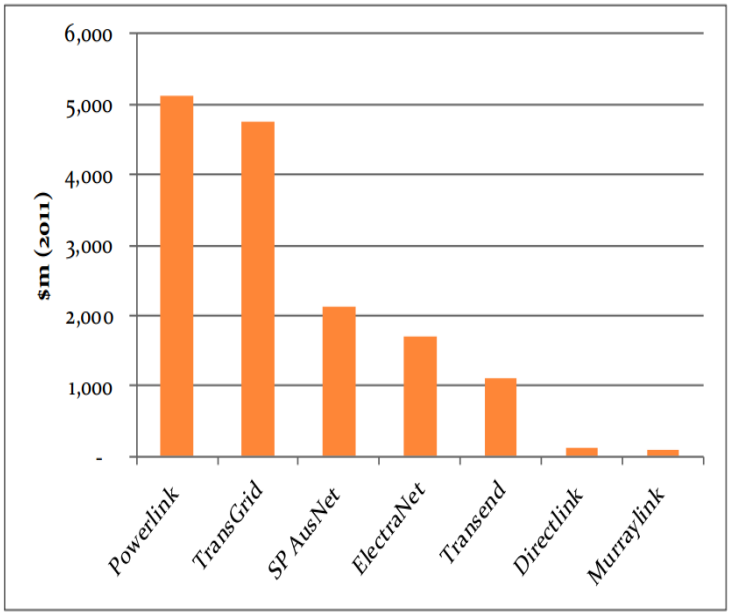


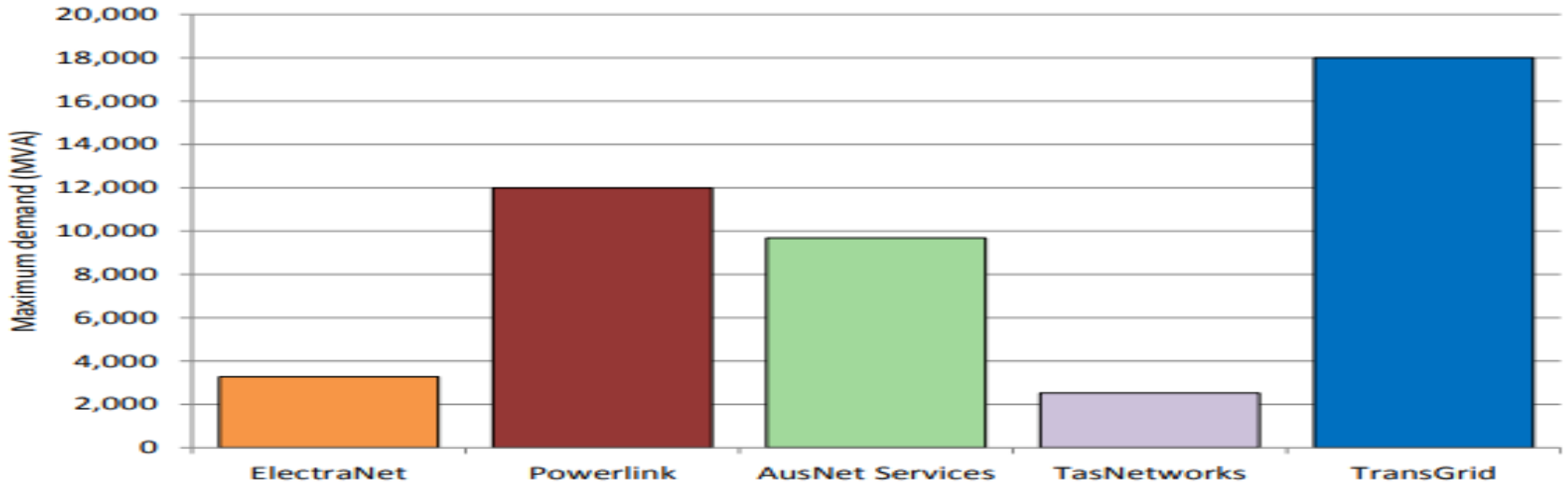
Figure 5.3 shows that based on the regulatory asset base Powerlink is the largest TNSP in the NEM, with an average RAB of $5.1 billion. TransGrid closely follows at $4.8 billion. SP AusNet has the third largest average RAB at $2.1 billion, which is less than half of TransGrid and Powerlink.

AER: Electricity Transmission Service Providers | Performance report 2010-11

1 Transend merged with the distribution division of Aurora Energy to form the combined network business TasNetworks in 2014. Reports prior to 2014 will refer to Transend, post 2014 will refer to TasNetorks

TNSP by Max Demand

Figure B.3 Maximum demand for 2016 (MVA)

