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Energy in Australia

2015

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Further information

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Foreword

Australia is blessed with abundant and diverse energy resources. These resources will continue to support our domestic and global economy for many more decades. But the way we produce and use energy is changing. To understand these changes and to make sound policy and investment decisions, we need accurate, comprehensive and accessible energy statistics.

Energy in Australia 2015 provides a full picture of the Australian energy market. The annual publication contains the latest facts and figures on Australia's energy resources, production, consumption, trade and prices. It also tracks Australia's energy market performance against other countries. Now in its eleventh year of publication, *Energy in Australia* has proved to be a valuable source of information for decision-makers, investors, researchers and the community.

I highly recommend adding *Energy in Australia 2015* to your reading list for anyone who has an interest in the Australian energy sector.

Mark Cully
Chief Economist
Department of Industry, Innovation and Science
January 2016

Contents

Data sources

The information in *Energy in Australia 2015* is from the Office of the Chief Economist in the Department of Industry, Innovation and Science, and other sources, listed below. It is based on latest data available at the time of compilation, which can vary between datasets, energy types and industries. In particular, energy consumption statistics tend to lag behind energy production and trade statistics. Australian statistics are generally reported in fiscal years (1 July to 30 June), while international comparisons are generally reported in calendar years.

Australian Bureau of Statistics – www.abs.gov.au

Australian Energy Market Commission – www.aemc.gov.au

Australian Energy Market Operator – www.aemo.com.au

Australian Energy Regulator – www.aer.gov.au

Australian Institute of Petroleum – www.aip.com.au

Biofuels Association of Australia – www.biofuelsassociation.com.au

BP – www.bp.com

Bureau of Infrastructure, Transport and Regional Economics – www.bitre.gov.au

Clean Energy Regulator – www.cleanenergyregulator.gov.au

Department of Industry, Innovation and Science – www.industry.gov.au/oce

Energy Supply Association of Australia – www.esaa.com.au

EnergyQuest – www.energyquest.com.au

Geoscience Australia – www.ga.gov.au

Independent Market Operator of Western Australia – www.imowa.com.au

International Energy Agency – www.iea.org

Abbreviations and acronyms

ABS	Australian Bureau of Statistics
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
BREE	Bureau of Resources and Energy Economics (former)
CCS	Carbon capture and storage
CER	Clean Energy Regulator
CSG	Coal seam gas
EDR	Economic demonstrated resources
ESAA	Energy Supply Association of Australia
IEA	International Energy Agency
LNG	Liquefied natural gas
LPG	Liquefied petroleum gas
MEPS	Minimum energy performance standards
NEM	National electricity market
NGL	Natural gas liquids
OECD	Organisation for Economic Cooperation and Development
OPEC	Organization of the Petroleum Exporting Countries
ORF	Other refinery feedstock
PJ	Petajoules
SDR	Sub-economic demonstrated resources
TWh	Terawatt hours
WEM	Western Australian Electricity Market

1.Overview

6 per cent

Energy industry share of the economy 2014–15

$97 billion

Industry gross value added 2014–15

155,000 people

Employed in energy industries 2014–15

$67 billion

Energy exports 2014–15

18,715 petajoules

Energy production 2013–14

72 per cent

Net exports share of energy production 2013–14

8th

Largest energy producer in the world 2013

$34 billion

Energy imports 2014–15

Economic contribution

The energy industry is a major contributor to the Australian economy. In 2014–15 it contributed around $96.6 billion to industry gross value added, around 6 per cent of the Australian total. The coal, oil and gas extraction industries are the largest industries, contributing around $52.3 billion to industry gross value added in 2014–15. The electricity supply industry contributed a further $26.4 billion.

Energy-related industries also contributed 1.3 per cent to total Australian employment in 2014–15, employing around 155,000 people, as well as providing significant infrastructure investments.

Table 1.1: Australia's energy-related industries, 2014–15

	2013–14		2014–15	
	Gross value added A$b	Employment '000	Gross value added A$b	Employment '000
Coal mining	20.2	56.2	21.5	41.0
Oil and gas extraction	29.6	24.0	30.8	24.1
Petroleum and coal product manufacturing	16.3	7.4	16.0	10.0
Electricity supply	26.2	62.5	26.4	65.1
Gas supply	1.7	20.1	1.9	15.0
Energy industries total	94.0	170.2	96.6	155.1
Australian Total	**1,558.4**	**11,451.9**	**1,595.9**	**11,658.9**
Share of Australian total (per cent)	6.0	1.5	6.1	1.3

Source: ABS (2015) Australian System of National Accounts, cat. no. 5204/5206; Australian Labour Market Statistics, cat. no. 6291

Energy resources

Australia has extensive energy resources which include both renewable and non-renewable sources. Fossil fuel resources include black and brown coal, conventional and unconventional natural gas and oil. Australia also has the world's largest uranium resources. Renewable resources include wind, solar, hydro, bioenergy, geothermal and wave/tidal. Apart from oil, these resources are expected to last for many more decades, even with increasing production.

Energy production

Australia produces energy for its own use and for export for consumption overseas. Over the 10 years to 2013–14 Australian primary production grew at an average rate of 1.1 per cent per year. Total primary energy production in Australia in 2013–14 was 18,715 petajoules, around three times larger than domestic consumption. Net exports (exports minus imports) accounted for 72 per cent of production.

Black and brown coal accounted for 66 per cent of Australia's primary energy production (in energy content terms) in 2013–14, followed by uranium (14 per cent) and natural gas (13 per cent). Crude oil, condensate, and naturally occurring LPG accounted for another 5 per cent. Renewables, mostly bioenergy and hydro, contributed the remaining 2 per cent. In 2013–14 Australia's primary energy production decreased by 4 per cent, underpinned by a fall in uranium oxide, crude oil and brown coal production.

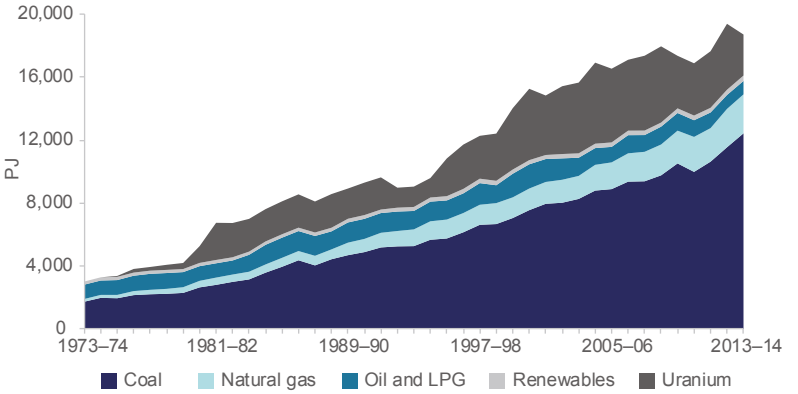
Queensland and New South Wales are the largest energy producing states, with most of Australia's coal production.

Table 1.2: Australia's energy production, by fuel type

	Energy production		Average annual growth	
	2013–14 (PJ)	Share (per cent)	2013–14 (per cent)	10 years (per cent)
Black coal	11,807	63.1	8.3	4.3
Brown coal	625	3.3	-3.0	-1.8
Crude oil and NGL	745	4.0	-5.4	-2.5
LPG	106	0.6	7.9	-1.8
Natural gas	2,479	13.2	1.6	4.7
Renewables	346	1.8	4.0	2.4
Uranium oxide	2,608	13.9	-37.8	-7.3
Total	**18,715**	**100.0**	**-3.5**	**1.1**

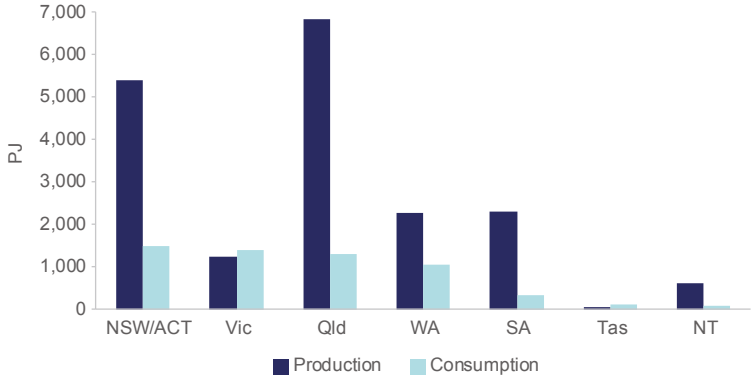
Source: Department of Industry and Science (2015) Australian Energy Statistics, Table J

Figure 1.1: Australia's primary energy production, by fuel type



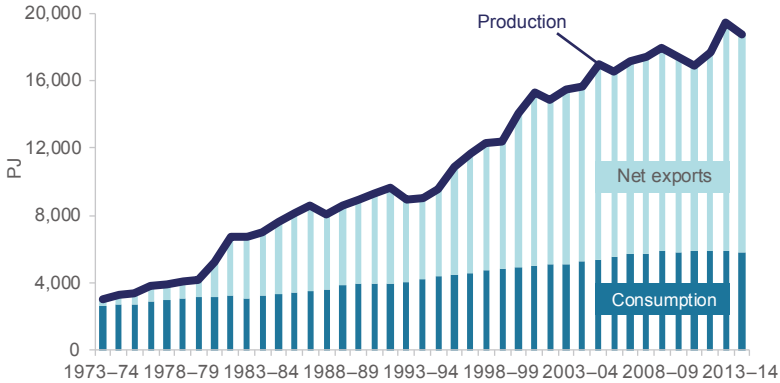
Source: Department of Industry and Science (2015) Australian Energy Statistics, Table J

Figure 1.2: Australia's energy production and consumption, by state and territory, 2013–14



Source: Department of Industry and Science (2015) Australian Energy Statistics, Table J; unpublished data

Figure 1.3: Australia's energy balance



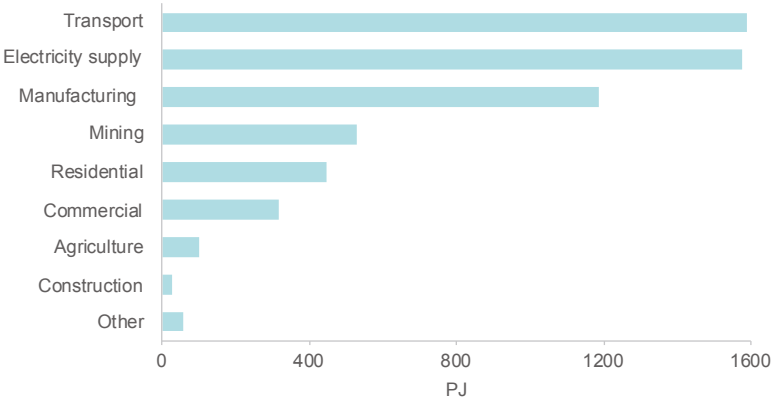
Source: Department of Industry and Science (2015) Australian Energy Statistics, Table J

Energy consumption

Australia's energy consumption grew by 1 per cent a year over the ten years to 2013–14, although energy use has been declining the past two years. In 2013–14 total energy consumption declined by 1.5 per cent to 5,831 petajoules; underpinned by declining energy use in the electricity generation sector. The transport, electricity supply and the manufacturing sectors are the largest energy consumers in Australia, together accounting for around three-quarters of total energy consumption.

Oil was the largest source of energy in Australia, accounting for 38 per cent of consumption in 2013–14. Coal was the second largest energy source, but its share has dipped to 32 per cent, its lowest since the early 1970s. Gas and renewable energy accounted for 24 per cent and 6 per cent respectively. Of the 6 percent renewables, 61 per cent was provided by bioenergy, 19 per cent was from hydro energy, 11 per cent from wind energy and 9 per cent from solar.

Figure 1.4: Australia's energy consumption, by industry, 2013–14



Source: Department of Industry and Science (2015) Australian Energy Statistics, Table E

Table 1.3: Australia's primary energy consumption, by fuel type, 2013–14

	Energy consumption		Average annual growth	
	2013–14 (PJ)	Share (per cent)	2013–14 (per cent)	10 years (per cent)
Coal	1,845.6	31.7	-5.0	-2.2
Oil	2,237.8	38.4	-1.5	2.0
Gas	1,401.9	24.0	2.2	3.9
Renewables	345.7	5.9	4.0	2.4
– bioenergy	211.8	61.3	0.3	-0.3
– hydro	66.3	19.2	0.8	1.9
– wind	36.9	10.7	28.8	31.3
– solar	30.7	8.9	14.1	30.0
Total	**5,831.1**	**100**	**-1.5**	**0.9**

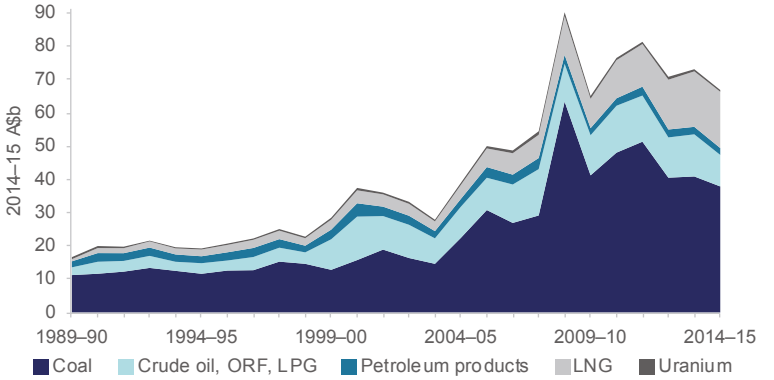
Source: Department of Industry and Science (2015) Australian Energy Statistics, Table A and D

Energy exports

Australia's net energy exports (exports minus imports) in 2013–14 were equivalent to 72 per cent of production. Energy exports accounted for 39 per cent of the value of Australia's total commodity exports in 2014–15 and were valued at $67 billion.

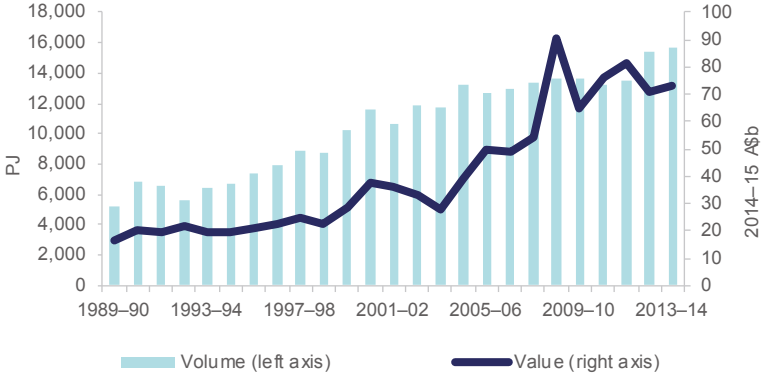
Coal was the largest energy export earner, with a value of around $37.9 billion in 2014–15, followed by liquefied natural gas (LNG) ($16.9 billion) and crude oil and other petroleum products ($11.5 billion). Export earnings from energy commodities decreased by 6 per cent in 2014–15, mainly as a result of a fall in coal prices.

Figure 1.5: Australia's energy export value, by energy type



Source: Department of Industry, Innovation and Science (2015) Resources and Energy Quarterly

Figure 1.6: Australia's energy exports

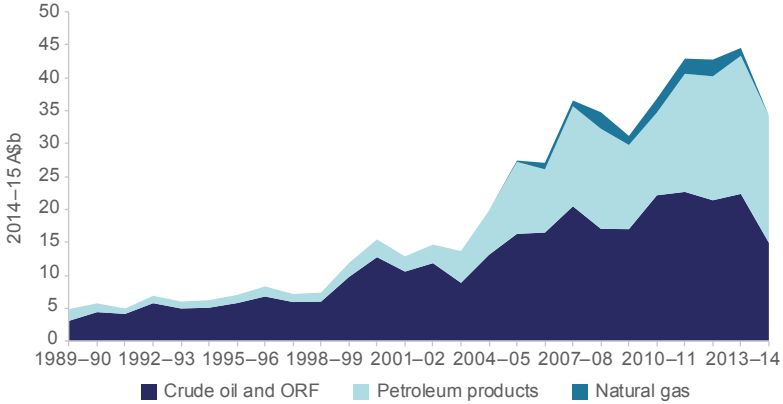


Source: Department of Industry and Science (2015) Australia Energy Statistics, Table J, Resources and Energy Quarterly

Energy imports

Australia's petroleum imports were valued at $34.2 billion in 2014–15. Crude oil was valued at $14.9 billion, while refined petroleum products were valued at $19.3 billion. Australia is a net importer of oil products, with refined product imports accounting for half of consumption in 2013–14. Australia also imports natural gas from the Joint Petroleum Development Area in the Timor Sea, for liquefaction and export as LNG.

Figure 1.7: Australia's energy import value, by energy type



Notes: Natural gas import values are confidential from 2013–14

Source: Department of Industry, Innovation and Science (2015) Resources and Energy Quarterly

Box 1: Energy flows through the Australian economy

Australia produces energy directly from natural resources, such as coal, crude oil, natural gas and wood, referred to as **primary energy**. This primary energy can be exported, or used domestically. Domestically, primary energy is generally transformed in power plants and refineries into other types of energy such as electricity, petrol and diesel (**derived fuels**), for use by Australian industries and households. Industries and households can also use primary energy sources such as natural gas and wood directly. Australia imports both primary energy such as crude oil, and derived energy products such as diesel and petrol.

Energy consumption is a net concept. To avoid double counting, derived fuels that are produced domestically are subtracted from primary fuels, as the energy embodied in these fuels is already accounted for in the primary fuels that they are produced from.

Figure 1.8 shows the flow of energy through the Australian economy. To illustrate, in 2013–14 Australia produced 2,479 petajoules of natural gas, and imported a further 260 petajoules of gas from the Joint Petroleum Development Area in the Timor Sea. Of this combined total, 1,265 petajoules were exported as liquefied natural gas, 576 petajoules were transformed into other energy types such as electricity, and 826 petajoules were used directly by industries and households (plus a statistical discrepancy of 73 petajoules).

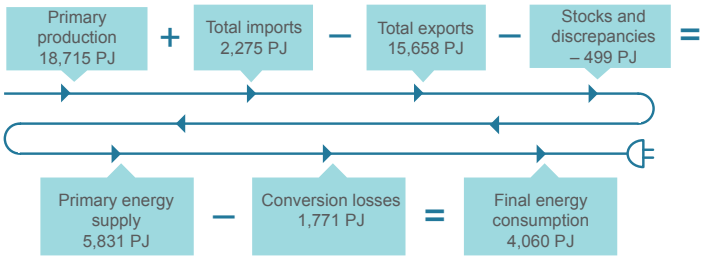
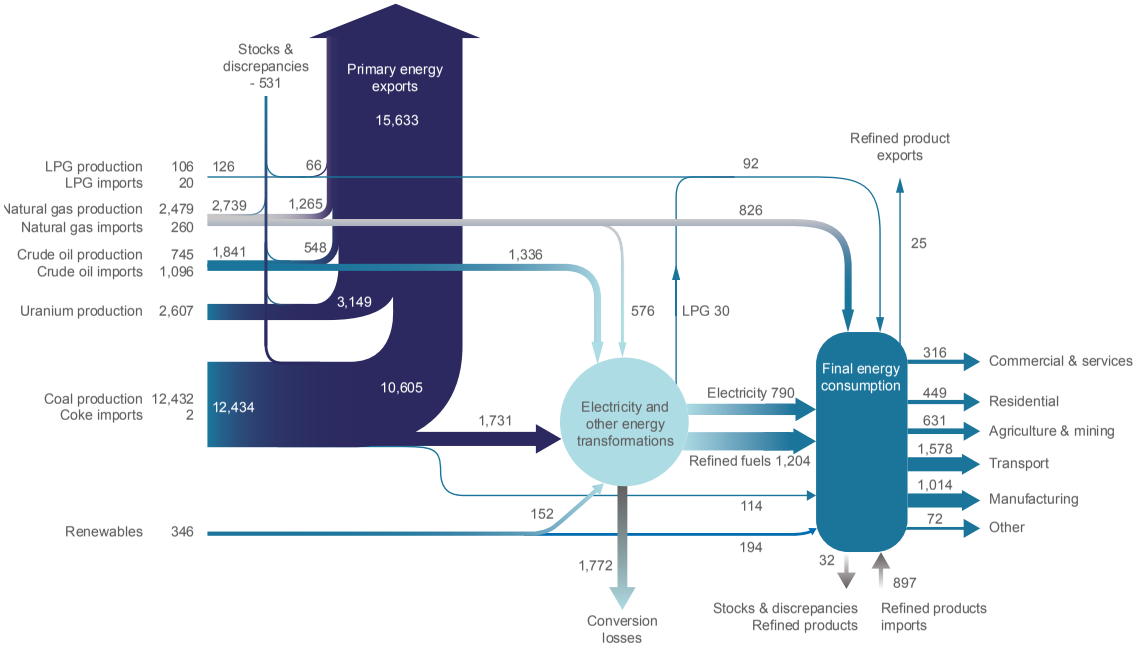
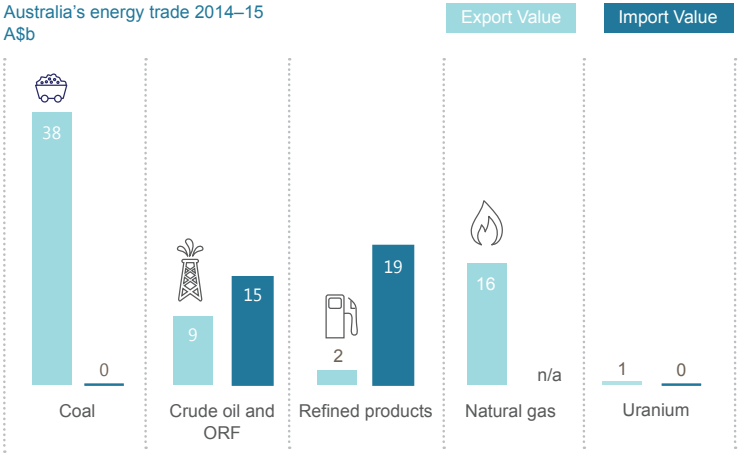


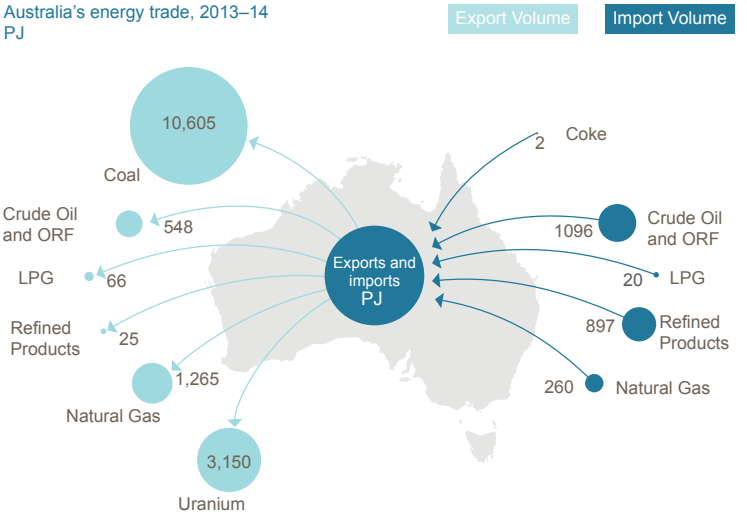
Figure 1.8: Australia's energy flows, petajoules, 2013–14



Source: Department of Industry and Science (2015) Australian Energy Statistics, Table A

Figure 1.9: Energy trade insight

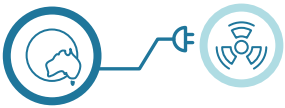




Source: Department of Industry and Science (2015) Australian Energy Statistics; Resources and Energy Quarterly

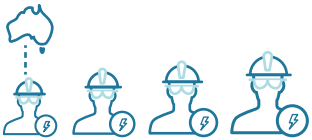
2. Energy resources

One-third
Of global uranium resources



$4.1 billion
Spent on exploration 2014–15

4th largest
Coal reserves in the world



More than 100 years
Of black coal reserves remaining

11th largest
Gas reserves
in the world

51 years
Of gas reserves
remaining

58,000,000 PJ
Annual solar
radiation

Some of the best
renewable resources
in the world

Overview

Energy can be extracted or captured directly from natural resources, including coal, crude oil, natural gas, wood, wind and solar energy, or by transforming these sources into other types of energy, such as burning coal to make electricity and refining crude oil to make petrol and diesel. Australia has abundant and diverse natural resources, including non-renewable and renewable resources. These high quality energy resources are widely distributed across the country and supply energy for domestic consumption and the world market.

Australia holds the world's largest economic uranium resources, the fourth largest black and brown coal resources, and substantial conventional and unconventional gas resources. This globally significant resource base is capable of meeting domestic and export demand for many more decades. There remain significant underexplored and unquantified resources both onshore and offshore, with the potential for future resource discovery and development.

Identified resources of crude oil, condensate and liquefied petroleum gas are more limited, and Australia is increasingly reliant on oil imports.

Australia has significant renewable energy resources, with utilisation growing strongly over the past decade. Australia has some of the highest solar radiation levels per square kilometre of any continent in the world. Wind, geothermal, wave and tidal energy resources are also world class and hold considerable potential.

