



Energy in Australia 2010



Australian Government
Department of Resources
Energy and Tourism

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Securing access to affordable, reliable and clean energy is one of the great challenges facing governments around the world. The Australian Government is committed to ensuring the security of Australia's domestic energy systems as a fundamental part of Australia's social and economic prosperity.

With the International Energy Agency predicting world primary energy demand to increase by 40 per cent by 2030, we must ensure that Australia, as a leading exporter of resources and energy, is equipped to supply its share of this demand. We must also ensure that the Australian community derives the benefits from the use of our resources, and therefore the responsible use and management of our resources is a key policy objective of the government.

Energy in Australia 2010 is a key reference for anyone with an interest in Australian energy issues. It provides a detailed overview of energy in Australia from production to consumption, and serves as a useful resource to inform industry, government and the community.

The Australian Government is committed to encouraging the diversification and strengthening of our generation base in the energy sector. The \$4.5 billion Clean Energy Initiative is evidence of this commitment, with funding toward the establishment of innovative flagship programs to turn emerging clean energy technologies into large-scale commercial projects.

We are also working to encourage investment and development in our energy resources sector to intensify the exploration and development of our oil and gas provinces and thereby assist in bringing new supplies on-line.

Continued reforms to the demand and supply side of Australia's gas and electricity markets will increase their efficiency and continue to ensure the reliability of supply to Australian households and industry.

Against a strengthening global economic backdrop and increasing demand for energy exports, Australia must continue to address the issue of domestic energy security. *Energy in Australia 2010* is a valuable resource as we work to secure Australia's future energy needs.



A handwritten signature in black ink, appearing to read 'M Ferguson', with a long horizontal flourish extending to the right.

The Hon. Martin Ferguson AM MP
Minister for Resources and Energy



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Abbreviations and principal sources of energy information

| | |
|-------|---|
| ABARE | Australian Bureau of Agricultural and Resource Economics |
| AEMO | Australian Energy Market Operator |
| DOE | Department of Energy (United States) |
| EIA | Energy Information Administration (US DOE) |
| ESAA | Energy Supply Association of Australia |
| IEA | International Energy Agency |
| LNG | liquefied natural gas (principally methane) |
| LPG | liquefied petroleum gas (principally propane and butane) |
| NGL | natural gas liquid hydrocarbons, other than methane, derived from the natural gas stream in separation and/or liquefaction facilities |
| OECD | Organisation for Economic Cooperation and Development |
| ORF | other refinery feedstock |
| RET | Department of Resources, Energy and Tourism |

| | |
|---|--|
| Apelbaum Consulting Group | www.apelbaumconsulting.com.au |
| ABARE | www.abare.gov.au |
| Australian Bureau of Statistics | www.abs.gov.au |
| Australian Energy Market Operator | www.aemo.com.au |
| Australian Financial Markets Association | www.afma.com.au |
| Australian Institute of Petroleum | www.aip.com.au |
| BP Statistical Review of World Energy | www.bp.com |
| Clean Energy Council | www.cleanenergycouncil.org.au |
| Department of Climate Change | www.climatechange.gov.au |
| Department of Resources, Energy and Tourism | www.ret.gov.au |
| Energy Information Administration | www.eia.doe.gov |
| Energy Networks Association | www.ena.asn.au |
| Energy Supply Association of Australia | www.esaa.com.au |
| Geoscience Australia | www.ga.gov.au |
| International Energy Agency | www.iea.org |
| Global-ream Pty Ltd | www.nem-review.info |
| Office of the Renewable Energy Regulator | www.rec-registry.gov.au |
| Ozmine | www.ozmine.com.au |
| Platts (McGraw Hill) | www.platts.com |
| Ports Australia | www.portsaustralia.com.au |
| Uranium Information Centre | www.uic.com.au |

Glossary



| | |
|---|--|
| Bagasse | The fibrous residue of the sugar cane milling process that is used as a fuel (to raise steam) in sugar mills. |
| Biogas | Landfill (garbage tips) gas and sewage gas. Also referred to as biomass gas. |
| Brown coal | (see lignite) |
| Coal byproduct | Byproducts such as blast furnace gas (from iron and steel processing), coal tar and benzene/toluene/xylene (BTX) feedstock and coke oven gas (from the coke making process). |
| Coal seam gas | Methane held within coal deposits, bonded to coal under the pressure of water. It may also contain small amounts of carbon dioxide and nitrogen (also referred to as coal seam methane and coal bed methane). |
| Conversion | The process of transforming one form of energy into another (derived) form before final end use. Energy used in conversion is the energy content of fuels consumed as well as transformed by energy producing industries. Examples are natural gas and liquefied petroleum gas used in town gas manufacturing, all hydrocarbons used as feedstocks in oil refineries, and all fuels (including electricity) used in powerstations — therefore, energy used in conversion also includes energy lost in the production, conversion and transport of fuels (such as energy lost in coke production) plus net energy consumed by pumped storage after allowance for the energy produced. |
| Crude oil | Naturally occurring mixture of liquid hydrocarbons under normal temperature and pressure. |
| Condensate | Hydrocarbons recovered from the natural gas stream that are liquid under normal temperature and pressure. |
| Conventional gas | Generally refers to methane held in a porous rock reservoir frequently in combination with heavier hydrocarbons. It may contain small amounts of ethane, propane, butane and pentane as well as impurities such as sulphur dioxide, and inert gases such as nitrogen. |
| Derived or secondary fuels | Fuels produced or derived by conversion processes to provide the energy forms commonly consumed. They include petroleum products, thermal electricity, town gas, coke, coke oven gas, blast furnace gas and briquettes. |
| Economic demonstrated resources | The quantity of resources that is judged to be economically extractable under current market conditions and technologies. |
| Electricity capacity utilisation | Actual electricity generation output as a proportion of generation capacity. |

| | |
|---|---|
| Electricity generation capacity | The maximum technically possible electricity output of generators at a given hour. The maximum annual output from generators is equal to generation capacity multiplied by the number of hours in a year. |
| Lignite | Non-agglomerating coals with a gross calorific value less than 17 435 kJ/kg, including brown coal which is generally less than 11 000 kJ/kg. |
| Liquid fuels | All liquid hydrocarbons, including crude oil, condensate, liquefied petroleum gas and other refined petroleum products. |
| Natural gas | Methane that has been processed to remove impurities to a required standard for consumer use. It may contain small amounts of ethane, propane, carbon dioxide and inert gases such as nitrogen. In Australia natural gas comes from conventional gas and coal seam gas. Landfill and sewage gas are some other potential sources (also referred to as sales gas in some sectors of the gas industry). |
| Petajoule | 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, or 278 gigawatt hours, is the heat energy content of about 43 000 tonnes of black coal or 29 million litres of petrol. |
| Petroleum | Generic term for all hydrocarbon oils and gases, including refined petroleum products. |
| Petroleum products | All hydrocarbons used directly as fuel. These include liquefied petroleum gas, refined products used as fuels (aviation gasoline, automotive gasoline, power kerosene, aviation turbine fuel, lighting kerosene, heating oil, automotive diesel oil, industrial diesel fuel, fuel oil, refinery fuel and naphtha) and refined products used in nonfuel applications (solvents, lubricants, bitumen, waxes, petroleum coke for anode production and specialised feedstocks). |
| Primary fuels | The forms of energy obtained directly from nature. They include nonrenewable fuels such as black coal, lignite, uranium, crude oil and condensate, naturally occurring liquefied petroleum gas, ethane and methane, and renewable fuels such as wood, bagasse and municipal waste gas, hydro and wind power, solar and geothermal energy. |
| Total final energy consumption | The total amount of energy consumed in the final or 'end use' sectors. It is equal to total primary energy consumption less energy consumed or lost in conversion, transmission and distribution. |
| Total primary energy consumption | Also referred to as total domestic availability. The total of the consumption of each primary fuel (in energy units) in both the conversion and end use sectors. It includes the use of primary fuels in conversion activities — notably the consumption of fuels used to produce petroleum products and electricity. It also includes own use and losses in the conversion sector. |

Units

| | |
|----|----------------------------|
| J | joule |
| L | litre |
| t | tonne |
| g | gram |
| W | watt |
| Wh | watt-hour |
| b | billion (10 ⁹) |

Metric prefixes

| | | |
|---|------|--------------------------------|
| k | kilo | 10 ³ (thousand) |
| M | mega | 10 ⁶ (million) |
| G | giga | 10 ⁹ (1000 million) |
| T | tera | 10 ¹² |
| P | peta | 10 ¹⁵ |
| E | exa | 10 ¹⁸ |

Other abbreviations

| | |
|----------------|-------------------------------------|
| bcm | billion cubic metres |
| m ³ | cubic metre |
| bbl | barrel |
| Mtoe | million tonnes of oil equivalent |
| na | not available |
| pa | per annum |

Conversion factors

1 barrel = 158.987 L

1 kWh = 3600 kJ

1 mtoe (million tonnes of oil equivalent) = 41.868 PJ

1 MBTU = 1055 MJ (BTU = British Thermal Unit)

1 m³ = 35.515 cubic feet

1 L propane liquid = 0.272m³ gas

1 L butane liquid = 0.235 m³ gas

1 L LNG = 0.625 m³ natural gas

Indicative energy contents of fuels are listed at the end of the publication.

Conventions used in tables and figures

0.0 is used to denote a negligible amount. Small discrepancies in totals are generally the result of the rounding of components.

Care should be taken in comparing data across tables as sources and time periods may vary.

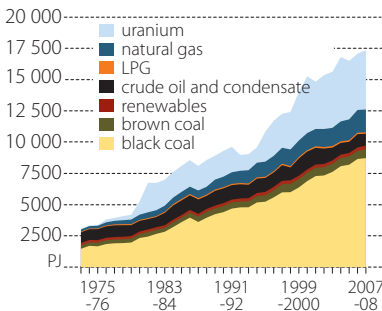
Australia's energy supply

In 2007-08, Australia's energy production was 17 360 petajoules. Australia produces energy for both domestic consumption and for export. Net energy exports accounted for 67 per cent of domestic energy production in 2007-08, while domestic consumption accounted for the remaining 33 per cent. Australia is the world's ninth largest energy producer, accounting for around 2.4 per cent of world energy production. Given its large energy resources, Australia is well positioned to continue its role as an important supplier of world energy needs, while maintaining domestic energy supply.

The rate of growth in Australia's production of energy has been increasing. Over the 10 years from 1997-98 to 2007-08, energy production increased at an average rate of 3.5 per cent a year, compared with 3.2 per cent over the previous 10 years, driven largely by a growing global demand for energy.

The main fuels produced in Australia are coal, uranium and natural gas. In 2007-08, Australia's energy production was dominated by coal, which accounted for 54 per cent of total Australian energy production in energy content terms, followed by uranium with a share of 27 per cent and natural gas with a share of 11 per cent. Crude oil and LPG represented 6 per cent of total energy production, and renewables represented 2 per cent.

Australian energy production



Source: ABARE, Australian energy statistics.

The Australian energy industry is a significant contributor to the economy. The electricity and gas supply industries contributed around \$17 billion to industry gross value added in 2007-08, representing 1.5 per cent of the Australian total. The coal and petroleum industries contributed another \$41 billion to industry value added.

