



**Australian Government**

**Department of the Environment and Energy**

# **Australian Energy Update 2017**

August 2017



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August 2017

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The Department acknowledges the traditional owners of country throughout Australia and their continuing connection to land, sea and community. We pay our respects to them and their cultures and to their elders both past and present.

## Foreword

Energy supply and use in Australia continues to change. The type of energy we use and how we use this energy is changing, as new technologies are adopted, as our economy changes in structure and as our awareness of our energy use grows. Energy production is increasingly export-oriented as our importance as a global energy supplier continues to grow, which is also affecting the domestic market.

To help understand these and other changes, to plan for Australia's energy future and to make sound policy and investment decisions, we need accurate, comprehensive and readily-accessible energy data.

The *Australian Energy Statistics* is the authoritative and official source of energy statistics for Australia to support decision making, and help understand how our energy supply and use is changing. It is updated each year and consists of detailed historical energy consumption, production and trade statistics and balances. It includes all types of energy and all parts of the economy. This edition contains the latest data for 2015–16. Along with this report, the full dataset and guide are available at <http://www.environment.gov.au/energy/energy-statistics>.

The latest set of statistics shows that energy consumption in Australia continued to rise in 2015–16, underpinned by an increase in energy use in the mining and electricity generation sectors to support the rapid growth in LNG exports. Gas production also increased strongly, as did production of renewable energy and imports of refined products.

Feedback regarding the Australian Energy Statistics can be provided to [Australianenergystatistics@environment.gov.au](mailto:Australianenergystatistics@environment.gov.au).

Energy Statistics and Analysis Section  
Department of the Environment and Energy  
August 2017

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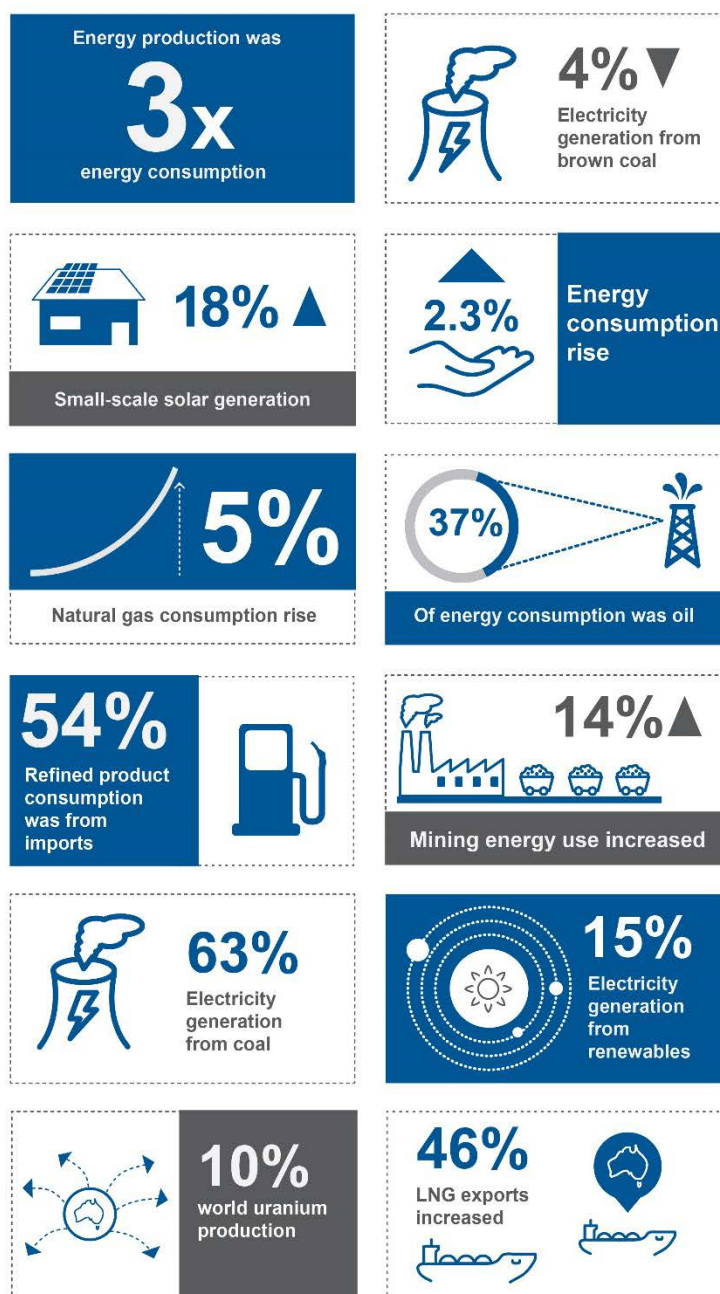
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## Abbreviations and acronyms

AES	Australian Energy Statistics
CSG	Coal seam gas
GWh	Gigawatt hours
LNG	Liquefied natural gas
LPG	Liquefied petroleum gas
NEM	National electricity market
NGERS	National Greenhouse and Energy Reporting Scheme
NGL	Natural gas liquids
ORF	Other refinery feedstock
PJ	Petajoules
PV	Photovoltaic

## 1. Executive summary

# Australian Energy Statistics 2015–16





## 1.1 Energy consumption

- Australian energy consumption rose by 2 per cent in 2015–16 to 6,066 petajoules, its highest ever level. On average, energy consumption has grown by 0.6 per cent a year over the past ten years.
- Energy productivity (gross domestic product divided by energy consumption) was relatively flat in 2015–16, following average annual growth of 2.0 per cent over the past ten years.
- Most of the growth in energy consumption was in the mining, electricity generation and transport sectors.
- Energy use in the mining sector rose by 14 per cent in 2015–16, mainly due to increased natural gas and electricity consumption to support LNG exports. Energy use in other parts of the mining sector was relatively stable.
- Energy use for electricity generation rose by 3 per cent in 2015–16, as black coal fired generation increased.
- Transport, the largest energy using activity in Australia after electricity generation, again grew steadily by 2 per cent in 2015–16.
- Energy use in manufacturing continued recent trends by falling 2 per cent in 2015–16, with much of the fall in chemical and rubber manufacturing.
- Final energy consumption, which excludes energy used in energy conversion activities such as electricity generation and petroleum refining, increased by 2 per cent in 2015–16.
- Oil remained the largest primary energy source in Australia, at 37 per cent in 2015–16, followed by coal (32 per cent), natural gas (25 per cent) and renewables (6 per cent).
- Coal consumption grew by 3 per cent in 2015–16, although consumption was still 17 per cent below the peak in 2008–09. All the growth in 2015–16 was black coal, with brown coal consumption falling by 4 per cent.
- Natural gas consumption grew by 5 per cent in 2015–16, mainly due to increasing activity to support LNG exports. Gas use in electricity generation and manufacturing fell in 2015–16.
- Renewable energy consumption grew by 4 per cent in 2015–16. Much of the growth in renewables was in hydro, as dam levels improved.

## 1.2 Energy production

- Energy production rose by 3 per cent in 2015–16 to 17,321 petajoules, as a result of increased gas production.
- Natural gas production grew by 27 per cent, underpinned by increased coal seam gas (CSG) production in Queensland. CSG accounted for almost 30 per cent of national gas production and over 60 per cent of eastern market gas production in 2015–16.
- Black coal production declined by 1 per cent in 2015–16, while brown coal production declined by more than 6 per cent. Despite this fall, coal still accounted for about three-quarters of Australian energy production.

- Crude oil, condensate and naturally occurring LPG production continued its longer term decline, falling by 3 per cent in 2015–16.

### 1.3 Electricity generation

- Electricity generation in Australia rose by 2 per cent in 2015–16 to 257 terawatt hours (927 petajoules). This reflected increased electricity demand in the National Electricity Market and continued growth in off-grid use.
- Brown coal fired generation declined by 4 per cent in 2015–16, while black coal rose by 6 per cent, with coal accounting for 63 per cent of total generation in Australia. The share of coal remained at 63 per cent in calendar year 2016.
- Despite this growth, Australia was less reliant on coal in 2015–16 than at the beginning of the century, when its share was more than 80 per cent of electricity generation.
- Natural gas fired generation fell by 4 per cent in 2015–16, a result of capacity closures and higher gas prices. Gas accounted for 20 per cent of total electricity generation in 2015–16. Its share continued to decline in calendar year 2016, to 18 per cent of total generation.
- Renewable generation increased by 12 per cent in 2015–16, comprising 15 per cent of total generation in Australia. Renewables continued to grow strongly in calendar year 2016, to reach more than 16 per cent of total generation.
- The majority of renewables growth was from hydro, but strong growth also occurred in solar and wind. Hydro accounted for 7 per cent of total generation in calendar year 2016, with wind accounting for 5 per cent. Solar accounted for 3 per cent of total generation in 2016 and almost all of this was small-scale PV.

### 1.4 Energy trade

- Australian net energy exports were 11,347 petajoules in 2015–16. This was equal to around two-thirds of energy production.
- Energy exports grew by 4 per cent in 2015–16 to 13,638 petajoules. LNG exports grew by 46 per cent to 2,025 petajoules, as new capacity in Queensland and Western Australia came online. Exports of black coal and crude oil fell slightly.
- Australia also exports uranium oxide, for use in nuclear power plants overseas. Uranium exports increased by 42 per cent in 2015–16.
- Energy imports increased by 1 per cent in 2015–16 to 2,291 petajoules. Most growth was in imports of refined oil products (up 18 per cent) such as diesel, petrol and aviation fuels. Imports of crude oil and other refinery feedstocks fell by 20 per cent due to reduced domestic refining capacity.

## 2. About the Australian Energy Statistics

The *Australian Energy Statistics* (AES) is the authoritative and official source of annual energy statistics for Australia. It provides information designed to increase the understanding of energy supply and use in Australia, to support decision making in government and industry, and to meet Australia's annual international energy reporting obligations. This official energy dataset also underpins the calculation of Australia's greenhouse gas emissions from energy supply and use.

The AES provides detailed energy consumption, production and trade statistics and balances, by state and territory, by energy type and by industry, in energy content and physical units. The most detailed sub-sectoral coverage is provided in the energy-intensive manufacturing sectors. Where possible, the data is compiled and presented using concepts and definitions intended to align the AES with the framework used by the International Energy Agency (IEA).

Key data sources include facility level reporting from the National Greenhouse and Energy Reporting Scheme (NGERS), the *Australian Petroleum Statistics* (APS), the *Resources and Energy Quarterly*, datasets and estimates from other Australian and state government agencies, internal databases, estimates using statistical techniques, and public company reporting. Some datasets from private subscription services and industry associations are also used to compare with these estimates and sources.