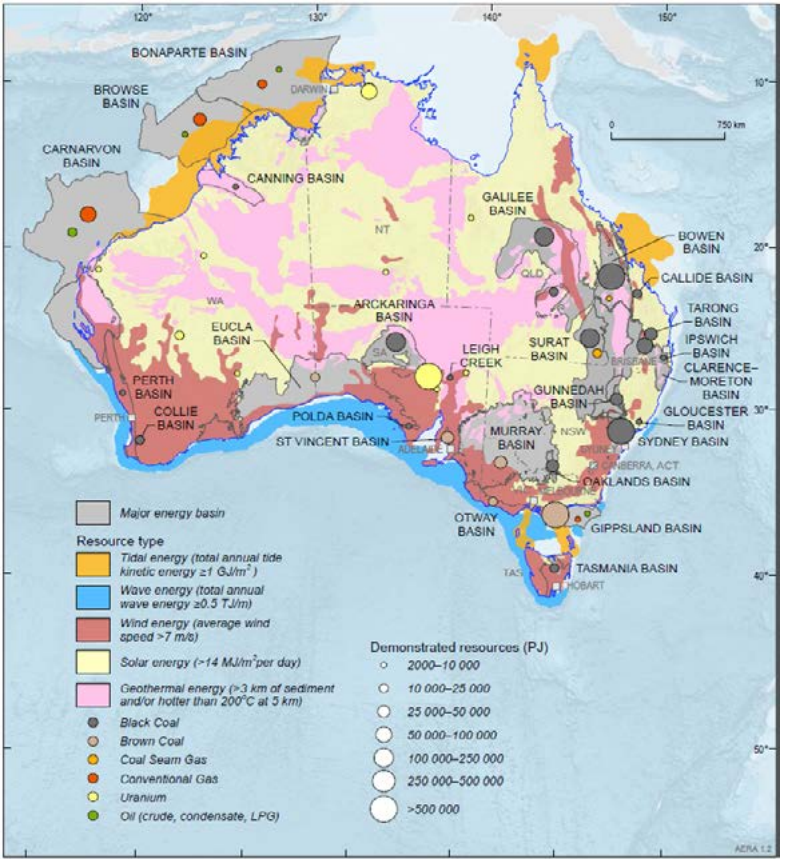
Table 2.1: Australia's Economic Demonstrated Resources, as at December 2014

				Share of world	Reserves to production
		Volume	PJ	Per cent	Years
Coal	Brown	44.2 Gt	454,889	22	728
	Black	62.6 Gt	1,705 851	9.1	111
Oil[a]	Crude	856 Mbbl	5,038	0.2	7–10
	LPG	959 Mbbl	4,118	na	16
	Condensate	1,938 Mbbl	11,403	na	25
Gas	Conventional[a]	2.83 tcm	110,120	1.6	51
	Coal seam gas	1.17 tcm	45,553	na	133
Uranium[b]		1,151 kt	592,765	31.1	231

Notes: a) Figures as at December 2012
b) Reasonably assured resources recoverable at costs less than US$130/kg

Source: Geoscience Australia (2015) Australia's Identified Mineral Resources; Geoscience Australia and BREE (2014), Australian Energy Resource Assessment

Map 2.1: Australia's energy resources, excluding hydro and bioenergy



Source: Geoscience Australia and Department of Industry (2014) Australian Energy Resource Assessment

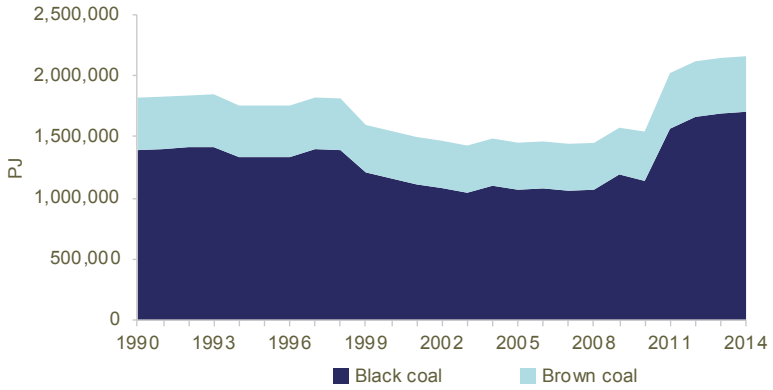
Coal

Australia holds around 9 per cent of the world's proven reserves of black coal and 22 per cent of the world's proven reserves of brown coal. Australia's total coal reserves rank fourth behind the United States (27 per cent), Russia (18 per cent) and China (13 per cent) at 9 per cent.

At the end of 2014, Australia's recoverable Economic Demonstrated Resources (EDR) of black coal were estimated at 1,705,851 petajoules (62.6 Gt). It is estimated that there are a further 139,169 petajoules (5.1 Gt) of Sub-economic Demonstrated Resources (SDR) of black coal. Brown coal EDR were estimated at 454,889 petajoules (44.2 Gt) at end of 2014. At current production rates, Australia's black coal EDR will support a further 111 years of production. Accessible brown coal EDR will support a further 728 years of production.

Coal deposits are generally located in the east of Australia close to areas of domestic energy demand. Most of Australia's recoverable black coal EDR is located in Queensland (61 per cent) and New South Wales (36 per cent), in the Bowen, Surat and Sydney basins. The majority of Australia's brown coal resources are in Victoria's Gippsland Basin.

Figure 2.1: Australia's Economic Demonstrated Resources of coal



Source: Geoscience Australia (2015)

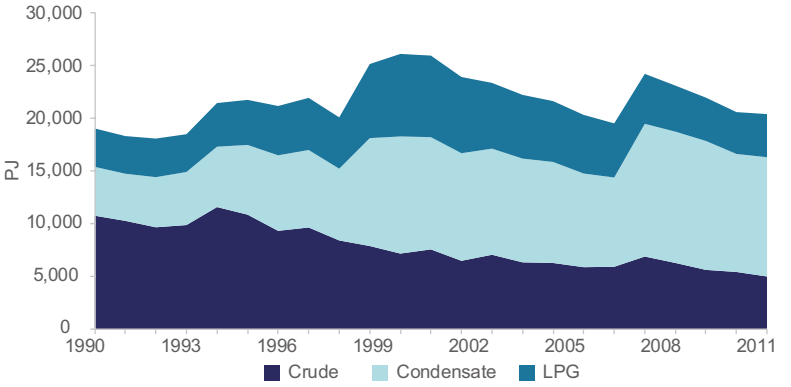
Oil

Australia has limited resources of crude oil, and most known remaining oil resources are condensate and naturally occurring liquefied petroleum gas (LPG) associated with large offshore gas fields. Australia holds around 0.2 per cent of world crude oil reserves.

At the end of 2012, Australia's EDR of oil were estimated at 20,559 petajoules (3,753 Mbbl), comprising 11,403 petajoules (1,938 Mbbl) of condensate, 5,038 petajoules (856 Mbbl) of crude oil and 4,118 petajoules (959 Mbbl) of LPG. Australia's ratio of EDR to current production is estimated at around 16 years for LPG, 7 to 10 years for crude oil and 25 years for condensate. The ratio for oil has remained around this level since the 1980s due to new discoveries and existing resources becoming more economic.

Approximately 94 per cent of Australia's oil resources are located in four basins. These are the Carnarvon, Browse and Bonaparte Basins off the north-west coast of Western Australia and the Northern Territory, and the Gippsland Basin off the south-east coast of Victoria.

Figure 2.2: Australia's Economic Demonstrated Resources of oil



Source: Geoscience Australia (2015)

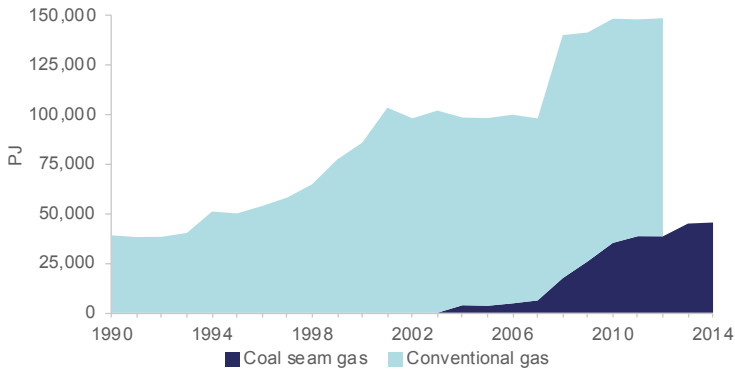
Gas

Australia holds approximately two per cent of world EDR of conventional gas. At the end of 2012, Australia's EDR of conventional gas were estimated at 110,120 petajoules (2.83 tcm). At current production rates, there are sufficient EDR of conventional gas to last another 51 years.

Australia also has significant unconventional gas resources. Coal seam gas (CSG) EDR has continued rising to an estimated 45,553 petajoules (1.17 tcm) at the end of 2014. Australia may also have significant resources of shale and tight gas, although estimates of potential resources have a high degree of uncertainty.

Most (around 92 per cent) of Australia's conventional gas resources are located in the Carnarvon, Browse and Bonaparte basins off the north-west coast. There are also resources in south-west, south-east and central Australia. Large CSG resources exist in the coal basins of Queensland and New South Wales. Most potential shale gas resources are in South Australia.

Figure 2.3: Australia's Economic Demonstrated Resources of conventional and coal seam gas



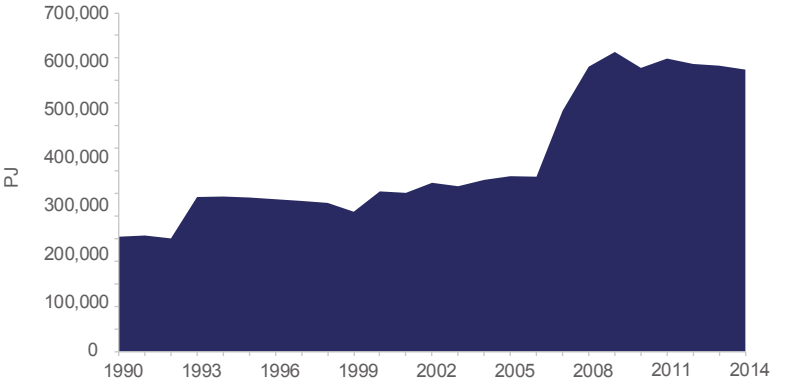
Notes: Conventional gas figures last updated end of 2012
Source: Geoscience Australia and COAG Energy Council (2015)

Uranium

Australia has the world's largest EDR of uranium with an estimated 592,765 petajoules (1,151 kt) at the end of 2014. This represents around one-third of global resources. At current rates of production, Australia's uranium resources are sufficient for a further 231 years of production.

The majority of Australia's uranium resources are located in South Australia, the Northern Territory and Western Australia. The Olympic Dam deposit in South Australia is the world's largest uranium deposit. Australia has significant potential for the discovery of new uranium resources, including through the Woomera Protected Area in South Australia.

Figure 2.4: Australia Economic Demonstrated Resources of uranium



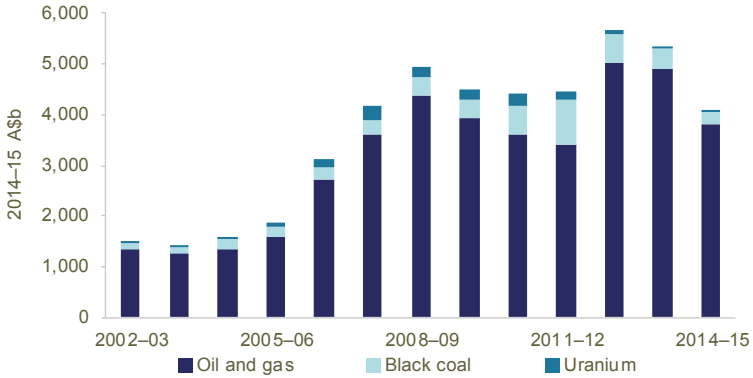
Source: Geoscience Australia (2015)

Exploration

Exploration expenditure on energy resources in Australia was $4.1 billion in 2014–15, about $1 billion less than 2013–14. Oil and gas accounted for 92 per cent of total expenditure at around $3.8 billion.

Coal and uranium exploration spending has dropped significantly since 2012–13, as Australia continues to transition from the investment to production phase of the mining boom. Slowed expenditure can also be attributed to softening energy prices.

Figure 2.5: Australia's energy exploration expenditure

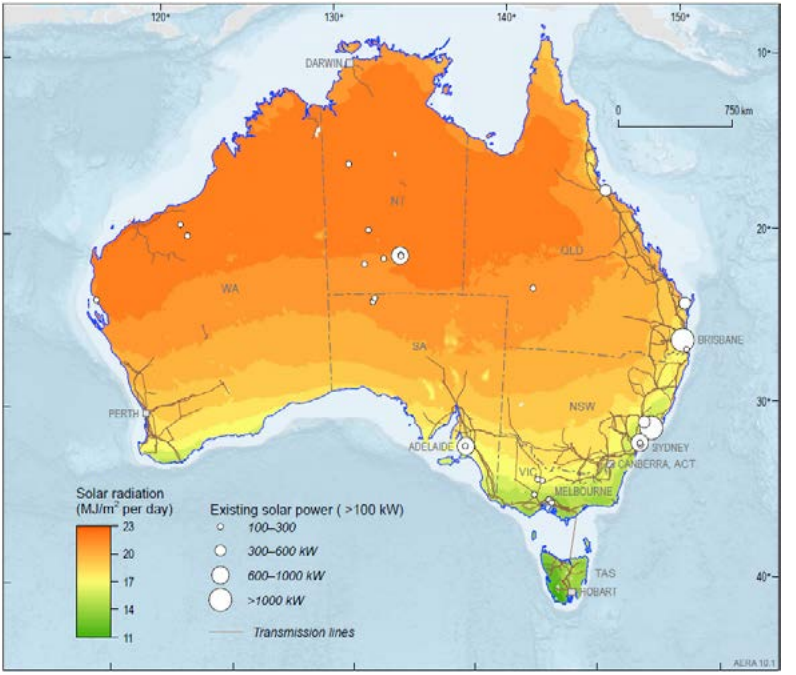


Source: ABS (2015) 8412.0 Mineral and petroleum exploration

Renewables

Australia has a rich diversity of renewable energy resources, including wind, solar, geothermal, hydro, wave, tidal and bioenergy. Uptake of renewable energy is growing and there is significant potential for further development. Renewable energy resources are generally transient and not always available, and are therefore not readily classifiable and comparable to non-renewable resources.

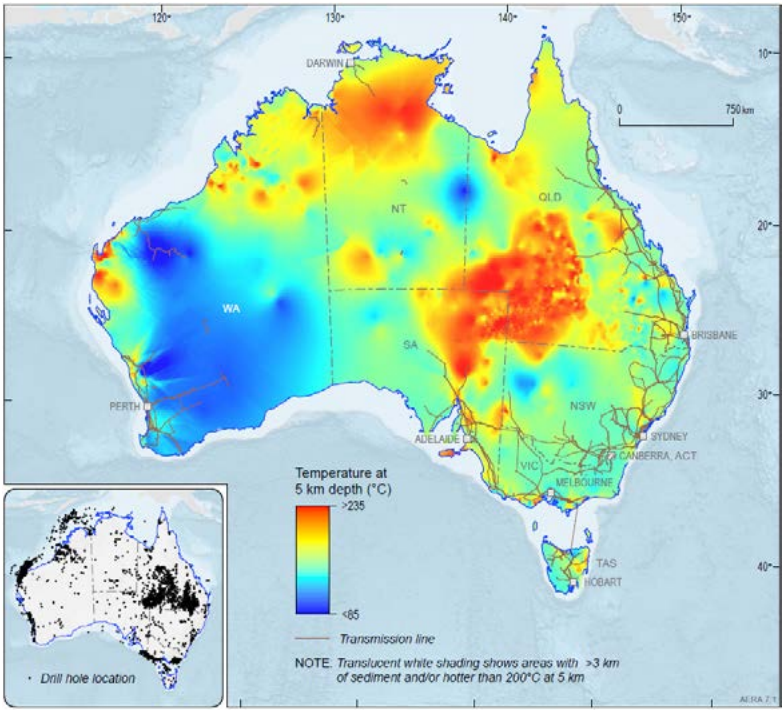
Map 2.2: Australia's solar energy potential



Source: Geoscience Australia and BREE (2014) Australian Energy Resource Assessment

Australia's wind resources are some of the best in the world, primarily in the south-western, southern and south eastern margins and extending hundreds of kilometres inland. These resources are making an increasing contribution to Australia's electricity generation. High solar radiation levels over much of Australia provide some of the best solar resources in the world, and developments in commercial scale solar technologies are expected to encourage further utilisation. The annual solar radiation falling on Australia is approximately 58,000,000 petajoules, nearly ten thousand times larger than Australia's current annual energy consumption.

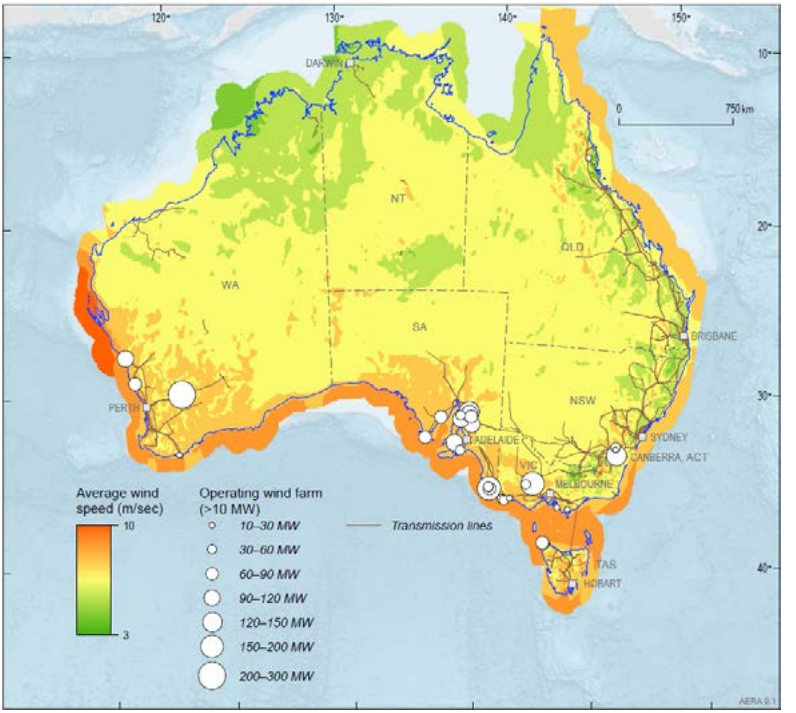
Map 2.3: Australia's geothermal energy potential



Source: Geoscience Australia and BREE (2014) Australian Energy Resource Assessment

Australia has world class wave energy potential, particularly along the south-western and southern coasts. Australia also has potential tidal energy resources off the northwest coast of Western Australia. Wave and tidal energy projects are still at the development/pilot stage. Hydro has limited potential for further development, with any future growth being determined by water availability. Australia's technically feasible hydro energy potential is estimated to be around 216 petajoules a year.

Figure 2.4: Australia's wind energy potential



Source: Geoscience Australia and BREE (2014) Australian Energy Resource Assessment

3.Energy consumption

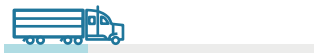
5,831 PJ
Energy consumption 2013–14

38 per cent
Oil share of primary energy consumption 2013–14

1.5 per cent
Decline in energy consumption 2013–14

4 per cent
Rise in energy productivty 2013–14

27 per cent
Transport share of primary energy consumption 2013–14



7 per cent
Growth in energy consumption in mining 2013–14

3 times
Australia's energy production is three times larger than consumption

20th
Largest energy consumer in the world 2013

Overview

Australia consumed 5,831 petajoules of energy in 2013–14, with 94 per cent coming from fossil fuel sources (coal, oil and gas). Australia was the world's twentieth largest energy consumer in 2013, and ranked seventeenth on a per person basis.

Australian energy consumption fell by 1.5 per cent in 2013–14. Growth in energy use in the mining, transport and services sectors was offset by declines in energy use for electricity generation and manufacturing sectors. The transport, electricity supply and manufacturing sectors accounted for three-quarters of Australia's energy consumption in 2013–14.

Energy intensity and productivity

Growth in energy consumption in Australia has generally remained below the rate of economic growth over the past three decades. This has led to a decline in Australia's energy intensity (the ratio of energy use to activity in the Australian economy), and an improvement in energy productivity. This can be attributed mainly to improvements in energy efficiency associated with technological advancement, and a shift in economic structure towards less energy-intensive sectors such as services. In 2013–14, energy productivity, as defined by the ratio of gross domestic product to energy consumption, increased by 4 per cent.

Trends in energy intensity are not uniform across states and territories, reflecting different economic structures and relative shares of energy intensive industries. Queensland and the Northern Territory had the highest energy intensities in 2013–14, while New South Wales and South Australia had relatively low energy intensities.

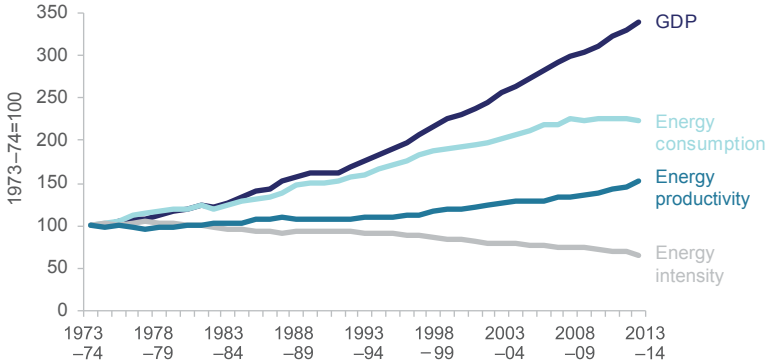
Primary energy

Fossil fuels, including coal, oil and gas, dominate Australia's primary energy consumption. Oil is Australia's largest source of energy, accounting for 38 per cent of consumption in 2013–14. Oil consumption fell by 1 per cent in 2013–14 as the full effect of the closure of the Clyde refinery in late 2012 was realised.

Coal is the second largest primary fuel consumed in Australia, but its share of total energy consumption has been falling. In 2013–14 black and brown coal accounted for 32 per cent of energy consumption, compared with 42 per cent a decade ago. Coal consumption fell by 5 per cent in 2013–14, underpinned by falling use in the electricity and iron and steel sectors.

The share of natural gas has been increasing, supported by greater uptake in electricity generation and industrial use. In 2013–14, natural gas accounted for 24 per cent of energy consumption, with consumption rising by 2 per cent. Renewable energy sources accounted for the remaining 6 per cent of Australia's energy consumption in 2013–14. Renewable energy consumption rose by 4 per cent in 2013–14.

Figure 3.1: Australia's energy consumption, intensity and productivity



Source: Department of Industry and Science (2015) Australian energy statistics, Table B

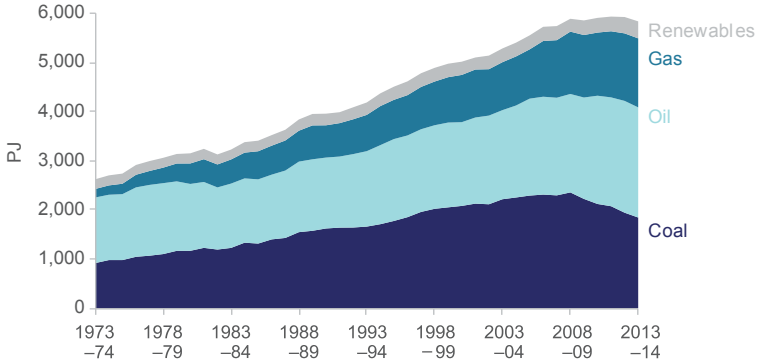
Table 3.1: Energy consumption, intensity and productivity, by state and territory

	Energy consumption		Energy intensity		Energy productivity	
	2013–14 (PJ)	10 years (CAGR per cent)	2013–14 (GJ/$ million)	10 years (CAGR per cent)	2013–14 ($ million/PJ)	10 years (CAGR per cent)
New South Wales[a]	1,511	-0.2	2,888	-2.3	346	2.3
Victoria	1,416	0.5	4,118	-1.8	243	1.8
Queensland	1,319	0.8	4,468	-2.4	224	2.5
Western Australia	1,049	3.8	4,096	-1.3	244	1.3
South Australia	329	-0.9	3,451	-2.9	290	3.0
Tasmania	108	0.1	4,354	-1.2	230	1.2
Northern Territory	100	5.8	4,694	1.6	213	-1.5
Australia	**5,831**	**0.9**	**3,741**	**-1.9**	**267**	**1.9**

Notes: a) Includes Australian Capital Territory. CAGR compound average growth rate

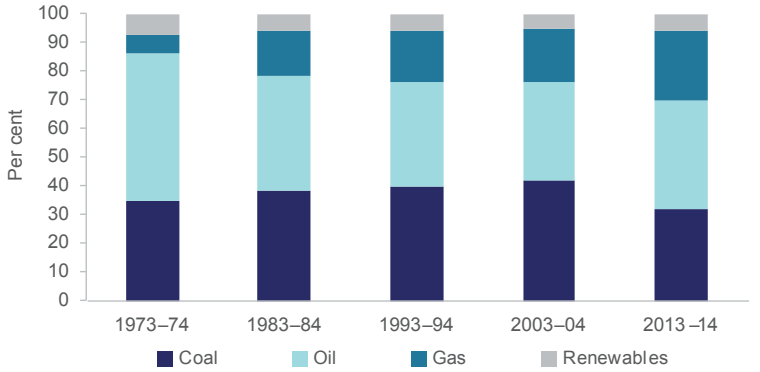
Source: Department of Industry and Science (2015) Australian Energy Statistics, Table B

Figure 3.2: Australia's primary energy consumption, by energy type



Source: Department of Industry and Science (2015) Australian Energy Statistics, Table C

Figure 3.3: Fuel mix in primary energy consumption



Source: Department of Industry and Science (2015) Australian Energy Statistics, Table C

Table 3.2: Australia's primary energy consumption, by energy type, 2013–14

	Energy consumption		Annual growth	
	2013–14 (PJ)	Share (per cent)	2013–14 (per cent)	10 years (per cent)
Coal	1,845.6	31.7	-5.0	-2.2
Oil	2,237.8	38.4	-1.5	2.0
Gas	1,401.9	24.0	2.2	3.9
Renewables	345.7	5.9	4.0	2.4
Total	**5,831.1**	**100.0**	**-1.5**	**0.9**

Source: Department of Industry and Science (2015) Australian Energy Statistics, Table C

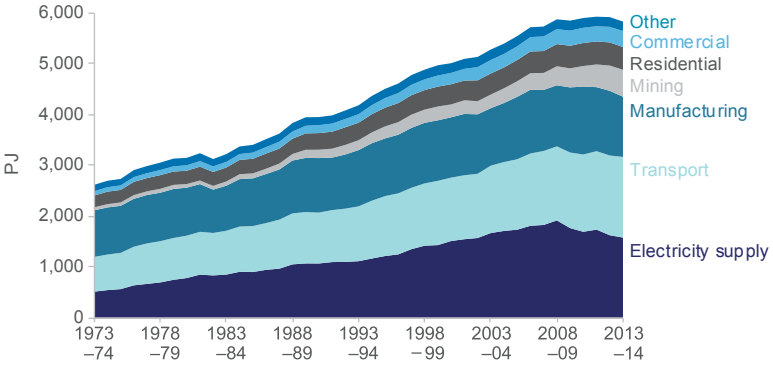
By industry

Australian energy consumption fell by 1.5 per cent in 2013–14. Growth in energy consumption in the transport, mining and commercial and services sectors was largely offset by declines in energy use in the manufacturing, electricity supply and residential sectors.