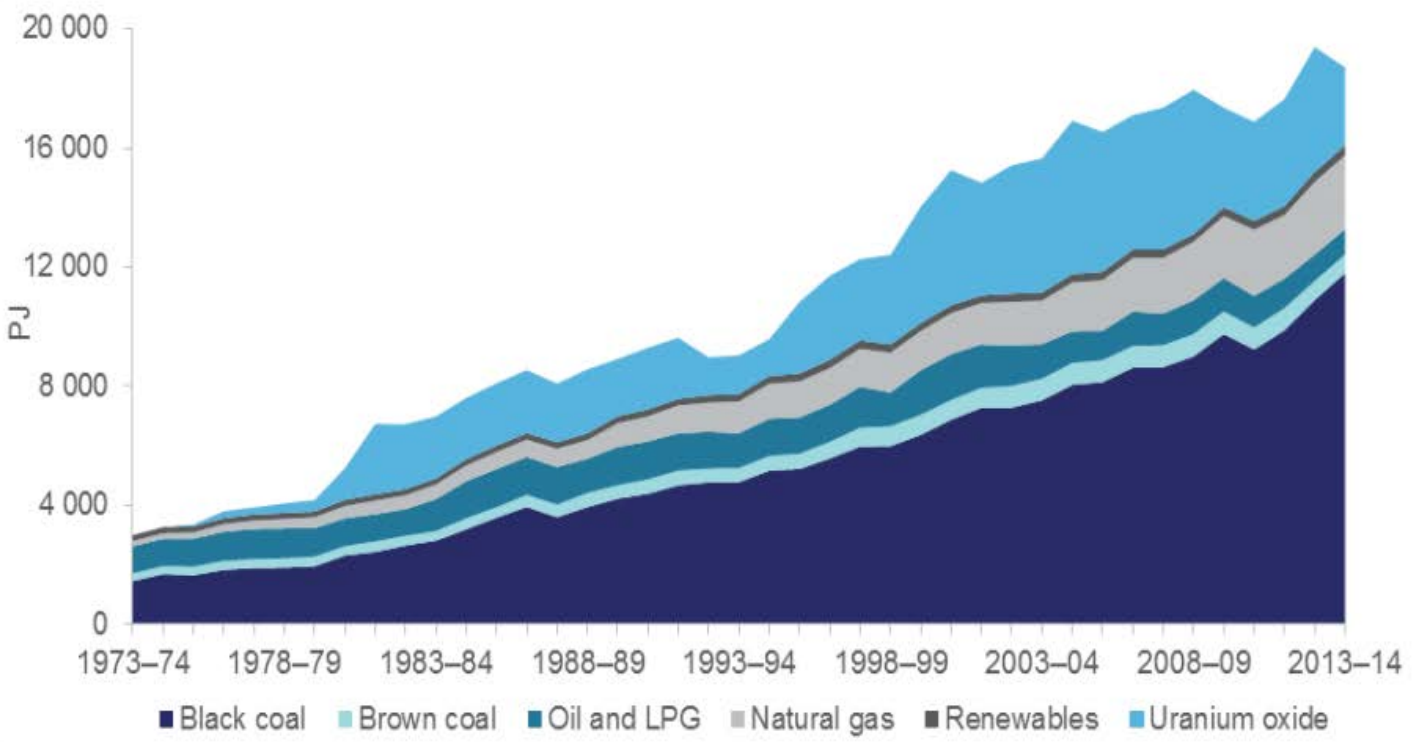


B.1.4 Voltage of entry and exit points (original output)

The number of entry and exit points represents the number of points to which a transmission network must connect. We use the summation of the total voltage of transmission node identifiers (TNIs) as the measure of the entry and exit points of the transmission networks.[36] The summation of the voltages of the connection points is required so that the aggregate measure reflects the differing sizes of TNIs across transmission networks. Specifically, higher voltage TNIs will typically require more assets as they will have a higher capacity. Where a single node services multiple distributors or a distributor and a generator, and hence has multiple TNIs, we have only counted this node once. B.4 shows each TNSP's aggregate voltage of entry and exit points in 2016.

Australian Energy Production by Fuel type

Figure 4.1: Australian energy production, by fuel type



Source: Department of Industry and Science (2015) *Australian Energy Statistics*, Table J.

Generation by Fuel type

Table 4.2: Australian electricity generation, by fuel type

	2013–14		*Average annual growth*	
	GWh	Share (per cent)	2013–14 (per cent)	10 years (per cent)
Fossil fuels a	**211 254.8**	**85.1**	**- 2.4**	**0.2**
Black coal	105 772.4	42.6	- 5.1	- 2.1
Brown coal	46 076.2	18.6	- 3.1	- 1.6
Gas	54 393.9	21.9	6.5	9.6
Oil	5 012.4	2.0	12.3	6.5
Renewables	**37 042.2**	**14.9**	**11.6**	**6.8**
Hydro	18 421.0	7.4	0.8	1.9
Wind	10 252.0	4.1	28.8	31.3
Solar PV	4 857.5	2.0	27.0	58.3
Bioenergy	3 511.3	1.4	11.4	- 1.0
Geothermal	0.5	0.0	0.0	0.0
Total	**248 297.1**	**100.0**	**- 0.6**	**0.9**