1 Energy related industries in Australia, 2007-08

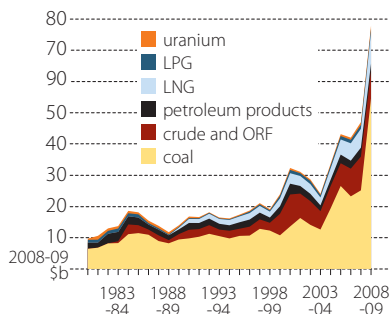
| | gross value added \$b | gross fixed capital formation \$b | employment '000 |
|---|-----------------------------|---|--------------------|
| Coal mining | 14.3 | 5.3 | 31.0 |
| Oil and gas extraction | 23.6 | 8.9 | 10.0 |
| Petroleum and coal product manufacturing | 3.2 | 0.6 | 8.0 |
| Electricity supply | 15.5 | 9.0 | 46.0 |
| Gas supply | 1.1 | 0.2 | 2.5 |
| Total | 57.7 | 24.0 | 97.4 |
| Australia | 1 091.7 | 312.2 | 10 644.1 |

Sources: Australian Bureau of Statistics, *Australian Industry*, cat. no. 8155; *Australian System of National Accounts*, cat. no. 5204; *Australian Labour Market Statistics*, cat. no. 6105.

Energy exports

Australia is a net energy exporter, with net exports equivalent to more than two-thirds of domestic energy production. However, Australia is a net importer of crude oil and refined petroleum products. Coal is Australia's largest

Australian energy exports

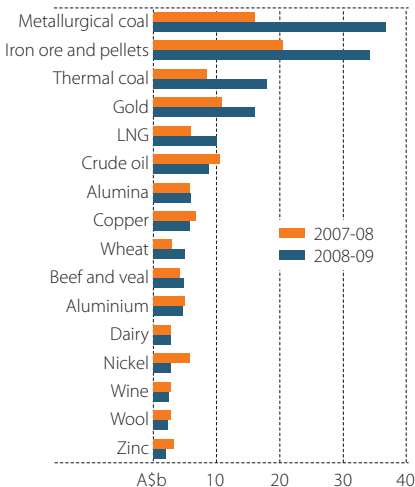


Source: ABARE, *Australian commodity statistics; Australian commodities*.

energy export earner, with a value of \$55 billion in 2008-09, followed by LNG and crude oil. Crude oil and LNG are also among Australia's 10 highest value commodity exports. Energy exports accounted for 33 per cent of Australia's total exports of goods and services in 2008-09.

Since 1988-89, the value of Australia's energy exports (in 2008-09 Australian dollars) has increased at an average rate of 10 per cent a year. In 2008-09, energy export earnings increased by 66 per cent to \$78 billion.

Major Australian commodity exports



Source: ABARE, Australian commodities.

The global financial crisis resulted in sharp falls in prices for energy commodities from July 2008. However, record contract prices for bulk coal that were in place from April 2008 to March 2009 resulted in the large increase in energy export earnings in 2008-09. Since April 2009 there have been steady increases in the prices of most energy commodities, reflecting strong import demand from China and an improved outlook for a recovery in world economic growth. Nevertheless, bulk coal prices are expected to remain lower in 2009-10 than in 2008-09.

Domestic energy consumption

Although Australia's energy consumption is growing, the rate of growth has slowed over the past 50 years. Australia's energy consumption increased at an average rate of 1.9 per cent a year over the 10 years from 1997-98 to 2007-08, compared with 2.8 per cent over the previous 10 years. In 2007-08 energy consumption increased by 1.5 per cent to 5772 petajoules, representing 33 per cent of total Australian energy production.

Over the past 20 years, domestic energy consumption has increased at a slower rate than production. Rapid growth in global demand for Australia's energy resources has driven growth in domestic production. As a result, the share of domestic consumption in Australian energy production has been decreasing, from an average of 49 per cent in the 1980s to an average of 42 per cent in the 1990s, and down to an average of 34 per cent in the current decade.

2 Australia's economic demonstrated resources, December 2008

| unit | | Australia | share of World % | reserves to production yrs |
|--------------------------|----|-----------|------------------------|----------------------------------|
| Coal ^a | | | | |
| Black coal | PJ | 883 400 | 9.5 | 90 |
| Lignite | PJ | 362 000 | 9.0 | 490 |
| Petroleum | | | | |
| Oil | PJ | 6952 | 0.3 ^b | 10 |
| Condensate | PJ | 12563 | na | 31 |
| LPG | PJ | 4611 | na | 20 |
| Gas | | | | |
| Conventional gas | PJ | 122 100 | 1.4 | 63 |
| Coal seam methane | PJ | 16 180 | na | 100 |
| Uranium ^c | PJ | 651 280 | 38.2 | 140 |

^a Recoverable resources. ^b Crude oil, condensate and LPG combined. ^c Reasonably assured resources recoverable at costs of less than US\$80/kg U.

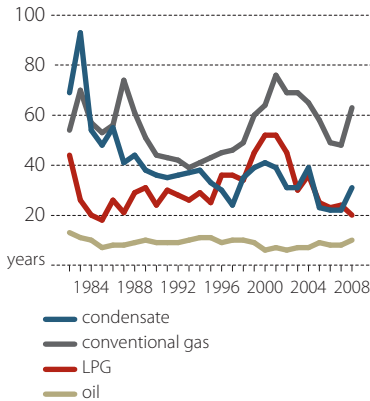
Sources: Geoscience Australia 2009, *Australia's Identified Mineral Resources 2009*, *Oil and Gas Resources of Australia 2008*; BP 2009, *BP Statistical Review of World Energy*.

Energy resources

Australia has abundant, high quality energy resources. Australian resources of uranium, for instance, account for 38 per cent of total world resources, while Australian coal resources represent 9 per cent of the world total. In this report, data on energy resources are presented in energy units to allow comparison across different resources. A large proportion of Australian black coal resources are high quality bituminous coals, characterised by a low sulphur and low ash content. A significant amount of natural gas reserves are also located in Australia. Although Australia's oil resources are much smaller than its gas or coal resources, Australian crude oil is typically low in sulphur and of the light variety of liquid fuels, which have a higher value than the heavy variety because of their lower wax content.

At current rates of production, Australia's energy resources are expected to last for many more decades. The proportion of economic demonstrated reserves (EDR) to current production is estimated at 490 years for brown coal,

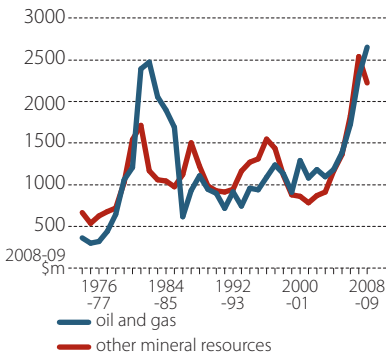
Reserves to production ratios



Source: Geoscience Australia 2009, *Oil and gas resources of Australia 2008*.

90 years for black coal, 63 years for conventional gas and 100 years for coal seam methane. Despite increasing energy production, reserves to production ratios have remained relatively steady over the past 10 years, reflecting the addition of new discoveries and the upgrading of resources which meet economic criteria. For example, over the past 20 years, the reserves to production ratio for oil has only fluctuated between six and eleven years. The reserves to production ratios for crude oil, condensate and natural gas all increased in 2008, with only a small decrease in the LPG reserves to production ratio.

Private energy and minerals exploration expenditure



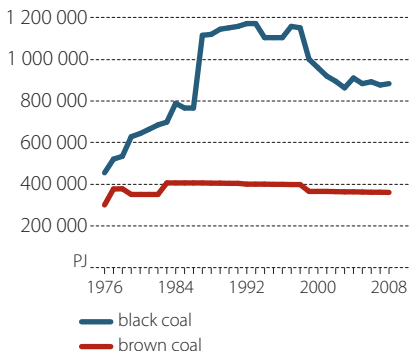
Source: ABARE, *Australian commodity statistics 2009*.

Crude oil, LPG and natural gas exploration expenditure increased by 15 per cent in 2008-09, to \$2.7 billion. However, other minerals exploration expenditure, including exploration for coal resources, fell by 12 per cent in 2008-09, to \$2.2 billion. There was a sharp increase in exploration expenditure from 2001-02 to 2007-08, reflecting a significant increase in exploration activity, in response to high energy and minerals prices. Despite a fall in the number of oil and gas exploration wells drilled from 2007-08 to 2008-09, exploration expenditure continued to

Overview

increase as a result of high exploration costs. Exploration costs increased markedly in the first half of 2008 as a result of a global shortage of drilling equipment and skilled labour.

Australia's economic demonstrated resources of coal



Source: Geoscience Australia.

Coal

Black coal resources are located in most states with significant quantities of high quality black coal in New South Wales and Queensland. These two states have 42 per cent and 53 per cent, respectively, of Australia's black coal economic demonstrated resources. There are brown coal deposits in all Australian states, although Victoria accounts for 96 per cent of identified brown coal resources.

Petroleum

Australia's resources of crude oil and condensate represent a small proportion of world resources. Resources of crude oil, condensate

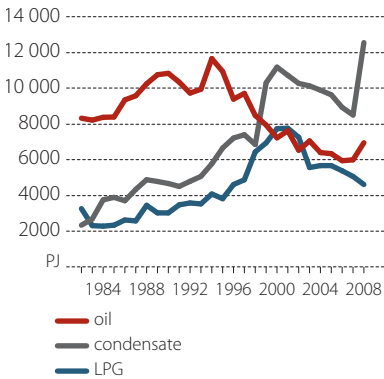
3 Australia's petroleum resources ^a by state 2008

| | crude oil | condensate | LPG | conventional gas |
|--------------|------------|------------|------------|------------------|
| | GL | GL | GL | bcm |
| Vic | 37 | 19 | 24 | 225 |
| Qld | 1 | 0.3 | 0 | 12 |
| SA | 9 | 2 | 4 | 20 |
| WA | 121 | 255 | 98 | 2 592 |
| NT | 19 | 61 | 45 | 288 |
| Tas | 1 | 2 | 2 | 6 |
| Total | 188 | 339 | 173 | 3 143 |

^a Economic demonstrated resources as at 1 January 2009.

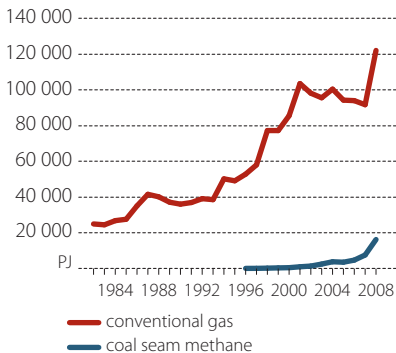
Sources: Geoscience Australia 2008, *Oil and gas resources of Australia, 2008*.

Australia's economic demonstrated resources of petroleum



Source: Geoscience Australia.

Australia's economic demonstrated gas resources



Source: Geoscience Australia.

and LPG all followed a generally decreasing trend from 2000 to 2007; however, crude oil and condensate resources both increased in 2008.

Most of Australia's petroleum resources are located off the coasts of Western Australia, the Northern Territory and Victoria. Western Australia has 64 per cent of Australia's economic demonstrated resources of crude oil, 75 per cent of condensate resources and 57 per cent of LPG resources.