In 2013–14 transport overtook the electricity supply sector as the largest energy user, growing by 1.1 per cent. Energy consumption in the electricity supply sector declined by 2.8 per cent in 2013–14. Energy consumption in the manufacturing sector also fell by 6.9 per cent.

However, transport, electricity supply and manufacturing remained the largest energy users in 2013–14, accounting for around three-quarters of Australia's energy consumption.

Figure 3.4: Australia's energy consumption, by industry



Source: Department of Industry and Science (2015) Australian Energy Statistics, Table E

By region

New South Wales and Victoria, the largest two energy consuming states, together account for around half of energy consumption in Australia. Queensland and Western Australia account for another 40 per cent.

The transport, electricity and manufacturing sectors were the largest energy using sectors in the eastern states and territories except Tasmania. The electricity sector has the highest share in total energy consumption in Victoria and Queensland; while the transport sector comprised the largest share in New South Wales and South Australia. The mining sector is the largest energy user in the Northern Territory and Western Australia. In Tasmania the manufacturing and transport sectors are among the largest energy users.

The fuel mix varied between states and territories. New South Wales, Victoria and Queensland consumed the most amount of coal in the state's total energy consumption while Western Australia, the Northern Territory and South Australia consumed the largest amount of gas in 2013–14 in their energy mix. Renewable energy dominated Tasmania's total energy consumption.

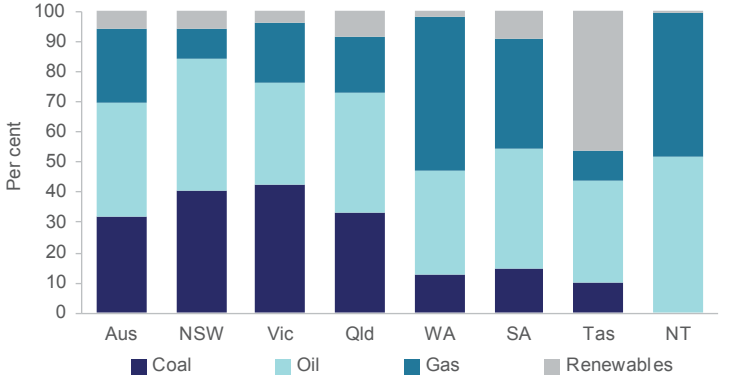
Table 3.3: Australia's energy consumption, by state and territory, 2013–14

	Energy consumption		Average annual growth	
	2013–14 (PJ)	Share (per cent)	2013–14 (per cent)	10 years (per cent)
New South Wales[a]	1,511.0	25.9	-4.2	-0.2
Victoria	1,415.7	24.3	1.6	0.5
Queensland	1,318.6	22.6	-1.4	0.8
Western Australia	1,049.3	18.0	-1.4	3.8
South Australia	328.5	5.6	-1.9	-0.9
Tasmania	108.4	1.9	-3.4	0.1
Northern Territory	99.5	1.7	0.2	5.8
Total	**5,831.1**	**100.0**	**-1.5**	**0.9**

Notes: a) Includes Australian Capital Territory

Source: Department of Industry and Science (2015) Australian Energy Statistics, Table C

Figure 3.5: Energy consumption, by state, by fuel, 2013–14



Source: Department of Industry and Science (2015) Australian Energy Statistics, Table C

Table 3.4: Australia's energy consumption, by industry, 2013–14

	Energy consumption		Annual growth	
	2013–14 (PJ)	Share (per cent)	2013–14 (per cent)	10 years (per cent)
Transport	1,589.2	27.3	1.1	1.8
Electricity supply	1,575.6	27.0	-2.8	-0.9
Manufacturing	1,186.2	20.2	-6.9	0.2
Mining	531.1	9.1	6.6	6.9
Residential	449.0	7.7	-1.4	1.0
Commercial	315.8	5.4	2.8	1.9
Agriculture	99.7	1.7	0.3	-0.2
Construction	26.7	0.5	7.1	-0.5
Other	58.0	1.0	-13.9	-2.6
Total	**5,831.1**	**100.0**	**-1.5**	**0.9**

Source: Department of Industry and Science (2015) Australian Energy Statistics, Table E

Final energy

Total final energy consumption is the energy used by the final or end-use sectors. It includes all energy consumed, except energy that is used to convert or transform primary energy into different forms of energy. For example, refinery feedstock that is used to produce petroleum products and fuels consumed in the generation of electricity are excluded. Final energy consumption in 2013–14 increased by 1 per cent, to 4,060 petajoules. Petroleum products comprised more than half of this total, with gas and electricity providing a further 40 per cent.

Table 3.5: Australia's energy balance, 2013–14

	Coal[a]	Natural gas	Crude oil, ORF	LPG	Refined products
	PJ	PJ	PJ	PJ	PJ
Supply					
Indigenous production	12,432.1	2,479.2	744.9	105.6	
– plus all imports	2.4	260.2	1,095.6	19.7	897.3
– less all exports	10,604.9	1,264.6	548.2	66.4	24.6
– less stock changes	12.6		-8.1	0.1	-2.4
– less discrepancies	-28.4	72.9	-36.3	-3.3	36.2
Total primary energy supply[c]	1,845.6	1,401.9	1,336.7	62.2	838.9
– less conversion and transformation					
– Coke ovens	40.9				
– Petroleum refining		6.7	1,333.5	-23.1	-1,371.7
– Electricity generation	1,641.0	530.8	0.6	0.2	48.6
– Other conversion[d]	49.5	14.6		-6.9	
– Fuel use in conversion		24.2		0.1	119.8
Consumption					
Total final energy consumption[e]	114.1	825.5	2.6	92.0	2,042.1
– Agriculture		1.4		1.9	87.5
– Mining[f]	3.4	198.5	1.9	1.7	221.3
– Manufacturing	108.1	407.6	0.7	16.8	139.2
– Construction	1.5	3.0		0.3	21.3
– Transport[g]		3.6		52.3	1,497.8
– Commercial and services[h]	1.1	52.5		3.5	28.4
– Residential		158.9		15.4	1.1
– Lubes, bitumen, solvents					45.4

Notes: Totals may not add due to rounding. For a detailed version of this table, please refer to Department of Industry and Science (2015) Australian Energy Statistics, Table A

a) Includes coal byproducts; b) Bioenergy includes liquid/gas biofuels and biomass; c) Total primary energy supply is a measure of the total energy supplied within the economy. It is equal to indigenous production plus imports minus exports, plus stock changes and statistical discrepancies; d) Includes return streams to refineries from the petrochemical industry, consumption of coke in blast furnaces, blast furnace gas manufacture, briquette manufacturing, lignite tar in char manufacture and gas

Wind	Bioenergy[b]	Solar	Hydro	Total electricity	Solar hotwater	Uranium oxide	Total
PJ	PJ	PJ	PJ	PJ		PJ	PJ
36.9	211.8	17.5	66.3		13.2	2,607.6	18,715.1
							2,275.2
						3,149.5	15,658.2
						-541.9	-539.7
							40.9
36.9	211.8	17.5	66.3		13.2		5,831.1
				0.5			41.4
				4.4			-50.1
36.9	31.0	17.5	66.3	-893.9			1,479.1
				1.8			58.9
				97.5			241.6
	180.8			789.9	13.2		4,060.1
				8.9			99.7
	2.6			101.6			531.1
	113.0			225.6			1,014.0
				0.6			26.7
	8.4			16.3			1,578.5
	2.1			227.9	0.4		315.8
	51.8			208.9	12.9		449.0
							45.4

manufacturing; e) Total final energy consumption is the total energy consumed in the final or 'end-use' sectors. It is equal to total primary energy supply less energy consumed or lost in conversion, transmission and distribution; f) Energy consumption in LNG production is included in the Mining sector; g) Includes air and water transport bunker fuels. h) Commerical and services includes ANZSIC 281 water and sewage.

Source: Department of Industry and Science (2015) Australian Energy Statistics, Table A

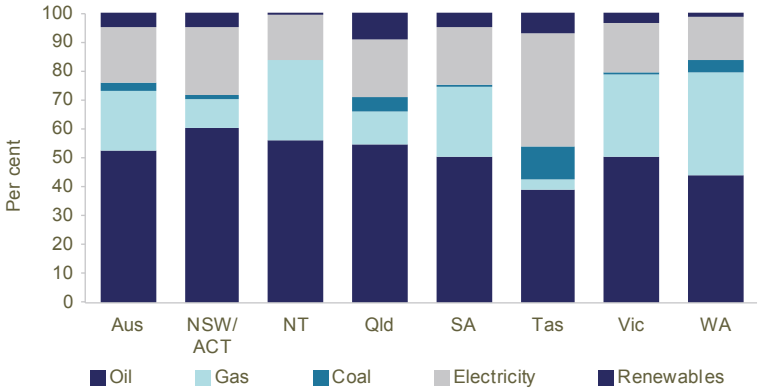
Table 3.6: Total final energy consumption, by state, 2013–14

	Coal	Gas	Oil	Electricity	Renewables	Total
NSW[a]	12.1	97.8	612.0	236.6	49.4	1,007.9
NT	0.0	21.2	42.7	12.2	0.4	76.4
QLD	48.5	105.9	510.8	181.5	87.4	934.0
SA	3.1	58.6	124.4	49.3	10.8	246.3
TAS	11.4	3.6	39.5	39.6	7.2	101.2
VIC	4.2	246.7	441.3	148.1	28.8	869.1
WA	34.9	2,91.7	366.0	122.6	10.0	825.2
Australia	114.1	825.5	2,136.6	789.9	194.0	4,060.1

Notes: (a) includes ACT

Source: Department of Industry and Science (2015) Australian Energy Statistics, unpublished data

Figure 3.6: Total final energy consumption, by state, 2013–14



Source: Department of Industry and Science (2015) Australian Energy Statistics, unpublished data

4.Electricity

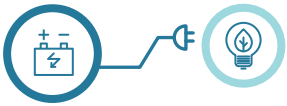
248 TWh
Electricity generation 2013–14

61 per cent
Electricity generation is coal-fired 2013–14

4 per cent
Decline in residential sector electricity consumption 2013–14

26 per cent
Of Australia's electricity use is for manufacturing 2013–14

63,000 MW
Of installed generation capacity 2013–14



15 per cent
Renewables share of electricity generation 2013–14

12 per cent
Share of off grid electricity generation 2013–14

4 per cent
Decdecrease in retail electricity price index 2014–15

Structure of the Australian Electricity Market

The Australian electricity market is made up of three separate large-scale systems: the National Electricity Market (NEM), the Western Australian Market, and the Northern Territory Market. These markets are distinct from one another due to their geographical separation and the high costs of transporting electricity over such distances.

In each market, electricity is generated by generators and this electricity is sent out via transmission networks to electricity distributors and large-scale end users, such as large industrial facilities. Electricity distributers then distribute electricity to smaller-scale end users, including residential, commercial and industrial. Electricity retailers buy electricity in wholesale markets and sell it to end users, packaged to include the costs of generation, transmission and distribution, and the retail services.

National Electricity Market (NEM)

The NEM refers to both the wholesale market in which electricity is traded, and the physical interconnected electricity grid of the eastern states. The grid extends from Port Douglas in Queensland, through New South Wales, the Australian Capital Territory, Victoria and Tasmania, and across to Port Lincoln in South Australia, connected by six major transmission interconnectors and approximately 804,000 kilometres of transmission and distribution lines.

The Australian Energy Market Operator (AEMO) is responsible for the operation of the NEM. AEMO schedules electricity to be dispatched from specific generators to create a gross energy pool, which is then sent out in order to meet demand.

Western Australia

There are two large electricity markets in Western Australia: the North West Interconnected System (NWIS) and the South West Interconnected System (SWIS). The two systems are not connected electronically.

The NWIS network consists of about 8,000 kilometres of transmission and distribution lines and covers an area of approximately 2.3 million square

kilometres, predominantly covering the mining areas in the north. These areas include the Kimberly, Pilbara, Gascoyne, Mid West and Esperance, Hopetoun and Norseman in the Southern Goldfields.

The SWIS accounts for approximately three-quarters of generation in Western Australia and includes Perth. Approximately 98,500 kilometres of transmission and distribution lines make up the SWIS. The Independent Market Operator (IMO) administers and operates the Wholesale Electricity Market (WEM) which covers the buying and selling of electricity in the SWIS.

Northern Territory

There are three small, separate electricity systems in the Northern Territory: the Darwin-Katherine, Alice Springs and Tennant Creek regulated systems. There are also a number of mini-grid systems in remote mining and indigenous communities.

Electricity production

Electricity generation in Australia has been declining since 2010–11, with a decline of 0.6 per cent in 2013–14 to 248 terawatt hours. This decline is in response to lower demand for electricity in the NEM. In contrast, generation increased in Western Australia (8 per cent growth in 2013–14) and the Northern Territory (5 per cent), which can largely be attributed to continued expansion in off-grid generation, particularly in the mining sector. Off-grid generation accounted for an estimated 12 per cent of total electricity generation in 2013–14.

Coal-fired power stations continue to provide the majority of Australian electricity generation, as coal is a relatively low cost and abundant energy source. However, the share of black and brown coal in the generation mix fell to 61 per cent in 2013–14, down from 79 per cent a decade ago. This is its lowest share since 1996–97.

Gas is Australia's second largest source of electricity generation, accounting for 22 per cent of generation in 2013–14. Generation from gas-fired plants increased by 6.5 per cent in 2013–14, with recent capacity additions in Queensland, Western Australia and the Northern Territory.

Generation from renewable fuels constituted 15 per cent of Australia's electricity generation in 2013–14. Hydro is the predominant renewable energy source, followed by wind and solar. A more detailed analysis of renewable generation can be found in the following chapter.

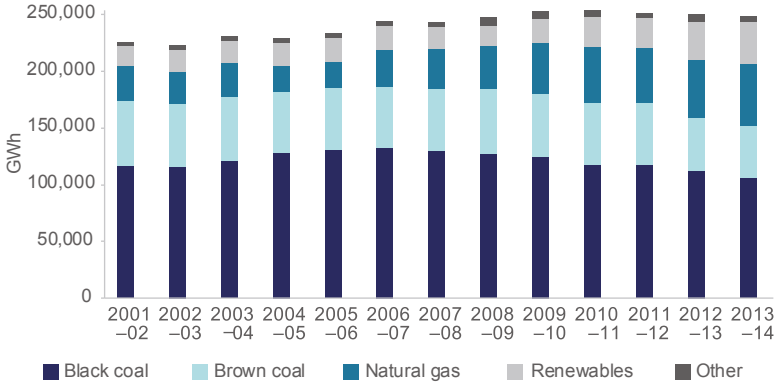
The major electricity supply companies in Australia include Macquarie Generation, EnergyAustralia Holdings Limited and AGL Energy Limited. These companies each generated approximately 8 or 9 per cent of total electricity generation in 2013–14.

Table 4.1: Australia's electricity generation, by fuel type, 2013–14

	2013–14		Average annual growth	
	TWh	Share (per cent)	2013–14 (per cent)	10 years (per cent)
Non-renewables	211.3	85.1	-2.4	0.2
Black coal	105.8	42.6	-5.1	-2.1
Brown coal	46.1	18.6	-3.1	-1.6
Natural gas[a]	54.4	21.9	6.5	9.6
Oil products[a]	5.0	2.0	12.3	6.5
Renewables	37.0	14.9	11.6	6.8
Biomass	1.9	0.8	21.1	-5.9
Biogas	1.6	0.7	2.1	11.9
Wind	10.3	4.1	28.8	31.3
Hydro	18.4	7.4	0.8	1.9
Solar PV	4.9	2.0	27.0	58.3
Geothermal	0.0	0.0	0.0	0.0
Total[a]	**248.3**	**100.0**	**-0.6**	**0.9**

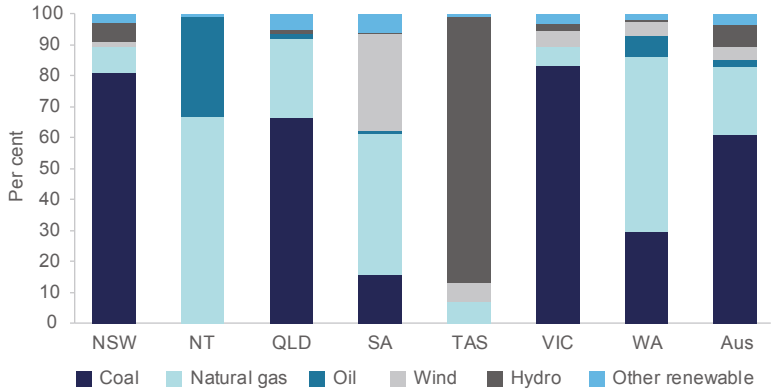
Notes: a) Some growth in 2013–14 includes reallocation of multi fuel generation to specific fuel types
Source: Department of Industry and Science (2015) Australian Energy Statistics, Table O

Figure 4.1: Australia's electricity generation, by fuel type



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

Figure 4.2: Electricity generation by fuel type, and by state and territory, 2013–14



Notes: New South Wales includes the Australian Capital Territory

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

Table 4.2: Top 10 electricity generation companies in Australia, 2013–14

	Total electricity generated (GWh)	Share of total (per cent)
Macquarie Generation	22,893	9.2
EnergyAustralia Holdings Limited	22,166	8.9
AGL Energy Limited	21,962	8.8
Stanwell Corporation Limited	19,774	8.0
Origin Energy Limited	15,258	6.1
Hydro-Electric Corporation	13,111	5.3
C S Energy Limited	11,330	4.6
National Power Australia Investments Limited	11,087	4.5
Electricity Generation and Retail Corporation	10,486	4.2
Delta Electricity	9,815	4.0
Total Australia	**248,297**	**100.0**

Source: Department of Industry and Science (2015) Australian Energy Statistics, Table O; Clean Energy Regulator (2015) 2013–14 Greenhouse and energy information for designated generation facilities

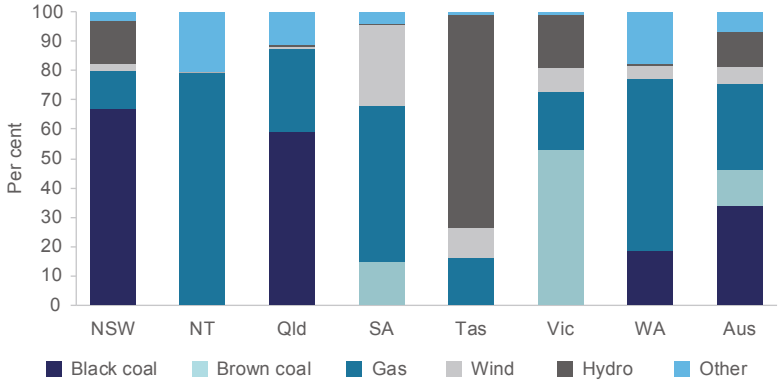
Capacity

There are approximately 310 principal generating plants of over 10 megawatts of capacity in Australia, with a combined installed capacity of 62,984 megawatts in 2013–14. However, many mining areas and remote communities have their own off-grid or mini-grid systems that are not captured in this number.

The majority of Australia's electricity generation capacity is in steam power plants fuelled by coal and gas. Most black coal-fired generation capacity occurs in New South Wales and Queensland. Queensland also has the largest installed gas-fired generation capacity. Victoria relies heavily on brown coal compared with other states, while gas fired generation capacity is more prevalent in South Australia, Western Australia and the Northern Territory. South Australia also has a high proportion of installed wind generation capacity. Hydroelectricity accounts for the majority of installed capacity in Tasmania.

In 2013–14 the majority of new investment in electricity generation in Australia was in wind power, with completed projects contributing 220 megawatts of additional capacity. Investment in new capacity in Australia has slowed, reflecting current overcapacity and declining electricity demand.

Figure 4.3: Australia's principal installed electricity generation capacity, 2013–14



Notes: NSW includes ACT

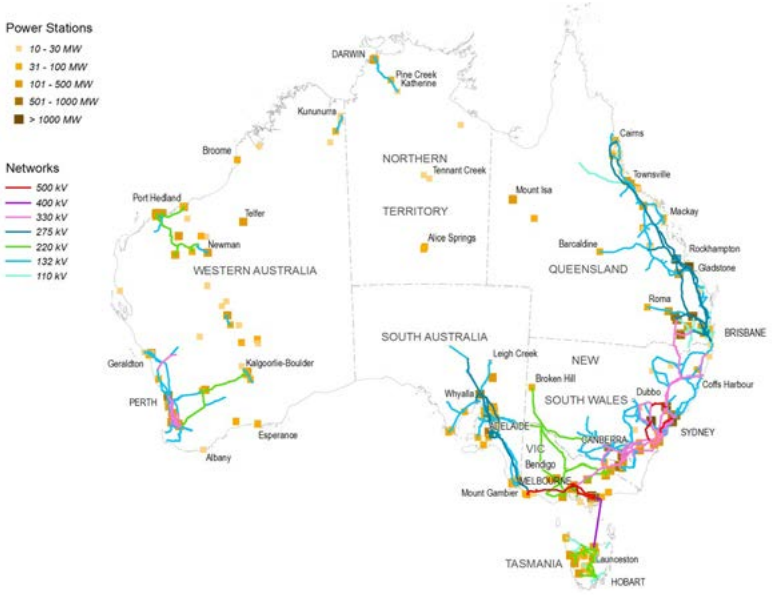
Source: Energy Supply Association Australia (ESAA) (2015) Electricity Gas Australia 2015, Appendix 1

Table 4.3: Australia's principal installed electricity generation capacity, 2013–14

	NSW/ ACT (MW)	NT (MW)	Qld (MW)	SA (MW)	Tas (MW)	Vic (MW)	WA (MW)	Aus (MW)
Black coal	11,515	0	8,164	0	11	0	1,762	21,452
Brown coal	0	0	0	784	0	6,825	0	7,609
Gas	2,208	721	4,011	2,869	506	2,611	5,597	18,523
Oil	125	186	546	197	21	0	415	1,490
Wind	448	0	12	1,474	311	1,071	481	3,797
Hydro	2,488	0	173	4	2,289	2,313	30	7,297
Other	418	3	966	21	6	131	1,271	2,817
Total installed capacity	**17,202**	**909**	**13,873**	**5,349**	**3,144**	**12,951**	**9,556**	**62,984**

Notes: Other includes solar (excluding rooftop solar PV), geothermal, biomass, biogas, wave, pumped storage and multi-fuel power plants
Source: Energy Supply Association Australia (ESAA) (2015) Electricity Gas Australia 2015, Tables 2.1, 2.2, 2.4

Map 4.1: Australia's electricity infrastructure and power plants



Source: Geoscience Australia (2014)

Electricity consumption

Electricity consumption in Australia has been declining since 2010–11. This is largely due to energy efficiency improvements in many sectors, consumer responses to higher retail electricity prices, and declines in the petroleum refining, non-ferrous metals, and food, beverage and tobacco manufacturing industries. Electricity consumption fell by 4 per cent in the residential sector in 2013–14 and by 3 per cent in the manufacturing sector which, together with the commercial and services sector which remained fairly flat, are the largest users of electricity.

Energy efficiency improvements have occurred in appliances, such as refrigeration and air conditioning, and energy efficiency requirements in the Building Code of Australia.

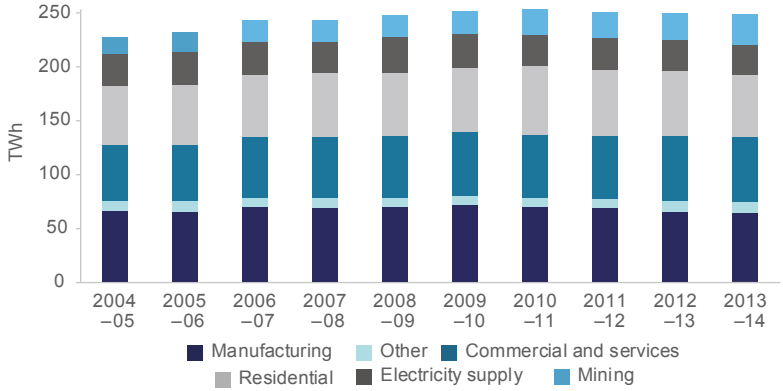
Electricity consumption varies between regions due to differences in population size, climate conditions, seasonal variations, and the composition of the customer base. The NEM states accounted for 84 per cent of electricity consumption in Australia in 2013–14. However, this share has declined by 1 per cent per year, on average, since 2009–10, while consumption has increased in Western Australia and the Northern Territory, as a result of increasing end-use activity, largely in the mining sectors.

Table 4.4: Australian electricity consumption, by sector, 2013–14

	2013–14		Average annual growth	
	TWh	Share (per cent)	2013–14 (per cent)	10 years (per cent)
Manufacturing	64.5	26.0	-2.6	-0.2
Commercial and services	60.6	24.4	0.4	1.7
Residential	58.0	23.4	-4.1	0.6
Electricity supply	26.8	10.8	-2.6	-1.3
Mining	28.2	11.4	11.9	6.9
Other	10.2	4.1	3.8	2.1
Total	**248.3**	**100.0**	**-0.5**	**0.9**

Source: Department of Industry and Science (2015) Australian Energy Statistics, Table F

Figure 4.4: Australian electricity consumption, by sector, 2013–14



Source: Department of Industry and Science (2015) Australian Energy Statistics, Table F

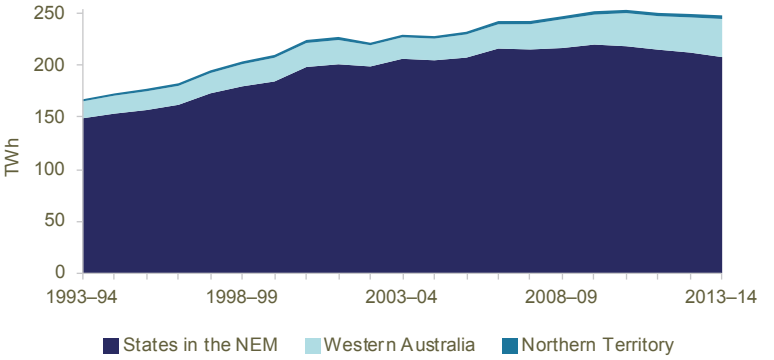
Table 4.5: Australia's electricity consumption, by region

	2013–14		Average annual growth	
	TWh	Share (per cent)	2013–14 (per cent)	10 years (per cent)
National Electricity Market (NEM) states	208.1	83.8	-2.0	0.2
Western Australia	36.7	14.8	8.4	6.4
Northern Territory	3.5	1.4	5.0	4.2
Total	**248.3**	**100.0**	**-0.5**	**0.9**

Notes: NEM States include New South Wales, Victoria, Queensland, South Australia, Tasmania and the Australian Capital Territory

Source: Department of Industry and Science (2015) Australian Energy Statistics, Table L

Figure 4.5: Australian electricity consumption, by region, 2013–14



Notes: New South Wales includes the Australian Capital Territory
Source: Department of Industry and Science (2015) Australian Energy Statistics, Table L

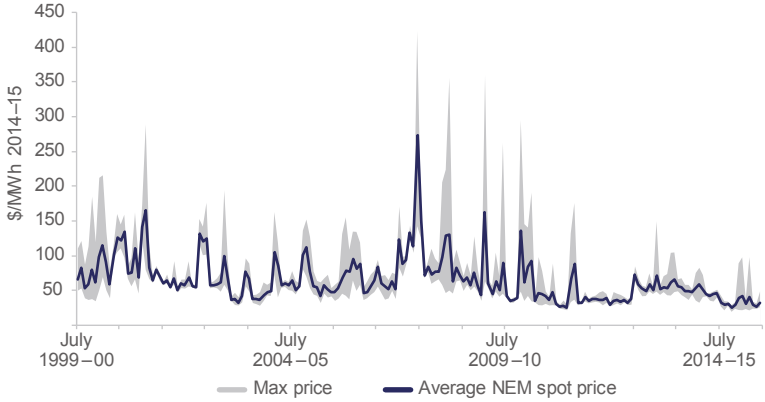
Electricity prices

There are notable differences in the wholesale energy purchase costs across states in the NEM which partly reflect actual differences in wholesale prices faced by retailers in each state as network capacity constraints limit the amount of electricity transmitted across state borders.