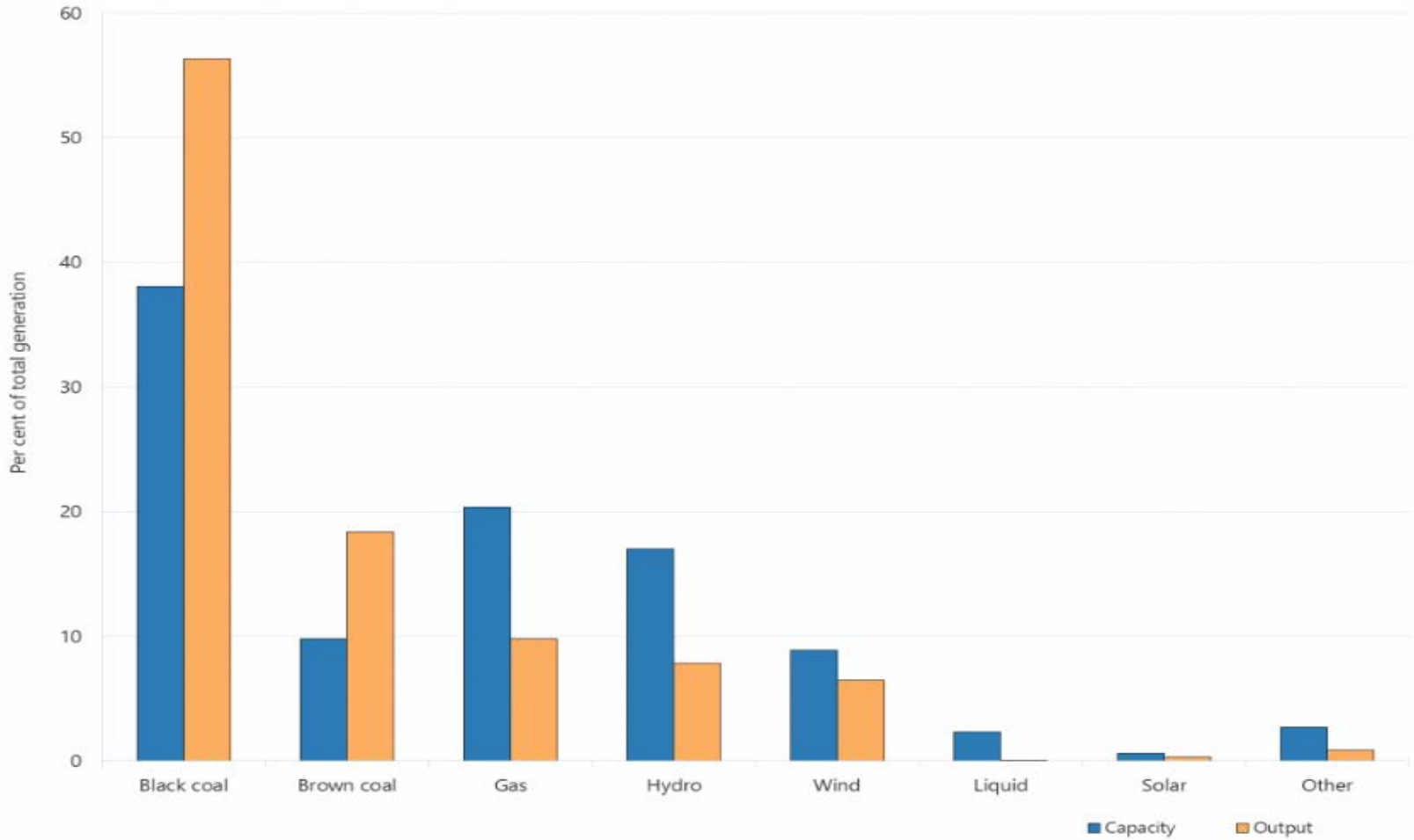
Notes: a A small share of 2013–14 growth includes reallocation of multi fuel to specific fuel types.

Source: Department of Industry and Science (2015) *Australian Energy Statistics*, Table O.