Gas

Australia's identified conventional gas resources have increased threefold over the past 20 years. Around 90 per cent of estimated recoverable reserves of conventional gas are located off the west and north-west coast of Australia.

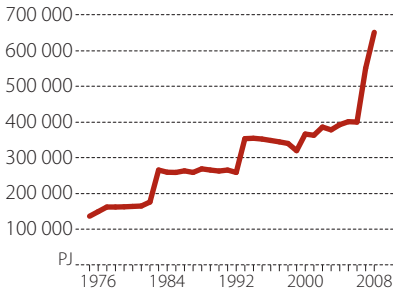
In addition to conventional gas resources, there is growing commercial utilisation of Australia's resources of coal seam gas. Most of these resources are located in the black coal deposits of Queensland and New South Wales.

Uranium

Australia's identified uranium resources have more than doubled over the past two decades, and

Overview

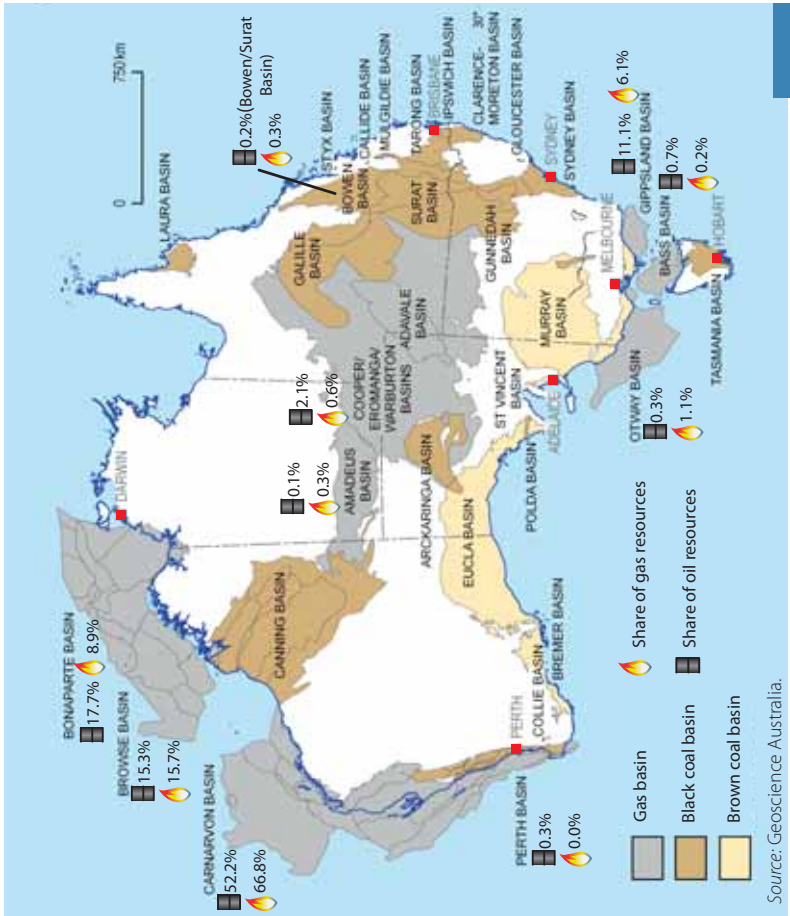
Australia's economic demonstrated resources of uranium



Source: Geoscience Australia.

increased by 63 per cent from 2006 to 2008. 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.

Distribution of Australia's energy resources



Source: Geoscience Australia.



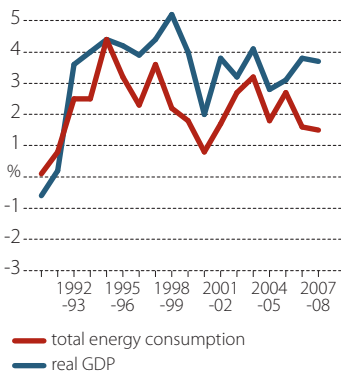
Australia is the world's twentieth largest primary energy consumer, and ranks sixteenth on a per person basis.

Energy intensity

During the past five decades, Australia's growth in primary energy consumption has gradually slowed. Following growth of around 5 per cent during the 1960s, annual growth in energy consumption fell during the 1970s to an average of around 4 per cent a year, largely as a result of the

two major oil price shocks. During the 1980s, economic recession and sharply rising energy prices resulted in annual growth falling to an average of 2.3 per cent a year. Despite falling real energy prices and robust economic growth, annual average growth in energy consumption remained at around 2.3 per cent in the 1990s. Since 2000, growth in energy consumption has averaged 2 per cent.

Annual growth in primary energy consumption in Australia

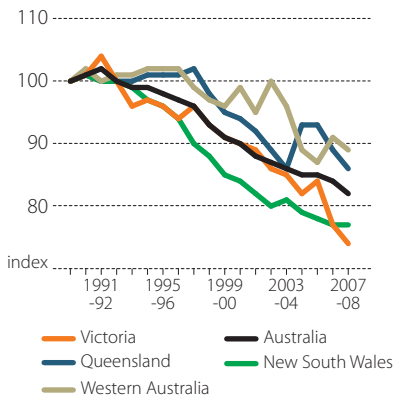


Source: ABARE, *Australian energy statistics*; ABS, *Australian National Accounts: State Accounts*, cat. No. 5220.

There has been a long-term decline in the energy intensity (energy consumption per unit of GDP) of the Australian economy. This trend can be attributed to two main factors. First, greater efficiency has been achieved through both technological improvement and fuel switching. Second, rapid growth has occurred in less energy intensive sectors such as the commercial and services sector relative to the more moderate growth of the energy intensive manufacturing sector. Trends in energy intensity are not uniform across

Energy consumption

Energy intensity trends



Source: ABARE, *Australian energy statistics*; ABS, *Australian National Accounts: State Accounts*, cat. No. 5220

Australia. For example, in recent years the growing resources sectors of Western Australia and Queensland have led to energy intensity being higher in these states than in Victoria and New South Wales, where the services sectors have grown strongly.

Energy consumption, by fuel

Australian primary energy consumption consists predominantly of petroleum and coal. Black and brown coal accounted for the greatest share of the fuel mix, at around 40 per cent, followed by petroleum products

4 Energy consumption by state, by fuel, 2007-08

| | black coal PJ | brown coal PJ | renewables ^a PJ | petroleum products PJ | natural gas PJ | state share ^b % |
|-----------------------|------------------|------------------|-------------------------------|--------------------------|-------------------|-------------------------------|
| New South Wales | 831 | 0 | 48 | 527 | 128 | 27 |
| Victoria | 2 | 611 | 34 | 452 | 266 | 24 |
| Queensland | 631 | 0 | 125 | 453 | 140 | 23 |
| Western Australia | 122 | 0 | 18 | 279 | 514 | 16 |
| South Australia | 80 | 0 | 11 | 119 | 153 | 6 |
| Tasmania | 15 | 0 | 39 | 42 | 15 | 2 |
| Northern Territory | 0 | 0 | 0 | 70 | 33 | 2 |
| Total | 1 681 | 611 | 290 | 1 941 | 1 249 | |
| Share of total | 29% | 11% | 5% | 34% | 22% | |

^a State renewables data only include hydroelectricity, solar hot water and biomass. Does not include wind, solar PV or biogas, but all these are included in the total. ^b Excluding wind, solar PV and biogas.

Source: ABARE, *Australian energy statistics*.

(34 per cent), natural gas (22 per cent) and renewables (5 per cent). The share of natural gas in Australian energy consumption has increased in the past 30 years and this trend is likely to continue in the longer term.

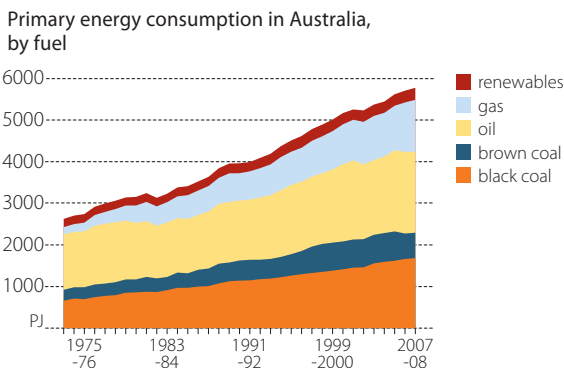
5 Australian energy consumption by fuel

| | 2003-04 | 2004-05 | 2005-06 | 2006-07 | 2007-08 |
|---|---------|---------|---------|---------|---------|
| | PJ | PJ | PJ | PJ | PJ |
| Consumption of fuels | | | | | |
| Black coal | 1 578 | 1 618 | 1 639 | 1 686 | 1 701 |
| Brown coal/lignite | 684 | 689 | 705 | 611 | 611 |
| Coke | 80 | 77 | 76 | 77 | 78 |
| Coal by-products | 77 | 76 | 77 | 75 | 79 |
| Brown coal briquettes | 4 | 5 | 4 | 3 | 3 |
| Liquid biofuels | 1 | 1 | 1 | 2 | 5 |
| Wood, woodwaste | 97 | 92 | 90 | 93 | 96 |
| Bagasse | 101 | 108 | 109 | 111 | 112 |
| Refinery input | 1 527 | 1 541 | 1 407 | 1 503 | 1 462 |
| Petroleum products | 1 885 | 1 945 | 1 969 | 1 990 | 2 036 |
| Natural gas | 1 066 | 1 052 | 1 078 | 1 195 | 1 262 |
| Town gas | 6 | 7 | 8 | 7 | 4 |
| Solar energy | 3 | 3 | 2 | 6 | 7 |
| Total electricity | 852 | 884 | 890 | 904 | 926 |
| of which hydro electricity | 59 | 56 | 58 | 52 | 43 |
| and wind and solar PV | 2 | 3 | 9 | 15 | 21 |
| Production of derived fuels | | | | | |
| Coke | 103 | 103 | 98 | 98 | 98 |
| Coal by-products | 78 | 76 | 77 | 78 | 79 |
| Brown coal briquettes | 2 | 4 | 4 | 3 | 3 |
| Petroleum products | 1 617 | 1 648 | 1 429 | 1 534 | 1 557 |
| Town gas | 5 | 5 | 5 | 5 | 4 |
| Thermal electricity | 807 | 813 | 847 | 857 | 868 |
| Net energy consumption^a | | | | | |
| | 5 350 | 5 447 | 5 595 | 5 688 | 5 772 |

^a Net energy consumption is the total quantity (in energy units) of primary and derived fuels consumed less the quantity of derived fuels produced.

Source: ABARE, *Australian energy statistics*.

Energy consumption



Source: ABARE, Australian energy statistics.