The cost of purchasing energy rose sharply between 2006 and 2009, as droughts produced relatively dry conditions which limited hydro-electric generation and the availability of water resources for cooling in the operation of thermal generation plants. The effect of the carbon pricing mechanism contributed to higher dispatch prices in 2012–13 and 2013–14, but there is, overall, a declining trend in wholesale prices, reflecting weak demand and the oversupply of electricity generation in the NEM.

The main factors that determine retail electricity prices are wholesale prices, transport prices (transmission and distribution), retail costs, and environmental policies.

Figure 4.6: Spread of monthly average real spot prices across states in the NEM region compared to the average NEM spot price



Notes: Excludes the wholesale prices reported for the Snowy Scheme as well as the price spike in 2005 which may be associated with high prices in Tasmania at the time that state joined the NEM

Source: Global Roam

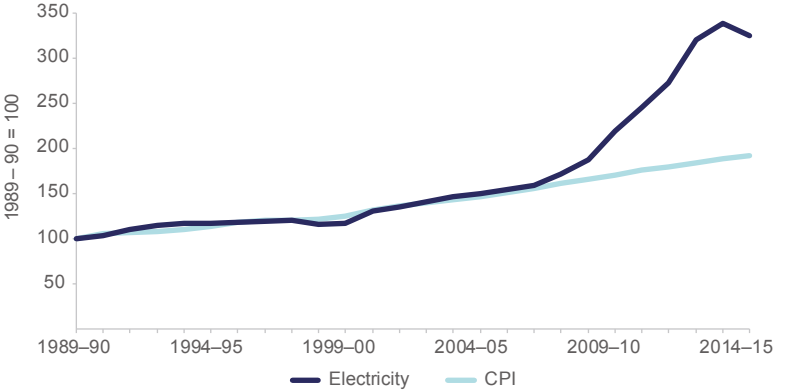
Retail electricity prices in Australia, for both households and businesses nearly doubled over the period from 2007–08 to 2013–14, but have started to fall since then and are expected by the Australian Energy Market Commission to plateau going forward. Increases were caused by network costs associated with investment in transmission and distribution infrastructure, due to the need to replace aging assets and reliably meet increasing occurrences of peak electricity demand.

Recent price decreases have occurred due to the removal of the carbon pricing mechanism, and due to lower wholesale electricity prices, which are being passed on to consumers.

Retail electricity prices are either regulated or determined in a competitive market. Regulated pricing structures in the NEM were designed to allow for recovery of estimated supply costs and have been used to determine investment in new generation capacity. Market contracts represent an alternative pricing structure for residential electricity customers and are largely driven by retail competition.

In Queensland, Western Australia, Tasmania, the Australian Capital Territory and the Northern Territory, the prices electricity retailers can charge households and small businesses are limited by price controls imposed by state regulators, although in many jurisdictions consumers are free to switch to the market offer. Prices have been deregulated in Victoria since 2009. In South Australia, retail price controls were removed in 2013, and New South Wales removed retail price regulation from 1 July 2014. While electricity prices in Tasmania have been open to full competition since 1 July 2014, Aurora remains the sole retailer.

Figure 4.7: Household electricity prices



Source: ABS (2015) cat no 6401.0 Consumer Price Index, Australia

Figure 4.8: Representative average customer bill and supply chain components, 2014–15

Notes: a) In the Northern Territory and Western Australia, residential electricity prices are subsidised, meaning that the price paid by residential customers is lower than the cost of supplying them with electricity.

Source: AEMC (2015) 2015 Residential Electricity Price Trends

Rooftop solar panels, Sydney Australia
Source: Shutterstock

5. Renewable energy

1.5 million
Households with solar PV
October 2015

17 per cent
Households with solar PV
October 2015

11 per cent
Households with solar hot water
October 2015

15 per cent
Renewables share of electricity generation 2013–14

2 per cent
Renewable share of energy production 2013–14

4 per cent
Wind share of electricity generation 2013–14

61 per cent
Bioenergy share of renewable energy production 2013–14

12,590
People employed in renewable energy 2014–15

Overview

In Australia, renewable energy sources are currently used for generating electricity, both on and off-grid, for residential heating and cooling, for transport fuels, and in the manufacturing sector to produce heat. Hydro and wind energy are used on a commercial scale for electricity generation. Solar energy use is growing strongly for electricity generation, both on and off grid, and for hot water. Bioenergy is used for small scale electricity generation, directly for heating and cooling in residential and industrial settings, as well as for transport fuels.

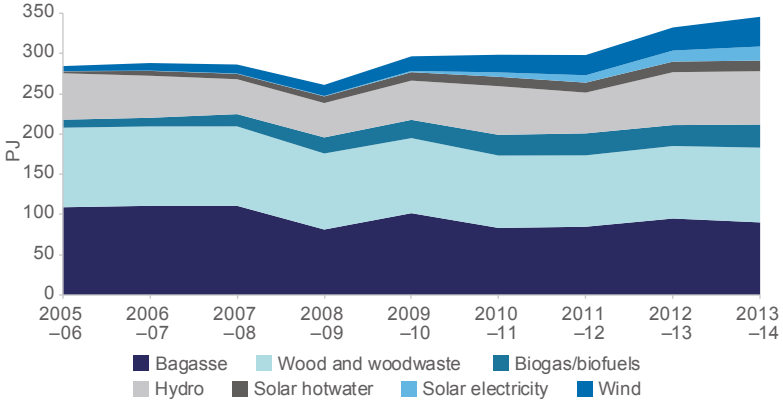
Australia has an abundance of renewable energy sources, and there is significant potential for future development in large scale solar energy, geothermal energy and marine energy. Many of these renewable technologies are currently at the proof of concept stage, or in the early stages of commercialisation. Upfront costs continue to be relatively high for some renewable energy technologies. Additionally, some renewable energy sources are far from transmission and distribution infrastructure and markets, making development costly and difficult.

Production and consumption

In 2013–14 renewable energy accounted for about 2 per cent of Australia's energy production and 6 percent of consumption, equal to 346 petajoules. In general, the overall share of renewables in the energy mix in Australia has been reasonably constant over the past decade.

The main sources of renewable energy in 2013–14 were wood and wood products (27 per cent), bagasse (26 per cent), and hydroelectricity (19 per cent). The remainder of renewable energy production comes from wind, solar, and other forms of bioenergy. Geothermal energy technology is not at a commercial stage; however pilot projects are being tested and one small generation facility operates in Queensland. The completion of a wave energy project in early 2015 and the expected development of further capacity in wave technology in 2016 will further diversify Australia's renewable energy mix.

Figure 5.1: Australia's renewable energy production



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

Total renewable energy production increased by 3 per cent a year over the ten years to 2013–14. The largest increases over the past ten years have occurred in solar electricity and wind electricity production (58 per cent and 31 per cent growth a year respectively). The increase in renewable energy production was also underpinned by the growth in hydroelectricity although the growth in hydroelectricity reflects variable flow associated with periods of rain and drought, rather than increased capacity.

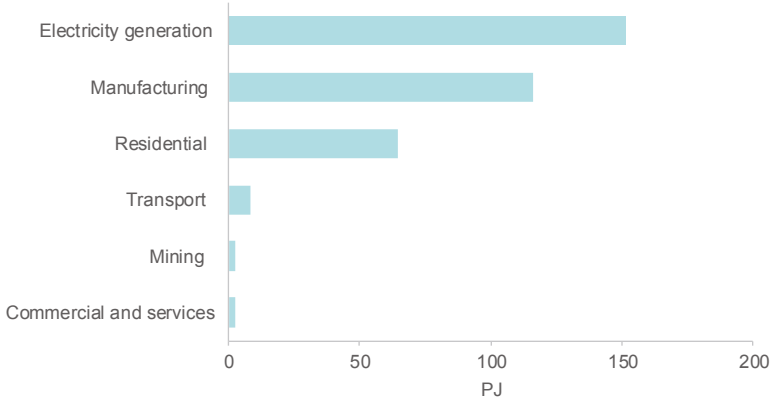
The manufacturing sector accounted for 34 per cent of total renewable energy consumption in 2013–14. This is mainly in the food, beverages and textiles and the wood, paper and printing subsectors, which use wood and bagasse in manufacturing processes to produce heat. The residential sector accounted for 19 percent of renewable energy use in Australia in 2013–14, mostly firewood, for heating and cooking, and solar energy for hot water. Rooftop solar PV is not included in the residential sector, and is captured in the electricity generation sector. Ethanol and biodiesel for road transport accounted for 2 per cent of renewable energy use in Australia in 2013–14.

Table 5.1: Australia's renewable energy production

	2013–14		Average annual growth	
	PJ	Share (per cent)	2013–14 (per cent)	10 years (per cent)
Biomass	183.2	53.0	-1.1	-1.4
– wood, woodwaste	92.9	26.9	3.1	-0.9
– bagasse	90.2	26.1	-5.1	-2.0
Biogas	16.4	4.7	17.0	9.1
Biofuels	12.3	3.6	2.6	24.3
– ethanol	7.1	2.1	-12.1	na
– biodiesel	5.1	1.5	33.5	na
Hydro	66.3	19.2	0.8	1.9
Wind	36.9	10.7	28.8	31.3
Solar PV	17.5	5.1	27.0	58.3
Solar hot water	13.2	3.8	0.7	19.7
Total	**345.7**	**100.0**	**4.0**	**2.4**

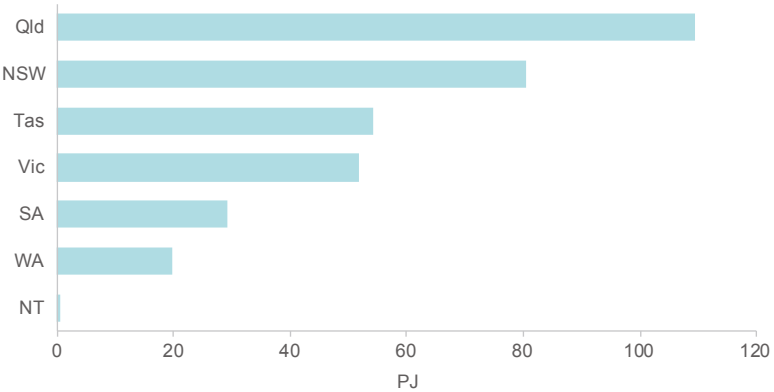
Source: Department of Industry and Science (2015) Australian Energy Statistics, Table D, F and O

Figure 5.2: Renewable energy consumption, by sector, 2013–14



Source: Department of Industry and Science (2015) Australian Energy Statistics, Table A

Figure 5.3: Renewable energy consumption by state and territory, 2013–14



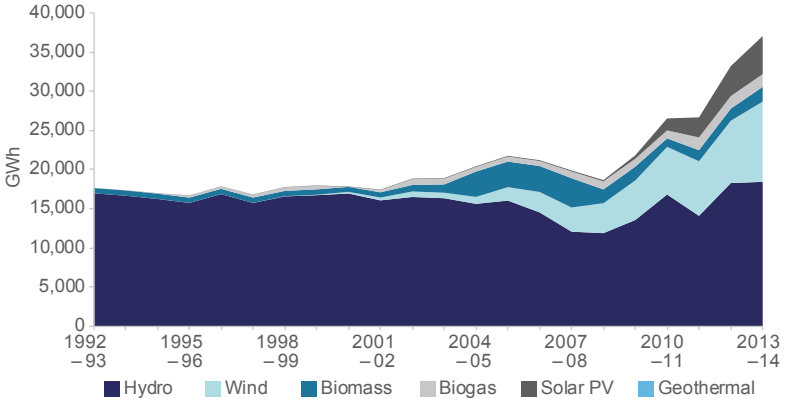
Source: Department of Industry and Science (2015) Australian Energy Statistics, Table F and O

Electricity generation

Around 44 per cent of renewable energy use in Australia is in the electricity generation sector, generating electricity from hydro, bioenergy, wind, solar PV and geothermal sources. These fuel types accounted for 15 per cent of total electricity generation in 2013–14, up from 10 per cent in 2010–11. This recent growth reflects rapid expansion in wind and solar PV generation and the recovery in hydro generation after a sustained period of drought.

Hydro continues to be the largest energy source for renewable electricity generation although its share in total renewable electricity generation has fallen in recent years. In 2013–14 hydro generation accounted for 50 per cent of total renewable electricity generation and 7 per cent of Australia's total electricity generation. Wind power and solar PV followed, accounting for 28 per cent and 13 per cent of total renewable electricity generation respectively.

Figure 5.4: Australia's electricity generation from renewable energy



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

Table 5.2: Capacity of renewable generation (MW) at 30 June 2014

Fuel type	NSW	VIC	QLD	SA	TAS	WA	NT	Total
Hydro	2,487.6	2,313.5	172.6	3.7	2,289.5	30.1	0	7,297
Bagasse	75.5	0	395.3	0	0	6.0	0	476.8
Biomass	4.4	1.1	38.0	0	0	1.0	0	44.5
Black liquor	20.0	54.5	2.0	0	0	0	0	76.5
Geothermal	0	0	0.1	0	0	0	0	0.1
Landfill gas	64.8	49.9	24.4	13.3	6.0	25.6	1.1	185.1
Sewage gas	7.9	21.5	4.5	5.5	0.1	1.8	0	41.2
Large-scale solar	5.4	3.6	2	2.4	0.1	12.2	2.6	28.4
Solar PV	768.3	628.2	1,165.3	541.3	74.0	392.5	15.0	3,584.7
Wave	0.5	0.2	0	0	0	0.1	0	0.8
Wind	447.7	1,071.2	12.5	1,474	310.5	481.2	0.1	3,797.1
Total	**3,882.1**	**4,143.7**	**1,816.7**	**2,040.2**	**2,680.2**	**950.5**	**18.8**	**15,532.2**

Notes: NSW includes Australian Capital Territory

Source: Energy Supply Association of Australia (ESAA) (2015) Electricity Gas Australia

The location of renewable energy production facilities in Australia is directly related to the climatic and geographical characteristics of different regions. Hydroelectricity capacity in Australia is primarily located in south eastern Australia, while wind farms are generally located in the windy southern and western regions. Bagasse-powered electricity facilities are located predominately in the sugarcane growing regions of Queensland, while biogas (landfill and sewerage) facilities are more uniformly distributed. There is one small-scale geothermal electricity facility in Queensland.

Tasmania continues to generate the largest amount of renewable electricity in Australia, accounting for 35 per cent of Australia's total renewable electricity generation. Renewable energy accounted for 93 per cent of Tasmania power generation in 2013–14, predominantly hydro.

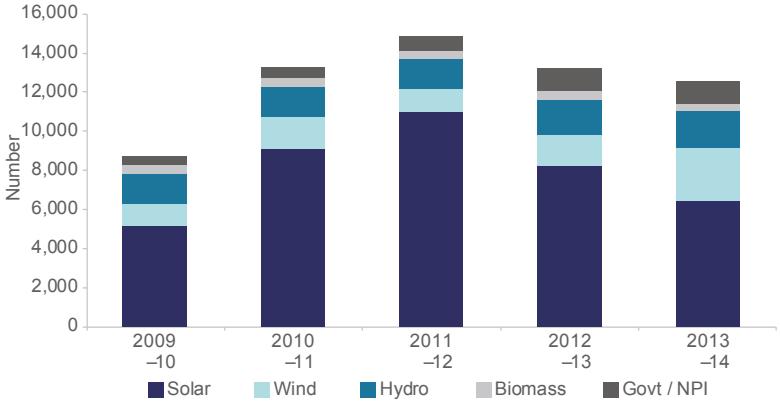
New South Wales is the second largest producer of renewable electricity, although this constituted only 10 per cent of its total electricity generation in 2013–14. Hydroelectricity led the generation mix but solar PV was the fastest growing power source over the past five years to 2013–14.

South Australia has the second largest share of renewable energy in its generation mix with renewable fuels (predominately wind energy) accounting for 38 per cent of its total generation in 2013–14. The remaining states have about 10 per cent or less of renewable electricity in their generation mix.

Employment in renewable energy activity

It is estimated that the total direct annual full time equivalent employment in renewable energy activities was 12,590 in 2013–14. Solar activity (solar PV and solar hot water) was the largest source of direct employment, accounting for 51 per cent of the total direct employment in renewable energy activity in 2013–14. Wind and hydro energy activities together accounted for another 36 per cent.

Figure 5.5: Direct employment in renewable energy activity, by renewable energy type



Notes: Full time equivalent. Number of employees recorded in hydro includes geothermal

Source: ABS (2015) Employment in renewable energy activities, Australia 2013–14, cat no. 4631.0

Table 5.3: Renewables insight, 2013–14

	Renewable production	Renewable generation	Share in total generation	Employment[a]
	PJ	GWh	Per cent	Number
NSW[b]	81	7,062	10	3,580
Vic	52	5,529	10	2,810
QLD	110	3,959	7	2,520
WA	20	2,464	7	820
SA	29	4,984	38	1,330
Tas	54	13,009	93	1,450
NT	1	35	1	80
Australia	**346**	**37,042**	**15**	**12,590**

Notes: a) Full time equivalent; b) Includes Australian Capital Territory

Source: Department of Industry and Science (2015) Australian Energy Statistics, Table C and O; ABS (2015), Employment in renewable energy activities, Australia 2013–14, cat no 4631.0

Solar energy

Solar has been the most rapidly expanding renewable energy source in Australia over the last ten years. Solar energy refers to using energy from the sun for heating, or converting this energy into electricity. There are two main types of solar energy: solar thermal and solar photovoltaic (PV).

Solar PV technology uses solar PV cells to convert sunlight into electricity. It is currently mostly utilised in small-scale rooftop systems, both on and off-grid. These systems can be installed on residential dwellings or public buildings, to generate electricity. The electricity may be used on site, or fed back into the grid.

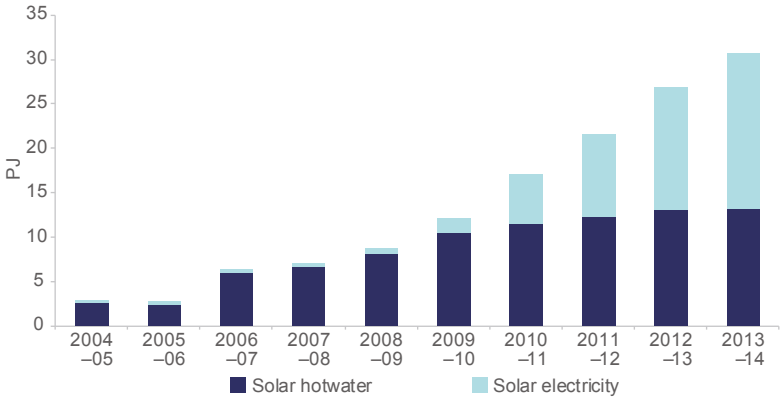
Solar thermal technologies convert sunlight into heat or thermal energy. This heat can be used to drive steam turbines to generate electricity, but in Australia are more typically used directly for space heating (primarily solar hot water systems). Large-scale electricity generation from solar thermal systems is still limited to pilot-scale demonstration projects in Australia, with the exception of one solar thermal power plant in Liddell, New South Wales.

Over the past 10 years to 2013–14, solar energy grew by 30 per cent per year on average, underpined by growth in both solar PV and solar hot water. However this was from a low base and solar remains a relatively small contributor to Australia's energy mix.

The recent rapid expansion in solar energy reflects price reductions for purchasing the technologies, making them more accessible to the average household, rising energy bills causing households to seek alternative measures, and feed-in-tariffs and rebate schemes, which provided financial incentives and increased awareness about energy use. Currently, about 11 per cent of Australian households have installed small-scale solar hot water heaters, while about 17 per cent of Australian households have installed rooftop solar PV.

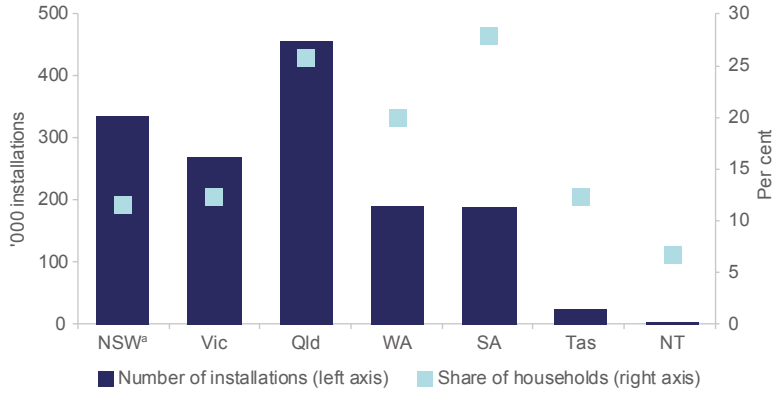
In 2013–14 about 4.9 terawatt hours (17.5 petajoules) of electricity was generated from solar PV technologies. This represents 2 per cent of Australia's total electricity generation. Queensland generated the largest share of Australia's solar PV generation, at 33 percent, followed by New South Wales (22 per cent), Victoria (16 per cent) and South Australia (15 per cent).

Figure 5.6: Solar energy production, by technology



Source: Department of Industry and Science (2015) Australian Energy Statistics, Tables F and O

Figure 5.7: Small-scale solar PV installations, as at 31 October 2015



Notes: a) Includes Australian Capital Territory
Source: Clean Energy Regulator (2015)

Table 5.4: Australia's solar PV electricity snapshot, 2013–14

	Solar PV generation	Share in renewable generation	Share in total generation
	GWh	Per cent	Per cent
New South Wales[a]	1,067	15	2
Victoria	756	14	1
Queensland	1,618	41	3
Western Australia	555	23	2
South Australia	747	15	6
Tasmania	88	1	1
Northern Territory	26	75	1
Total Australia	**4,858**	**13**	**2**

Notes: a) Includes Australian Capital Territory
Source: Department of Industry and Science (2015) Australian Energy Statistics, Table O

Wind energy

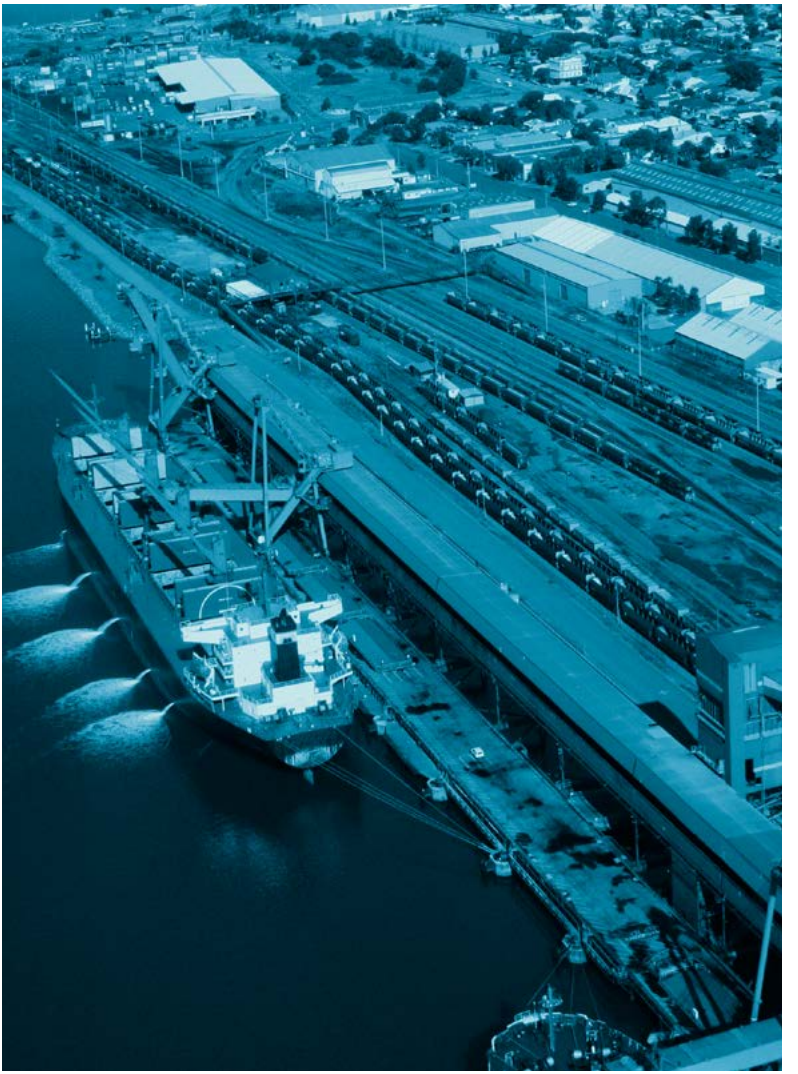
After solar energy, wind energy has been the second fastest growing renewable energy source in Australia over the past ten years, averaging 31 per cent a year. Wind is currently the second biggest contributor to renewable electricity generation in Australia, after hydroelectricity, generating 10.3 terawatt hours in 2013–14, 4 per cent of Australia's total electricity generation. Use of wind began increasing rapidly from the mid-2000s due to lowering costs of the technology, and government policies to support renewable electricity generation.