National Electricity Market Consumption

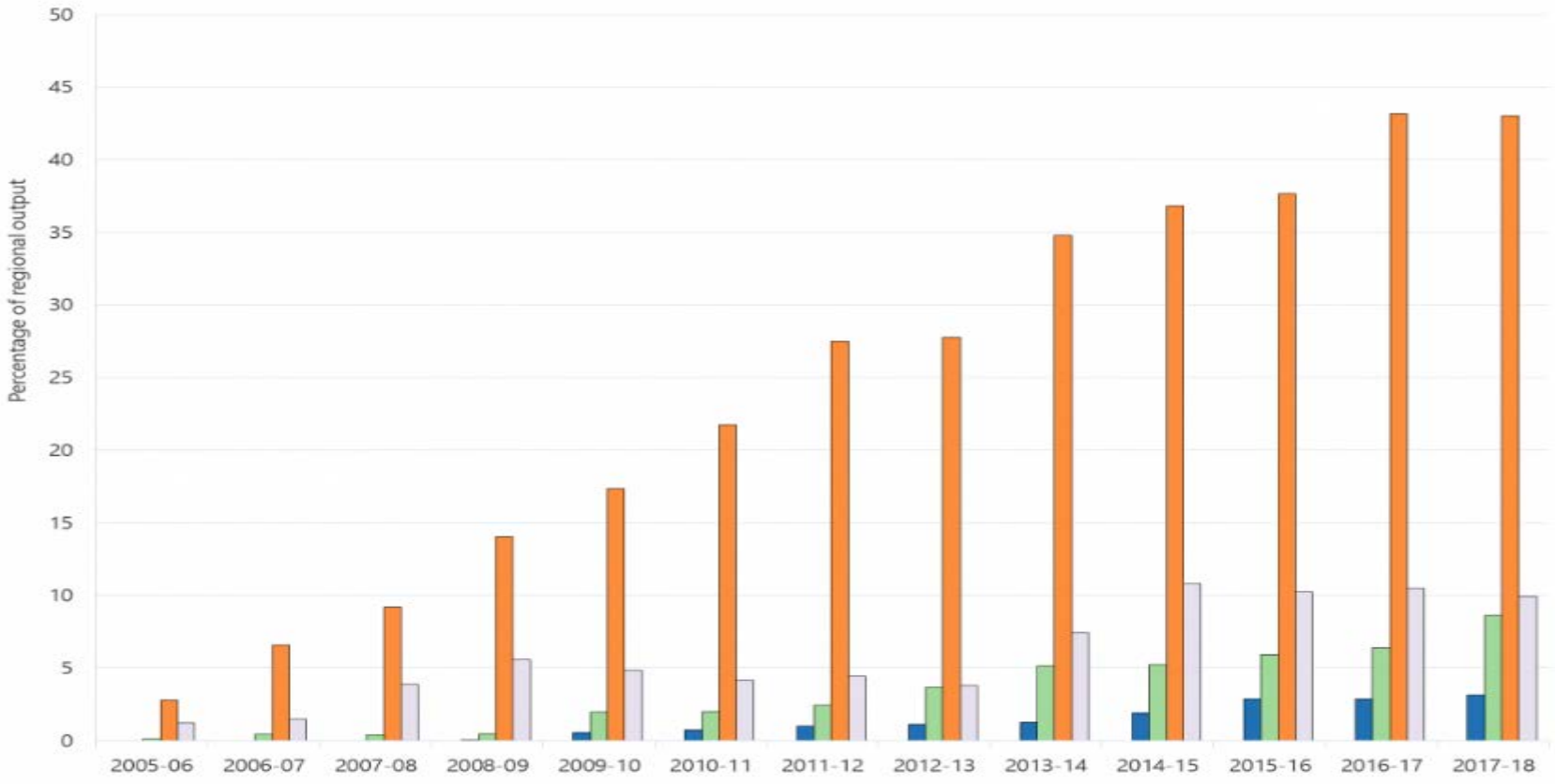
Generation capacity and output by fuel source

Graph | Data | Information



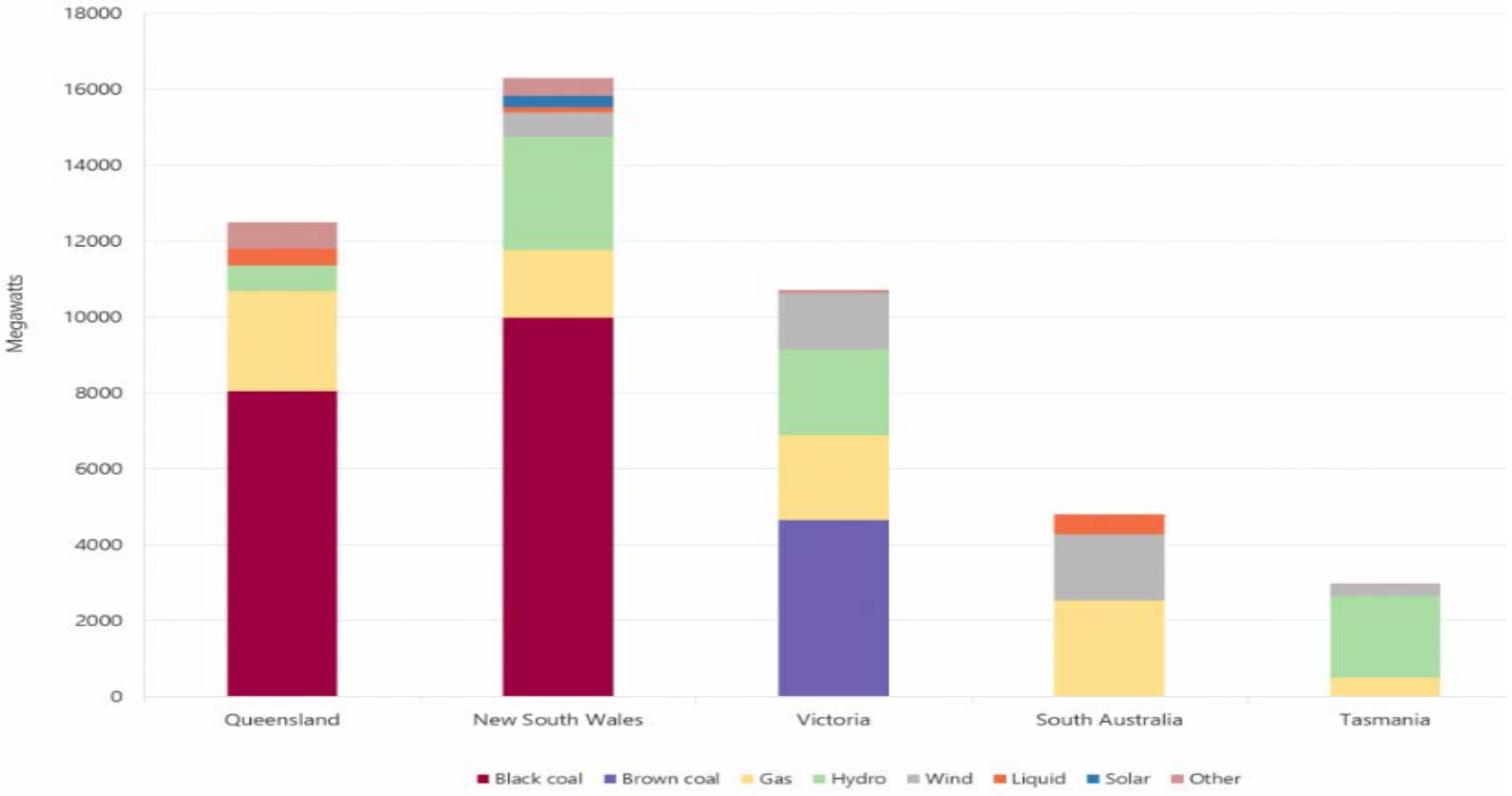
Wind output as a percentage of regional output