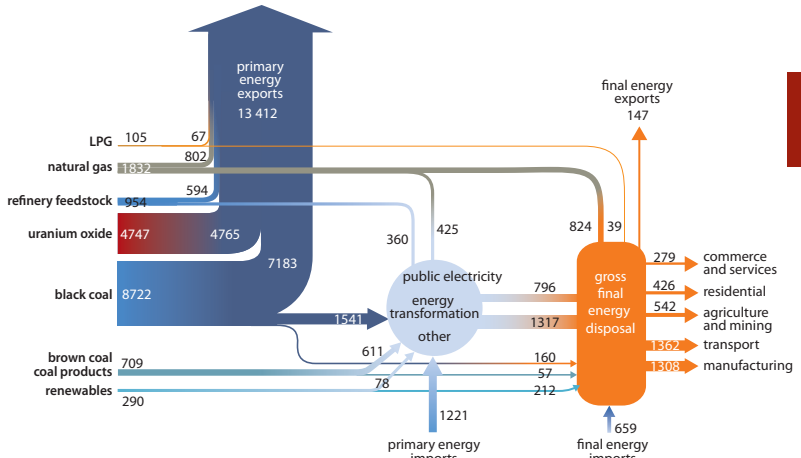
Energy consumption, by industry

Australia's primary energy consumption is estimated to have risen by 1.5 per cent, to 5772 petajoules in 2007-08. The diagram of Australia's energy flows is a simplification of the energy supply and disposal table on pages 16 and 17. It shows the movement of primary fuels from the point at which they become available, through Australia's energy conversion sectors, until the final distribution to industries and households. Domestically produced or imported primary energy may be used directly by industries and households but is generally first transformed in refineries and power plants for use as petroleum products and electricity. Additionally, many final energy products are not manufactured in Australia, but are directly imported for use by Australian industries and households. Australia is a net exporter of primary energy, with a far greater amount of Australia's primary energy production exported than consumed domestically.

The major energy using sectors of electricity generation, transport and manufacturing together accounted for more than 75 per cent of Australia's primary energy consumption. Next in terms of energy consumption were the mining, residential, and commercial and services sectors.

Australian energy flows, 2007-08

units: petajoules



Source: ABARE, Australian energy statistics.

6 Energy consumption in Australia by industry

| | 1974-75 | 1979-80 | 1989-90 | 1999-00 | 2007-08 |
|------------------------|---------|---------|---------|---------|---------|
| | PJ | PJ | PJ | PJ | PJ |
| Agriculture | 39 | 47 | 55 | 72 | 93 |
| Mining | 65 | 81 | 160 | 273 | 436 |
| Manufacturing | 928 | 965 | 1 067 | 1 192 | 1 301 |
| Electricity generation | 540 | 743 | 1 066 | 1 427 | 1 760 |
| Construction | 29 | 38 | 41 | 29 | 26 |
| Transport | 701 | 825 | 1 012 | 1 267 | 1 388 |
| Commercial a | 87 | 104 | 151 | 219 | 268 |
| Residential | 246 | 262 | 322 | 392 | 426 |
| Other b | 59 | 66 | 69 | 77 | 76 |
| Total | 2 695 | 3 131 | 3 946 | 4 971 | 5 772 |

a Includes ANZSIC Divisions F, G, H, J, K, L, M, N, O, P, Q and the water, sewerage and drainage industries. b Includes consumption of lubricants and greases, bitumen and solvents, as well as energy consumption in the gas production and distribution industries.

Note: Totals may not add because of rounding. Source: ABARE, Australian energy statistics.

7 Australian energy supply and disposal, 2007-08

| | coal and coal by-products | natural gas, CSM | crude oil and ORF | propane, butane, LPG | refined products | liquid/ gas biofuels |
|--|---------------------------------|------------------------|-------------------------|----------------------------|---------------------|----------------------------|
| | PJ | PJ | PJ | PJ | PJ | PJ |
| Supply | | | | | | |
| Primary indigenous | 9 430.9 | 1 832.5 | 954.2 | 105.2 | | 17.6 |
| <i>plus</i> all imports | | 202.2 | 1 019.0 | 24.8 | 633.9 | |
| <i>less</i> all exports | 7 183.4 | 802.4 | 594.3 | 66.5 | 146.9 | |
| <i>less</i> stock changes and discrepancies | - 44.5 | - 16.9 | 0.5 | 8.0 | - 16.9 | |
| Total domestic availability | 2 292.0 | 1 249.2 | 1 378.4 | 55.4 | 507.7 | 17.6 |
| <i>less</i> conversions | | | | | | |
| Coke ovens | 13.0 | | | | 0.9 | |
| Briquetting | 3.0 | | | | | |
| Petroleum refining | 0.5 | 20.7 | 1 461.3 | - 39.2 | -1 422.1 | |
| Gas manufacturing | | 0.6 | | - 2.9 | | |
| Electricity generation a | 2 017.5 | 381.9 | 3.1 | 0.1 | 33.9 | 12.1 |
| Other conversion b | 41.8 | | - 88.7 | - 6.4 | 14.4 | |
| Fuel use in conversion | | 22.1 | | 2.2 | 116.1 | |
| Final domestic availability c | 216.1 | 823.8 | 2.7 | 101.7 | 1 764.5 | 5.5 |
| Disposal | | | | | | |
| Agriculture | | 0.1 | | 1.6 | 84.1 | |
| Mining | 6.8 | 239.0 | 1.3 | 1.3 | 128.3 | |
| Food, beverages, textiles | 10.6 | 39.0 | 0.6 | 1.1 | 12.5 | 0.8 |
| Wood, paper and printing | 11.3 | 20.4 | | 0.8 | 1.5 | |
| Chemical | 12.1 | 96.4 | | 15.3 | 62.8 | |
| Iron and steel | 58.6 | 26.5 | | 0.6 | 1.9 | |
| Non-ferrous metals | 77.5 | 137.7 | 0.8 | 0.6 | 65.1 | |
| Other industry | 31.8 | 78.4 | | 5.9 | 6.5 | 1.3 |
| Construction | | 3.1 | | 0.3 | 22.7 | |
| Road transport | | 1.7 | | 59.1 | 964.0 | 2.8 |
| Rail transport | | | | | 28.9 | |
| Air transport | | | | | 226.3 | |
| Water transport | 5.6 | 0.1 | | | 64.9 | |
| Commercial and services | 1.7 | 44.6 | | 3.4 | 30.7 | 0.6 |
| Residential | 0.1 | 136.9 | | 11.8 | 1.3 | |
| Lubes, bitumen, solvents | | | | | 62.9 | |
| Gross final energy disposal | 216.1 | 823.8 | 2.7 | 101.7 | 1 764.5 | 5.5 |

continued...

7 Australian energy supply and disposal, 2007-08

continued

| | biomass | wind electricity | solar | hydro- electricity | total electricity | U ₃ O ₈ uranium | total |
|---|---------|---------------------|-------|-----------------------|----------------------|--|----------|
| | PJ | PJ | PJ | PJ | PJ | PJ | PJ |
| Supply | | | | | | | |
| Primary indigenous | 207.9 | 14.2 | 6.9 | 43.4 | | 4 747.2 | 17 360.0 |
| <i>plus</i> all imports | | | | | | | 1 879.9 |
| <i>less</i> all exports | | | | | | 4 765.3 | 13 558.8 |
| <i>less</i> stock changes and discrepancies | | | | | | -18.1 | -91.6 |
| Total domestic availability | 207.9 | 14.2 | 6.9 | 43.4 | | | 5 772.8 |
| <i>less</i> conversions | | | | | | | 0.0 |
| Coke ovens | | | | | 0.1 | | 14.0 |
| Briquetting | | | | | 0.3 | | 3.2 |
| Petroleum refining | | | | | 7.0 | | 28.3 |
| Gas manufacturing | | | | | | | -2.3 |
| Electricity generation a | 7.6 | 14.2 | 0.4 | 43.4 | -877.5 | | 1 636.8 |
| Other conversion b | | | | | -48.6 | | -87.6 |
| Fuel use in conversion | | | | | 123.0 | | 263.5 |
| Final domestic availability c | 200.3 | | 6.5 | | 795.6 | | 3 916.9 |
| Disposal | | | | | | | |
| Agriculture | | | | | 6.7 | | 92.6 |
| Mining | | | | | 72.9 | | 449.7 |
| Food, beverages, textiles | 117.7 | | | | 29.9 | | 212.1 |
| Wood, paper and printing | 19.1 | | | | 21.9 | | 75.1 |
| Chemical | | | | | 15.7 | | 202.3 |
| Iron and steel | | | | | 29.8 | | 117.4 |
| Non-ferrous metals | 2.4 | | | | 177.3 | | 461.5 |
| Other industry | 0.9 | | | | 25.6 | | 150.4 |
| Construction | | | | | 0.3 | | 26.4 |
| Road transport | | | | | | | 1 027.5 |
| Rail transport | | | | | 8.6 | | 37.5 |
| Air transport | | | | | | | 226.3 |
| Water transport | | | | | | | 70.6 |
| Commercial and services | 0.3 | | 0.2 | | 197.3 | | 278.9 |
| Residential | 59.8 | | 6.4 | | 209.5 | | 425.7 |
| Lubes, bitumen, solvents | | | | | | | 62.9 |
| Gross final energy disposal | 200.3 | | 6.5 | | 795.6 | | 3 916.9 |

a Grid connected power stations only, except for Total electricity. **b** Includes return streams to refineries from the petrochemical industry, consumption of coke in blast furnaces, blast furnace gas manufacture, electricity produced through cogeneration and lignite tar in char manufacture. **c** After conversion sector use and losses. Equals gross final energy disposal which is the final disposal of energy within the end use sectors.

Note: Because it is not possible to separate the fuels used to produce embedded electricity, those fuels are included in the industry in which production occurs although the electricity produced is included under Total electricity against Electricity generation and Other conversion.

Source: ABARE, *Australian energy statistics*.

8 Australian consumption of petroleum products

| | 2004-05 | 2005-06 | 2006-07 | 2007-08 | 2008-09 |
|-----------------------------|---------|---------|---------|---------|---------|
| | ML | ML | ML | ML | ML |
| LPG ^a | 3 386 | 4 050 | 4 038 | 4 024 | 3 996 |
| Automotive gasoline | 19 876 | 19 048 | 19 251 | 19 234 | 18 734 |
| Avgas | 91 | 86 | 90 | 88 | 96 |
| Turbine fuel | 4 730 | 5 359 | 5 837 | 6 070 | 6 173 |
| Kerosene | 12 | 27 | 32 | 43 | 25 |
| Heating oil | 34 | 25 | 15 | 12 | 7 |
| Automotive diesel oil | 15 185 | 15 804 | 17 028 | 18 245 | 18 587 |
| Industrial diesel fuel | 15 | 19 | 15 | 11 | 16 |
| Fuel oil | 1 595 | 1 586 | 1 513 | 1 583 | 1 423 |
| Lubes and greases | 470 | 451 | 421 | 435 | 437 |
| Bitumen | 812 | 805 | 808 | 785 | 809 |
| Other ^b | 939 | 973 | 699 | 258 | 311 |
| Total products ^c | 47 145 | 48 234 | 49 746 | 50 788 | 50 614 |

^a Includes LPG used as petrochemical feedstock. ^b Includes other refined products, crude oil used as a fuel and speciality feedstocks. ^c Some petroleum products are produced from the conversion of other petrochemical products.

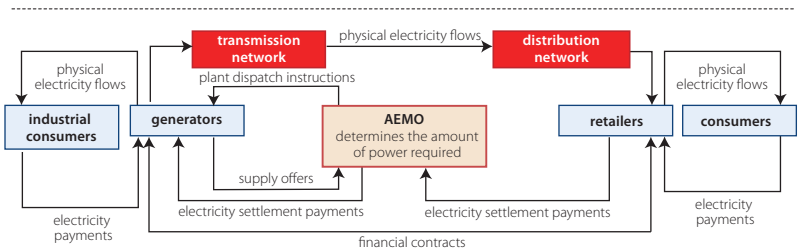
Sources: RET, *Australian petroleum statistics*.