South Australia generates the largest share of wind electricity in Australia, accounting for 40 per cent of Australia's total wind generation. The penetration of wind in South Australia is relatively high by global standards, with wind accounting for approximately 31 per cent of South Australia's total electricity generation. Victoria was the second biggest generator of wind electricity, producing 27 per cent of Australia's total but accounting for only 5 per cent of Victoria's total electricity generation.

Table 5.5: Australia's wind electricity snapshot, 2013–14

	Wind generation	Share in renewable generation	Share in total generation
	GWh	Per cent	Per cent
New South Wales	899	13	1
Victoria	2,772	50	5
Queensland	34	1	0
Western Australia	1,579	64	4
South Australia	4,150	83	31
Tasmania	818	6	6
Total Australia	**10,252**	**28**	**4**

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



Coal being loaded onto a ship, Newcastle, Australia
Source: Shutterstock

6.Coal

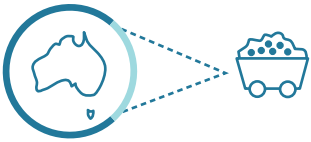
4th
Largest hard coal producer in the world 2014

$38 billion
Coal exports 2014–15

392 Mt
Coal exports 2014–15

442 Mt
Black coal production 2014–15

27 per cent
World coal trade 2014



58 per cent
Australia's share of metallurgical coal exports 2014

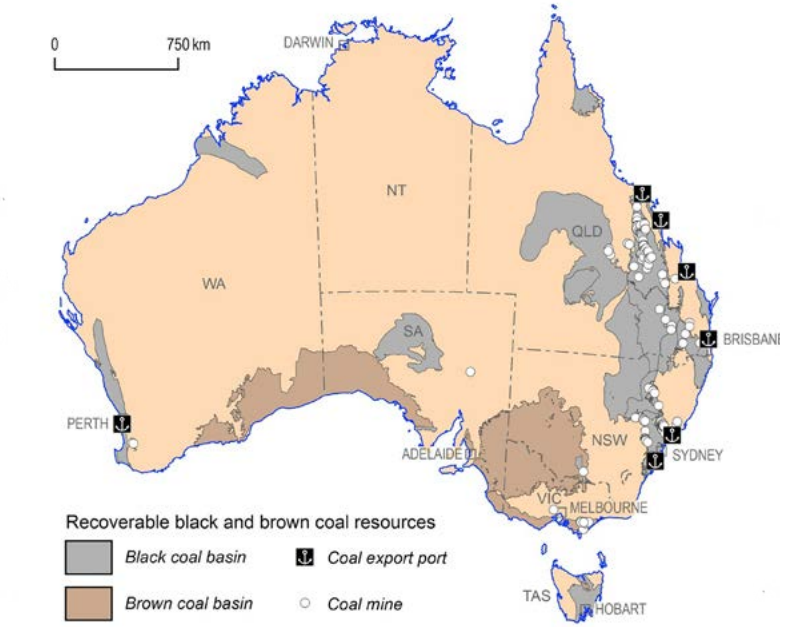
2nd
Largest coal exporter behind Indonesia 2014

6 per cent
Decline coal fired electricity generation 2014–15

Overview

Australia is the fourth largest hard coal producing country, behind China, India and the United States. Coal plays an important role in the Australian economy. In 2013–14, coal accounted for nearly 32 per cent of primary energy consumption, and 61 per cent of electricity generation. Domestic coal consumption has declined by around 1.6 per cent a year, while coal exports grew by 5 per cent a year over the past 10 years. Australia is currently the world's largest exporter of metallurgical coal, and the second largest for thermal coal. Coal is Australia's second largest export earner behind iron ore, and valued at around $38 billion in 2014–15.

Map 6.1: Australia's coal resources, operating mines and ports



Source: Geoscience Australia

Production

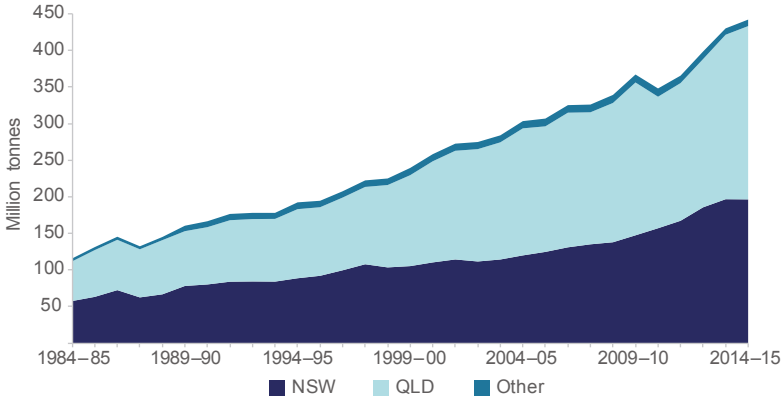
Australia produced 442 million tonnes of black coal in 2014–15, up 2.8 per cent from the previous year. Black coal production has increased by 3.8 per cent a year over the past decade, mainly to support growth in export markets. In 2014–15, around 89 per cent of the production was exported.

The majority of the black coal mines are located in Queensland and New South Wales. Queensland and NSW accounted for 54 per cent and 44 per cent respectively of Australia's total black coal production in 2014–15.

Brown coal production totalled around 61 million tonnes in 2013–14, mainly from the Gippsland basin in Victoria. Brown coal is all consumed domestically, primarily as a fuel for electricity generation, with many mines co-located with power generation facilities. Brown coal production has fallen by 1.8 per cent a year over the past decade, in line with declining brown coal fired generation.

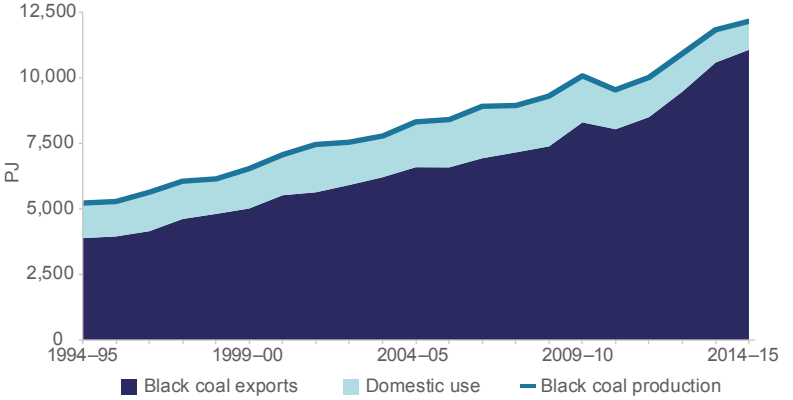
Open-cut coal mining accounts for 77 per cent of coal production in Australia. This reflects lower mining costs, and the recovery of a higher proportion of the coal deposit than underground mining. The top five coal producers account for around 57 per cent of the Australian black coal market.

Figure 6.1: Australia's black coal production, by region



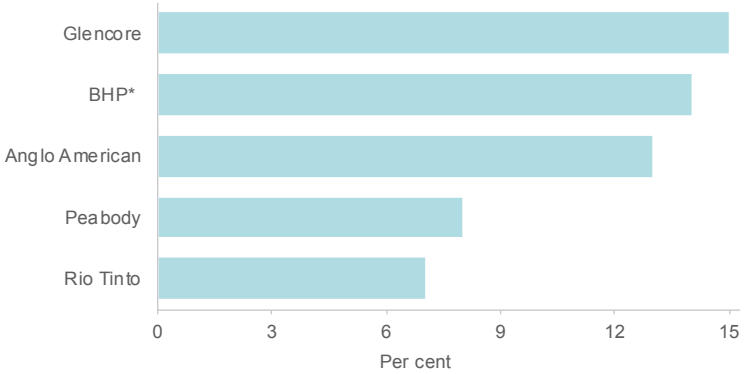
Source: Department of Industry and Science (2015) Australian energy statistics

Figure 6.2: Australia's black coal balance



Source: Department of Industry and Science (2015) Australian energy statistics

Figure 6.3: Australia's top five producers of black coal, 2014–15



Notes: Includes partnerships with BMA and Mitsui Coal
Source: Compiled from company reports

Domestic consumption

Australian coal consumption was 1,845 petajoules (around 116 million tonnes) in 2013–14. Coal consumption fell by 5 per cent in 2013–14, underpinned by a decline in coal-fired electricity generation and demand from the iron and steel sector. This continues a longer term decline in the use of coal in Australia, with coal consumption declining by 1.6 per cent a year on average over the past decade. The vast majority of Australian coal consumption is as a fuel for electricity generation. Black coal is also used to manufacture coke, for use in blast furnaces in the iron and steel sector.

Trade

In 2014–15 Australia exported 392 million tonnes of black coal, a 4.5 per cent increase from 2013–14. Over the past decade, coal exports grew at an average rate of 5 per cent per year. Coal is Australia's second largest export earner behind iron ore, valued at around $38 billion in 2014–15. Metallurgical coal comprised $22 billion of the total, with the remaining $16 billion from thermal coal.

In 2014, Australia accounted for 58 per cent of the world metallurgical coal market, and 27 per cent of total coal trade. Australia's high share of the world metallurgical coal market reflects Australia's large resource endowment of high quality coal and proximity to Asian steel mills.

Japan is Australia's largest export destination, accounting for 31 per cent of Australia's coal exports in 2014–15. China is Australia's fastest growing export destination, with its share rising from 1 per cent in 2007–08 to 22 per cent in 2014–15.

Australia has world class rail and port facilities that provide competitive advantage for Australian coal in the international markets. There are currently nine port facilities in Queensland and New South Wales, with a combined export capacity of around 517 million tonnes a year. The Wiggins Island Coal Export Terminal at the Port of Gladstone in Queensland was completed during 2015. A number of rail projects are being upgraded or developed to link the ports with the mines in Queensland and New South Wales for further increase production and export capacity.

Table 6.1: Australia's coal consumption, 2013–14

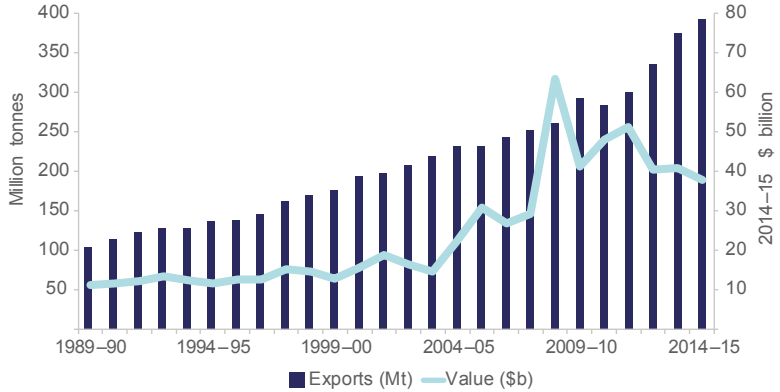
Consumption	Black coal	Brown coal	Met. coke	Coal by products	Total
	PJ	PJ	PJ	PJ	PJ
Electricity generation	1,018.4	621.7		0.9	1,641.0
Coke ovens	117.1		-76.1	-0.1	40.9
Other conversion [a]	5.1	5.9	43.1	-4.6	49.5
Mining	3.1		0.3		3.4
Food, beverages, textiles	9.1			1.8	10.9
Wood, paper and printing	3.1			0.1	3.2
Chemical	6.3		0.2	0.0	6.5
Iron and steel	1.0		3.8	0.1	4.9
Non-ferrous metals	56.0		3.3	0.9	60.2
Other industry	21.9		0.5	0.0	22.4
Construction	1.5				1.5
Commercial and services	0.1			0.9	1.0
Total	**1,242.7**	**627.6**	**- 24.9**	**0.0**	**1,845.4**

Notes: Totals may not add due to rounding

a) Includes return streams to refineries from the petrochemical industry, consumption of coke in blast furnaces, blast furnace gas manufacture, briquette manufacturing and lignite tar in char manufacture.

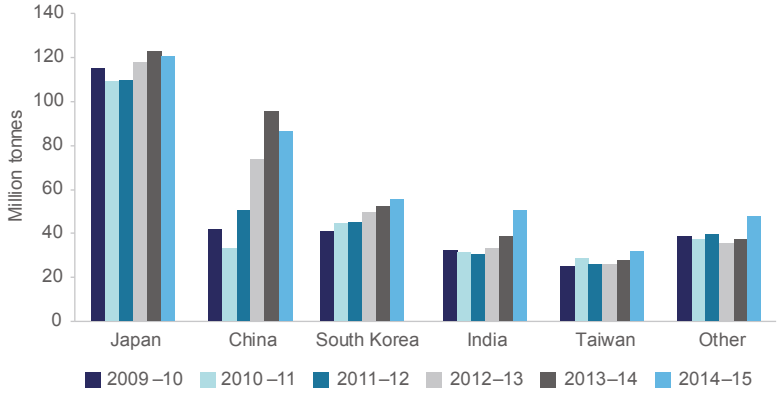
Source: Department of Industry and Science (2015) Australian energy statistics, Table A

Figure 6.4: Australia's black coal exports, volume and value



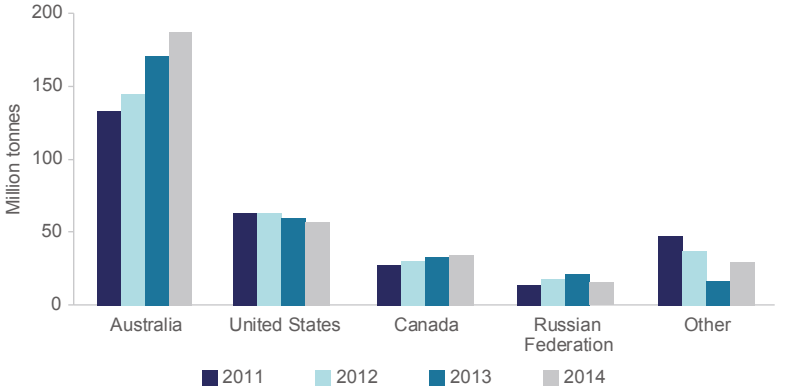
Source: Department of Industry, Innovation and Science (2015) Resources and Energy Quarterly

Figure 6.5: Australia's coal exports by destination



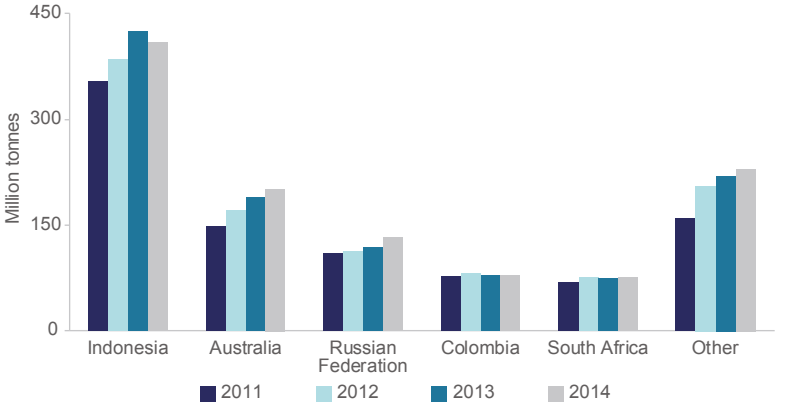
Source: Department of Industry, Innovation and Science (2015) Resources and Energy Quarterly

Figure 6.6: World's largest metallurgical coal exporters



Source: Department of Industry, Innovation and Science (2015) Resources and Energy Quarterly; IEA (2015) Coal information

Figure 6.7: World's largest thermal coal exporters



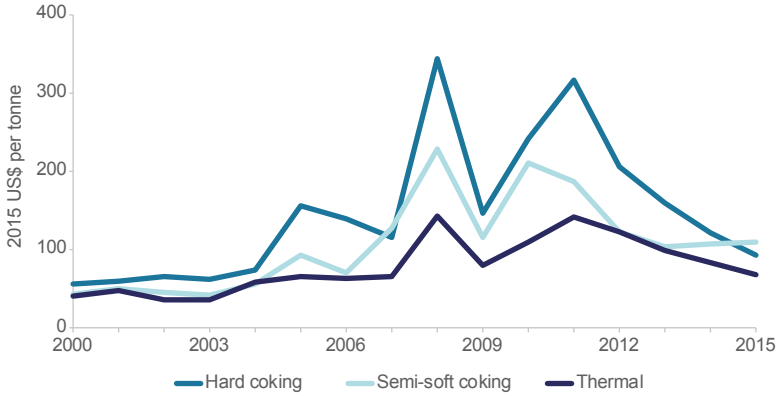
Source: Department of Industry, Innovation and Science (2015) Resources and Energy Quarterly; IEA (2015) Coal information

Prices

The majority of Australian coal export contracts are based on the Japanese fiscal year, starting 1 April. Coking coal contracts are now negotiated on a quarterly basis, a shift from the annual contracts of previous years. Thermal coal contracts have in recent years also been standardised with a common coal trading platform, increasing the liquidity of seaborne coal supply.

High quality hard coking coal prices for JFY 2015 averaged US$93 a tonne, a 22 per cent fall from the previous year. Semi-soft coking coal averaged US$110 a tonne, an increase of 5 per cent. Average thermal coal prices fell by 17 per cent in 2015 to US$68 a tonne. The decline in average coal prices in the past three years is mainly attributed to abundant supply of seaborne coal.

Figure 6.8: Australian benchmark coal prices for Japanese fiscal year



Source: Department of Industry, Innovation and Science (2015) Resources and Energy Quarterly

Low emissions coal

Burning fossil fuels such as coal, natural gas and oil releases carbon dioxide (CO2) and other greenhouse gases (GHG) into the atmosphere, adding to the potential for climate change.

The Australian Government is encouraging industry to reduce GHG emissions through a range of measures, including adoption of high efficiency low emissions technologies and carbon capture and storage (CCS), brown coal value adding, coal mine methane abatement and international research and collaboration.

Demonstration projects under these programmes are contributing to the rate of innovation, and furthering the commercial deployment of low emission coal technologies. For example, the CarbonNet Project is investigating the potential to develop a large scale carbon capture and storage network. The project is being designed to bring together multiple CO2 capture projects in Victoria's Latrobe Valley, transporting CO2 via a shared pipeline and injecting into offshore storage sites in the Gippsland basin.

The Callide Oxyfuel project in Central Queensland is the world's first successful industrial scale demonstration of oxyfuel combustion and carbon capture technology. When completed, Western Australia's Gorgon CO2 Injection Project will be one of the largest projects of its type globally, reducing the Gorgon LNG project's emissions by up to 40 per cent. It aims to inject 100 million tonnes of CO2 into the Dupuy Formation saline aquifer under Barrow Island.

High Efficiency, Low Emissions (HELE) coal technologies have the potential to significantly reduce the carbon emissions produced by coal-fired power generation. Australia has four plants in Queensland; the most recent at Kogan Creek operated by CS Energy is a single unit of 750 MWe capacity.

Low emissions coal technologies are positioned to be part of the broad technology solution to addressing climate change and facilitate Australia's competitive advantage of accessible and affordable fossil fuel resources.

7. Gas

$17 billion

LNG exports 2014–15

3rd

Largest LNG exporter 2014

18 per cent

Coal seam gas share of production 2014–15

22 per cent

Gas share of electricity generation 2013–14

48 per cent

Australian gas production comes from Western Australia 2014–15

Half

Of Australia's gas production is exported

38 per cent

Of Australia's gas is use for electricity generation 2013–14

80 per cent

Of Australia's LNG is exported to Japan

Overview

Gas — conventional and unconventional — plays an important role in the Australian economy. Gas accounts for nearly one-quarter of primary energy consumption, one-fifth of electricity generation, and is one of Australia's highest valued commodity exports. More than half of national gas production is exported, and Australia is currently the world's third largest exporter of LNG.

The Australian gas market consists of three distinct regional markets:

- the Eastern market, comprising Queensland, New South Wales, the Australian Capital Territory, Victoria, Tasmania and South Australia
- the Western market, comprising Western Australia and
- the Northern market, comprising the Northern Territory.

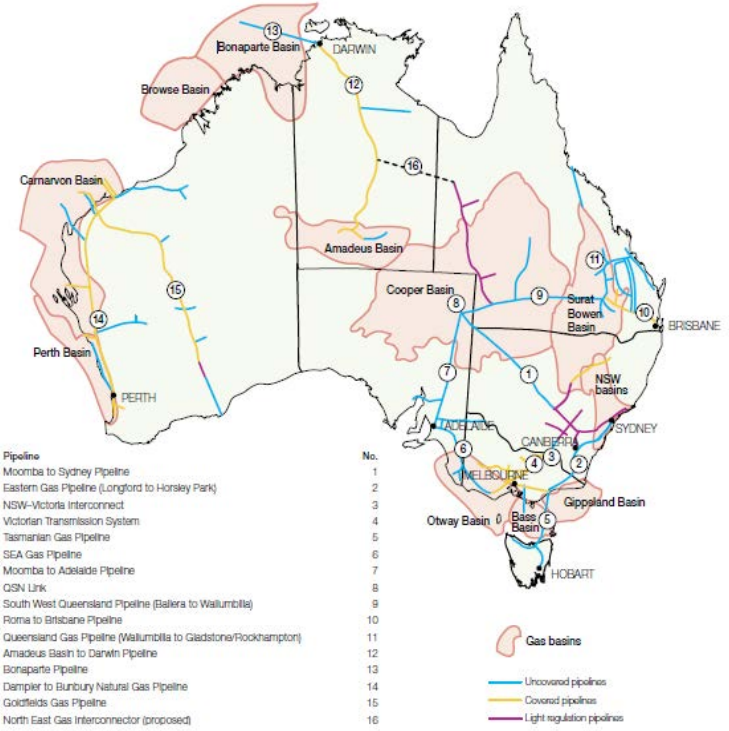
The three markets are physically and economically separate from each other. They each have different characteristics, including size and location of gas resources, demand profile, and relative exposure to international markets. The vast distance between the markets makes interconnection costly and currently uneconomic. A pipeline to connect the Northern and Eastern markets has been proposed.

Production

Australia produced 2,587 petajoules (around 66 billion cubic metres) of natural gas in 2014–15. Gas production increased 6 per cent in 2014–15, supported by the start-up of the QCLNG project in Queensland. Over the past decade, Australian gas production has expanded by an average of 5 per cent a year.

Western Australia accounted for 60 per cent of Australia's total gas production in 2014–15 (1,616 petajoules). The majority of this production is slated for LNG exports. Almost all gas production in Western Australia is in the Carnarvon basin, with a small volume produced in the Perth basin.

Map 7.1: Australia's gas basins and transmission



Pipeline	No.
Moomba to Sydney Pipeline	1
Eastern Gas Pipeline (Longford to Horsley Park)	2
NSW–Victoria Interconnect	3
Victorian Transmission System	4
Tasmanian Gas Pipeline	5
SEA Gas Pipeline	6
Moomba to Adelaide Pipeline	7
QSN Link	8
South West Queensland Pipeline (Ballera to Wallumbilla)	9
Roma to Brisbane Pipeline	10
Queensland Gas Pipeline (Wallumbilla to Gladstone/Rockhampton)	11
Amadeus Basin to Darwin Pipeline	12
Bonaparte Pipeline	13
Dampier to Bunbury Natural Gas Pipeline	14
Goldfields Gas Pipeline	15
North East Gas Interconnector (proposed)	16

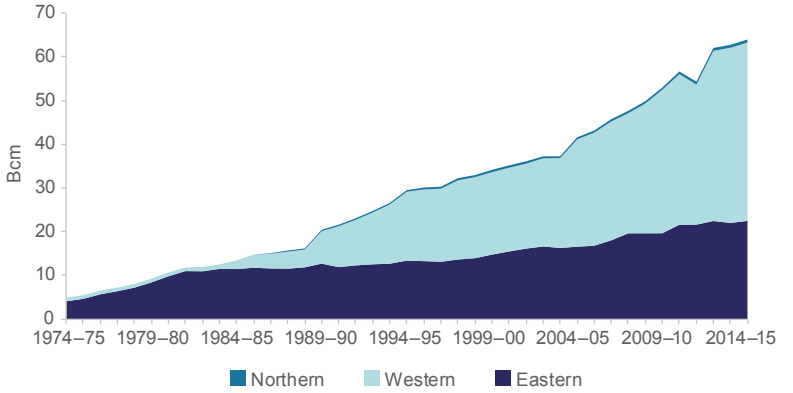
Source: AER (2015) State of the Energy Market

The eastern market produced 921 petajoules of natural gas in 2014–15, an increase of 12 per cent relative to 2013–14. Queensland overtook Victoria to become the largest eastern market gas producer at 479 petajoules, reflecting a 45 per cent increase in coal seam gas production in Queensland. The majority of this gas is sourced from the Bowen and Surat basins. Victoria slipped to the second largest producer of gas in the eastern market in 2014–15 and produced 369 petajoules of gas. Production was mainly from the Gippsland and Otway basins.

In 2014–15 coal seam gas production increased 45 per cent to 443 petajoules and now accounts for nearly half of eastern market gas production, and 18 per cent of national gas production — up from a national share of 2 per cent a decade ago. Almost all coal seam gas was produced in Queensland in 2014–15 (98 per cent), with the remainder of production in New South Wales. Production of CSG is expected to continue to grow to support LNG exports from the east coast. Recent projects to come online include the BG Group's Curtis Island based QCLNG project with an annual capacity of 8.5 million tonnes and Santos's Gladstone based GLNG project with an annual capacity of 7.8 million tonnes when fully operational.

The northern market is the smallest market in Australia, producing around 28 petajoules of gas in 2014–15. It does not include production in the Joint Petroleum Development Area, which is captured as a gas import into Australia and re-exported from Darwin as LNG. Nearly all the gas production in the northern market is from the Bonaparte basin, with a small volume also produced in the Amadeus basin.