Graph | Data | Information



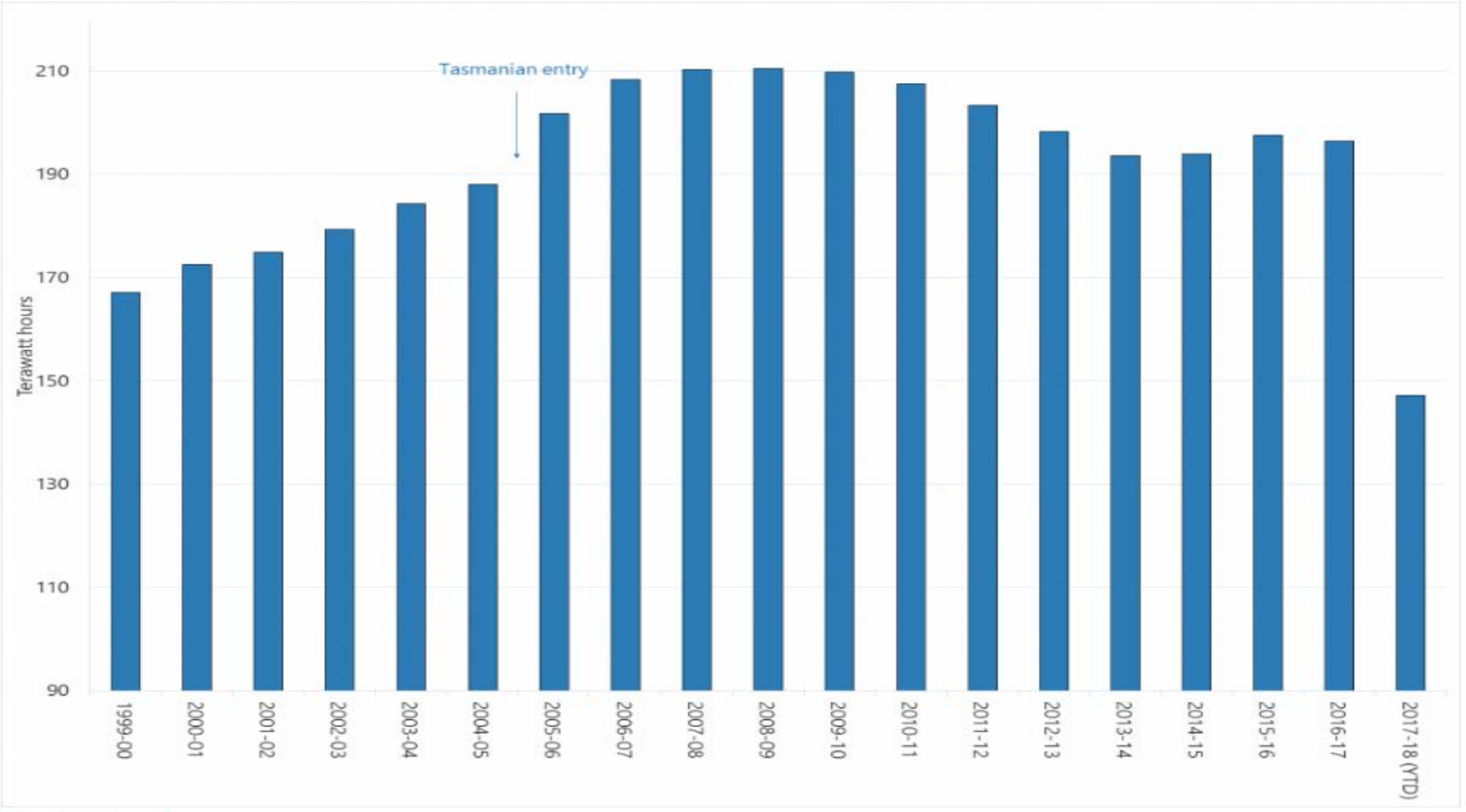
Registered capacity in regions by fuel source

Graph | Data | Information



National Electricity Market electricity consumption

Graph | Data | Information



Location of renewable energy sources

[Click on map or here to goto interactive table]