The electricity industry, consisting of generators, transmission and distribution networks and retailers, is one of Australia's largest industries and contributed 1.4 per cent to Australian industry value added in 2007-08. Over the 10 years from 1997-98 to 2007-08, Australia's electricity use increased at an average rate of 2.8 per cent a year.

Industry structure

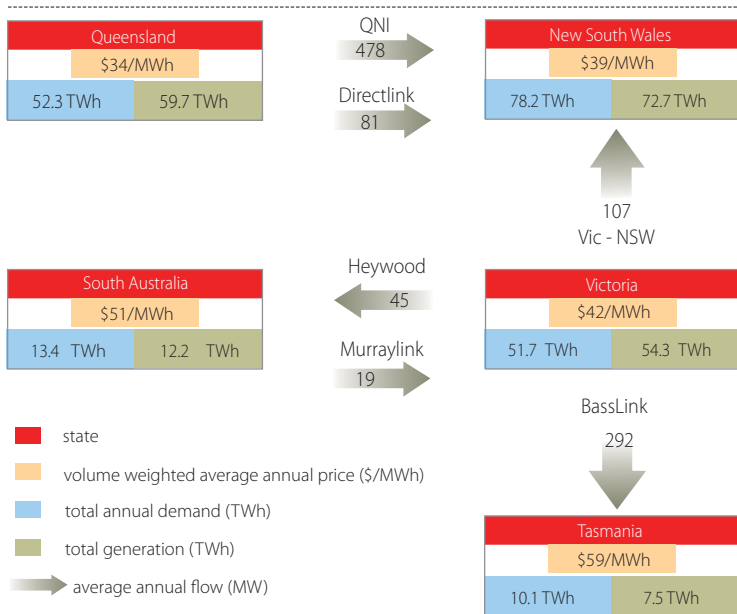
The current structure of Australia's south-east electricity market was shaped by industry reforms in the early 1990s. A key element of these reforms was the establishment of the National Electricity Market (NEM) in 1998, which allowed market determined power flows across the Australian Capital Territory, New South Wales, Queensland, South Australia and Victoria (Tasmania joined in 2005). Western Australia and the Northern Territory are not connected to the NEM primarily because of their geographic distance. The NEM operates as a wholesale spot market in which generators and retailers trade electricity through a gross pool managed by the Australian Energy Market Operator (AEMO) who aggregate and dispatch supply to meet demand. In addition to the physical wholesale market, retailers may

Market structure

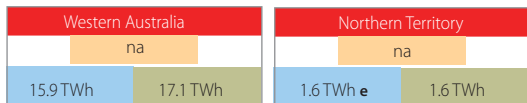


Electricity

Regional electricity market activity, 2008-09



Outside the national electricity market



e ABARE estimate

na not available.

Source: Global Roam, NEM Review, WA Office of Energy; NT Power and Water Corporation, Annual Report 2009.

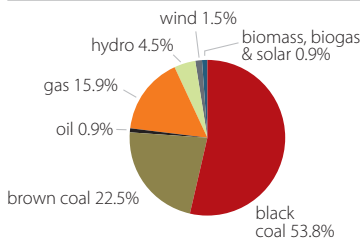
also contract with generators through financial markets to better manage any price risk associated with trade in the spot market.

The regulation of electricity transmission and distribution networks in the NEM is the responsibility of the Australian Energy Regulator (AER). AER is also responsible for reporting on generator bidding behaviour in the NEM. AER's responsibilities also extend to gas markets and gas transmission in all states except Western Australia. This allows a consistent near-national approach to regulation in Australia's energy markets. Western Australia will retain state-based regulation of its electricity sector and, while the National Gas Law came into effect in Western Australia on 1 January 2010, the WA legislation is limited to regulatory matters and adopts the local Economic Regulation Authority and Gas Disputes Arbitrator to regulate the market in Western Australia instead of the Australian Energy Regulator.

Production

Around 265 terawatt hours of electricity (including off-grid electricity) was generated in Australia in 2007-08. Over the past five years, the industry has increased electricity generation by 7 per cent and the number of customers has also increased by around 7 per cent. Average capacity utilisation has remained relatively constant over the past five years at 54 to 56 per cent.

Australian electricity generation by fuel, 2007-08



Source: IEA, *World Energy Balances 2009*; ABARE.

The majority of Australia's electricity is produced using coal, which accounted for 76 per cent of total electricity generation in 2007-08. This is because coal is a relatively low cost energy source in Australia. It also reflects the abundance of coal reserves along the eastern seaboard where the majority of electricity is generated and consumed.

Natural gas is Australia's second largest fuel source for electricity generation, accounting for 16 per cent of electricity generation in

Electricity

9 Key performance indicators for the Australian electricity industry

| | unit | 2003-04 | 2004-05 | 2005-06 | 2006-07 | 2007-08 |
|--|--------|---------|---------|---------|---------|---------|
| Generation capacity | GW | 45 | 45 | 45 | 47 | 49 |
| Capacity utilisation | % | 54 | 55 | 56 | 55 | 54 |
| Electricity generation ^a | TWh | 213 | 217 | 220 | 227 | 229 |
| Employment | ('000) | 37 | 38 | 41 | 44 | 46 |
| Number of customers | ('000) | 9 268 | 9 351 | 9 530 | 9 684 | 9 892 |
| Wholesale price ^b | | | | | | |
| – Nominal | c/kWh | 3.27 | 3.73 | 3.92 | 6.17 | 5.37 |
| – Real ^c | c/kWh | 3.68 | 4.09 | 4.17 | 6.38 | 5.37 |
| System minutes not supplied ^d | mins | 4.58 | 4.43 | 3.70 | 5.80 | 3.51 |
| System energy not supplied ^e | MWh | 1 494 | 1 566 | 1 112 | 1 915 | 994 |
| Distribution losses ^f | % | 5.70 | 5.90 | 5.90 | 5.60 | 5.10 |

^a Grid-connected electricity only. ^b Volume weighted - average price (National Electricity Market). ^c 2007-08 A\$. ^d Energy not supplied to customers by the transmission network as a result of planned and unplanned outages. Average minutes - excludes Northern Territory, and excludes Queensland in 2006-07 and 2007-08. ^e System peak demand multiplied by the system minutes not supplied (divided by minutes in one hour to convert to MWh). ^f Energy losses incurred in the transfer of electricity over the distribution network, equal to total energy supplied minus energy delivered, as a proportion of total energy supplied. Sources: Energy Supply Association of Australia, *Electricity Gas Australia 2009*; Australian Bureau of Statistics.

10 Australian electricity generation by fuel

| | 2003-04 | 2004-05 | 2005-06 | 2006-07 | 2007-08 |
|---------------------|---------|---------|---------|---------|---------|
| | TWh | TWh | TWh | TWh | TWh |
| Fossil fuels | | | | | |
| Black coal | 124.4 | 131.9 | 137.2 | 136.7 | 142.7 |
| Brown coal | 57.5 | 60.8 | 61.7 | 57.5 | 59.6 |
| Oil | 1.6 | 1.9 | 2.4 | 2.2 | 2.4 |
| Gas | 32.6 | 32.2 | 30.6 | 39.2 | 42.2 |
| Total fossil fuels | 216.1 | 226.8 | 231.9 | 235.6 | 246.9 |
| Renewables | | | | | |
| Hydro | 16.3 | 15.6 | 16.0 | 14.5 | 12.1 |
| Wind | 0.7 | 0.9 | 1.7 | 2.6 | 3.9 |
| Solar | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Biomass | 1.1 | 1.1 | 1.1 | 1.1 | 1.2 |
| Biogas | 0.8 | 0.8 | 0.9 | 0.9 | 1.0 |
| Total renewables | 19.0 | 18.5 | 19.8 | 19.2 | 18.3 |

Source: IEA, *World Energy Balances 2009*; ABARE.

2007-08. Given that a large proportion of proposed electricity projects will be using natural gas or coal seam methane as fuel, these energy sources will account for an increasing proportion of electricity generation into the future.

Capacity

In 2007-08, Australia's principal electricity generation capacity was around 49 gigawatts. The majority of Australia's electricity generation is supplied by steam plants utilising coal or natural gas as fuels. Most of Australia's black coal fuelled generation capacity is located in New South Wales and Queensland, while Queensland also has the greatest generation capacity of gas fuelled plants.

11 Australian thermal electricity generation capacity by plant and fuel type, 2007-08

| | NSW ^a | Vic | Qld ^b | SA | WA ^c | Tas | NT | AUS |
|-----------------------------------|------------------|-------|------------------|------|-----------------|-----|-----|--------|
| | MW | MW | MW | MW | MW | MW | MW | MW |
| Steam | | | | | | | | |
| - black coal | 11 730 | 0 | 8 805 | 0 | 1 329 | 0 | 0 | 21 864 |
| - brown coal | 0 | 6 555 | 0 | 780 | 0 | 0 | 0 | 7 335 |
| - natural gas | 0 | 510 | 132 | 1280 | 268 | 240 | 0 | 2 430 |
| - multi-fuel | 0 | 0 | 0 | 0 | 880 | 0 | 0 | 880 |
| Reciprocating engine | 0 | 0 | 0 | 50 | 0 | 0 | 76 | 126 |
| Open cycle gas turbine | | | | | | | | |
| - conventional gas | 0 | 1 321 | 907 | 605 | 1 441 | 105 | 279 | 4 658 |
| - oil products | 50 | 0 | 338 | 113 | 83 | 0 | 30 | 614 |
| - multi fuel | 0 | 0 | 0 | 0 | 586 | 0 | 0 | 586 |
| Combined cycle gas turbine | | | | | | | | |
| - conventional gas | 160 | 0 | 215 | 663 | 360 | 0 | 131 | 1 529 |
| - coal seam methane | 0 | 0 | 625 | 0 | 0 | 0 | 0 | 625 |

^a Includes the ACT. ^b Includes generating capacity at Mt Isa. ^c Includes plants owned by Western Power Corporation (now Verve Energy) in the South West Interconnected System, and excludes plants operated under power purchase agreements.

Source: Energy Supply Association of Australia, *Electricity Gas Australia 2009*.

12 Australian major power network transfer capabilities, 2007-08

| interconnector | location | forward | reverse |
|---|--------------------------|----------------------------|-------------------------------|
| | | capability MW | capability MW |
| New South Wales to Queensland (QNI) | Armidale to Braemar | 483 | 1 078 |
| New South Wales to Queensland (Terranora) | Terranora to Mullumbimby | 105 | 245 |
| Snowy to New South Wales | Murray to Dederang | 3 114 | 1 134 |
| Victoria to Snowy | Buronga to Red Cliffs | 1 274 | 1 780 |
| Victoria to South Australia (Heywood) | Heywood to Tailem Bend | 460 | 300 |
| Victoria to South Australia (Murraylink) | Red Cliffs to Berri | 220 | 220 |
| Tasmania to Victoria (Basslink) | Seaspray to Georgetown | 594 | 478 |
| Transmission and distribution length (km) | | overhead 779 917 | underground 108 818 |

Sources: Energy Supply Association of Australia, *Electricity Gas Australia 2009*.