Figure 7.1: Australia's gas production, by market



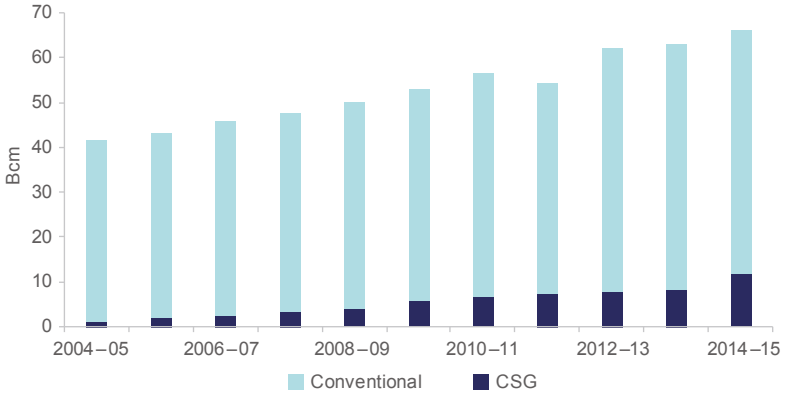
Source: Department of Industry, Innovation and Science (2015) Resources and Energy Quarterly; Australian Energy Statistics, Table Q

Table 7.1: Australia's gas production, by market

	2013–14		2014–15	
	PJ	mcm	PJ	mcm
Eastern market	837	22,176	936	24,890
—Conventional	530	13,986	493	13,049
Queensland	47	1,255	47	1,265
Victoria	418	11,003	375	9,876
South Australia	65	1,728	71	1,908
—Coal seam gas	307	8,190	443	11,841
Queensland	302	8,051	438	11,707
New South Wales	5	139	5	134
Northern market	27	669	28	700
Western market	1,604	40,099	1,616	40,412
Total	**2,468**	**62,945**	**2,580**	**66,002**

Source: Department of Industry, Innovation and Science (2015) Resources and Energy Quarterly, Australian Energy Statistics, Tables Q and R

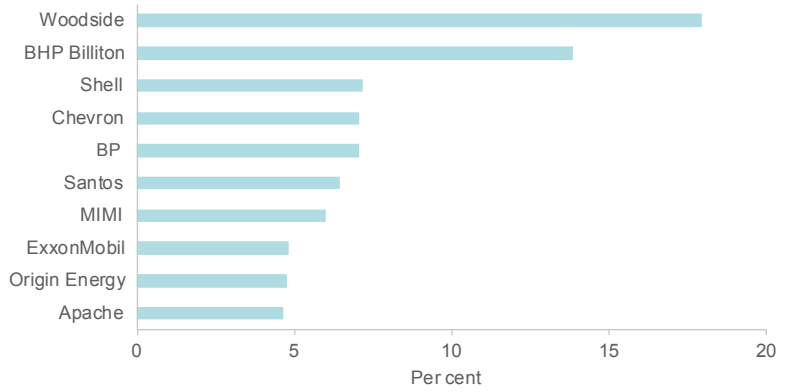
Figure 7.2: Australia's gas production, by gas type



Source: Department of Industry, Innovation and Science (2015) Resources and Energy Quarterly September; Australian Energy Statistics, Table Q; Queensland government

The two largest companies, Woodside and BHP Billiton, jointly accounted for nearly one-third of Australian gas production in 2014–15, similar to the previous year. The next four largest companies — Shell, BP, Chevron and Santos — each accounted for around 7 per cent of production.

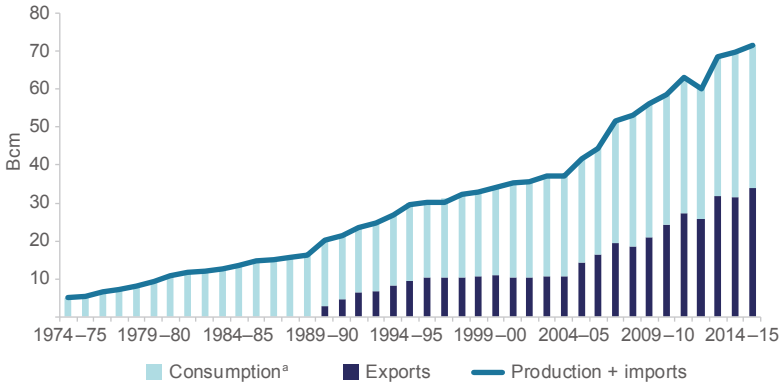
Figure 7.3: Share of Australian gas production, by company, 2014–15



Source: Energyquest (2015)

Around 50 per cent of Australia's gas was produced for the domestic market, with the remainder exported as liquefied natural gas (LNG). The share of production for the domestic market has fallen from 71 per cent only a decade ago, with exports increasing at a faster rate than domestic consumption.

Figure 7.4: Australia's gas balance



Notes: a) Includes statistical discrepancies

Source: Department of Industry, Innovation and Science (2015) Resources and Energy Quarterly, Australian Energy Statistics, Tables M, N and Q

Domestic consumption

Australian gas consumption has been growing robustly, by 3.7 per cent a year on average over the past decade. The growth in gas consumption reflects greater uptake of gas in electricity generation, and use in mining and industry. Natural gas consumption in Australia was 1,402 petajoules in 2013–14, equal to 24 per cent of energy consumption.

This share of energy consumption varies between states and territories, with half of Western Australia's energy sourced from natural gas and 48 per cent in the Northern Territory. In the eastern market, natural gas accounted for 18 per cent of energy consumption in 2013–14.

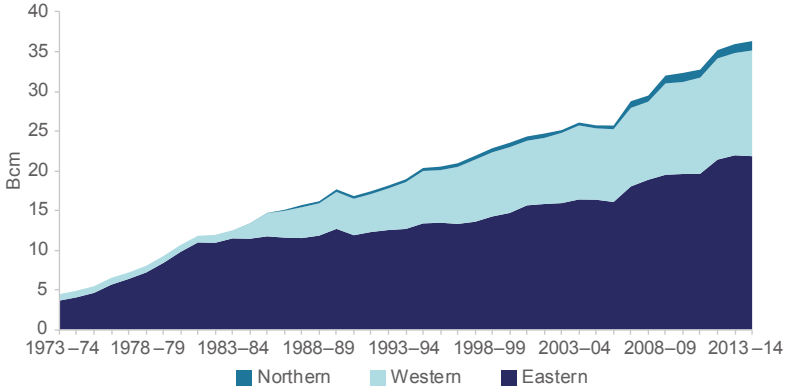
Table 7.2: Gas consumption, by state, 2013–14

	Consumption (PJ)	Gas share of energy mix (per cent)
Eastern market	822	18
—New South Wales, ACT	155	10
—Victoria	287	20
—Queensland	252	19
—South Australia	116	35
—Tasmania	12	11
Northern market	47	48
Western market	533	51
Australian total	**1,402**	**24**

Source:Department of Industry and Science (2015) Australian Energy Statistics, Table C

The eastern market is the largest domestic market, accounting for 59 per cent of Australia's gas consumption in 2013–14. The largest consumers of gas in the eastern market are Victoria at 287 PJ (20 per cent of total Australian consumption) and Queensland at 252 PJ (18 per cent of total Australian consumption). Western Australia is the largest consumer of gas in the country and accounted for 38 per cent of total gas consumption in 2013–14 at 532 petajoules.

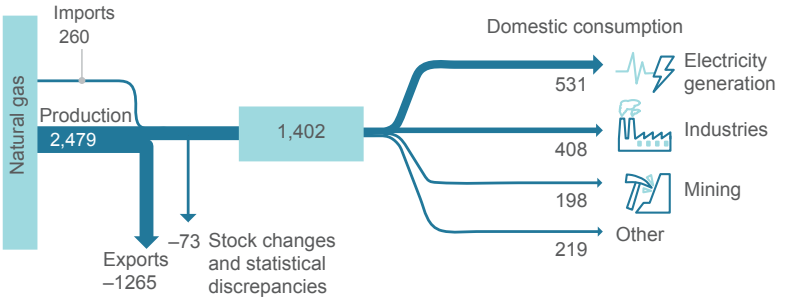
Figure 7.5: Australia's gas consumption, by market



Source: Department of Industry and Science (2015) Australian Energy Statistics, Table Q

The electricity generation sector remains the largest user of gas in Australia, accounting for 38 per cent of gas consumption in 2013–14. The manufacturing sector is the second largest user of gas in Australia, and accounted for 31 per cent of consumption. The largest consumers within this category were the basic non-ferrous metals and, chemical, polymer and product manufacturing industries. The majority of gas consumption in the mining industry was in Western Australia and accounted for 53 per cent of total consumption in this sector 2013–14. Victoria consumed the majority of gas in the residential sector.

Figure 7.6: Australia's gas market flows, 2013–14



Source: Department of Industry and Science (2015) Australian energy statistics, Table A

Table 7.3: Gas consumption, by sector and market, 2013–14

	Eastern (PJ)	Western (PJ)	Northern (PJ)	Australia (PJ)
Electricity generation	278	226	26	531
Manufacturing	252	179		431
– Metals	c	c		150
– Chemical	c	c		133
– Other	c	c		148
Mining	73	106	20	198
Residential	148	11		159
Commercial and services	47	3	1	52
Other	24	7		31
Total	**822**	**533**	**47**	**1,402**

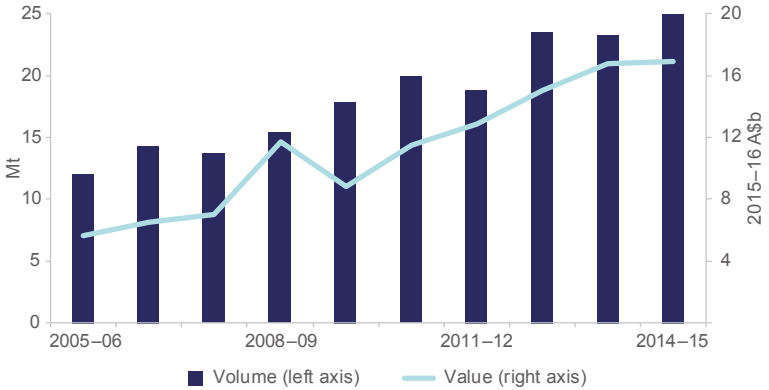
Notes: c) State level sub sector split is confidential, but included in total manufacturing
Source: Department of Industry, Innovation and Science (2015) Australian energy statistics, Table F

LNG exports

Australian gas is exported as LNG — the gas is cooled to -161°C, at which point it becomes a liquid. Australia began exporting LNG in 1989 from the North West Shelf, in the Carnarvon Basin off the north west coast of Western Australia. LNG exports from Darwin commenced in 2006 (sourcing gas from the Joint Petroleum Development Area), the Pluto LNG project in the Carnarvon Basin commenced exports in 2012 and the QCLNG and GLNG projects started exporting in 2015 from Queensland. As of late-2015, Australia's annual LNG export capacity is 41.2 million tonnes. Australia's LNG exports increased 8 per cent in 2014–15 to 25 million tonnes. LNG export volumes have on average increased 7 per cent a year over the past five years, supported by new export capacity and growth in demand for Australian LNG. LNG exports were valued at nearly $17 billion in 2014–15.

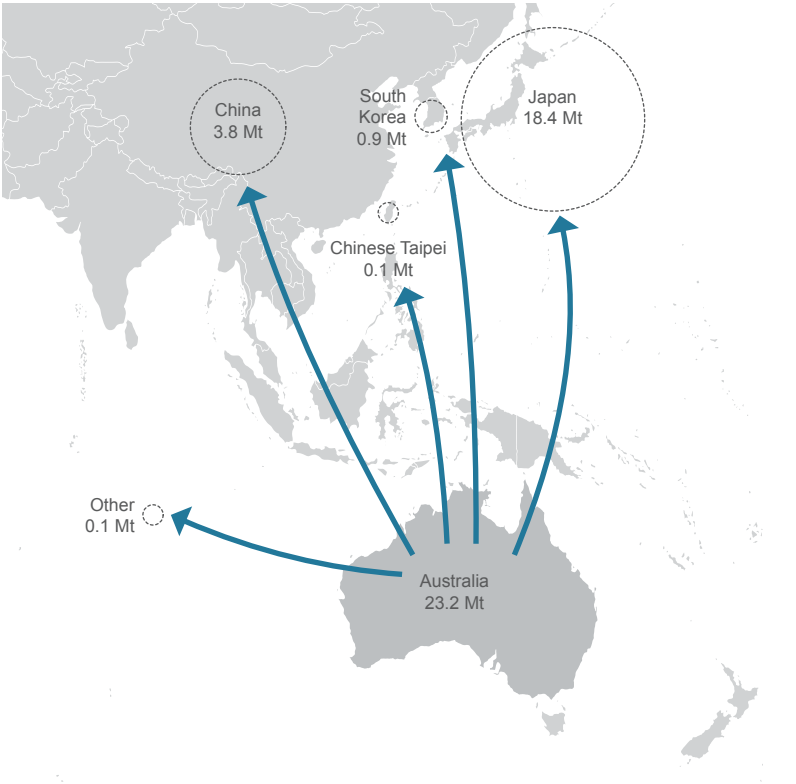
Australia remained the world's third largest LNG exporter in 2014, behind Qatar and Malaysia, and accounted for 10 per cent of world LNG trade. Around 80 per cent of Australia's LNG exports in 2014 were to Japan, and Australia accounted for one-fifth of Japan's LNG imports. China was Australia's second largest LNG export destination and accounted for 16 per cent of Australia's total LNG exports.

Figure 7.7: Australia's LNG exports, volume and value



Source: Department of Industry, Innovation and Science (2015) Resources and Energy Quarterly September

Map 7.2: Australian LNG trade by market, 2014



Source: IEA (2015) Natural gas information

As of late 2015, there were around 45 million tonnes of LNG capacity under construction in Australia. Once built, this is expected to make Australia the world's largest exporter of LNG by the end of the decade. This expansion in capacity will include new conventional gas projects in western and northern Australia, floating LNG projects, and coal seam gas based LNG projects on the east coast.

Table 7.4: Australia's LNG export capacity, existing and under construction

Project	Capacity (Mtpa)	Start up
Eastern market		
Queensland Curtis LNG (QCLNG)	8.5	2014
Australia Pacific LNG (APLNG)		
—Train 1	4.5	2015
—Train 2	4.5	2016
Gladstone LNG (GLNG)		
—Train 1	3.9	2015
—Train 2	3.9	2016
Western market		
North West Shelf (NWS)	16.3	1989
Pluto	4.3	2012
Gorgon	15.6	2016
Wheatstone	8.9	2017
Prelude Floating LNG	3.6	2017
Northern market		
Darwin LNG	3.7	2006
Ichthys	8.9	2017

Source: Department of Industry, Innovation and Science (2015) Resources and Energy Major Projects

Prices

The majority of Australian LNG is sold under long term contracts linked to oil prices. While volumes are still relatively small, an increasing proportion of LNG is also sold under short term contracts and traded on the spot market. Spot market prices are based on exisiting market conditions. Landed LNG prices in Japan (Australia's largest LNG importer) in 2015 are estimated to be around US$10.30 a gigajoule (around A$13.70 a gigajoule). Average Australian LNG export prices (total export value divided by volume) declined 3.8 per cent in 2014–15 to around A$676 a tonne (A$12.43 a gigajoule).

Table 7.5: Gas prices in 2014–15 dollars

		2011–12	2012–13	2013–14	2014–15
Natural Gas					
Domestic Spot Price [a]	A$/GJ	3.72	5.37	4.23	3.25
Liquefied Natural Gas [b]					
Export unit value	A$/t	690.91	637.17	718.84	677.99
	A$/GJ	12.70	11.71	13.21	12.46

Notes: a) Financial year average of eastern market daily spot prices
b) Calculated from LNG export volumes and values

Source: AEMO; Department of Industry, Innovation and Science (2015) Resources and Energy Quarterly

Gas producers sell gas domestically in wholesale markets to major industrial, mining and power generation customers, and to energy retailers that sell it to business and residential customers. Until recently, Australian gas prices have generally been low by international standards, typically $3 to $4 per gigajoule. Most historical gas prices have been under confidential long term contracts, with limited exposure to international prices.

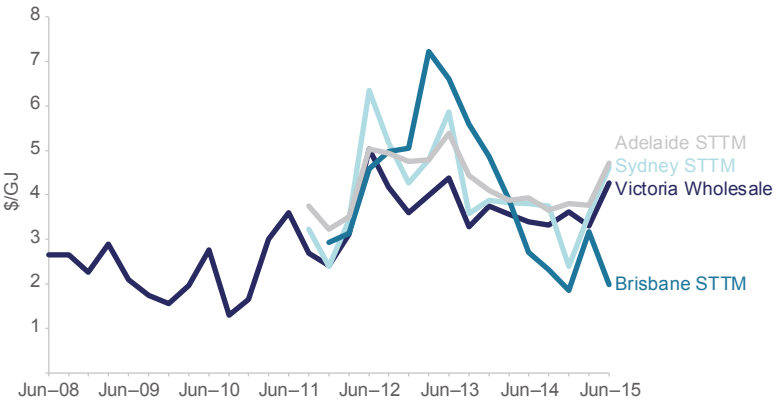
There has been a recent shift towards shorter term contracts and spot markets. Victoria established a wholesale spot market in 1999 for gas sales, to manage system imbalances and pipeline network constraints.

A short term trading market for gas was launched in Sydney and Adelaide in 2010, with Brisbane following in 2011. The market provides a means for participants to manage contractual imbalances, and is supported by a National Gas Market Bulletin Board. The Wallumbilla gas hub in Queensland was launched in early 2014. The exchange aims to alleviate unnecessary bottlenecks in the Queensland gas market by facilitating short term gas trades.

Average daily spot prices for gas in the eastern market declined in 2014–15 by 22 per cent. Aaverage prices declined 50 per cent in Brisbane, 14 per cent in Sydney, 5 per cent in Melbourne and 13 per cent in Adelaide. The fall in prices is mainly a result of increased CSG production associated with ramp-up for LNG projects meeting relatively flat domestic consumption, particularly from the electricity generation sector.

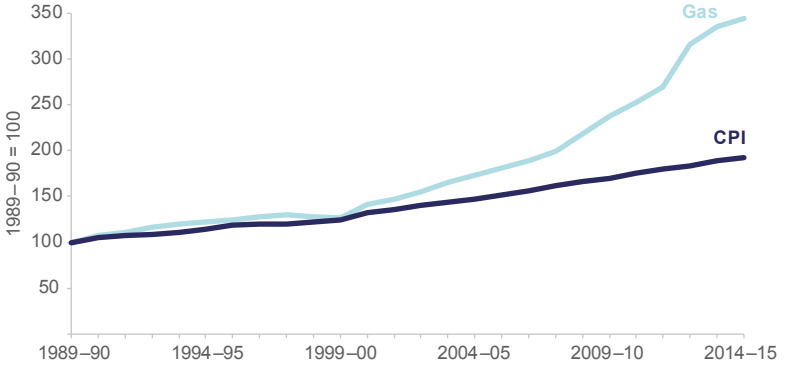
The energy bills paid by retail customers include the costs of wholesale gas, transport through transmission and distribution networks, and retail services. In 2014–15 the retail price for gas increased 3 per cent, considerably lower than the annual average average increase of 8 per cent over the past five years, mainly associated with the increase in distribution costs.

Figure 7.8: Quarterly domestic gas spot prices



Source: AEMO

Figure 7.9: Retail household gas price index



Source: ABS (2015) 6401.0 Consumer price index, Australia

Seri Bakti arrives at Santos GLNG
Source: Santos GLNG

8.Petroleum

$9.5 billion
Crude oil and LPG exports value in 2014–15

77 per cent
Crude oil and condensate production exported in 2014–15

83 per cent
Imports share of refinery feedstock in 2014–15

$34.2 billion
Total oil imports 2014–15

73 per cent
Transport share of oil consumption in end-use sectors

50 per cent
Imports share of refined product consumption in 2014–15

7.4 per cent
Growth per year in diesel use in the mining sector over the past decade

6 per cent
Alternative fuels share of transport energy use

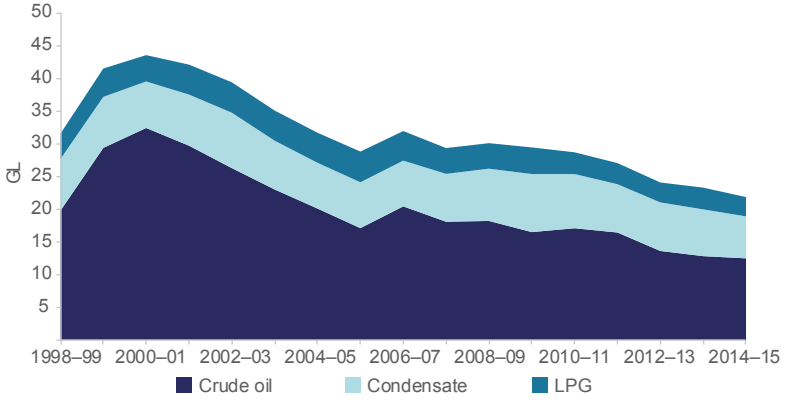
Overview

Australia produces a range of liquid fuels — crude oil, condensate and naturally occurring LPG. In 2014–15, around 77 per cent of this production was exported, with the majority being sourced from the north-west coast of Australia. Australian oil production has been declining over the last decade and Australia is a net importer of crude oil and condensate. About 83 per cent of refinery feedstock for Australia is sourced from imports. Imports also account for a significant share of Australia's consumption of refined products. In 2014–15, imports of refined products equalled 50 per cent of domestic consumption.

Primary petroleum production

In 2014–15 Australia's crude oil and condensate production declined by 5 per cent to average 19 gigalitres, underpinned by declining production from mature fields that outweighed additional output from new projects. Naturally occurring liquefied petroleum gas (LPG) production also fell by 11 per cent to average 3 gigalitres. The falls in output continues a longer term decline in Australia's production of primary petroleum.

Figure 8.1: Australia's production of primary petroleum



Source: Department of Industry, Innovation and Science (2015) Resources and Energy Quarterly

Australia's largest petroleum producing basins are the Carnarvon Basin in the north-west of Australia, the Cooper-Eromanga Basin, which straddles the border between South Australia and Queensland, and the Gippsland Basin in Bass Strait. Production from the Carnarvon Basin is mostly exported, while production from the Gippsland and Cooper-Eromanga basins is used to support domestic refining. The Carnarvon basin accounted for 64 per cent of Australia's crude oil and condensate production in 2014–15.

Table 8.1: Australia's production of crude oil and condensate [a], by basin, 2014–15

	Crude oil	Condensate	Total crude oil and condensate	
	ML	ML	ML	'000 bbls
Amadeus	42	7	48	303
Bonaparte	1,706	12	1,718	10,809
Carnarvon / Perth [b]	7,274	4,949	12,223	76,880
Cooper-Eromanga	2,062	256	2,318	14,582
Gippsland / Otway / Bass [b]	1,506	1,240	2,747	17,277
Surat-Bowen	5	1	6	40
Total	**12,596**	**6,465**	**19,061**	**119,890**

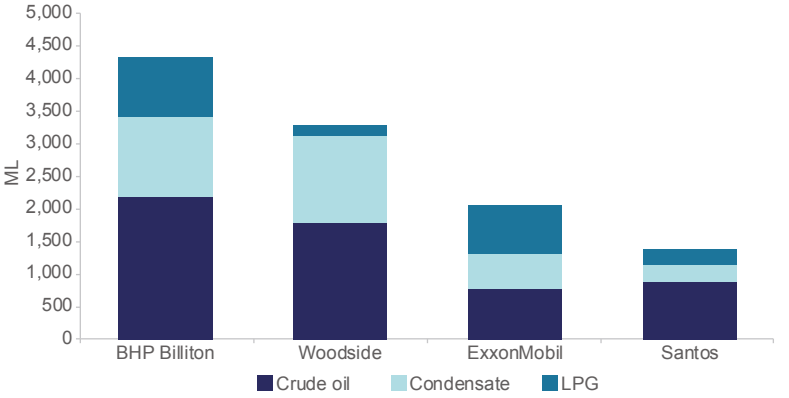
Notes: a) Data reported in this table is predominately on a gross basis, which excludes own-use and losses. However, for several companies that do not provide data to the APS, publically available quarterly production company data is used, which is reported on a net basis

b) Data grouped for confidentiality reasons

Source: Department of Industry, Innovation and Science (2015) Australian Petroleum Statistics, September

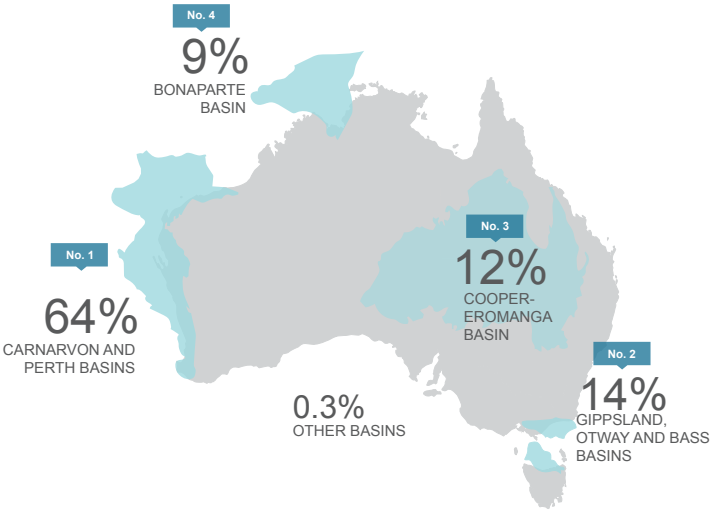
By volume, the four largest petroleum producers in Australia are BHP Billiton, Woodside, ExxonMobil and Santos. In 2014–15 output from these top four companies accounted for about half of Australia's primary petroleum production.

Figure 8.2: Australia's primary petroleum production, 2014–15, top four companies



Source: EnergyQuest (2015) Energy Quarterly

Map 8.1: Australia's production of oil, by basin, 2014–15



Source: Department of Industry, Innovation and Science (2015) Australian Petroleum Statistics, September

Refining

The refining industry in Australia produces a wide range of petroleum products, including gasoline, diesel oil, aviation turbine fuel, fuel oil, and LPG. In 2014–15, Australian refineries produced 30.6 gigalitres of marketable refined petroleum products. Of this, automotive gasoline and diesel fuel made up 79 per cent with a combined production of 24.2 gigalitres.