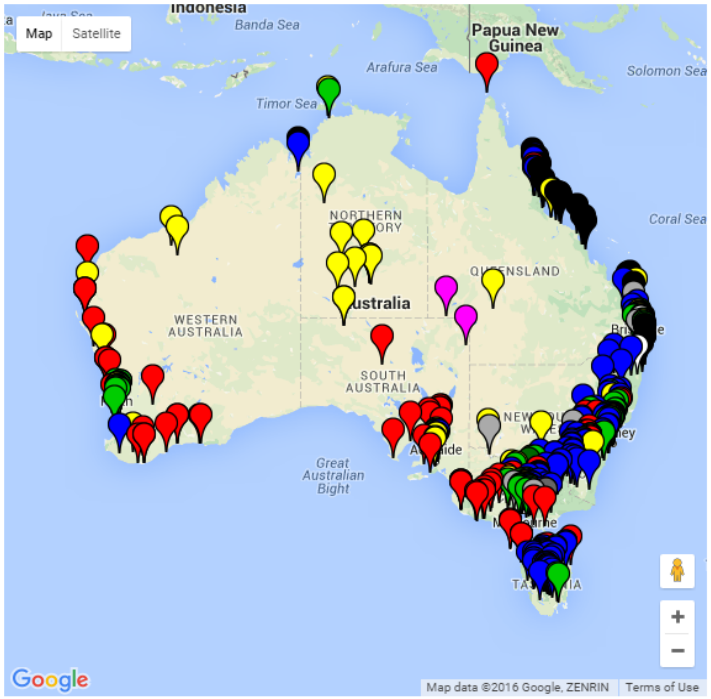
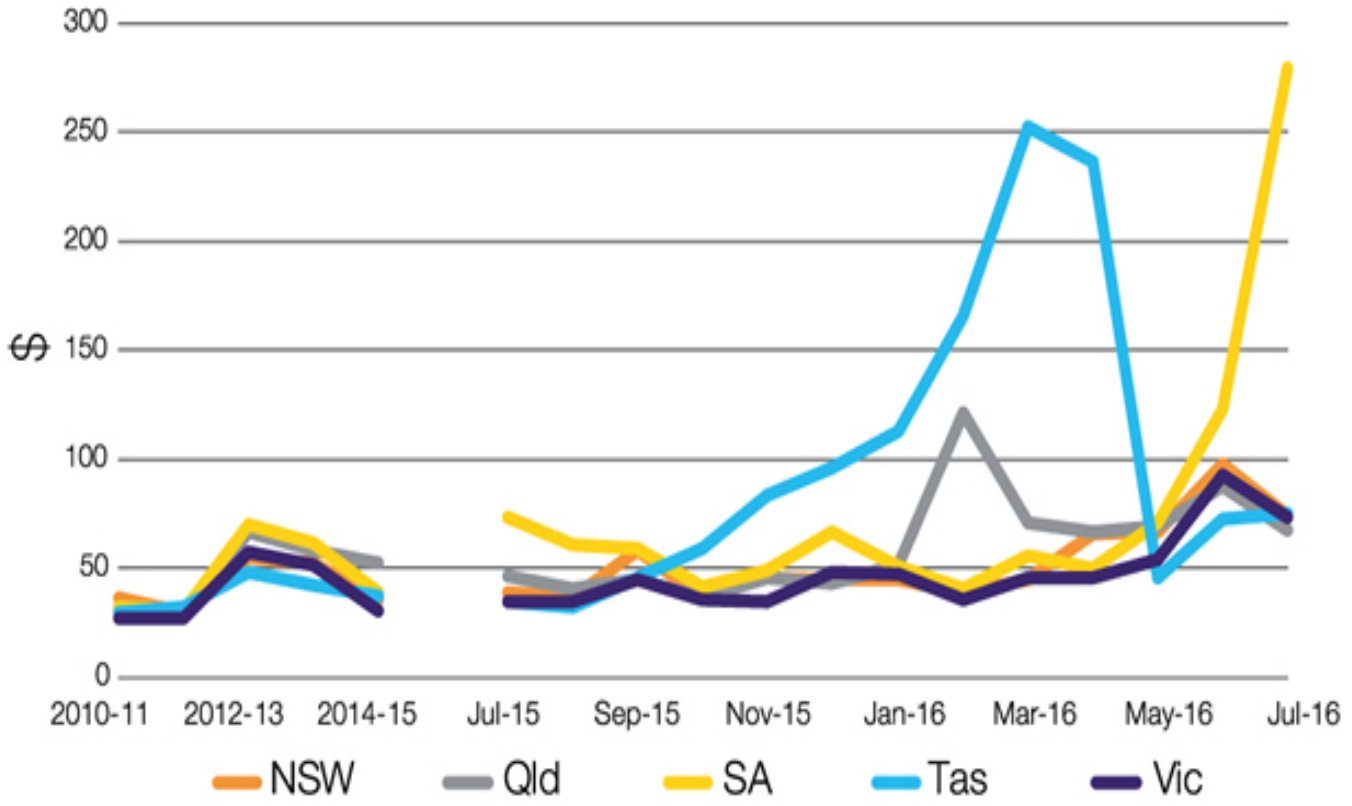
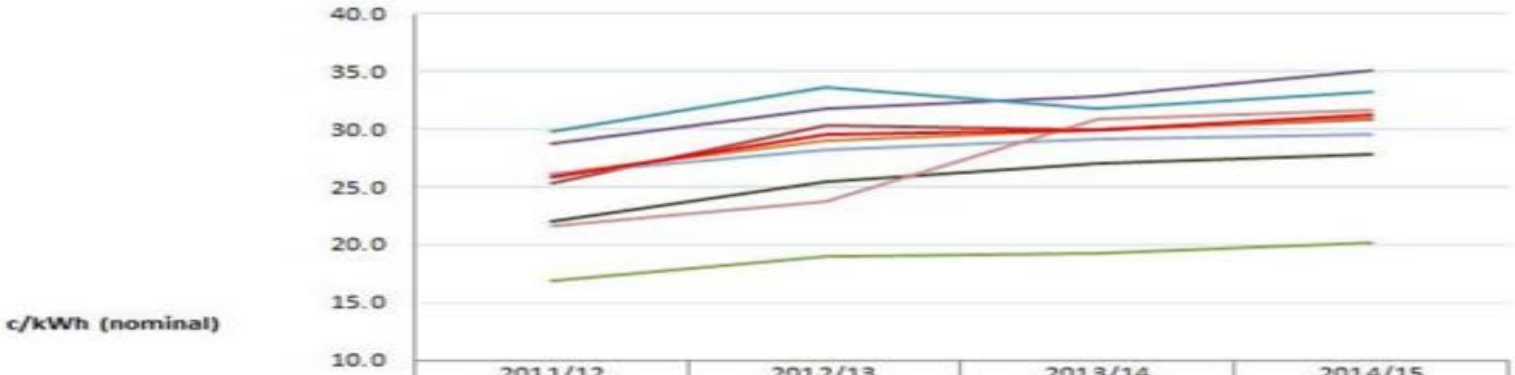