As at the end of October 2009, there were 18 electricity generation projects at an advanced stage of development and an additional 127 projects at a less advanced stage. The combined capacity of the 18 advanced projects was 3569 megawatts, of which 38 per cent will be supplied by conventional gas projects and 22 per cent will be supplied by coal seam gas projects.

The NEM is linked by seven major transmission interconnectors. These interconnectors link the electricity networks in Queensland, New South Wales, Victoria, South Australia and Tasmania. The NEM electricity transmission and distribution networks consist of more than 779 900 kilometres of overhead transmission and distribution lines and more than 108 800 kilometres of underground cables. The table below identifies major committed transmission projects in the NEM. There are a number of projects which are under development to expand the capabilities of the interconnector system.

13 Major committed transmission projects for Australia's National Electricity Market

| region | project details | start-up |
|-----------------|---|-------------------|
| Queensland | Installation of a 200 MVAR capacitor bank at Tarong; a fifth 200 MVAR capacitor bank at Greenbank; and a 120 MVAR capacitor bank at the Mt England and South Pine 275 kV substations. | Summer 2009-10 |
| New South Wales | Upgrade of the Tamworth-Armidale 330 kV line no.86 to increase the thermal rating by 250MW. | Summer 2009-10 |
| New South Wales | Conversion of the Bayswater-Mt Piper and Mt Piper-Bannaby transmission lines from 330kV to 500kV. | Summer 2009-10 |
| New South Wales | Installation of real-time thermal rating equipment on several 330kV circuits in New South Wales. | From 2010 to 2014 |
| Queensland | Construction of a Strathmore-Ross 275 kV line. | Summer 2010-11 |
| South Australia | Construction of a 275/132kV injection point to provide supply to Dorrien and feed Roseworthy. | Summer 2010-11 |
| South Australia | Construction of a 275/66kV connection point at Mount Barker South. | Summer 2012-13 |
| South Australia | Installation of a second 160MVA transformer at Cultana to feed the lower Eyre Peninsula. | Winter 2015 |
| South Australia | Installation of a 100MVAR capacitor bank at the Tungkillio switching station. | Winter 2015 |

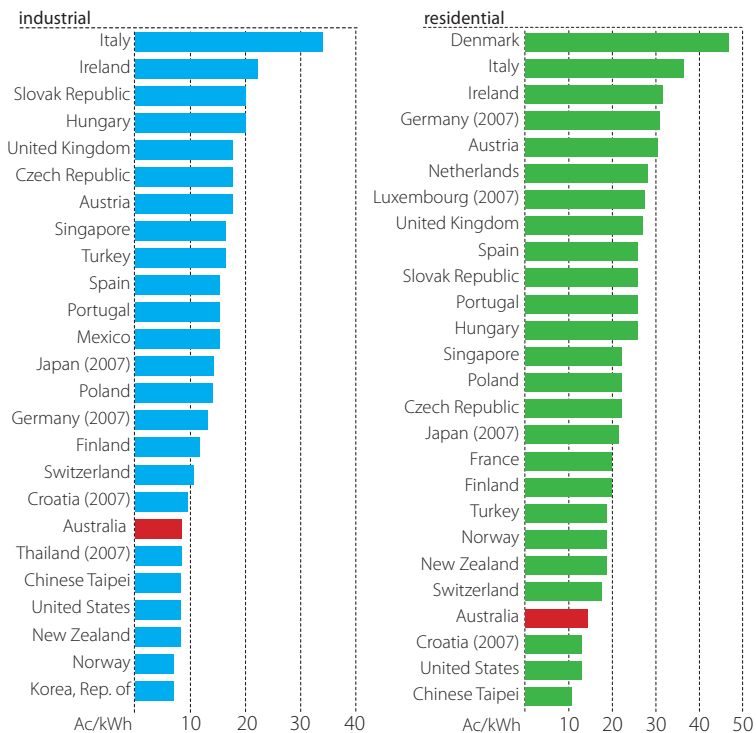
Source: AEMO 2009, *Electricity Statement of Opportunities 2009*.

Electricity

Prices

Australia has low electricity prices compared with most other OECD countries. Although the electricity prices in the United States were lower than in Australia in 2008, Australian electricity prices were below those in most European countries.

World electricity prices, selected countries, 2008 a



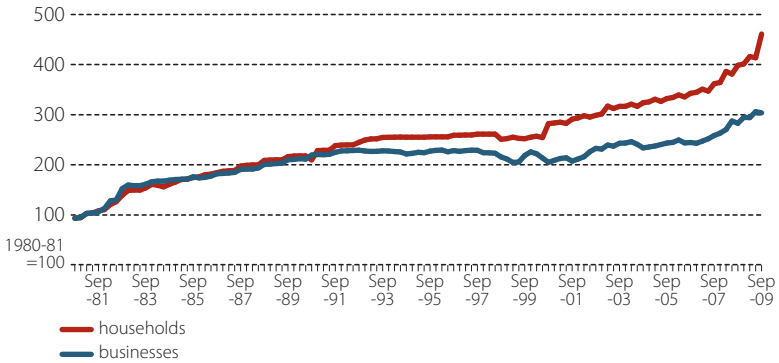
a Australian prices estimated using 2004 prices from IEA Energy Prices and Taxes, and ABS index of electricity prices for households and businesses. Australian industrial electricity price is based on commercial prices and is likely to be an overestimate of industrial prices.

Sources: IEA, *Energy Prices and Taxes 2009*; ABS.

Electricity prices paid by households have increased at a faster rate than those paid by Australian businesses since 1991. Since the beginning of 2008 the difference in the growth rate of household and business prices has been more significant.

Electricity prices for households and businesses

quarterly index



Source: ABS, cat. no. 6427.0 Producer Price Indexes Australia, cat. no. 6401.0 Consumer Price Index Australia.

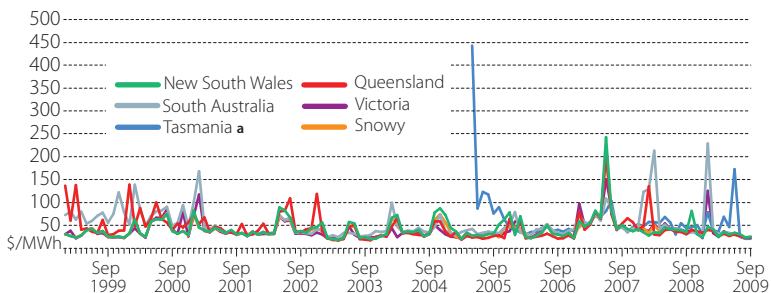
Average wholesale electricity prices in the National Electricity Market increased in 2007, largely as a result of record average demand over the year combined with tight supply. However, electricity prices have generally moderated since 2007. In 2008, wholesale electricity prices averaged 29 per cent lower than in 2007, and in the nine months to September 2009 they have averaged a further 10 per cent lower than in 2008.

Occasional price spikes are often caused by factors such as widespread heatwaves, industrial disputes or generator malfunctions. For example, electricity spot prices in South Australia increased considerably in March 2008 following a 15 day heatwave, which encouraged record high electricity demand.

Electricity

Spot market prices in the National Electricity Market

average monthly wholesale, in 2008-09 dollars



^a Tasmania joined the National Electricity Market in 2005.

Source: AEMO, www.aemo.com.au

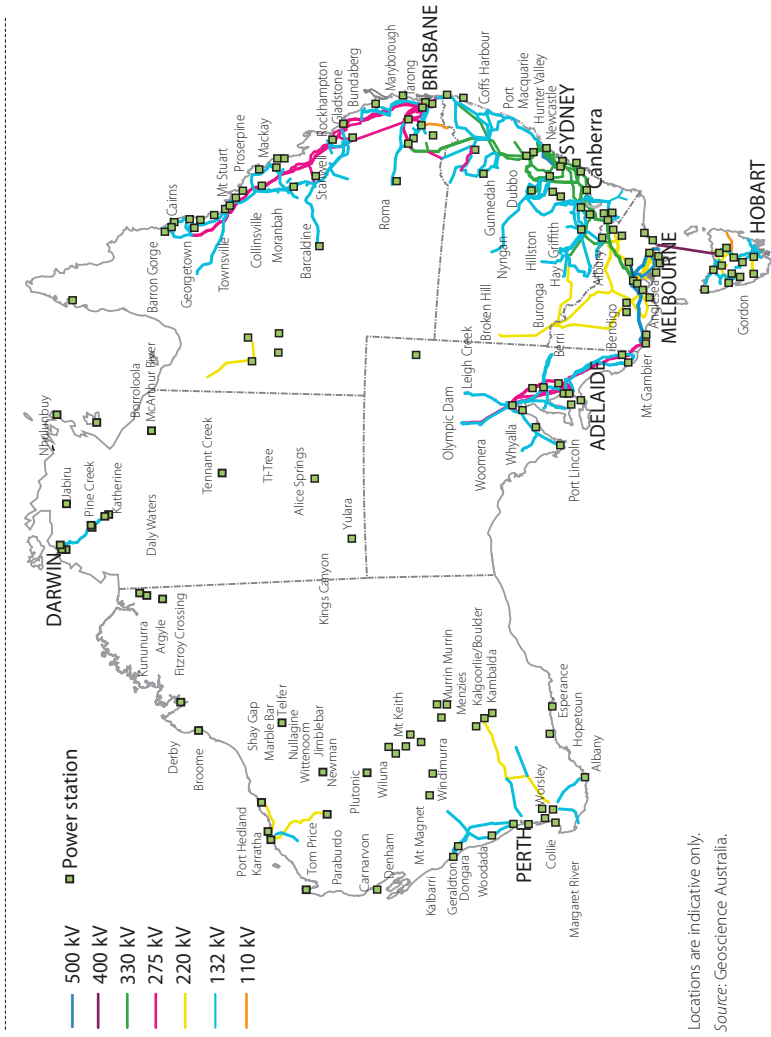
14 Principal generation businesses in Australia, 2008-09