The AES has been published by the Department of the Environment and Energy (2017), the Department of Industry, Innovation and Science (2015 and 2016), the Bureau of Resources and Energy Economics (BREE) (2012 to 2014), the Australian Bureau of Agricultural and Resources Economics and Sciences (ABARES) (1989 to 2011), and various previous Australian government agencies, since the mid-1970s.

The AES dataset is made available through a series of tables in Excel format at <http://www.environment.gov.au/energy/energy-statistics>. A list of the AES tables available on the website is provided in Table 2.1.

The AES is accompanied by this report, the *Australian Energy Update*, which highlights recent trends in Australian energy consumption, production and trade.

The *Guide to the Australian Energy Statistics* is designed to assist users in better understanding the AES and to increase the transparency of the dataset. It contains information on the publication tables, definitions and concepts, data sources and methodology, conversion factors, confidentiality and historical revisions.

The AES main unit is the petajoule (PJ).  $1 \text{ PJ} = 1 \times 10^{15} \text{ joules}$ . One petajoule, or 278 gigawatt hours, is the heat energy content of about 43,000 tonnes of black coal or 29 million litres of petrol. A car using 6.7 litres of petrol per hundred kilometres could drive around 436 million kilometres on one petajoule.

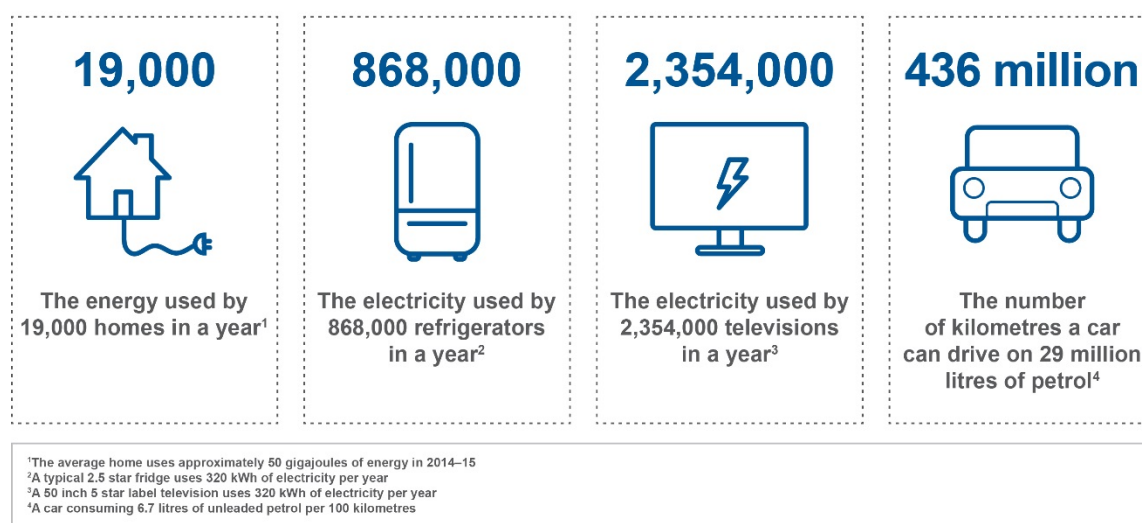
Table 2.1: 2017 Australian Energy Statistics tables

Table name	
Table A	Australian energy supply and consumption, energy units
Table B	Australian energy consumption indicators, by state, energy units
Table C	Australian total primary energy consumption, by state, by fuel, energy units
Table D	Australian total primary energy consumption, by state, by detailed fuel, energy units
Table E	Australian total net energy consumption, by state, by industry, energy units
Table F	Australian energy consumption, by state, by industry, by fuel, energy units
Table G	Australian energy consumption, by state, by fuel, physical units
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Table N	Australian energy exports, by fuel type, physical units
Table O	Australian electricity generation, by state, by fuel type, physical units
Table P	Australian consumption and production of coal, by state, physical units
Table Q	Australian consumption and production of natural gas, by state, physical units
Table R	Australian production of natural gas, by type and state, energy units
Table S	Australian production and exports of uranium, physical and energy units

## One petajoule (PJ) explained

The joule is the standard unit of energy in general scientific applications. One joule is the equivalent of one watt of power radiated or dissipated for one second.

**One petajoule is 10<sup>15</sup> joules (1 million billion) or 278 gigawatt hours.**



### 3. Energy consumption

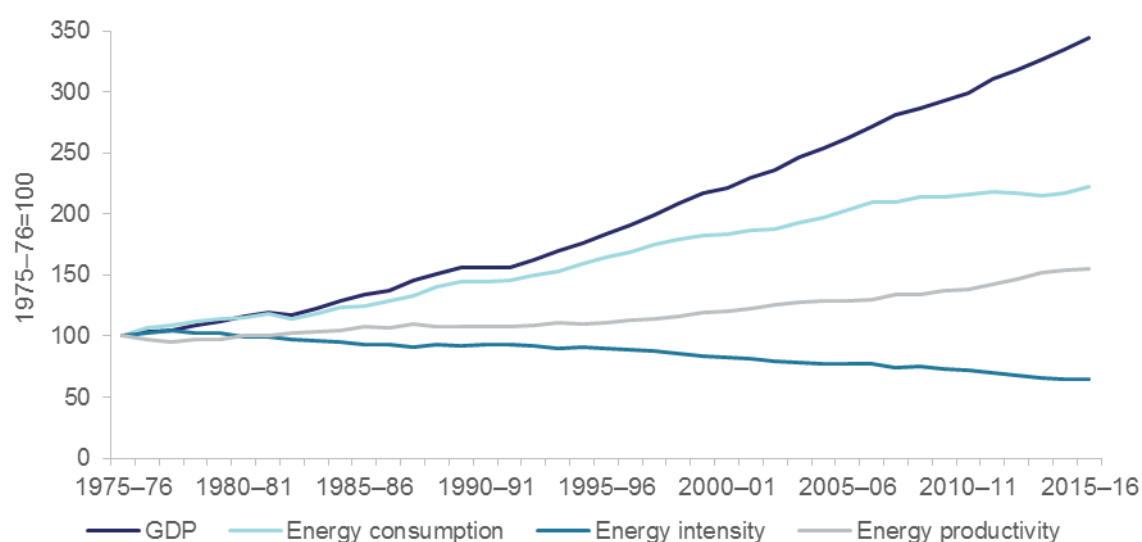
Energy consumption measures the amount of energy used in the Australian economy. It is equal to indigenous production plus imports minus exports (and changes in stocks). It includes energy consumed in energy conversion activities (such as electricity generation and petroleum refining), but excludes derived or secondary fuels (such as electricity and refined oil products) produced domestically to avoid double counting of energy. It can be referred to as total net energy consumption and is also equal to total primary energy supply. Further detail is provided in Department of Environment and Energy (2017) *Guide to the Australian Energy Statistics*.

Australian energy consumption rose by 2.3 per cent in 2015–16 to 6,066 petajoules, its highest ever level. This compares with average growth of 0.6 per cent a year over the past decade. In 2015–16, the Australian economy grew by 2.8 per cent to reach \$1.7 trillion, and the Australian population grew by 1.4 per cent to over 24 million people.

#### 3.1 Energy productivity

The relationship between energy use and economic output can be described in terms of the energy intensity, or inversely the energy productivity, of the Australian economy. Energy intensity measures the amount of energy used to produce a unit of economic output (energy consumption/GDP), and inversely, energy productivity measures the amount of economic output produced per unit of energy input (GDP/energy consumption).

Figure 3.1: Australian energy intensity and energy productivity



Source: Department of the Environment and Energy (2017) *Australian Energy Statistics*, Table B

As economic growth in Australia over recent decades has generally outpaced growth in energy consumption, the Australian economy has tended towards lower energy intensity and higher energy productivity over time (Figure 3.1). This reflects cumulative improvements in energy efficiency as well as a shift in

the Australian economy away from highly energy-intensive industries such as manufacturing towards less energy-intensive industries such as services.

Energy intensity and energy productivity were relatively flat in 2015–16 because gross domestic product and energy consumption increased at a similar rate. Energy productivity rose by 0.4 per cent in 2015–16. In particular, growth in energy use to support LNG exports increased significantly in that year, while the value of production in that sector was relatively flat, with a decline in international oil-linked LNG prices largely offsetting the growth in output. On average energy productivity increased by around 2 per cent a year over the past decade.

### 3.2 Energy consumption, by fuel type

Oil, including crude oil, liquefied petroleum gas (LPG) and refined products, accounted for the largest share of Australian energy consumption, at 37 per cent in 2015–16, slightly lower than the previous year (Table 3.1). Oil consumption increased marginally by 0.3 per cent in 2015–16, with the increased consumption of refined products for transport largely offset by a decline in crude consumption following the closure of the Bulwer Island refinery in May 2015.