Figure 2: National electricity market wholesale prices, 2009-10 to July 2016 ($ per MWh)



Source: Australian Energy Market Operator (AEMO), 'Average price tables', AEMO website.

Household Electricity Price Trends



	2011/12	2012/13	2013/14	2014/15
Queensland (see note 1)	22.1	25.6	27.1	27.9
New South Wales	25.4	30.4	30.0	31.0
Australian Capital Territory	16.9	19.1	19.3	20.2
Victoria (see note 2)	28.8	31.9	32.9	35.2
South Australia	29.9	33.7	31.8	33.3
Tasmania	26.2	29.2	30.0	31.1
Western Australia	26.2	28.4	29.2	29.7
Northern Teritory	21.7	23.8	31.0	31.8
National	25.9	29.6	30.0	31.3

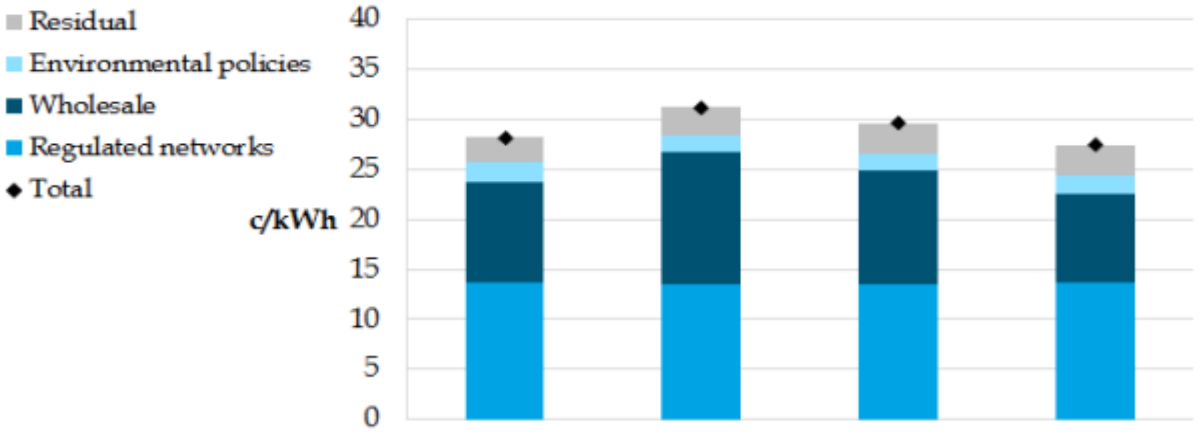
Notes:

1. Queensland prices do not incorporate recent pass through approvals by the AER in respect of feed-in tariff costs for 2011/12, or retail price proposals under the QCA's draft retail price determination for 2013/14. A preliminary assessment of the impact of these changes indicates that the total retail price in 2013/14 would increase by 0.5 c/kWh to 27.7 c/kWh (from 27.1 c /kWh), and in 2014/15 it would increase by 0.5 c/kWh to 28.5 c/kWh (from 27.9 c/kWh).
2. Victorian prices are based on published standing offers and are likely to overstate the actual prices paid by representative residential customers receiving supply on market offers. According to the Essential Services Commission in Victoria, based on 2011/12 prices, the published standing offers are, on average, 12 per cent higher than current market offers. This would reduce the estimated 2011/12 Victorian standing offer price of 28.8 c/kWh by 3.1 c/kWh, resulting in an average market offer price of 25.7 c/kWh.
3. Values are nominal (not adjusted for inflation) and exclusive of GST.
4. Numbers may not add due to rounding.