| | share of NEM generation | | share of NEM generation | |
|--|-------------------------------|-------|-------------------------------|---|
| | GWh | % | GWh | % |
| New South Wales ^a | | | | |
| Macquarie | | | | |
| Generation | 28 542 | 12.58 | | |
| Delta Electricity | 25 422 | 11.21 | | |
| Eraring Energy | 15 527 | 6.85 | | |
| Marubeni | 1 043 | 0.46 | | |
| Redbank Project Pty Ltd | 772 | 0.34 | | |
| Snowy Hydro | 1 406 | 0.62 | | |
| Victoria | | | | |
| Loy Yang Power | 16 705 | 7.36 | | |
| International Power | | | | |
| & Transfield Services | 12 220 | 5.39 | | |
| TRUenergy | 12 024 | 5.30 | | |
| International Power | | | | |
| & Mitsui | 8 618 | 3.80 | | |
| Prime Infrastructure | | | | |
| & Babcock Brown | 1 382 | 0.61 | | |
| Energy Brix | 1 228 | 0.54 | | |
| Alcoa | 1 195 | 0.53 | | |
| AGL | 336 | 0.15 | | |
| Snowy Hydro | 380 | 0.17 | | |
| Alinta | 199 | 0.09 | | |
| Eraring Energy | 31 | 0.01 | | |
| Queensland | | | | |
| CS Energy | 13 308 | 5.87 | | |
| Stanwell | 9 251 | 4.08 | | |
| Transfield Services | | | | |
| & Comalco | 7 975 | 3.52 | | |
| Tarong Energy | 7 766 | 3.42 | | |
| Queensland <i>continued</i> | | | | |
| OzGen & Marubeni | 6 199 | 2.73 | | |
| CS Energy & OzGen | 5 929 | 2.61 | | |
| Tarong, TEPCO & Mitsui | 3 233 | 1.43 | | |
| Wambo Power | 1 875 | 0.83 | | |
| Transfield Services | 1 687 | 0.74 | | |
| Origin Energy | 262 | 0.12 | | |
| Contact Energy, ERM | | | | |
| & Babcock Brown | 30 | 0.01 | | |
| Enertrade | 2 | 0.00 | | |
| Unknown | 2 231 | 0.98 | | |
| South Australia | | | | |
| Babcock and Brown | 4 920 | 2.17 | | |
| International Power | 3 303 | 1.46 | | |
| TRUenergy | 2 491 | 1.10 | | |
| Origin Energy and | | | | |
| ATCO Power | 1 241 | 0.55 | | |
| Origin Energy | 251 | 0.11 | | |
| AGL | 22 | 0.01 | | |
| Infratil | 2 | 0.00 | | |
| Tasmania | | | | |
| Hydro Tasmania | 6 851 | 3.02 | | |
| Bell Bay Power | 661 | 0.29 | | |
| Western Australia ^b | | | | |
| SWIS | 16 226 | 7.15 | | |
| NWIS | 426 | 0.19 | | |
| Horizon Power | 463 | 0.20 | | |
| Northern Territory ^b | | | | |
| Water and Power | | | | |
| Corporation | 1 631 | 0.72 | | |

^a Includes the Australian Capital Territory. ^b Not part of the national electricity market.

Sources: Global Roam, NEM Review; WA Office of Energy; NT Power and Water Corporation, Annual Report 2009.

Transmission lines and generators



Locations are indicative only.
 Source: Geoscience Australia.

Australia has access to a range of high quality renewable energy sources that are used for heating, electricity generation and transportation. Renewable energy accounts for 5 per cent of Australia's total energy consumption. At present, renewable sources used to generate electricity include hydro, biomass, wind and solar. Renewable energy contributes around 7 per cent to Australian electricity generation, with 4.5 per cent sourced from hydro-electricity. Wind energy has experienced strong growth over recent years and now represents 1.5 per cent of total electricity generation. Emerging renewable energy technologies include large-scale solar energy plants, geothermal and wave and tidal generation technologies.

Production

Australian production of renewable energy is dominated by bagasse, wood and wood waste, and hydroelectricity, which combined accounted for 87 per cent of renewable energy production in 2007-08. Wind, solar and biofuels (which include landfill and sewage gas) accounted for the remainder of Australia's renewable energy production. Most solar energy is used for residential water heating and this accounts for 1.5 per cent of final energy consumption in the residential sector.

15 Australian production of renewable energy ^a

| | 2002-03 | 2003-04 | 2004-05 | 2005-06 | 2006-07 | 2007-08 |
|---------------------|--------------|--------------|--------------|--------------|--------------|--------------|
| | PJ | PJ | PJ | PJ | PJ | PJ |
| Bagasse | 95.1 | 101.1 | 108.3 | 109.1 | 110.8 | 111.9 |
| Biogas and biofuels | 10.7 | 10.1 | 8.7 | 9.4 | 10.2 | 17.6 |
| Hydroelectricity | 59.4 | 58.8 | 56.2 | 57.7 | 52.3 | 43.4 |
| Solar hot water | 2.8 | 2.6 | 2.6 | 2.4 | 6.0 | 6.5 |
| Solar electricity | 0.2 | 0.3 | 0.3 | 0.4 | 0.4 | 0.4 |
| Wind | 1.0 | 1.6 | 3.2 | 6.2 | 9.4 | 14.2 |
| Wood and woodwaste | 105.3 | 97.3 | 91.5 | 90.3 | 92.8 | 96.0 |
| Total | 274.5 | 271.7 | 270.8 | 275.5 | 281.9 | 290.0 |

^a Includes both electricity and heat.

Source: ABARE.

Renewable energy

Renewable energy production increased by 6 per cent in the five years from 2002-03 to 2007-08, and increased by 3 per cent in 2007-08. Biogas experienced the largest increase, from 10 petajoules in 2006-07 to 18 petajoules in 2007-08. Wind energy also increased strongly, from 9 petajoules in 2006-07 to 14 petajoules in 2007-08. Hydroelectricity was the only renewable energy source to fall in 2007-08, decreasing by 17 per cent.

Capacity

The distribution of renewable energy production facilities in Australia reflects the climatic characteristics of different regions. Hydroelectricity capacity in Australia is located mostly in New South Wales, Tasmania, Queensland and Victoria, while wind farms are most abundant in South Australia and Victoria. Almost all bagasse fuelled energy production facilities are located in Queensland where sugar production plants are located. In contrast, there is a more even distribution of biogas fuelled facilities across Australia as these facilities are mostly based on gas generated from landfill and sewerage.

16 Capacity of renewable electricity generation in Australia, 2009

| | biogas | bagasse | wood- waste | hydro | wind | solar | ocean and geothermal | other ^b | total |
|--------------------|--------|---------|----------------|---------|-------|-------|-------------------------|--------------------|--------|
| | MW | MW | MW | MW | MW | MW | MW | MW | MW |
| NSW ^a | 73.3 | 80.5 | 42.5 | 4 276.4 | 149.0 | 6.1 | 0.5 | 3.0 | 4 654 |
| Vic | 79.6 | | | 561.1 | 383.9 | 0.9 | 0.2 | 34.0 | 1 060 |
| Qld | 18.9 | 377.5 | 15.0 | 659.4 | 12.5 | 0.6 | 0.1 | 3.5 | 1 087 |
| SA | 22.4 | | 10.0 | 3.5 | 810.9 | 0.9 | | | 848 |
| WA | 27.0 | 6.0 | 6.0 | 32.1 | 202.7 | 0.8 | 0.1 | | 275 |
| Tas | 4.0 | | | 2 275.7 | 143.9 | 0.1 | | | 2 424 |
| NT | 1.1 | | | | 0.1 | 1.8 | | | 3 |
| Other ^c | | | | | | 93.4 | | | 70 |
| AUS | 226 | 464 | 73 | 7 808 | 1 703 | 105 | 1 | 41 | 10 421 |

^a Includes the ACT. ^b Unspecified biomass and biodiesel. ^c Solar PV installations at unspecified locations, 2008 estimate.

Sources: Geoscience Australia; Watt, M 2009, *National Survey Report of PV Power Applications in Australia 2008*.

Potential

A range of policy measures have been introduced in Australia to support the uptake and development of renewable energy. These measures include the Australian Government's Mandatory Renewable Energy Target (MRET). The MRET was designed to increase electricity generation from renewable energy sources by 9500 gigawatt hours a year by 2010. The renewable energy sources that have experienced the greatest growth under the MRET are wind energy and solar hot water. In 2008, electricity generation from wind was 3125 gigawatt hours higher than in 1997. Australia's annual use of solar hot water has increased by 3229 gigawatt hours, or 12 petajoules, compared with 1997.

Legislation passed in August 2009 commits the Australian Government to ensuring that 20 per cent of Australia's electricity supply comes from renewable energy sources by 2020. This will be achieved through an expanded Renewable Energy Target (RET) scheme, which has increased the previous MRET from an additional 9500 gigawatt hours of renewable energy by 2010 to 45 000 gigawatt hours by 2020. This target will be maintained

17 Increase in renewable energy under MRET from 1997 to 2008 ^a

| | annual increase | | 1997 baseline generation |
|--------------------|-----------------|------------------------|--------------------------|
| | GWh | share of increase % | GWh |
| Bagasse | 553 | 6.4 | 497 |
| Black liquor | 100 | 1.2 | 154 |
| Hydro | 241 | 2.8 | 15 629 |
| Landfill gas | 675 | 7.8 | 264 |
| Sewage gas | 83 | 1.0 | 5 |
| Solar electricity | 400 | 4.6 | 0.01 |
| Solar hot water | 3 229 | 37.5 | 0 |
| Wind | 3 125 | 36.3 | 5 |
| Woodwaste | 108 | 1.3 | 33 |
| Other ^b | 98 | 1.1 | 0.1 |
| Total | 8 612 | 100 | 16 587 |

^a Reported generation under the Mandatory Renewable Energy Target scheme, above baseline levels in 1997.

^b Includes municipal solid waste combustion and food and agricultural wet waste.

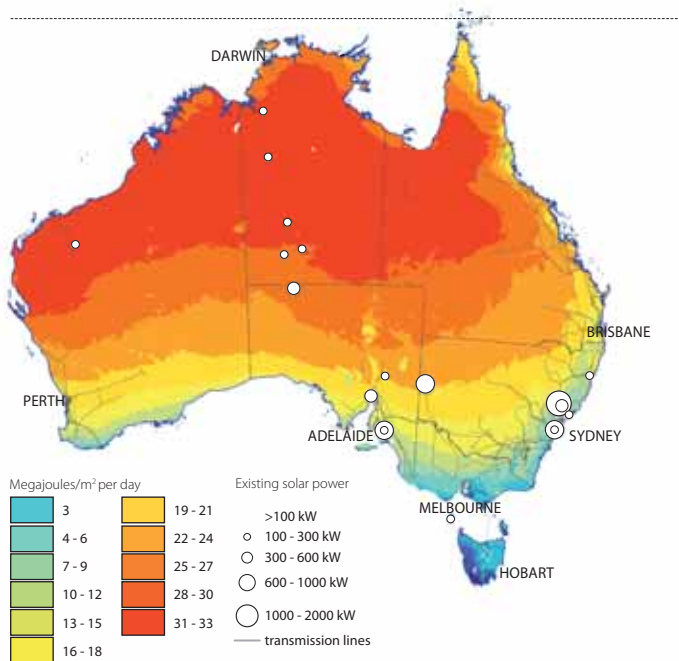
Source: Office of the Renewable Energy Regulator, *REC Registry*, <https://www.rec-registry.gov.au/>

Renewable energy

until 2030 when the RET scheme is scheduled to end. The increased targets under the expanded RET began on 1 January 2010. From 1 January 2011 the RET will include two components: the Small-scale Renewable Energy Scheme (SRES) and the Large-scale Renewable Energy Target (LRET).