Table 3.1: Australian energy consumption, by fuel type

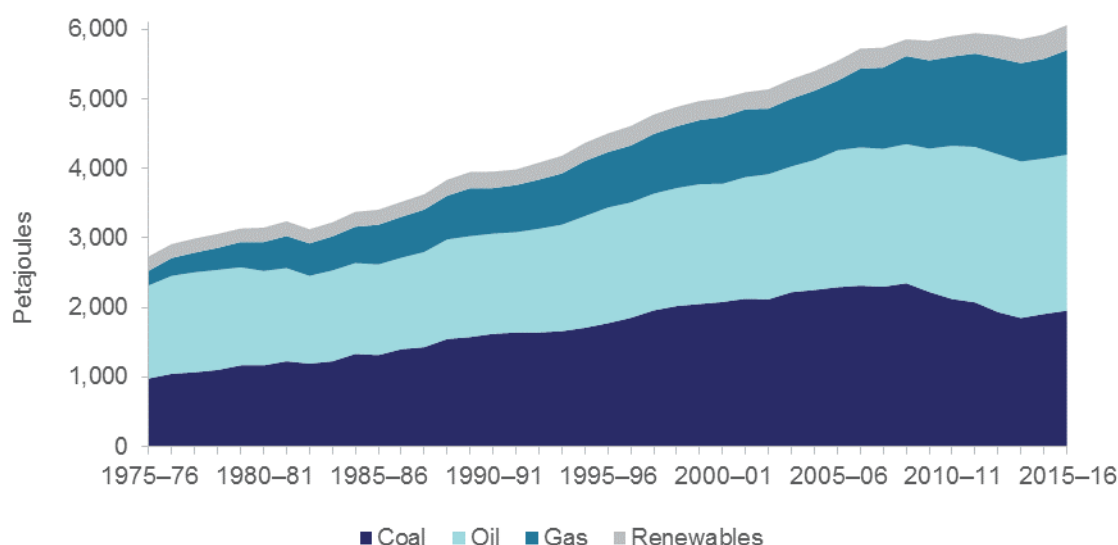
	2015–16		Average annual growth	
	PJ	share (per cent)	2015–16 (per cent)	10 years (per cent)
Coal	1,956.1	32.2	2.5	-1.9
Oil	2,243.3	37.0	0.3	1.3
Gas	1,504.9	24.8	4.9	3.2
Renewables	361.6	6.0	4.1	2.6
<b>Total</b>	<b>6,065.9</b>	<b>100.0</b>	<b>2.3</b>	<b>0.6</b>

Source: Department of the Environment and Energy (2017) *Australian Energy Statistics*, Table C

Coal remained the second largest fuel consumed in 2015–16, accounting for 32 per cent of energy consumption (Figure 3.2). After declining between 2008–09 and 2013–14, coal consumption increased over the last two years, including a rise of 2.5 per cent in 2015–16. The return to growth in coal consumption has been underpinned by increased black coal use in electricity generation. Brown coal consumption declined by 4 per cent in 2015–16 reflecting a contraction in electricity generation in South Australia and Victoria.

Despite the rise in the past two years, Australia's coal consumption remained around 17 per cent lower in 2015–16 than its peak in 2008–09, when its share of the energy mix was more than 40 per cent. Brown coal consumption in 2015–16 was around 14 per cent lower than in 2008–09.

Figure 3.2: Australian energy consumption, by fuel type



Source: Department of the Environment and Energy (2017) *Australian Energy Statistics*, Table C

Natural gas accounted for 25 per cent of energy consumption in 2015–16. Gas consumption rose by 5 per cent in 2015–16, supported by increased gas use in the mining sector in Queensland to support the expansion of LNG exports. In LNG production, around 9 per cent of gas flows are consumed by the plant during the liquefaction process, with the remainder exported as LNG. LNG plants accounted for approximately one-tenth of total Australian gas consumption in 2015–16 (Figure 3.3).

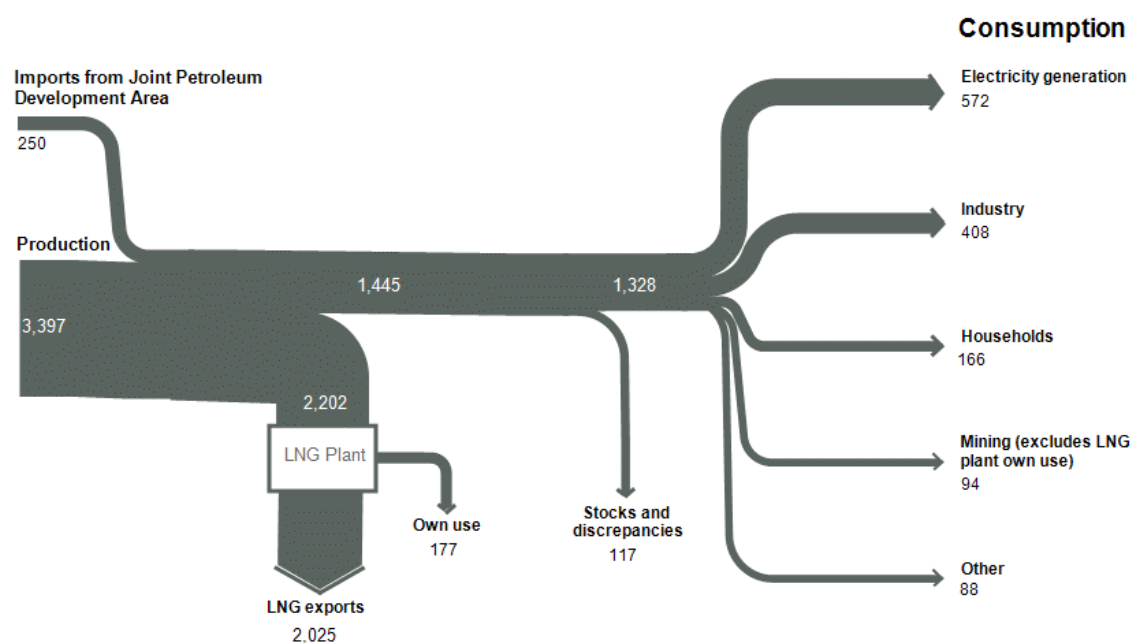
In contrast, a decline in gas consumption in 2015–16 was observed in the manufacturing sector, including in chemicals and petroleum refining.

Renewable energy sources accounted for the remaining 6 per cent of Australian energy consumption in 2015–16, comprising mainly biomass, hydro and wind energy. This includes renewable energy use for electricity generation, as well as direct use of renewables such as firewood for residential heating, bagasse use in manufacturing, and solar hot water.

In 2015–16, renewable energy consumption rose by 4 per cent, underpinned by growth in hydro, wind and solar (Table 3.2). Hydro rose by 14 per cent, as water availability improved. Wind energy continued to be a significant driver of growth in renewables, increasing by 6 per cent in 2015–16 as additional capacity came online. Solar PV use also grew strongly in 2015–16, by 24 per cent.



Figure 3.3: Natural gas flows, Australia, 2015–16



Unit: Petajoule (PJ)

Source: Department of the Environment and Energy (2017) *Australian Energy Statistics*, Tables A and F

Table 3.2: Australian renewable energy consumption, by fuel type

	2015-16		Average annual growth	
	PJ	share (per cent)	2015–16 (per cent)	10 years (per cent)
Biomass	198.1	54.8	1.6	-0.6
- wood, wood waste	93.3	25.8	3.8	-0.6
- bagasse	102.2	28.3	-0.7	-0.9
- other waste	2.5	0.7	19.1	na
Biogas	17.5	4.8	4.6	8.8
Biofuels	7.5	2.1	-34.4	12.6
- ethanol	6.2	1.7	-7.4	na
- biodiesel	1.2	0.3	-73.4	na
Hydro	55.1	15.3	13.9	0.6
Wind	43.9	12.1	6.4	18.7
Solar PV	24.6	6.8	23.6	59.1
Solar hot water	14.9	4.1	0.2	10.6
<b>Total</b>	<b>361.6</b>	<b>100.0</b>	<b>4.1</b>	<b>2.6</b>

Source: Department of the Environment and Energy (2017) *Australian Energy Statistics*, Tables D, F, O



### 3.3 Energy consumption, by sector

The electricity supply, transport and manufacturing sectors accounted for three-quarters of Australian energy consumption in 2015–16 (Table 3.3).

The electricity supply sector accounted for 29 per cent of Australia's energy consumption in 2015–16 (Table 3.3). Energy consumption in this sector (including fuel inputs to electricity generation, own use and losses) rose by 3 per cent during this period in response to increased electricity demand in the National Electricity Market (NEM) and off-grid, and an increase in the share of coal in the fuel mix.

When measuring primary energy consumption, an increase in coal fired electricity generation has a greater effect than an increase in renewable generation, because coal has a lower conversion efficiency. For example, if wind generation rises by 1,000 gigawatt hours, then energy consumption would rise by 3.6 petajoules, because the electricity generated rather than the wind itself is measured. If coal fired generation rises by 1,000 gigawatt hours, then energy consumption would increase by the amount of coal consumed to generate the electricity, which would be around 10 petajoules (assuming an efficiency of 35 per cent).

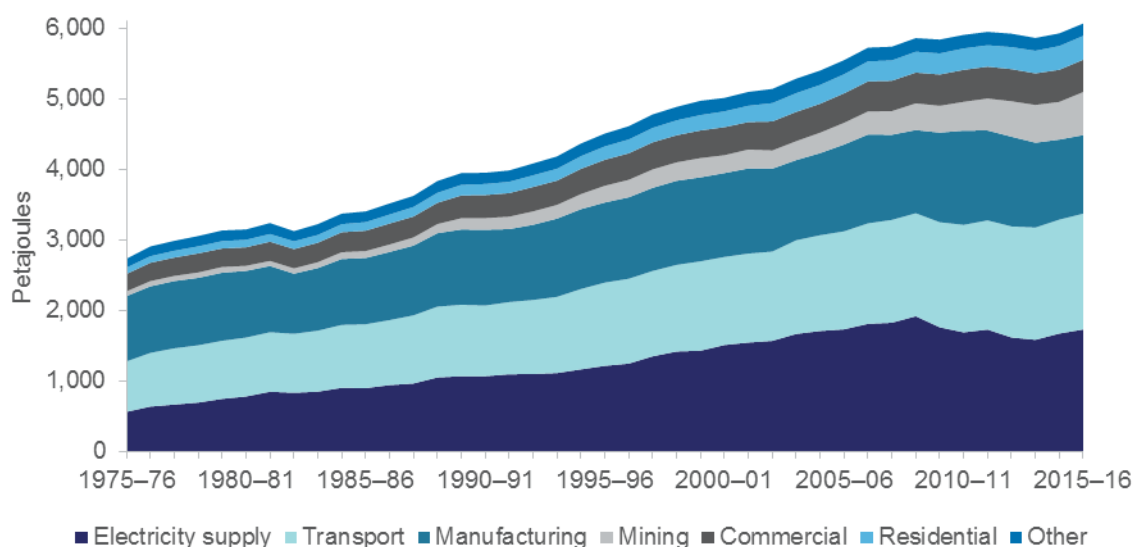
The transport sector accounted for 27 per cent of Australian energy consumption in 2015–16. Increased energy use in road and air transport resulted in a 2 per cent increase in the transport sector (Table 3.4). Road transport accounted for nearly three-quarters of energy consumption in the sector. Air transport, which accounted for a further 19 per cent of consumption, rebounded with an increase in activity, particularly for passenger air travel.