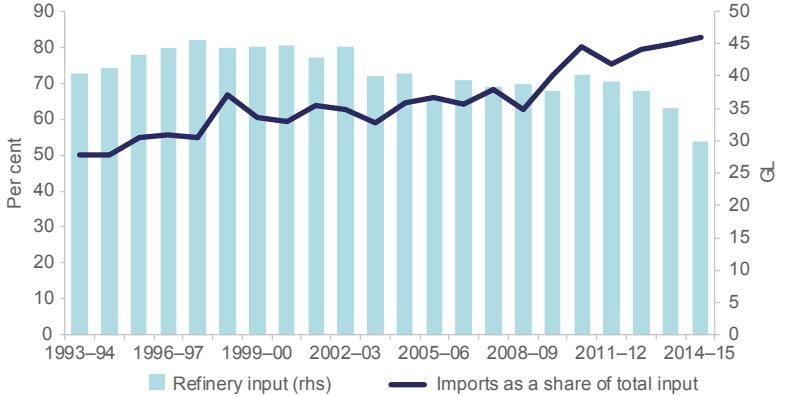
Table 8.2: Australia's refinery input and production of marketable refined petroleum products, 2014–15

	2014–15
	ML
Refinery input	29,898
Production of refined products	
—LPG [a]	976
—Automotive gasoline	12,753
—Aviation gasoline	87
—Aviation turbine fuel	4,255
—Kerosene	10
—Heating oil	1
—Diesel oil [b]	11,459
—Fuel oil	615
—Lubricating oils, greases & basestocks	0
—Bitumen	115
Other products	333
Total	**30,604**

Notes: a) Includes petrochemical transfer to industry
b) Includes automotive diesel oil and industrial and marine diesel fuel

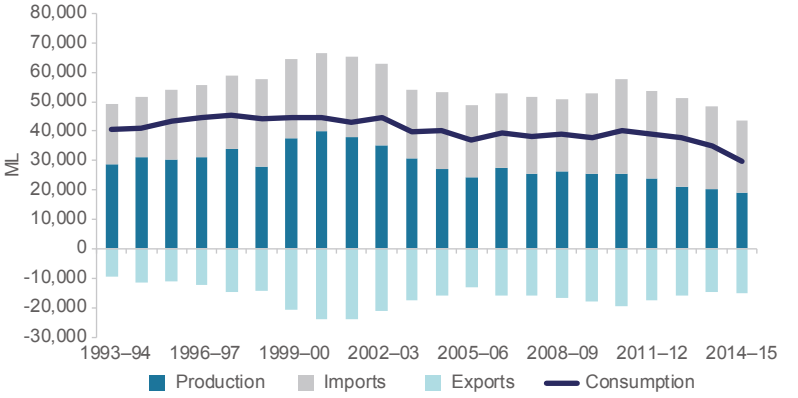
Source: Department of Industry, Innovation and Science (2015) Australian Petroleum Statistics, September

Figure 8.3: Australia's refinery feedstocks



Source: Department of Industry, Innovation and Science (2015) Australian Petroleum Statistics, September

Figure 8.4: Australia's crude oil and ORF balance



Notes: a) Includes statistical discrepancies

Source: Department of Industry, Innovation and Science (2015) Australian Petroleum Statistics, September

In 2014–15 the amount of refinery feedstocks (including imports) that went into Australia's refineries was 29.9 gigalitres. About 83 per cent of refinery feedstocks are sourced from imports. Dependence on imports of crude oil and other refinery feedstock has increased over the last three decades, with increases in consumption and declining east coast production.

Consumption of refined products

Australia's consumption of refined petroleum products remained relatively flat in 2014–15, at around 55.2 gigalitres. About 50 per cent of domestic petroleum consumption is sourced from imports. Diesel accounted for the largest share (43 per cent) of the consumption, followed by automotive gasoline or petrol (33 per cent).

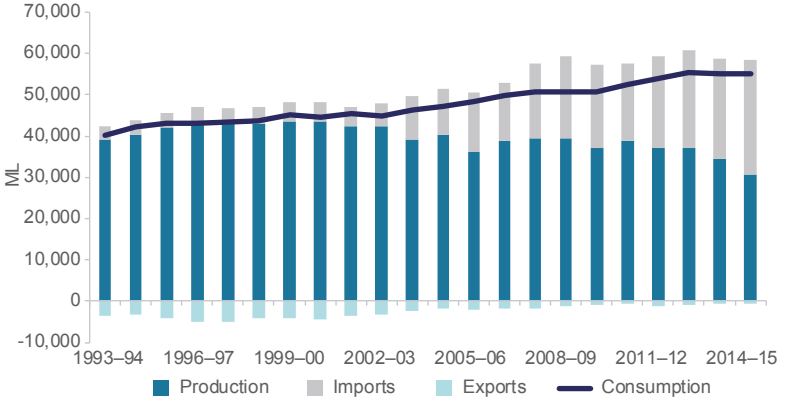
Table 8.3: Australia's sales of petroleum products[a]

	2010–11	2011–12	2012–13	2013–14	2014–15
	ML	ML	ML	ML	ML
LPG [b]	4,251	3,894	4,017	3,845	3,539
Automotive gasoline	18,725	18,762	18,659	18,120	18,070
Aviation turbine fuel	7,068	7,336	7,773	8,168	8,143
Aviation gasoline	79	84	81	73	68
Kerosene	27	13	26	11	19
Heating oil	5	4	6	7	6
Diesel oil [c]	20,061	21,643	22,631	23,081	23,619
Fuel oil	757	942	717	810	781
Lubricating oils & greases	430	348	342	335	324
Bitumen	719	730	735	575	468
Other products	289	283	265	149	123
Total	**52,410**	**54,040**	**55,252**	**55,173**	**55,159**

Notes: a) Includes reporting companies' own use, but excludes refinery fuel; b) This is a minimum level and includes only direct sales by the oil industry. The data does not include volumes sold to distributors etc. which are subsequently used or sold for automotive use but includes petrochemical transfers to industry; c) Includes automotive diesel oil and industrial & marine diesel fuel.

Source: Department of Industry, Innovation and Science (2015) Australian Petroleum Statistics, September

Figure 8.5: Australia's refined petroleum products balance

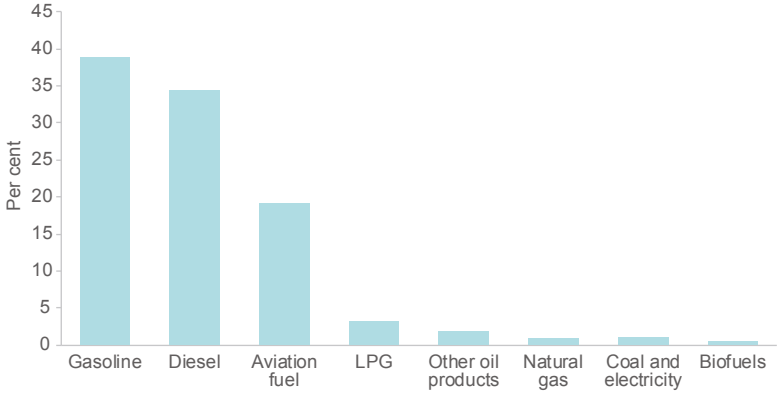


Source: Department of Industry, Innovation and Science (2015) Australian Petroleum Statistics, September

The transport sector is the largest consumer of petroleum products, with the majority being used in road and air transport. In 2013–14 oil consumption in the transport sector made up about 73 per cent of end-use sectors' total oil consumption. Automotive gasoline, diesel fuel and aviation fuel dominate energy consumption in the transport sector, together accounting for 92 per cent of the sector's total oil consumption.

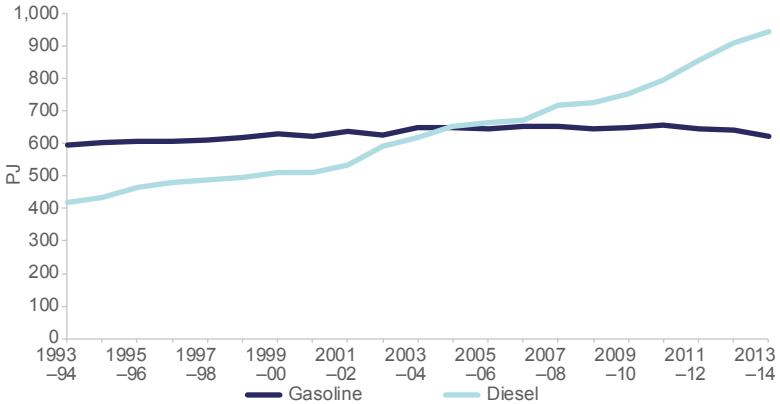
The share of petrol in the transport fuel mix has decreased slowly over recent decades, outstripped by growth in diesel and aviation fuel consumption. This reflects fuel switching and increased demand for diesel, particularly associated with mining activities. The mining sector was the fastest growing diesel user over the past 10 years to 2013–14, growing at an average 7.4 per cent a year. Aviation fuel use has also been increasing relatively strongly, reflecting increased air transport activity.

Figure 8.6: Share of fuel in energy consumption in the transport sector, 2013–14



Source: Department of Industry and Science (2015) Australian Energy Statistics, Table F

Figure 8.7: Australia's gasoline and diesel consumption



Source: Department of Industry and Science (2015) Australian Energy Statistics, Table F

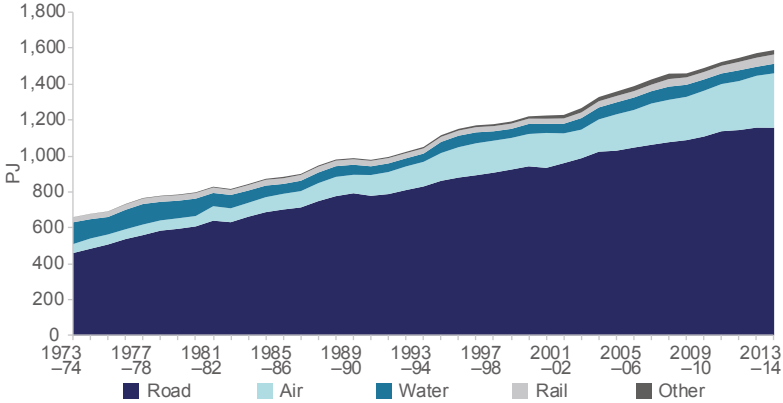
Table 8.4: Australia's diesel consumption [a], by sector

	Consumption	Share in consumption		Annual growth	
	2013–14 (PJ)	2004–05 (per cent)	2013–14 (per cent)	2013–14 (per cent)	10 years (per cent)
Agriculture	81.2	13.3	8.6	-1.1	-0.7
Mining	212.7	17.1	22.5	3.1	7.4
Manufacturing	18.5	1.7	2.0	5.9	6.2
Electricity supply	39.3	4.2	4.2	27.2	4.0
Construction	20.6	3.5	2.2	0.1	-1.2
Commercial	24.5	2.7	2.6	4.0	3.8
Road transport	488.1	50.9	51.7	3.6	4.4
Rail transport	42.9	4.1	4.5	2.4	5.2
Other	16.8	2.5	1.8	-3.4	0.4
Total	**944.6**	**100.0**	**100.0**	**3.7**	**4.2**

Notes: a) Includes automotive diesel oil and industrial and marine diesel oil
Source: Department of Industry and Science (2015) Australian Energy Statistics, Table F

Energy consumption in the transport sector has been growing over the past four decades, largely reflecting economic and population growth during the period. Government policies, energy prices, travel behavior and technological advancements are also important drivers of transport energy use. Road transport, as the dominant transport mode for goods and passengers in Australia, has remained the largest energy user over the last four decades, consistently accounting for around three quarters of energy consumption in the transport sector. The share of air transport in energy use has increased steadily over the same period, largely reflecting increased activity and popularity.

Figure 8.8: Australia's energy consumption in the transport sector, by transport mode



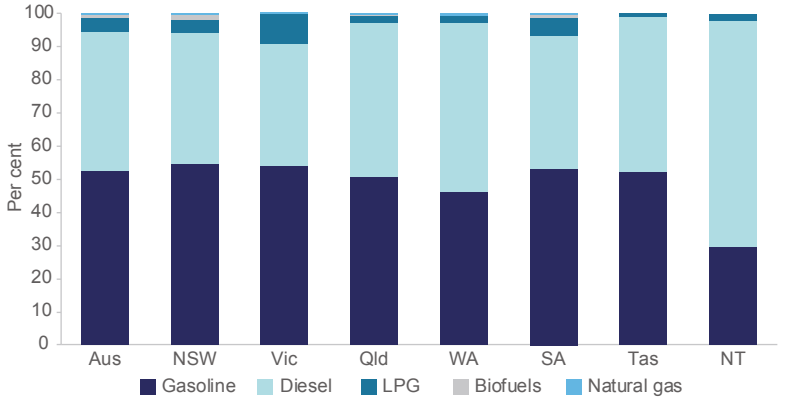
Notes: Other includes other transport services and storage

Source: Department of Industry and Science (2015) Australian Energy Statistics, Table F

The fuel mix in road transport varies between states and territories. Petrol accounted for more than 50 per cent in all states except Western Australia and the Northern Territory, where it accounted for 46 and 30 per cent of road transport fuel consumption in 2013–14.

Diesel accounts for more than one-third of road transport fuel use in all states. The amounts of diesel use were much higher in Western Australia and the Northern Territory compared to other states, reflecting greater mining and off road activity. LPG has the highest road transport share in Victoria and South Australia, at around 9 and 6 per cent. Biofuels use is the highest in New South Wales due to the ethanol blend mandate in that state.

Figure 8.9: Australia's energy consumption in the road transport sector in 2013–14, fuel mix by state



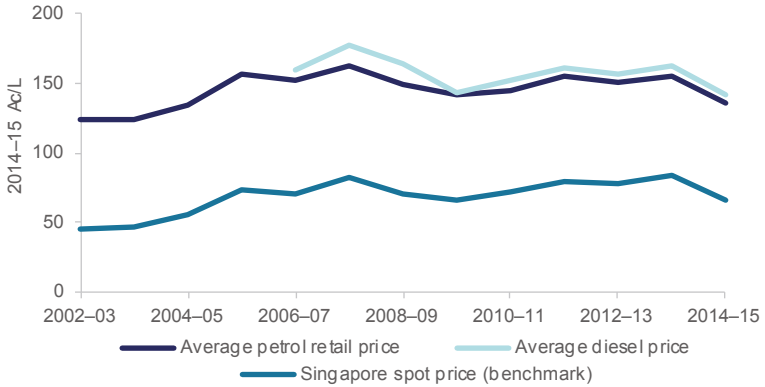
Source: Department of Industry and Science (2015) Australian Energy Statistics, Table F

Prices

The price of fuel affects the level of energy consumption and the type of energy consumed. Fuel prices can go up and down due to a combination of factors: changes in international benchmark prices, the value of the Australian dollar relative to the US dollar, levels of competition in different areas, and pricing decisions by wholesalers and retailers. International prices of crude oil largely drive international refined petrol prices, which in turn drive retail petrol prices in Australia. Because international prices are expressed in US dollars, changes in the AUD–USD exchange rate also affect domestic retail prices.

Australian wholesale gasoline and diesel prices closely follow movements in Singapore gasoline prices, which are in turn largely set by world oil prices. In 2014–15 the Singapore spot price fell by 21 per cent to average A$0.66 a litre (in 2014–15 Australian dollar) in response to weakening global economic conditions. Reflecting the fall in international oil prices Australia's real petrol and diesel price declined by 12 and 13 per cent respectively.

Figure 8.10: Retail fuel prices in Australia



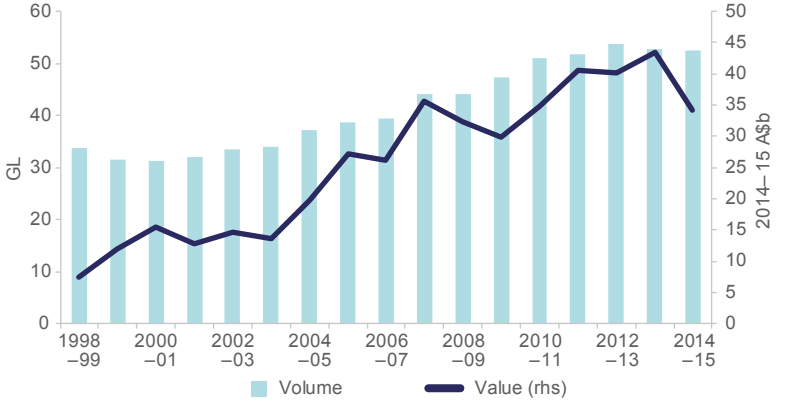
Notes: Prices are GST inclusive
Source: Australian Institute of Petroleum (2015) Annual Retail Prices; IEA (2015), Quarterly Prices and Taxes

Trade

Australia is a net importer of crude oil and other refinery feedstock but a net exporter of LPG. In 2014–15, Australia imported 24.7 gigalitres of crude oil and other refinery feedstock. The high proportion of imports as a share of total production reflects the fact that most of Australia's oil production occurs off the north-west coast of Western Australia, which is closer to Asian refineries than domestic refineries on the east coast, and is therefore more profitable to export.

With declining east coast production, domestic refineries on the east coast now mostly rely on imported feedstock. In addition to costs, crude grades produced in Australia are generally not as well suited for use by Australian refineries as those sourced from other countries.

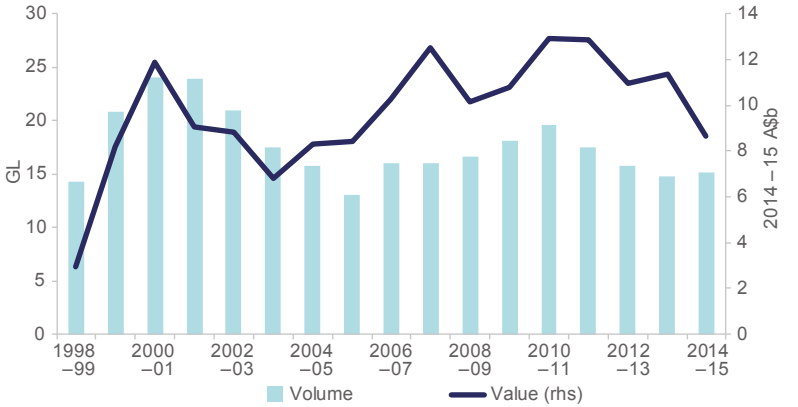
Figure 8.11: Australia's petroleum imports



Notes: Excludes imports from international waters

Source: Australian Bureau of Statistics (2015) International Trade in Goods and Services, Australia, cat no 5368.0

Figure 8.12: Australia's exports of crude oil and ORF



Notes: Excludes exports to international waters

Source: Australian Bureau of Statistics (2015) International Trade in Goods and Services, Australia, cat no 5368.0

Table 8.5: Australia's petroleum imports [a], 2014–15

	2014–15	
	ML	$m
Crude oil and other refinery feedstock	24,715	14,944
Refined products		
– LPG	959	314
– Automotive gasoline	5,534	3,722
– Aviation turbine fuel	4,300	2,845
– Diesel fuel [b]	15,178	10,699
– Fuel oil	262	142
– Lubricants	502	806
– Other products	1,110	771
Total	**52,561**	**34,242**

Notes: a) Excludes imports from international waters
b) Diesel fuel includes automotive diesel oil and industrial and marine diesel fuel

Source: Australian Bureau of Statistics (2015) International Trade in Goods and Services, Australia, cat no 5368.0

In 2014–15, Australia exported about 15.2 gigalitres of crude oil and other refinery feedstock, up by 2 per cent from 2013–14 level. Although the volume of exports increased, the value of crude oil and other refinery feedstock exports decreased considerably by 24 per cent in real terms to total $8.7 billion, reflecting a lower Australian dollar.

Table 8.6: Australia's petroleum exports [a], 2014–15

	2014–15	
	ML	$m
Crude oil and other refinery feedstock	15,152	8,656
LPG	2,111	811
Refinery products		
– Automotive gasoline	118	90
– Aviation turbine fuel	20	13
– Diesel fuel [b]	76	67
– Fuel oil	108	70
– Aviation gasoline	10	13
– Lubricants	299	249
– Other products	40	29
Total	17,934	9,998
Ship and aircraft stores		
– Aviation turbine fuel	1,985	1,310
– Fuel oil	261	176
– Other products	50	54

Notes: a) Excludes exports to international waters
b) Diesel fuel includes automotive diesel oil and industrial and marine diesel fuel

Source: Australian Bureau of Statistics (2015) International Trade in Goods and Services, Australia, cat no 5368.0

9.International comparisons

8th
Largest energy producer 2013

6th
Largest energy exporter 2013

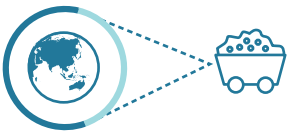
27 per cent
Australia's share of world coal exports 2014

10 per cent
Australia's share of world LNG exports 2014

8th
Largest solar PV generation 2013

4th
Lowest petrol prices in the OECD 2014–15

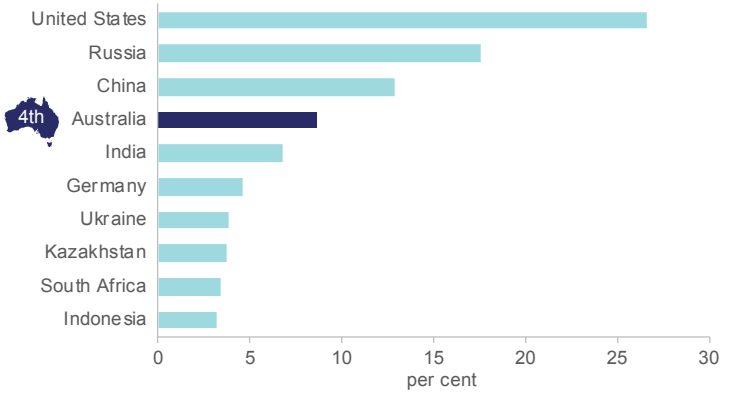
41 per cent
Coal share in global electricity generation 2013



2.5 per cent
Rise in world energy consumption 2013

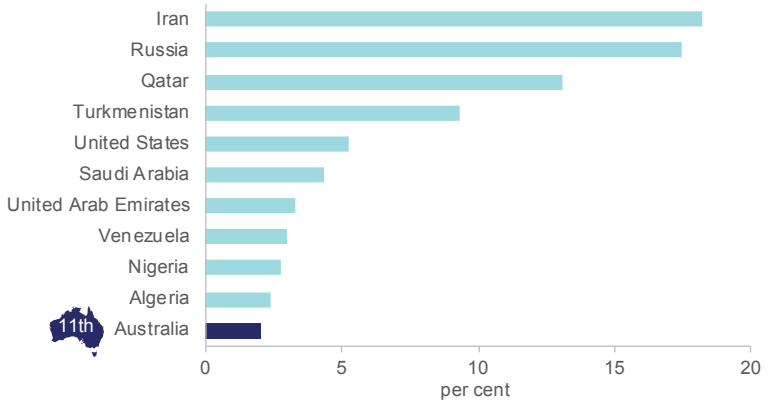
Reserves

Figure 9.1: Share of global proved coal reserves, top 10 countries, 2014



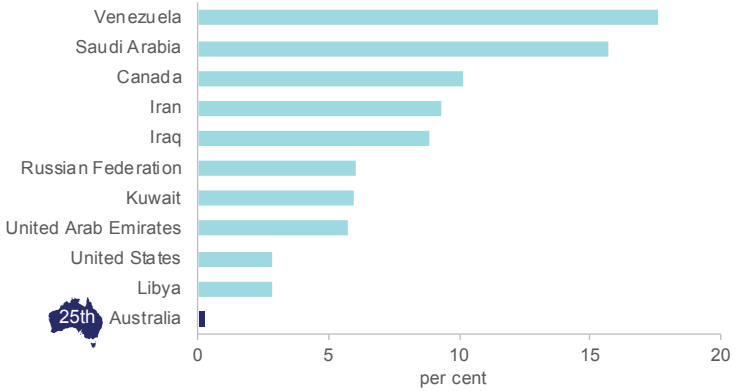
Notes: Includes black and brown coal
Source: BP (2015) Statistical Review of World Energy

Figure 9.2: Share of global proved natural gas reserves, top 10 countries, 2014



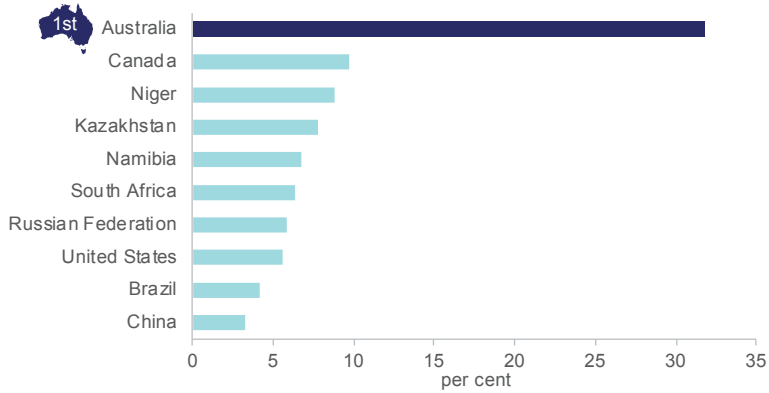
Source: BP (2015) Statistical Review of World Energy

Figure 9.3: Share of global proved oil reserves, top 10 countries, 2014



Notes: Includes crude oil, condensate and natural gas liquids
Source: BP (2015) Statistical Review of World Energy

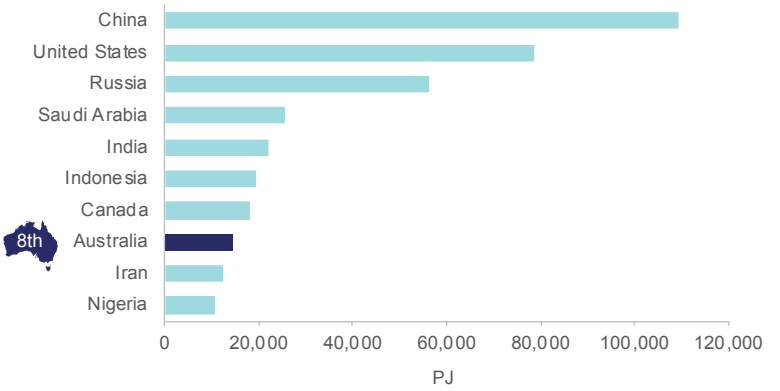
Figure 9.4: Share of global uranium resources, top 10 countries, 2013



Notes: Reasonably Assured Resources, <US$130/kgU
Source: OECD/NEA (2014) Uranium 2014: Resources, Production and Demand