Source: AEMC Report 2013

National Average Costs

Figure 3 Trends in National summary supply chain components



	2016/17 Base Year		2017/18 Current Year		2018/19		2019/20	
	c/kWh	$/yr	c/kWh	$/yr	c/kWh	$/yr	c/kWh	$/yr
Residual	**2.52**	**$116**	**2.87**	**$132**	**2.95**	**$135**	**3.03**	**$139**
Environmental policies	**2.01**	**$92**	**1.62**	**$74**	**1.78**	**$82**	**1.93**	**$89**
LRET	0.65	$30	0.76	$35	0.89	$41	1.03	$47
SRES	0.36	$17	0.32	$15	0.34	$15	0.32	$15
FIT Schemes	0.85	$39	0.37	$17	0.37	$17	0.39	$18
Other state schemes	0.15	$7	0.16	$7	0.19	$9	0.20	$9
Wholesale	**10.01**	**$460**	**13.23**	**$608**	**11.28**	**$518**	**8.81**	**$405**
Regulated networks	**13.63**	**$627**	**13.47**	**$619**	**13.57**	**$623**	**13.67**	**$628**
Transmission	2.48	$114	2.36	$108	2.36	$108	2.39	$110
Distribution	11.15	$512	11.11	$511	11.21	$515	11.28	$518
Total	**28.16**	**$1,294**	**31.19**	**$1,433**	**29.58**	**$1,359**	**27.45**	**$1,261**

Retail Price Index

Figure 2 Residential retail prices – historical and forecast trends, neutral scenario

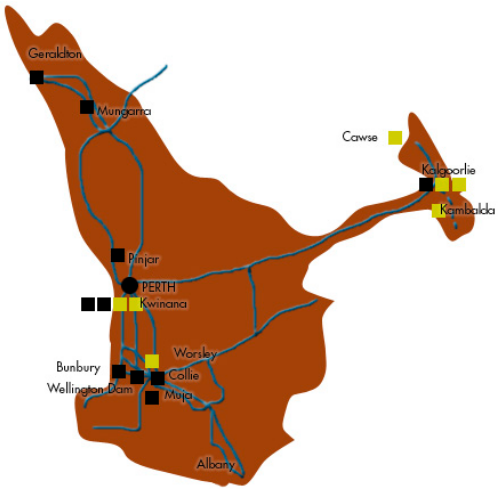
Source: Jacobs' analysis

Electricity market organisation

- NEM infrastructure comprises both state and private assets managed by many participants.
  The NEM:
- Supports 19 million residents.
- At over 5,000 km from far north Queensland to Tasmania, and west to Adelaide and Port Augusta, is the longest alternating current system in the world.
- Has about 40,000 km of transmission lines and cables.
- Supplies about 200 TWh of energy to businesses and households each year.
- Is long and linear compared with Europe and North America.
- Can be costly to upgrade because of the large distances.
- You can also view an Introduction to the National Electricity Market fact sheet here.

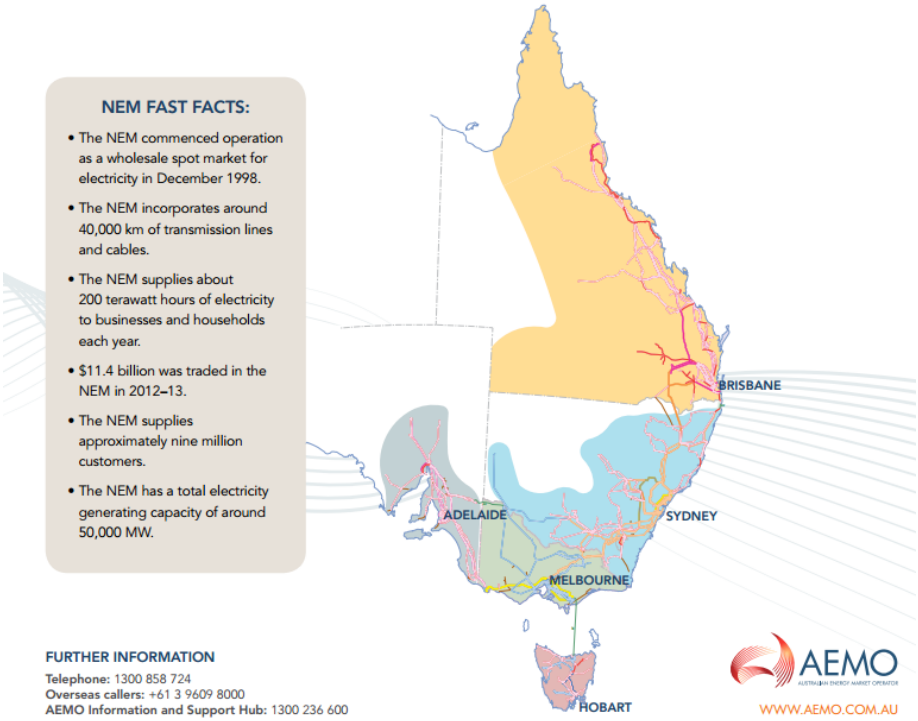
The Electricity Markets

The Western Australian Market (WEMS)



[Information on the WEM click here]

The National Electricty Market (NEM)



[Information on the NEM click here]