Table 3.3: Australian energy consumption, by industry

	2015–16		Average annual growth	
	PJ	share (per cent)	2015–16 (per cent)	10 years (per cent)
Electricity supply	1,755.7	28.5	3.4	-0.5
Transport	1,642.8	27.1	1.7	1.6
Manufacturing	1,114.4	18.4	-1.8	-1.3
Mining	610.0	10.1	14.2	7.2
Residential	457.4	7.5	0.3	0.8
Commercial	321.5	5.6	1.0	2.0
Agriculture	110.3	1.8	5.6	1.8
Construction	23.4	0.4	-8.6	-1.3
Other	30.5	0.7	-18.4	-6.3
<b>Total</b>	<b>6,065.9</b>	<b>100.0</b>	<b>2.3</b>	<b>0.6</b>

Source: Department of the Environment and Energy (2017) *Australian Energy Statistics*, Table E

Figure 3.4: Australian energy consumption, by sector



Source: Department of the Environment and Energy (2017) *Australian Energy Statistics*, Table E

Table 3.4: Australian transport energy consumption, by subsector

	2015–16		Average annual growth	
	PJ	share (per cent)	2015–16 (per cent)	10 years (per cent)
Road	1,189.8	72.4	0.9	1.3
Air	315.6	19.2	4.5	3.6
Rail	60.3	3.7	4.0	5.7
Water	48.6	3.0	1.4	-3.7
Other	28.5	1.7	3.5	-0.1
<b>Total</b>	<b>1,642.8</b>	<b>100.0</b>	<b>1.7</b>	<b>1.6</b>

Source: Department of the Environment and Energy (2017) *Australian Energy Statistics*, Table F

The manufacturing sector accounted for 18 per cent of energy consumption in 2015–16. Energy consumption in the manufacturing sector fell by 2 per cent in 2015–16, consistent with the declining trend in recent years (Table 3.5). This was mainly underpinned by a fall in energy use in the chemicals and rubber manufacturing sub-sector. Several fertiliser, pesticide and chemical plants closed in 2014 and 2015. Reduced demand from Australian motor vehicle manufacturers for rubber also contributed to the fall in the energy use in this sector.

Table 3.5: Australian manufacturing energy consumption, by subsector

	2015–16		Average annual growth	
	PJ	share (per cent)	2015–16 (per cent)	10 years (per cent)
Ferrous metals	117.4	10.5	0.1	-4.5
Non-ferrous metals	349.7	31.4	-0.4	-1.5
Chemicals	203.8	18.3	-7.3	1.3
Food, beverages and tobacco	161.1	14.5	-2.0	4.8
Petroleum refining a	78.6	7.1	-0.3	-6.9
Wood, paper and printing	62.2	5.6	3.0	-1.6
Cement	58.3	5.2	-3.1	-2.4
Other	83.4	7.5	0.0	-1.6
<b>Total</b>	<b>1,114.4</b>	<b>100.0</b>	<b>-1.8</b>	<b>-1.3</b>

Notes: a Energy consumption in petroleum refining equals total energy consumption of 1,098.3 PJ minus derived fuel production of 1,019.7 PJ. The derived fuel production is netted off to avoid double counting of this energy in other sectors.

Source: Department of the Environment and Energy (2017) *Australian Energy Statistics*, Table F

Energy consumption in the mining sector increased by 14 per cent in 2015–16 after a slight decline in energy use in 2014–15 (Table 3.6). A large part of this rebound in consumption was due to an increase in demand for gas and electricity to support growth in LNG exports from Gladstone in Queensland. Queensland LNG exports started in January 2015, with nameplate capacity now at 25 million tonnes (1,376 petajoules). The growth in production of these plants contributed to a trebling of energy consumption in Queensland's oil and gas sector during 2015–16. LNG plants accounted for 30 per cent of energy use in the mining sector in 2015–16.

Table 3.6: Australian mining energy consumption, by subsector

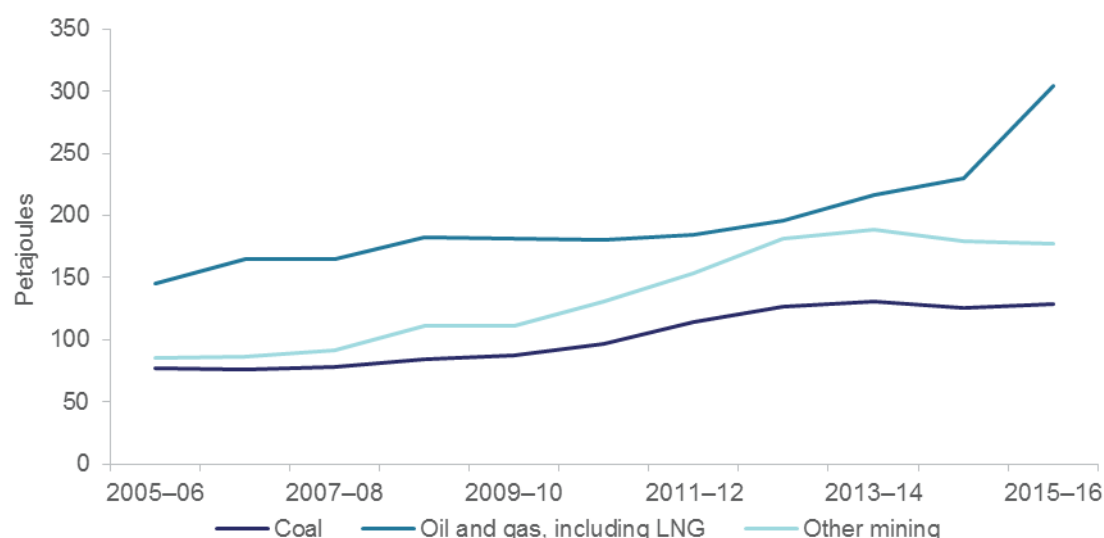
	2015–16		Average annual growth	
	PJ	share (per cent)	2015–16 (per cent)	10 years (per cent)
Oil and gas	304.2	49.9	32.4	7.0
- LNG	182.4	29.9	52.6	7.8
Coal	128.3	21.0	2.1	6.0
Other mining	177.4	29.1	-0.8	8.3
<b>Total</b>	<b>610.0</b>	<b>100.0</b>	<b>14.2</b>	<b>7.2</b>

Source: Department of the Environment and Energy (2017) *Australian Energy Statistics*, Table F.

Growth in consumption was also observed in Western Australia as new offshore oil and gas developments approached completion and in New South

Wales as a number of coal mines used more diesel to carry out expansion projects. Decreases in energy consumption were observed in other mining areas in Queensland, South Australia and the Northern Territory as prices for mineral commodities such as zinc, copper, nickel and iron ore remained relatively low during this period.

Figure 3.5: Australian energy consumption in mining



Source: Department of the Environment and Energy (2017) *Australian Energy Statistics*, Table F

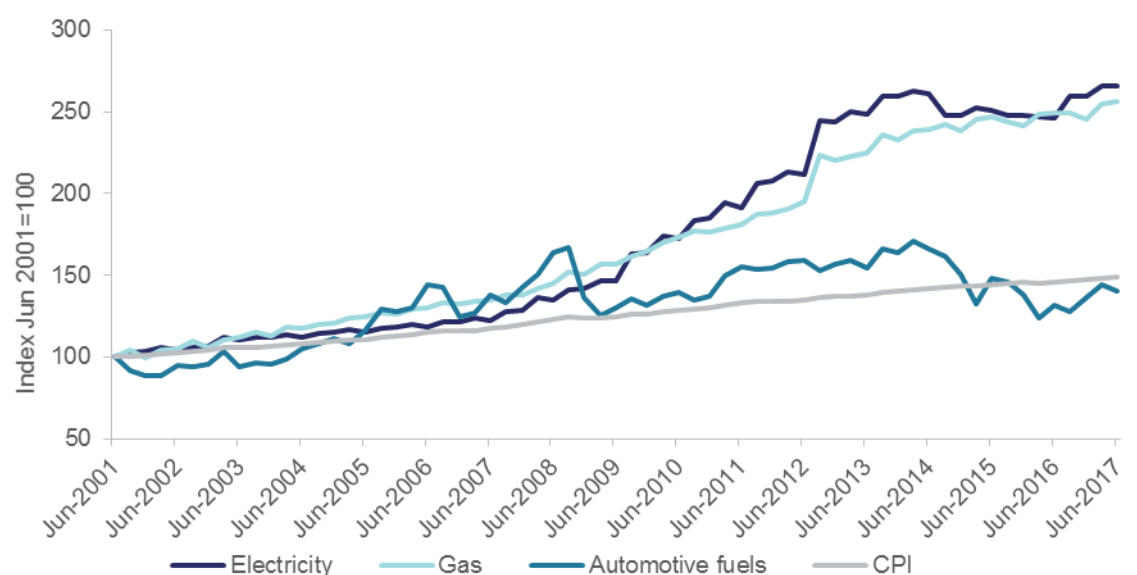
Energy consumption in the residential sector was relatively flat in 2015–16. Consumption in the residential sector includes the use of electricity generated from rooftop solar photovoltaic (PV) systems. In recent years, residential energy consumption has been relatively flat or in decline in response to higher electricity prices and adoption of more energy efficient practices, appliances and housing. Retail electricity prices for households in 2015–16 were relatively flat (Figure 3.6).

In the commercial and services sector, energy consumption rose moderately in 2015–16. The growth in electricity demand is attributed to hotter weather, which led to an increased demand for cooling in buildings. The number of cooling degree days, which is a measure of how much in degrees and for how long in days the outside air temperature was above a threshold, increased significantly across most states and territories in 2015–16.

### 3.4 Final energy consumption

Final energy consumption is the energy used by the final or end-use sectors, and is a subset of total energy consumption. 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 both excluded. Final energy consumption in 2015–16 increased by 2 per cent (Table 3.7).

Figure 3.6: Household energy price index



Source: Australian Bureau of Statistics (2017) *Consumer Price Index, Australia, June 2017*, 6401.1

Table 3.7: Australian total final energy consumption, by industry

	2015–16		Average annual growth	
	PJ	share (per cent)	2015–16 (per cent)	10 years (per cent)
Agriculture	110.3	2.7	5.5	1.8
Mining	610.0	14.8	14.2	7.2
Manufacturing	931.1	22.5	-2.3	-0.7
Construction	23.4	0.6	-8.5	-1.3
Transport	1,632.8	39.5	1.8	1.6
Commercial	339.3	8.2	1.0	2.0
Residential	457.4	11.1	0.3	0.8
Other	30.5	0.7	-23.4	-7.7
<b>Total</b>	<b>4,134.8</b>	<b>100.0</b>	<b>2.0</b>	<b>1.5</b>

Notes: Energy consumption in some sectors differs from Table 3.3 due to exclusion of energy used in conversion activities.