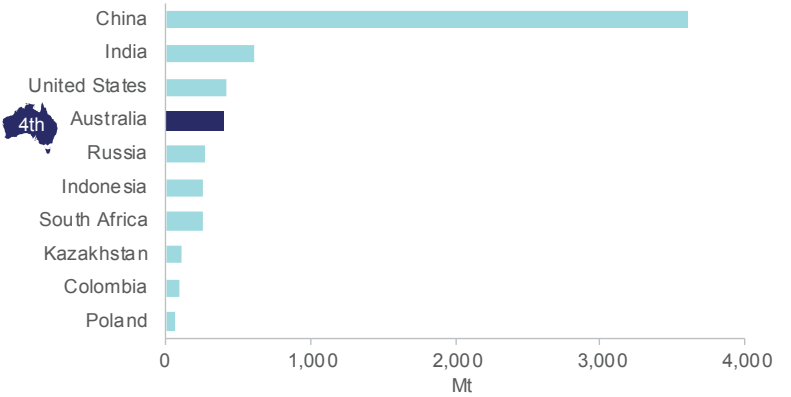
Production

Figure 9.5: Energy production, top 10 countries, 2013



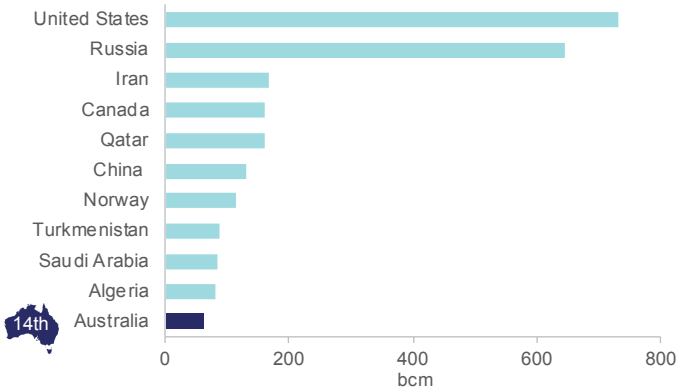
Source: IEA (2015) World energy balances

Figure 9.6: Hard coal production, top 10 countries, 2014



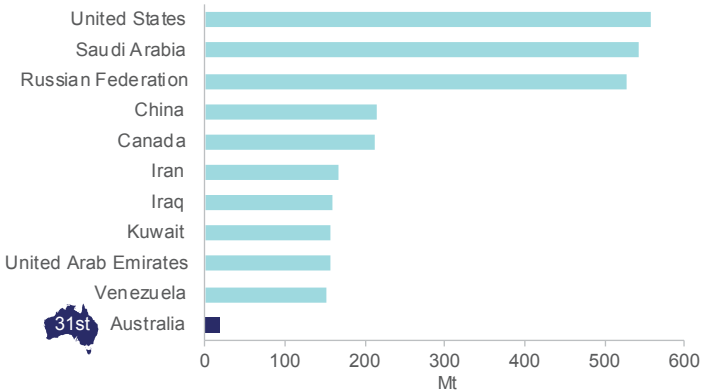
Source: IEA (2015) Coal information

Figure 9.7: Natural gas production, top 10 countries, 2014



Source: IEA (2015) Natural gas information

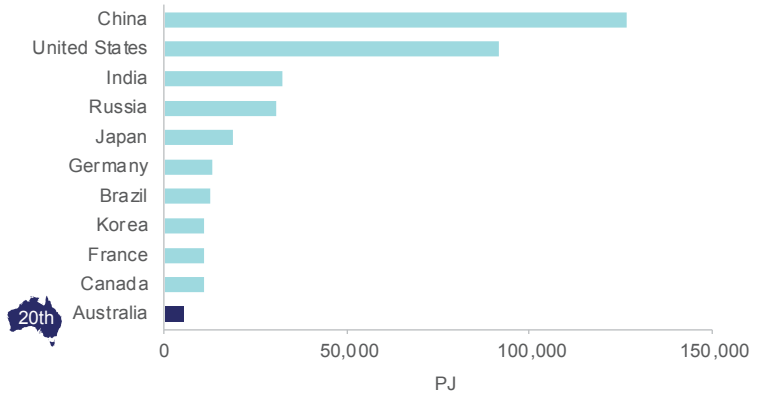
Figure 9.8: Oil production, top 10 countries, 2014



Source: IEA (2015) Oil information

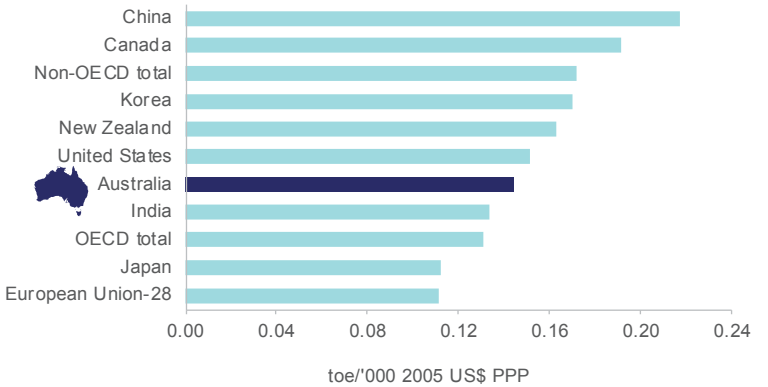
Consumption

Figure 9.9: Primary energy consumption, top 10 countries, 2013



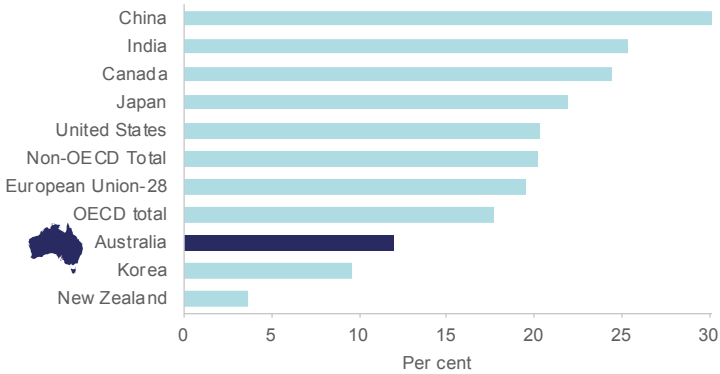
Source: IEA (2015) World energy balances

Figure 9.10: Energy consumption to GDP ratio, selected countries, 2013



Source: IEA (2015) World energy balances

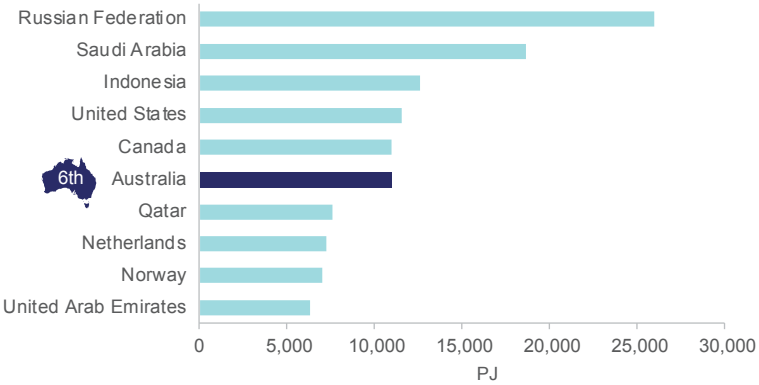
Figure 9.11: Growth in energy productivity, selected countries, 2004–2013



Notes: GDP ('000 2005 US$ PPP)/Total primary energy supply (toe)
Source: IEA (2015) World energy balances

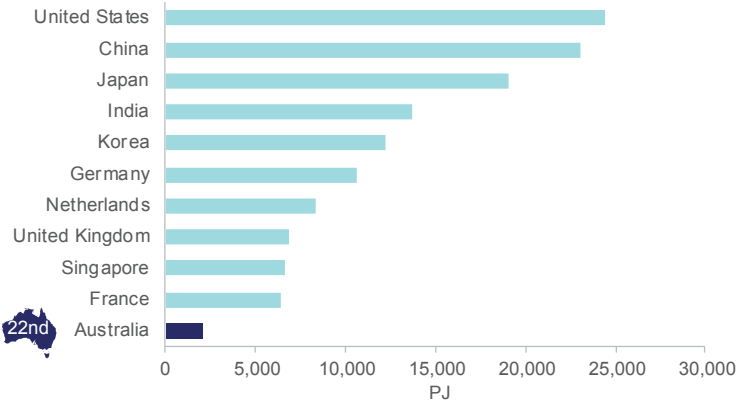
Energy trade

Figure 9.12: Energy exports, top 10 countries, 2013



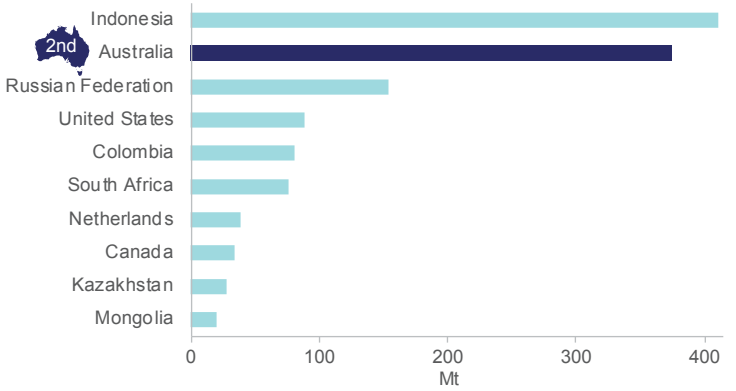
Source: IEA (2015) World energy balances

Figure 9.13: Energy imports, top 10 countries, 2013



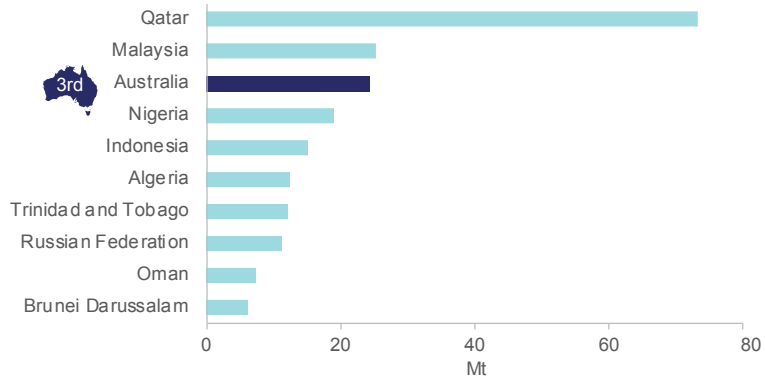
Source: IEA (2015) World energy balances

Figure 9.14: Black coal exports, top 10 countries, 2014



Source: IEA (2015) Coal information

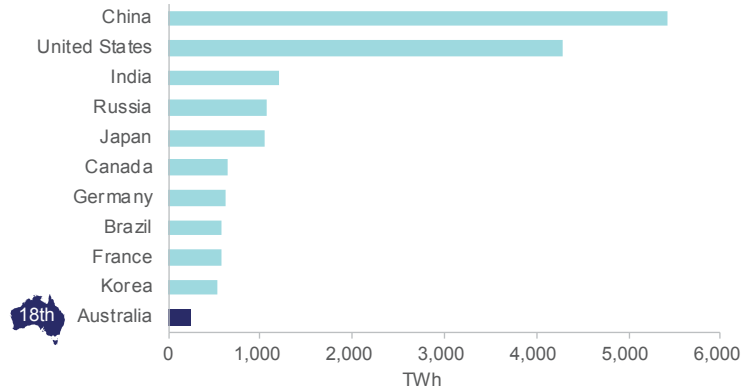
Figure 9.15: LNG exports, top 10 countries, 2014



Source: IEA (2015) Natural gas information

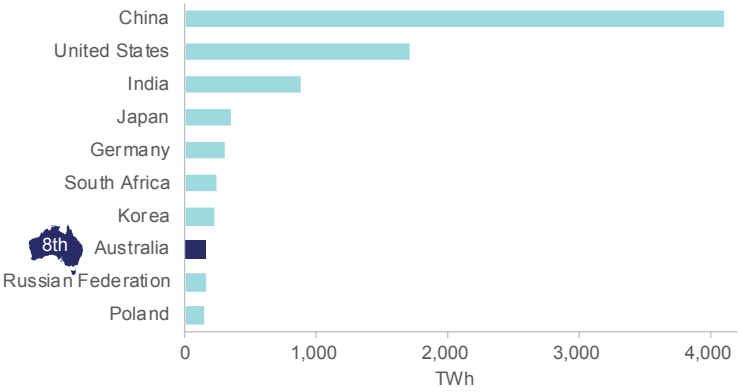
Electricity generation

Figure 9.16: Electricity generation, top 10 countries, 2013



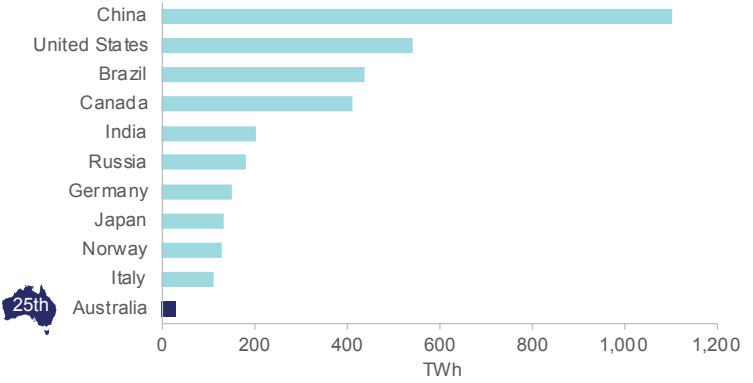
Source: IEA (2015) World energy balances

Figure 9.17: Coal fired electricity generation, top 10 countries, 2013



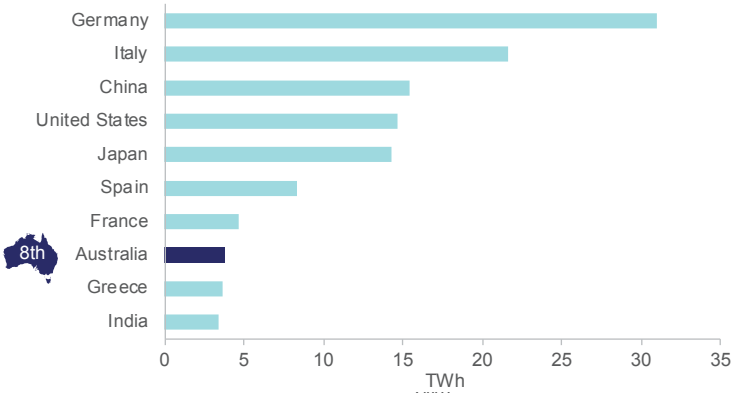
Source: IEA (2015) World energy balances

Figure 9.18: Electricity output from renewable energy sources, top 10 countries, 2013



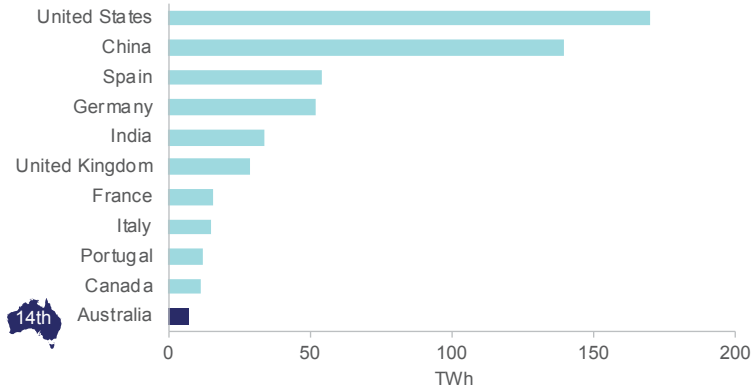
Source: IEA (2015) World energy balances

Figure 9.19: Solar PV electricity generation, top 10 countries, 2013



Source: IEA (2015) Renewables information

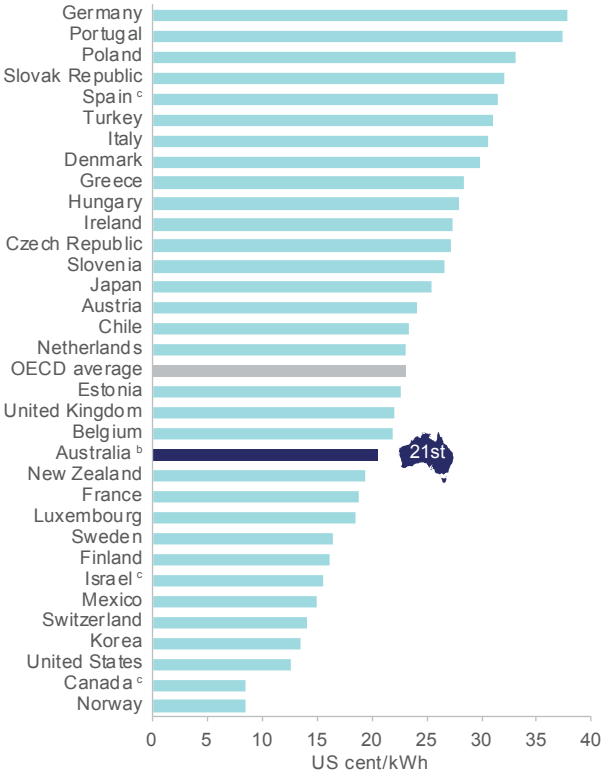
Figure 9.20: Wind electricity generation, top 10 countries, 2013



Source: IEA (2015) Renewables information

Prices

Figure 9.21: OECD household electricity prices, PPP measure[a], 2014



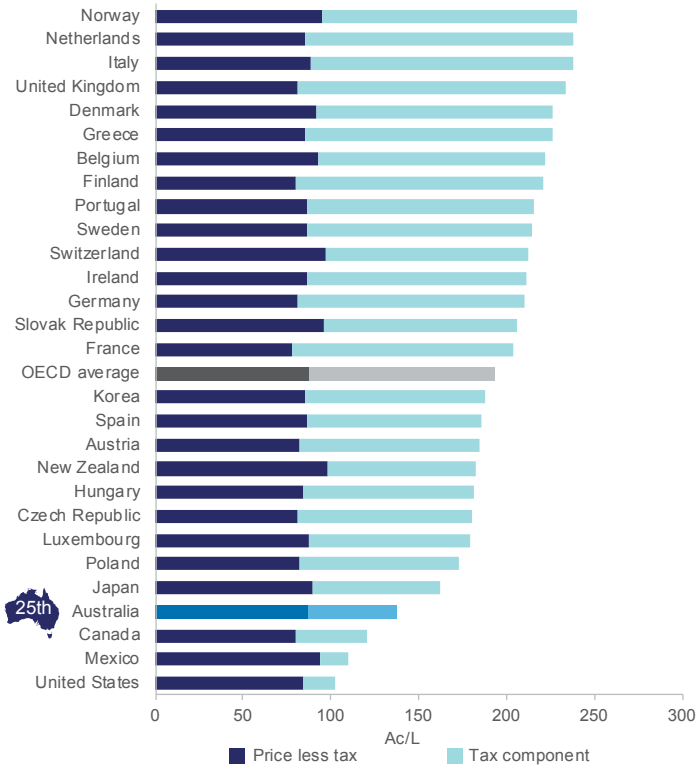
Notes: a) The purchasing power parity (PPP) measure is calculated using OECD PPPs for GDP to transform IEA electricity prices (national currency per unit) and AEMC electricity prices for Australia. PPPs are the rates of currency conversion that equalise the purchasing power of different countries by eliminating differences in price levels between countries.

b) AEMC electricity price for Australia is GST inclusive; total prices (including taxes) reported for other countries.

c) 2013 data for Canada and Israel; 2011 data for Spain

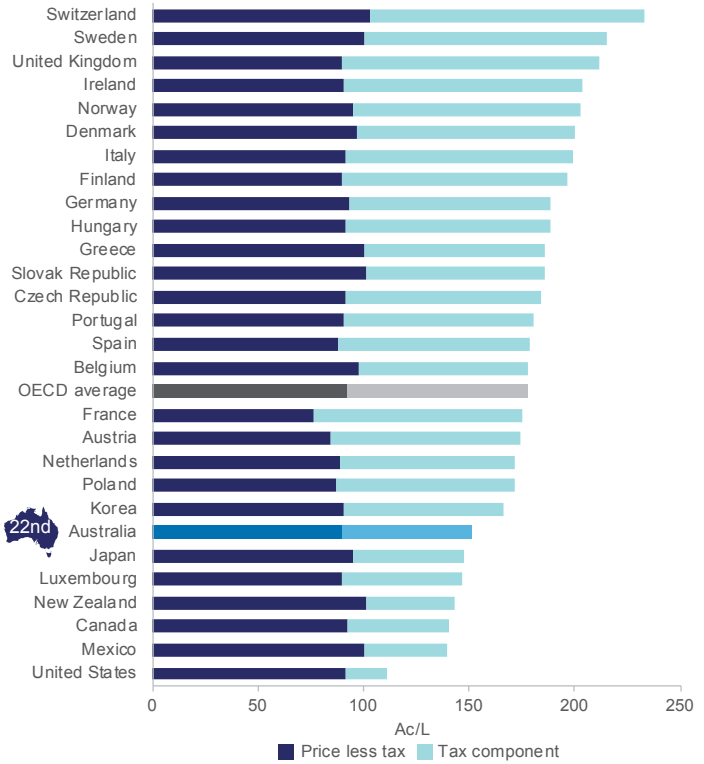
Source: AEMC (2015) 2014 Residential Electricity Price Trends; IEA (2015), Energy Prices and Taxes; OECD.Stat.

Figure 9.22: OECD gasoline prices, 2014–15



Source: IEA (2015) Energy Prices and Taxes; Australian Institute of Petroleum; ORIMA Research; MotorMouth; Informed Sources

Figure 9.23: OECD diesel prices, 2014–15



Source: IEA (2015) Energy Prices and Taxes; Australian Institute of Petroleum; ORIMA Research; MotorMouth; Informed Sources

Appendix A: Units and conversions

This section outlines the main units of measurement used in the *Australian Energy Statistics*, and conversions to other commonly used units. It also includes energy content conversions (calorific values), for converting between volume/mass units and energy units.

Table A.1: Units of measurement and abbreviations

Units		Metric prefixes			Other abbreviations	
J	joule	k	kilo	10^3 (thousand)	bcm	billion cubic metres
L	litre	M	mega	10^6 (million)	m^3	cubic metre
t	tonne	G	giga	10^9 (billion)	ft^3	cubic feet
g	gram	T	tera	10^{12} (trillion)	bbl	barrel
W	watt	P	peta	10^{15}	Mtoe	million tonnes of oil equivalent
Wh	watt hour	E	exa	10^{18}	Gcal	gigacalorie
		b	billion	10^9	MBtu	million British thermal units

Source: Department of Industry and Science (2015) Guide to the Australian Energy Statistics

Table A.2: Conversion between units of volume

To:	bbl	ft^3	L	m^3
From:	multiply by:			
bbl	1	5.615	159	0.159
ft^3	0.1781	1	28.3	0.0283
L	0.0063	0.0353	1	0.001
m^3	6.289	35.3147	1000	1

Source: Department of Industry and Science (2015) Guide to the Australian Energy Statistics

Table A.3: Conversion between units of energy

To:	PJ	Gcal	Mtoe	MBtu	GWh
From:	multiply by:				
PJ	1	238,800	0.02388	947,800	277.8
Gcal	4.1868×10^{-6}	1	10^{-7}	3.968	1.163×10^{-3}
Mtoe	41.868	10^{7}	1	3.968×10^{7}	11630
MBtu	1.0551×10^{-6}	0.252	2.52×10^{-8}	1	2.931×10^{-4}
GWh	0.0036	860	8.6×10^{-5}	3412	1

Source: Department of Industry and Science (2015) Guide to the Australian Energy Statistics

Table A.4: Gross energy content of solid fuels

	GJ/t		GJ/t
Black coal		**Brown coal**	
New South Wales		Victoria	10.3
Exports		South Australia	12.4
– metallurgical coal	29	Briquettes	22.1
– thermal coal	27		
Electricity generation	23	**Uranium**	
Steelworks	32	Metal (U)	560,000
Other	23	Uranium oxide (U_3O_8)	470,000
Queensland			
Exports		**Other**	
– metallurgical coal	29	Coke	27
– thermal coal	27	Wood (dry)	16.2
Electricity generation	21	Wood (green)	10.4
Other	23	Bagasse	9.6
Western Australia			
Thermal coal	19.7		
Tasmania			
Thermal coal	22		

Source: Department of Industry and Science (2015) Guide to the Australian Energy Statistics

Table A5: Gross energy content of gaseous fuels

	MJ/m³
Natural gas (production)	
Victoria	38
Queensland	37.45
Western Australia	40
South Australia, New South Wales	37.45
Northern Territory	40
Average sales quality	39.3
Ethane (average)	64.7
Town gas	39
Coke oven gas	18.1
Blast furnace gas	4

Source: Department of Industry and Science (2015) Guide to the Australian Energy Statistics

Table A6: Gross energy content of liquid fuels

	Volume MJ/L	Specific volume L/t	Weight GJ/t
Primary fuels			
Crude oil and other refinery feedstock			
– indigenous (average)	37	1,250	46.3
– imports (average)	38.7	1,160	44.9
Naturally occurring LPG (average)	27	1,866	49.4

Source: Department of Industry and Science (2015) Guide to the Australian Energy Statistics

Table A.6: Gross energy content of liquid fuels (continued)

	Volume MJ/L	Specific volume L/t	Weight GJ/t
Refined products			
Automotive diesel oil	38.6	1,182	45.6
Automotive gasoline	34.2	1,360	46.4
Aviation gasoline	33.1	1,412	46.8
Aviation turbine fuel	36.8	1,261	46.4
Ethanol	23.4	1,266	29.6
Fuel oil low sulphur	39.7	1,110	44.1
Heating oil	37.3	1,238	46.2
Industrial diesel fuel	39.6	1,135	44.9
Lubricants and greases	38.8	1,120	43.4
Bitumen	44	981	42.7
Solvents	34.4	1,229	44
Waxes	38.8	1,180	45.8
LPG			
– propane	25.5	1,960	49.6
– butane	28.1	1,760	49.1
– mixture	25.7	1,890	49.6
Methanol	15.6	1,263	19.7
Naphtha	31.4	1,534	48.1
Power kerosene	37.5	1,230	46.1
Refinery fuel (fuel oil equivalent)	40.8	1,050	42.9
Other			
Liquefied natural gas	25	2,174	54.4