Source: Department of the Environment and Energy (2017) *Australian Energy Statistics*, Table H

### 3.5 Energy use, by state and territory

New South Wales, Queensland and Victoria were the largest energy consumers in 2015–16, accounting for nearly three-quarters of Australia's energy consumption (Table 3.8). Western Australia accounted for a further 18 per cent of energy consumption. In 2015–16, most growth in energy use was

in Western Australia, Queensland and New South Wales, while energy use in Victoria fell.

Table 3.8: Australian energy consumption, by state and territory

	2015–16		Average annual growth	
	PJ	share (per cent)	2015–16 (per cent)	10 years (per cent)
New South Wales a	1,518.2	25.0	3.2	-0.4
Victoria	1,416.9	23.4	-1.0	-0.1
Queensland	1,477.8	24.4	1.7	1.2
Western Australia	1,119.9	18.5	6.9	3.5
South Australia	334.0	5.5	2.4	-1.3
Tasmania	108.4	1.8	2.0	-0.5
Northern Territory	90.7	1.5	0.2	1.0
<b>Total</b>	<b>6,065.9</b>	<b>100.0</b>	<b>2.3</b>	<b>0.6</b>

Notes: a Includes Australian Capital Territory

Source: Department of the Environment and Energy (2017) *Australian Energy Statistics*, Table C

In Queensland, energy consumption increased by 2 per cent in 2015–16. Queensland's growing LNG industry has driven higher demand for gas and electricity. This growth was offset somewhat by a decline in energy use in the petroleum refining sector following the closure of Bulwer Island refinery, as well as lower gas use for electricity generation.

Energy consumption in Western Australia rose by 7 per cent in 2015–16. Growth in energy use in electricity generation, road transport and the mining sector outweighed a moderate decline in energy use in the chemicals sector. In New South Wales, energy consumption returned to growth, reflecting increased coal use for electricity generation in that state. This was offset slightly by lower energy use in the chemicals and road transport sectors.

South Australian energy consumption rose by around 2 per cent in 2015–16, with an increase in energy used for electricity generation offset slightly by a fall in mining energy use. Tasmanian energy consumption rose by 2 per cent, mainly reflecting an increase in gas and oil consumption for electricity generation following problems with the Basslink Interconnector which connects Tasmania to Victoria.

In Victoria, energy consumption fell marginally in 2015–16, reflecting a fall in brown coal use for electricity generation and in the chemicals and rubber manufacturing sector.

## 4. Energy production

### 4.1 Primary production

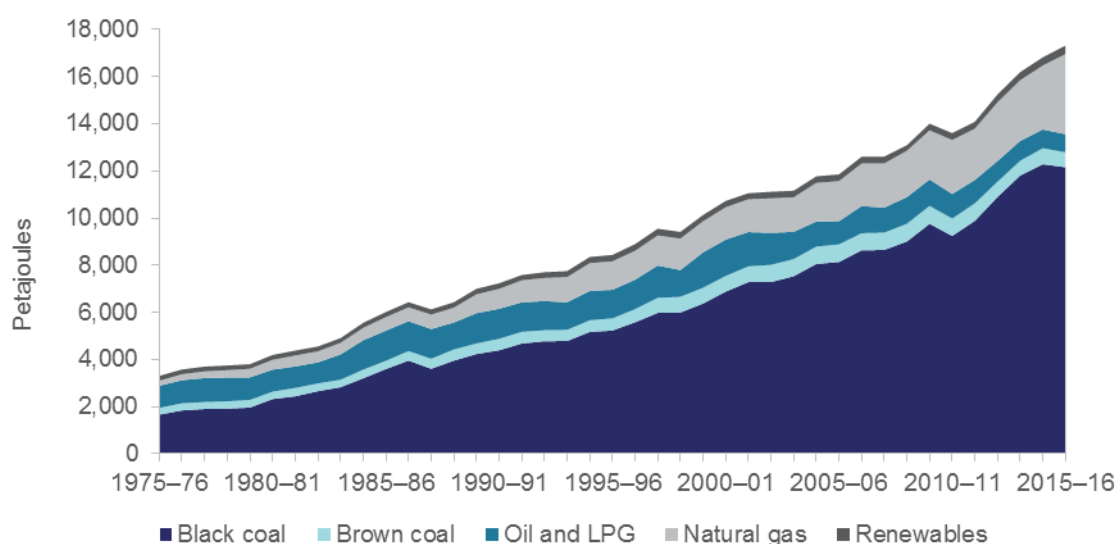
Energy production is defined as the total amount of primary energy produced in the Australian economy, measured before consumption or transformation. Forms of renewable energy that produce electricity directly without a thermal component, such as wind, hydro and solar PV, are considered primary energy sources. Coal-fired electricity generation is considered secondary energy production and is not included, as the coal is already accounted for when mined.

Domestic production of primary energy increased by 3 per cent in 2015–16, to reach 17,321 petajoules (Table 4.1). This is consistent with trends in energy production over the past decade (Figure 4.1). Production continued to become increasingly export-oriented. Australia is a net exporter of energy, including coal and natural gas, with net exports equal to around two-thirds of production (Figure 4.2). Australia also exports large volumes of uranium oxide.

Black coal production decreased by 1 per cent in 2015–16 to 12,157 petajoules (439 million tonnes), down from 12,288 petajoules in 2014–15. Production in Queensland and New South Wales was affected by closures and reductions at some mines, including due to bad weather and rock falls.

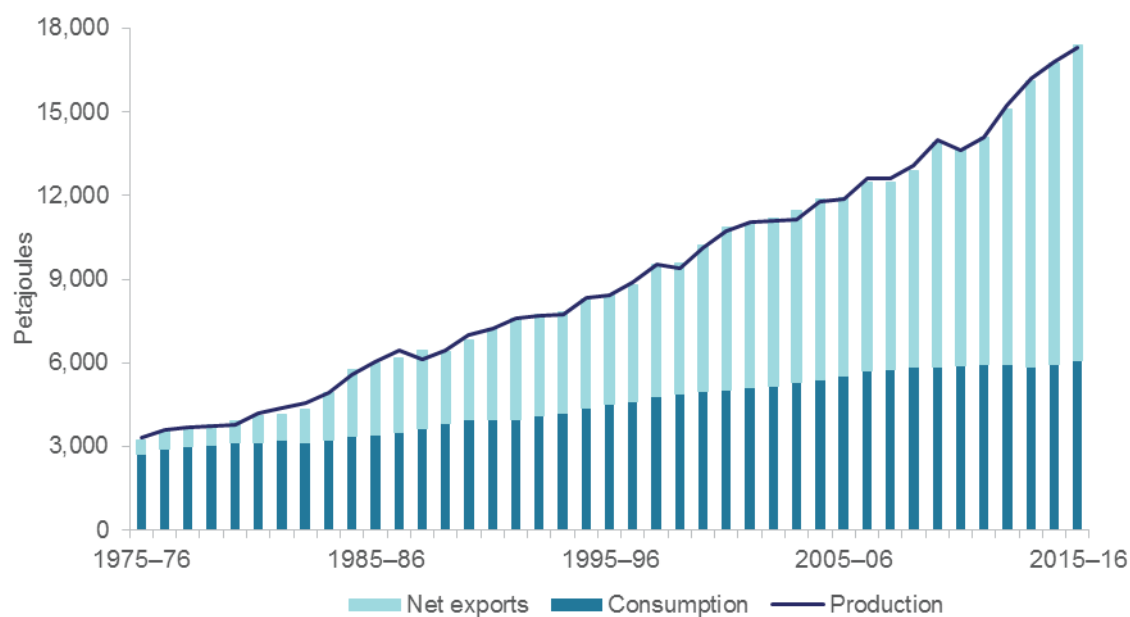
Brown coal production also fell in 2015–16, by 6 per cent to 635 petajoules (61 million tonnes). The level of production is now around 16 per cent lower than peak production in 2009–10. The fall in 2015–16 is in part due to the closure of the Leigh Creek coal mine in South Australia in November 2015, as well as a decline in Victorian production.

Figure 4.1: Australian energy production, by fuel type



Source: Department of the Environment and Energy (2017) *Australian Energy Statistics*, Table J

Figure 4.2: Australian energy balance



Source: Department of the Environment and Energy (2017) *Australian Energy Statistics*, Table J

Table 4.1: Australian energy production, by fuel type

	2015–16		Average annual growth	
	PJ	share (per cent)	2015–16 (per cent)	10 years (per cent)
Black coal	12,156.9	70.2	-1.1	3.9
Brown coal	634.9	3.7	-6.4	-1.5
Natural gas	3,396.6	19.6	27.1	7.3
Oil and NGL	680.6	3.9	-3.4	-4.5
LPG	90.3	0.5	0.6	-3.4
Renewables	361.6	2.1	4.1	2.6
<b>Total</b>	<b>17,320.9</b>	<b>100.0</b>	<b>3.2</b>	<b>3.6</b>

Source: Department of the Environment and Energy (2017) *Australian Energy Statistics*, Table J

Natural gas production rose by 27 per cent in 2015–16 to 3,397 petajoules (87 billion cubic metres) to support additional LNG export capacity in Queensland and Western Australia. Western Australia remained Australia's largest producer of natural gas, producing half of total gas production in 2015–16. Queensland gas production more than doubled in 2015–16, to account for 29 per cent of total production. In Victoria, production fell by 9 per cent, as production in the Otway Basin declined.

Production of coal seam gas increased significantly in 2015–16 to reach 955 petajoules (24 billion cubic metres) as new wells were drilled in Queensland to



support the expansion of LNG exports from Gladstone. Coal seam gas accounted for nearly 30 per cent of Australian gas production on an energy content basis, and over 60 per cent of east coast gas production in 2015–16.

Australia produced 681 petajoules (18 billion litres) of crude oil and natural gas liquids in 2015–16, a decline of 3 per cent relative to the previous year. The fall in output was largely the result of continued declines in production at mature fields in the eastern states.

Renewable energy production increased by 4 per cent in 2015–16 to reach 362 petajoules, with a slight decline in bagasse production partially offsetting continued growth in wind and solar PV, as well as a rebound in hydro. Renewable energy accounted for 2 per cent of total energy production in 2015–16, similar to its share in recent years.

Australia also produces uranium oxide, which is exported for use in nuclear power plants overseas. Uranium production increased by 18 per cent in 2015–16 to 7,665 tonnes, which is equivalent to around 3,603 petajoules. The growth in production came from a restart in production at the Four Mile mine in South Australia in September 2015, and production increasing at the Olympic Dam and Ranger mines following disruptions in 2014–15. For the purposes of calculating primary energy production, uranium oxide is not included. Instead, the heat content of the steam leaving the nuclear reactor for the turbine is counted, which is not applicable for Australia.

## 4.2 Electricity generation

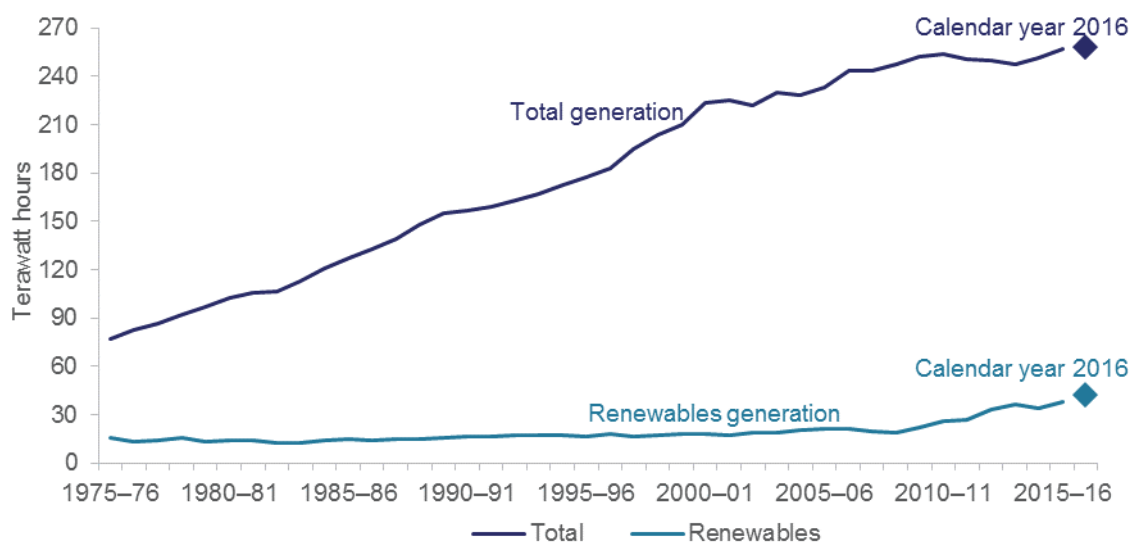
In 2015–16 total electricity generation in Australia increased by 2 per cent again, similar to growth in 2014–15. This followed three consecutive years of decline (Figure 4.3). Total electricity generation was 257 terawatt hours (927 petajoules) in 2015–16, the highest total generation on record for Australia. The return to growth in 2014–15 reflected increased demand for electricity, including in the commercial and residential sectors. In 2015–16, growth in demand has largely come from the mining sector.

This figure captures all electricity generation in Australia. In addition to power plants, it includes rooftop solar PV generation, generation by industrial facilities such as in mining and manufacturing, and off-grid generation.

Electricity generation decreased in 2015–16 in Queensland (by 1 per cent) and Victoria (by 4 per cent), but increased in all other states and territories. Generation in the National Electricity Market (NEM) states increased by 2 per cent overall in 2015–16. In part, this growth reflects continued expansion in off-grid and behind-the-meter generation. Off-grid electricity generation accounted for an estimated 19 per cent of total generation in 2015–16, up from 17 per cent in 2014–15.

Coal remained the major fuel source for electricity generation in 2015–16, with its share in the fuel mix increasing slightly to 63.4 percent, up from 62.8 per cent in 2014–15 and 61.2 per cent in 2013–14 (Table 4.2). However, this was still well below its share of more than 80 per cent at the beginning of the century (Figure 4.4).

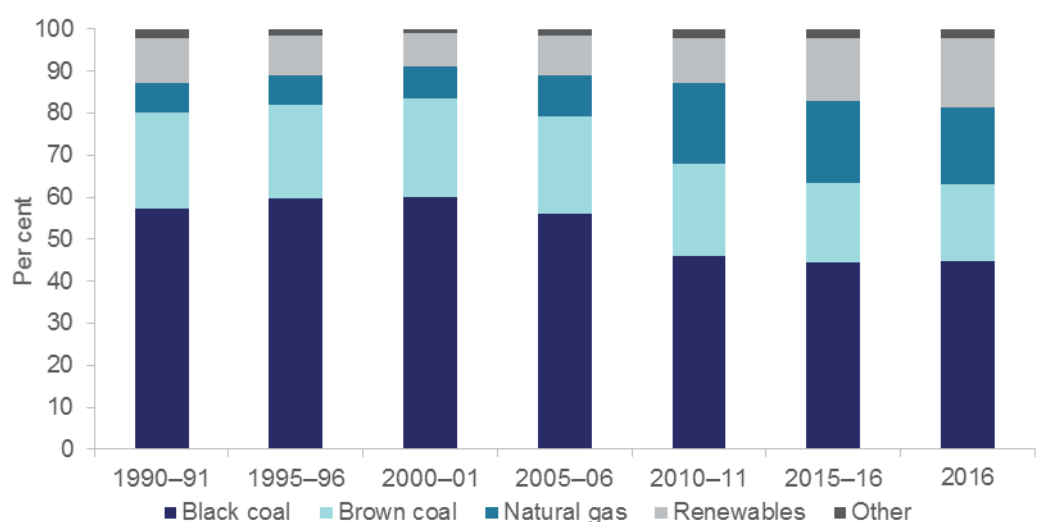
Figure 4.3 Australian electricity generation



Source: Department of the Environment and Energy (2017) *Australian Energy Statistics*, Table O and L

Coal fired generation increased in New South Wales, Western Australia and Queensland in 2015–16, with black coal fired generation rising by 6 percent. However, brown coal fired generation declined by 4 per cent in 2015–16. While coal fired generation in Australia also increased in 2014–15, it followed seven consecutive years of decline in black coal fired generation and five in brown. The decline in brown coal use in 2015–16 reflects the recent closure of capacity in South Australia and Victoria. The switching to black coal reflects higher prices for gas.

Figure 4.4: Australian electricity generation fuel mix



Source: Department of the Environment and Energy (2017) *Australian Energy Statistics*, Table O

Table 4.2: Australian electricity generation, by fuel type

	2015–16		Average annual growth	
	GWh	share (per cent)	2015–16 (per cent)	10 years (per cent)
<b>Fossil fuels</b>	<b>219,283</b>	<b>85.2</b>	<b>0.4</b>	<b>-0.1</b>
Black coal	114,295	44.4	6.2	-1.6
Brown coal	48,796	19.0	-4.3	-1.2
Gas	50,536	19.6	-4.5	5.3
Oil	5,656	2.2	-17.2	7.7
<b>Renewables</b>	<b>38,146</b>	<b>14.8</b>	<b>12.1</b>	<b>6.8</b>
Hydro	15,318	6.0	13.9	0.6
Wind	12,199	4.7	6.4	18.7
Bioenergy	3,790	1.5	5.5	-0.5
- bagasse	1,810	0.7	na	na
- wood, woodwaste	248	0.1	na	na
- municipal, industrial waste	43	0.0	na	na
- sulphyte lyes, biofuels	417	0.2	na	na
- landfill biogas	1,061	0.4	na	na
- sludge biogas	211	0.1	na	na
Solar PV	6,838	2.7	23.6	59.1
- small scale	6,381	2.5	17.6	57.9
- large scale	457	0.2	326.4	na
Geothermal	0	0	-64.1	-8.9
<b>Total</b>	<b>257,429</b>	<b>100.0</b>	<b>2.0</b>	<b>0.6</b>

Source: Department of the Environment and Energy (2017) *Australian Energy Statistics*, Table O

Natural gas fired generation decreased by 4 per cent in 2015–16, to account for 20 per cent of Australia's electricity generation. Generation fell in all states except for Tasmania and the Northern Territory. This overall general decline reflects the closure of some gas-fired power stations and higher gas prices. Tasmania was forced to turn back on the Tamar Valley power station in 2015–16, after allowing it to remain dormant for over a year, due to low dam levels, and problems with the Basslink Interconnector which connects Tasmania to Victoria.

Oil fired generation decreased in 2015–16, to 2.2 per cent of Australia's electricity generation, down from 2.6 per cent in 2014–15. This decline occurred across all states except Queensland (where it remained relatively flat) and Tasmania, where an increase of 370 per cent can be attributed to the same factors that led to the increase in gas fired generation in that state.

Renewable energy accounted for 15 per cent of Australia's electricity generation in 2015–16. Renewable generation increased by 12 per cent in 2015–16, driven by increases in hydro, wind and solar, which increased by 14 per cent, 6 per cent, and 24 per cent respectively. This is mainly attributable to

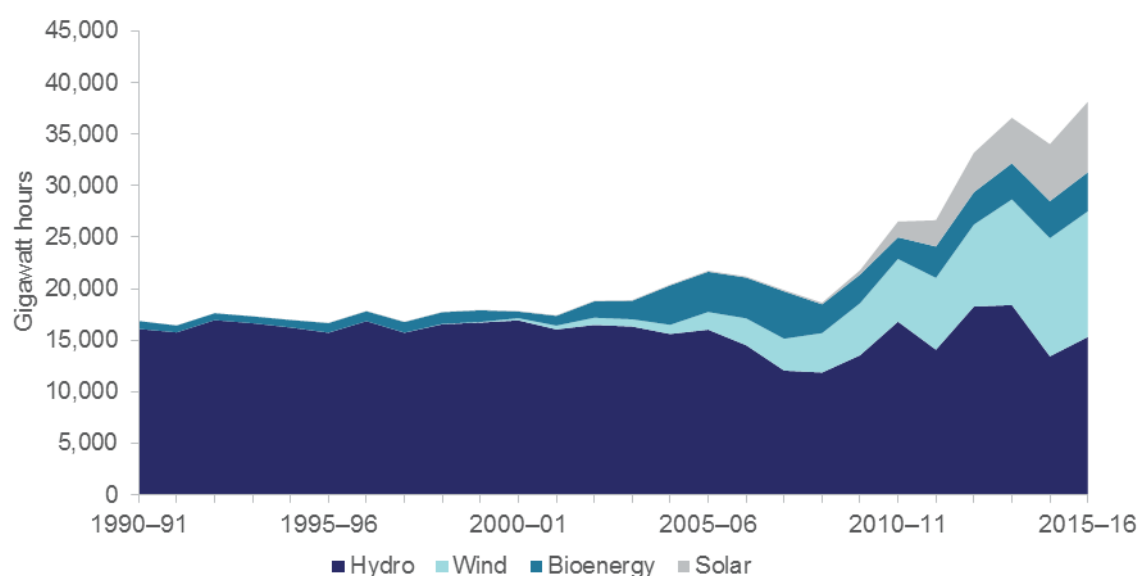
dam levels recovering after dry spells in the previous year, and additional investment in renewable capacity supported by the Renewable Energy Target.

Hydro continues to be the largest contributor to renewable generation, with a 40 per cent share of renewable generation in 2015–16. This compares with 95 per cent in 2000–01, with the composition of renewable energy in Australia diversifying significantly as wind and to a lesser extent solar capacity has come online (Figure 4.5).

Wind was a close second behind hydro in its contribution to renewable generation in 2015–16, contributing 32 per cent of renewable electricity and 5 per cent of total electricity generation in Australia. Wind generation rose by 6 per cent in 2015–16. Wind generation continues to be particularly prevalent in South Australia, accounting for over one-third of the total generation mix in that state in 2015–16.

Solar generation also continued to grow strongly in 2015–16, by 24 per cent, and accounted for 3 per cent of total electricity generation in Australia. The largest growth occurred in large-scale solar installations that have come online in New South Wales, including the Broken Hill and Moree solar farms. However, this growth was from a small base, and rooftop solar PV installations continue to make up the vast majority of total solar generation in Australia.

Figure 4.5: Australian electricity generation from renewable sources



Source: Department of the Environment and Energy (2017) *Australian Energy Statistics*, Table O

### 4.3 Electricity generation in calendar year 2016

In May 2017, estimates of electricity generation were published for the 2016 calendar year, to improve the availability of up-to-date official data on total generation in Australia. Total electricity generation in Australia was estimated to be 258,057 gigawatt hours in calendar year 2016, an increase of approximately 1 per cent compared with 2015 (Table 4.3).

Non-renewable sources contributed 216,034 gigawatt hours (84 per cent) of total electricity generation in 2016, a decrease of 1.5 per cent compared with 2015. Coal continued to account for the majority of electricity generation, at 63 per cent of total generation in 2016. Gas fired generation continued to fall in 2016, to represent 18 per cent of total generation.

Renewable sources contributed 42,022 gigawatt hours, or more than 16 per cent of total electricity generation in 2016, an increase of nearly 17 per cent compared with 2015. The largest source of renewable generation was hydro (7 per cent of total generation), followed by wind (5 per cent) and solar (3 per cent).

Generation varies quite a lot across Australia. In 2016, more than 70 per cent of electricity generation in Queensland, New South Wales and Victoria was coal fired (Figure 4.6). In Victoria, brown coal's share was 85 per cent in 2016. This does not include the closure of Hazelwood in early 2017. Gas accounted for majority of generation in Western Australia and Northern Territory, and Western Australia accounted for nearly half of Australia's gas fired generation in 2016.

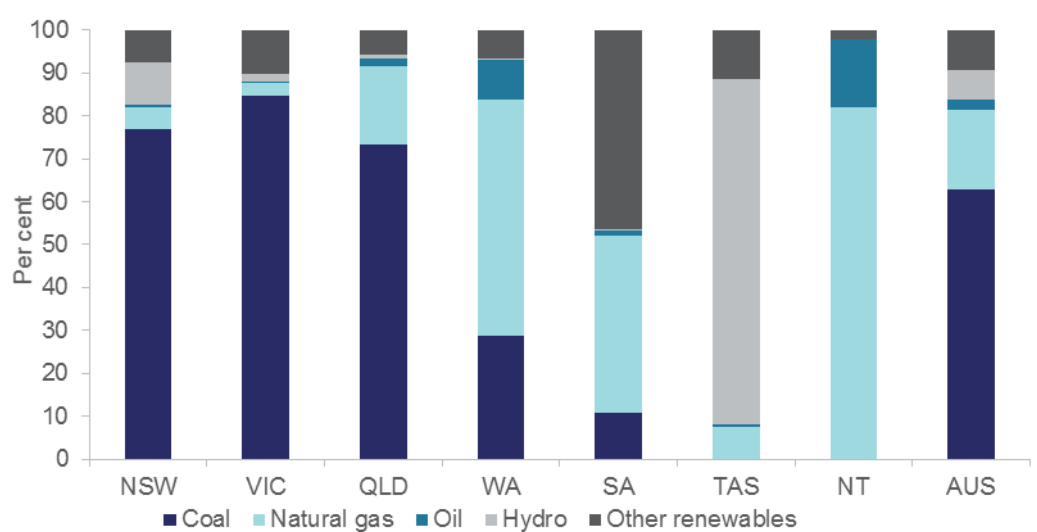
Renewable energy's share was 92 per cent in Tasmania and 47 per cent in South Australia in 2016. In Tasmania, it was mainly hydro. Wind accounted for 47 per cent of South Australia generation in 2016, but South Australia accounted for only 35 per cent of total wind generation. Victoria also accounted for nearly 30 per cent of wind generation.

Table 4.3: Australian electricity generation, by fuel type , 2016

	2016	
	GWh	share (per cent)
<b>Fossil fuels</b>	<b>216,034.9</b>	<b>83.7</b>
Black coal	115,392.6	44.7
Brown coal	46,979.4	18.2
Gas	47,694.1	18.5
Oil	5,968.8	2.3
<b>Renewables</b>	<b>42,022.1</b>	<b>16.3</b>
Hydro	17,925.0	6.9
Wind	12,973.0	5.0
Bioenergy	3,712.6	1.4
Solar PV small scale	6,847.5	2.7
Solar PV large scale	563.8	0.2
Geothermal	0.2	0.0
<b>Total</b>	<b>258,057.0</b>	<b>100.0</b>

Source: Department of the Environment and Energy (2017) *Australian Energy Statistics*, Table O

Figure 4.6: Australian electricity generation fuel mix, 2016



Source: Department of the Environment and Energy (2017) *Australian Energy Statistics*, Table O

## 5. Energy trade

### 5.1 Exports

Australia exports a significant proportion of its energy production. Around 90 per cent of black coal production was exported in 2015–16, as was around three-quarters of crude oil production and around 60 per cent of natural gas production. Australia's energy exports rose by 4 per cent in 2015–16 to reach 13,638 petajoules, supported by a large increase in LNG exports (Table 5.1; Figure 5.1).

Exports of black coal fell slightly in 2015–16 in energy content terms, to 11,001 petajoules (around 389 million tonnes), in part due to lower demand from major trading partners such as China. On average, coal exports have grown by 5 per cent a year over the past decade, with strong global demand, particularly from Asia, stimulating investment in a number of expansions and new mine and infrastructure capacity.

LNG exports increased by 47 per cent in 2015–16, to 2,025 petajoules (around 37 million tonnes), as new export capacity on the east coast expanded. Exports of LNG have increased by 11 per cent a year over the past decade, supported by two additional LNG trains at the North West Shelf (in 2004 and 2008), the start-up of Darwin LNG in 2006, Pluto LNG in 2012, QCLNG in late 2014 (with a second train in late 2015), GLNG and APLNG in late 2015, and Gorgon LNG in early 2016.

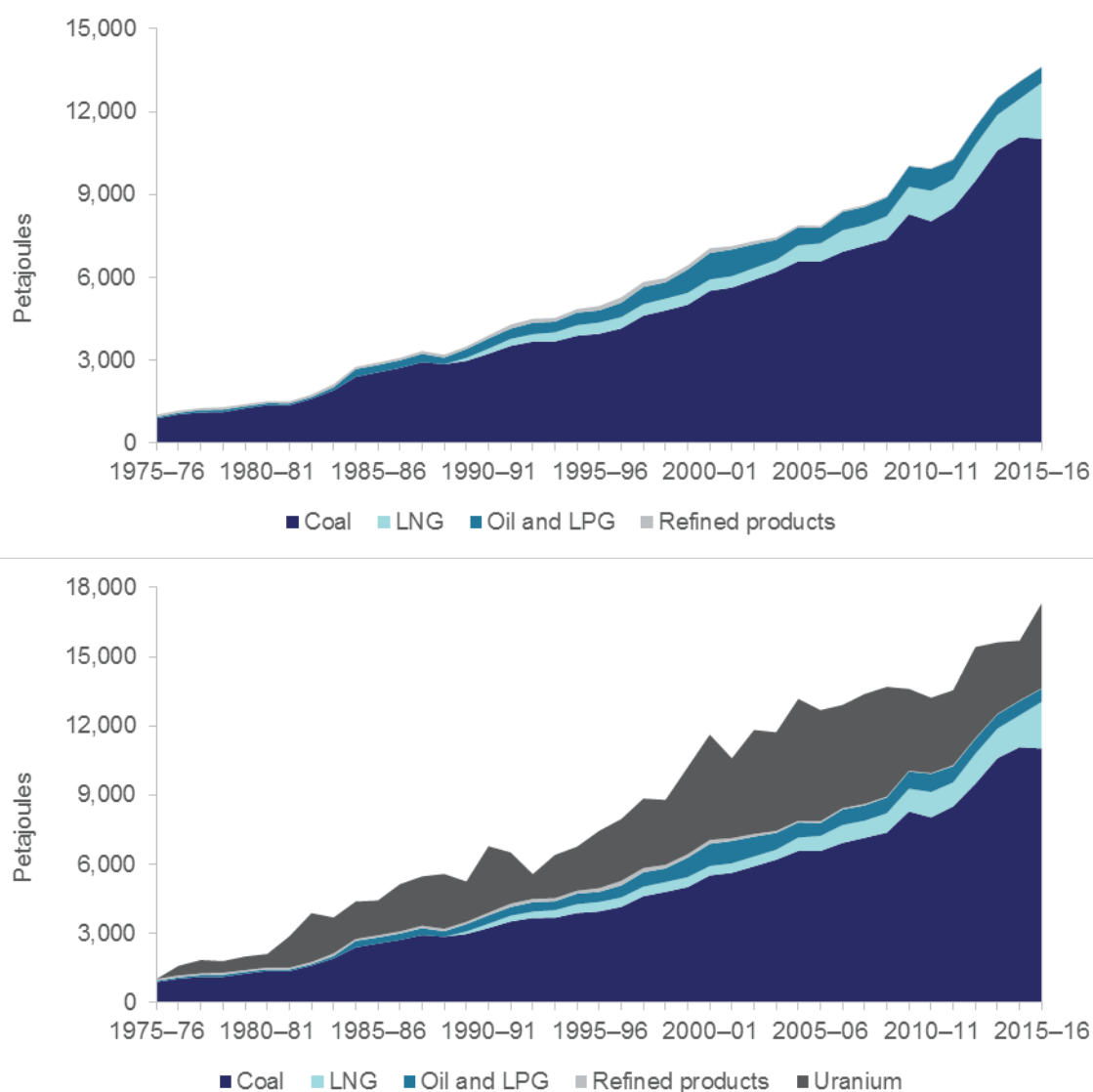
Crude oil exports fell by 8 per cent in 2015–16 to 514 petajoules (14 billion litres), reflecting the impact of lower production from the Carnarvon Basin, partly due to maintenance work in the June quarter of 2016.

Table 5.1: Australian energy exports, by fuel type

	2015–16		Average annual growth	
	PJ	share (per cent)	2015–16 (per cent)	10 years (per cent)
Black coal	11,001.1	80.7	- 0.6	5.3
Coke	20.4	0.1	10.5	na
LNG	2,025.4	14.9	46.5	11.2
Crude oil	514.0	3.8	- 8.3	- 1.5
LPG	53.7	0.4	- 5.8	- 3.8
Refined products	23.3	0.2	- 8.0	- 10.5
<b>Total</b>	<b>13,637.9</b>	<b>100.0</b>	<b>4.1</b>	<b>5.5</b>

Source: Department of the Environment and Energy (2017) *Australian Energy Statistics*, Table J

Figure 5.1: Australian energy exports, by fuel type



Source: Department of the Environment and Energy (2017) *Australian Energy Statistics*, Table J

Australia also exports uranium oxide, which is enriched overseas for use in nuclear power plants. Uranium exports rose by 43 per cent in 2015–16, to 7,837 tonnes, which has an energy content of around 3,683 petajoules. This growth reflects a restart in production from the Four Mile mine, and increased production Olympic Dam and Ranger mines following disruptions the previous year. While Australia exports all of its uranium production, production and export figures can differ due to stockpiling.

## 5.2 Imports

Australia's energy imports increased by 1 per cent in 2015–16, to 2,291 petajoules, although as with recent years, this masked large movements in individual fuels. Refined products and crude oil remained Australia's largest energy imports (Figure 5.2). Natural gas from the Joint Petroleum Development Area in the Timor Sea, which is liquefied at Darwin before being re-exported,

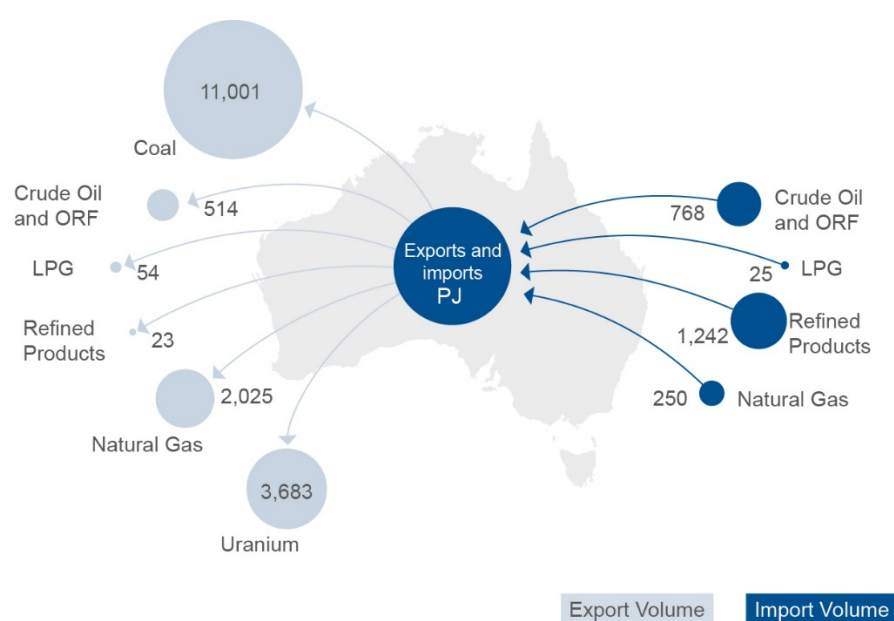


was the third largest energy import. Australia also imports small volumes of coke and brown coal briquettes.

Imports of crude oil declined by 20 per cent in 2015–16, to 768 petajoules (around 20 billion litres) in line with the closure of domestic refining capacity at Bulwer Island in May 2015 (Table 5.2).

Australia imports a relatively large proportion of its refinery feedstocks, with most of Australia's oil production occurring off the north-west coast, some distance from most domestic refining capacity on the east coast. In addition, domestically produced grades of crude oil are generally not as well suited for use by local refineries as those sourced from other countries. Imports accounted for about three-quarters of total refinery input in 2015–16.

Figure 5.2: Australian energy trade, 2015–16



Source: Department of the Environment and Energy (2017) *Australian Energy Statistics*, Table J

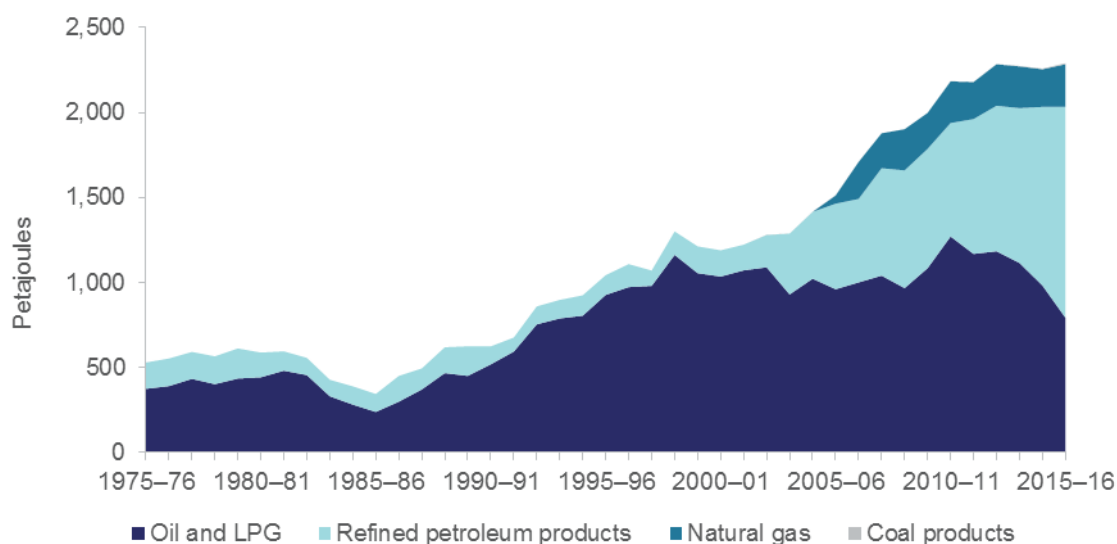
Table 5.2: Australian energy imports, by fuel type

	2015–16		Average annual growth	
	PJ	share (per cent)	2015–16 (per cent)	10 years (per cent)
Crude oil	768.2	33.5	-19.7	- 2.7
LPG	24.8	1.1	-4.2	2.3
Refined products	1,241.8	54.2	18.2	10.9
Natural gas	250.2	10.9	12.9	1.6
Coal products	6.0	0.3	70.8	18.3
<b>Total</b>	<b>2,291.0</b>	<b>100.0</b>	<b>1.4</b>	<b>3.3</b>

Source: Department of the Environment and Energy (2017) *Australian Energy Statistics*, Table J

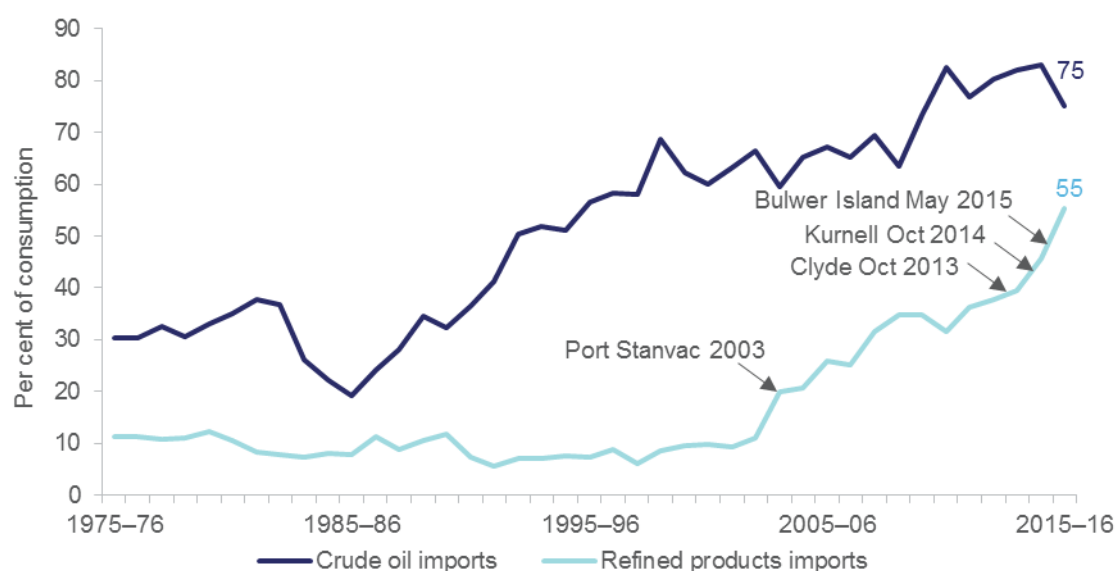
The decline in domestic refining capacity, along with growth in demand, also contributed to an increase in imports of refined products. Refined product imports, excluding LPG, grew by 18 per cent in 2015–16, reaching 1,242 petajoules (around 33 billion litres) (Figure 5.3). This continues the longer-term trend towards imported refined products, which have grown by an average of 11 per cent a year over the last decade and now account for around 55 per cent of total refined product consumption (Figure 5.4).

Figure 5.3: Australian energy imports, by fuel type



Source: Department of the Environment and Energy (2017) *Australian Energy Statistics*, Table J

Figure 5.4: Share of imports in total consumption of crude and refined products



Source: Department of the Environment and Energy (2017) *Australian Energy Statistics*, Tables J and D

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