Significant growth in renewable electricity generation capacity is planned for the next few years. As at the end of October 2009, there were nine renewable electricity projects at an advanced planning stage and a further 80 projects at a less advanced stage. Of these, eight are advanced wind energy projects and 71 are wind projects at a less advanced stage. There is growing interest in solar energy for electricity generation. There are currently five proposed solar energy projects in Australia, the largest of which is a 80 megawatt solar plant in Whyalla, South Australia, which is

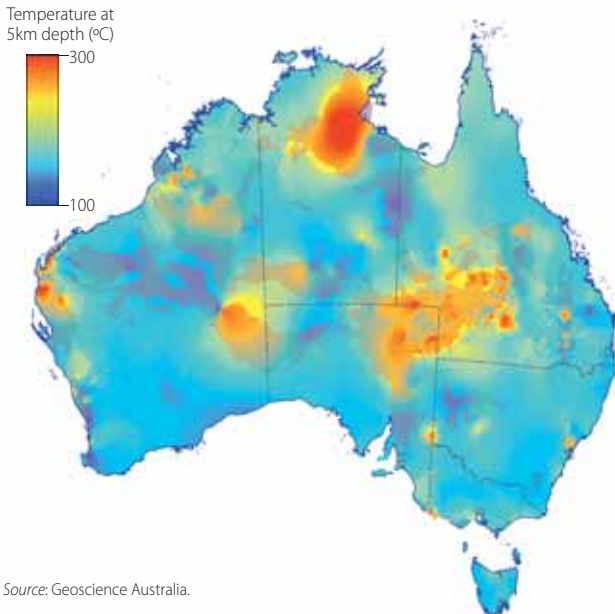
Annual average solar radiation



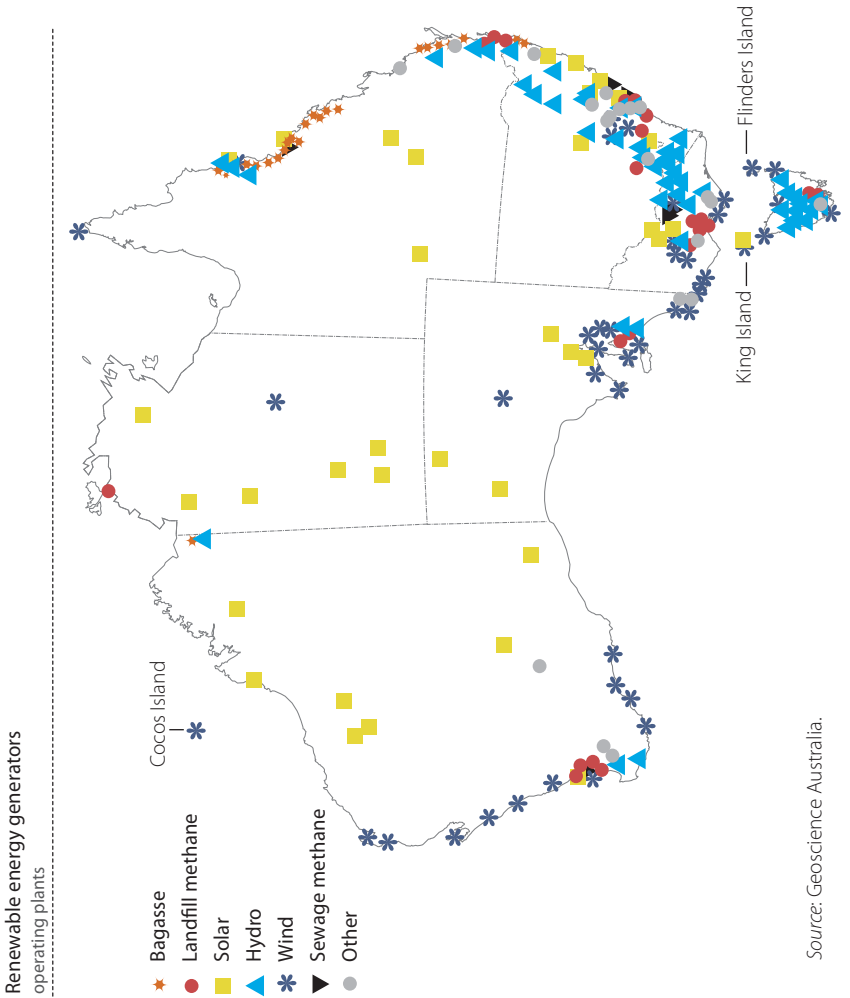
Source: Geoscience Australia.

expected to be completed in 2012. There is also a 22 megawatt solar plant planned for the ACT for the same year and a 10 megawatt solar thermal plant expected to be constructed in Cloncurry, Queensland, by 2010. Four ocean energy demonstration projects have been completed in Australia, and four other projects are in the early stages of development. These four proposed projects are planned for Portland and Port Phillip Heads, Victoria, Clarence Strait, Northern Territory, and Banks Strait, Tasmania. Geothermal energy, in the form of hot rock and hot sedimentary aquifer resources, is a renewable energy source that is at present relatively undeveloped. There is one geothermal project in operation in Australia at Birdsville, Queensland (see Appendix 1), but interest in this form of renewable energy has seen a surge in exploration activity, with two companies developing demonstration projects in South Australia's Cooper Basin, and others drilling for proof-of-concept projects in New South Wales, Victoria, South Australia and Western Australia.

Australian geothermal energy potential



Source: Geoscience Australia.



Source: Geoscience Australia.

Coal production and trade

Coal is Australia's largest commodity export, earning around \$55 billion in 2008-09. Australia's success in world coal markets has been based on reliable and competitive supplies of high quality metallurgical and thermal coal.

Coal is also a significant component of domestic energy needs, producing 76 per cent of Australia's electricity generation in 2007-08.

Production

Australia accounts for around 6 per cent of world black coal production, 97 per cent of which is sourced from New South Wales and Queensland. The majority of Australia's metallurgical (or coking) coal is produced in Queensland, while production in New South Wales is largely classed as thermal (or steaming) coal. Around three-quarters of this output is sourced from open cut mines.

Australian black coal production increased at an average annual rate of 1.5 per cent between 2004-05 and 2008-09, encouraged by strong global

18 Australian coal production^a by state

| | 2004-05 | 2005-06 | 2006-07 | 2007-08 | 2008-09 |
|-------------------|---------|---------|---------|---------|---------|
| | Mt | Mt | Mt | Mt | Mt |
| Brown coal | | | | | |
| Vic | 67.15 | 67.74 | 65.61 | 72.40 | 72.90 |
| Total | 67.15 | 67.74 | 65.61 | 72.40 | 72.90 |
| Black coal | | | | | |
| NSW | 122.06 | 124.61 | 130.88 | 134.98 | 135.33 |
| Qld | 172.67 | 171.69 | 184.08 | 180.92 | 181.71 |
| Tas | 0.42 | 0.44 | 0.56 | 0.62 | 0.62 |
| WA | 6.22 | 6.82 | 6.10 | 6.44 | 6.80 |
| SA | 3.64 | 3.48 | 3.60 | 3.84 | 3.84 |
| Total | 305.01 | 307.04 | 325.23 | 326.80 | 328.29 |

^a Saleable production.

Sources: Coal Services Pty Ltd; Queensland Department of Mines and Energy; Victorian Department of Primary Industries; ABARE, *Australian commodities*.

Coal production and trade

import demand. This growth was supported by the commissioning of new mines in Queensland and New South Wales. Australia's coal production is likely to continue to increase significantly over the medium term as a result of investment in new mining capacity, which has remained high despite economic contraction in many developed economies. As at November 2009, there were 12 committed coal mining projects and an additional 49 proposed projects (see Appendix 1).

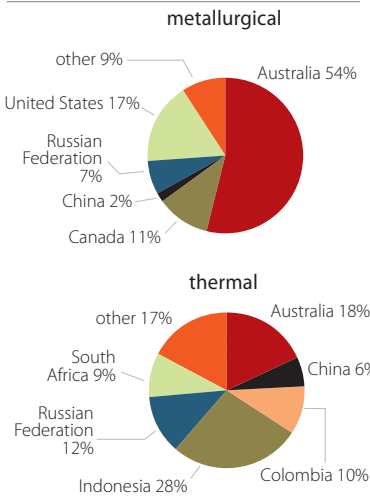
Trade

More than three-quarters of Australia's black coal production is destined for export. Australia accounts for around one-third of world black coal trade—54 per cent of world metallurgical trade and 18 per cent of thermal coal trade. Infrastructure has recently been a constraint on Australian coal

exports but additions to capacity in 2009, such as the expansion at Dalrymple Bay in Queensland, have begun to alleviate some of these constraints. The ability of the Australian coal industry to meet future coal demand will be improved by planned expansions to infrastructure capacity.

The majority of Australia's metallurgical coal exports are destined for Asia and Europe where it is used for steel manufacture. The largest importers of Australian metallurgical coal are Japan, India, Chinese Taipei and the European Union. Australia's thermal coal exports are mainly destined for Japan, the Republic of Korea and Chinese Taipei for use in electricity generation. Recently, China has become a significant importer of both types

World coal trade, 2008-09



Source: ABARE, *Australian commodity statistics*.

19 Australian coal exports by type by destination

| | | 2004-05 | 2005-06 | 2006-07 | 2007-08 | 2008-09 |
|---------------------------|----|---------|---------|---------|---------|---------|
| Metallurgical coal | | | | | | |
| Brazil | Mt | 3.09 | 3.17 | 3.05 | 3.87 | 4.19 |
| China | Mt | 4.19 | 2.86 | 2.97 | 1.53 | 14.76 |
| Chinese Taipei | Mt | 7.09 | 7.72 | 8.04 | 6.39 | 2.66 |
| European Union 27 | Mt | 24.67 | 24.34 | 24.87 | 24.51 | 14.69 |
| India | Mt | 17.44 | 16.39 | 19.61 | 24.23 | 24.27 |
| Japan | Mt | 44.96 | 44.22 | 48.86 | 50.20 | 42.23 |
| Korea, Rep. of | Mt | 12.46 | 7.70 | 6.25 | 8.36 | 13.05 |
| Other | Mt | 11.01 | 14.08 | 18.31 | 17.83 | 9.40 |
| World | Mt | 124.92 | 120.48 | 131.97 | 136.92 | 125.25 |
| Thermal coal | | | | | | |
| China | Mt | 1.75 | 3.99 | 3.22 | 1.48 | 8.40 |
| Chinese Taipei | Mt | 14.33 | 13.21 | 16.23 | 18.56 | 20.30 |
| European Union 27 | Mt | 3.48 | 2.32 | 3.81 | 2.15 | 3.72 |
| Japan | Mt | 57.28 | 59.33 | 58.64 | 66.92 | 62.57 |
| Korea, Rep. of | Mt | 17.95 | 20.24 | 15.06 | 18.55 | 30.14 |
| Other | Mt | 11.61 | 11.74 | 14.66 | 7.41 | 11.22 |
| World | Mt | 106.40 | 110.82 | 111.62 | 115.07 | 136.35 |

Source: ABARE, Australian commodity statistics.

of black coal, offsetting the effect of falling demand from many developed economies because of the global economic downturn.

After increasing in 2006-07 and 2007-08, Australian exports of metallurgical coal in 2008-09 fell to 2004-05 levels. This is a result of decreased demand for metallurgical coal associated with lower steel production because of the economic downturn. Exports to China grew strongly in 2008-09, largely because of the closure of mines in China for safety reasons. However, metallurgical coal exports grew at an average rate of 2 per cent a year from 2004-05 to 2007-08.

Over the period 2004-05 to 2008-09, thermal coal grew at an average rate of 5 per cent a year. This strong growth was largely a result of increased imports by the Republic of Korea, Japan and Chinese Taipei. In 2008-09, high import demand from China more than offset the decline in exports to

Coal production and trade

major importers such as Japan. China's imports of thermal coal grew strongly because of high domestic prices relative to the landed price of imports and high electricity demand.

In 2008-09, earnings from Australian coal exports increased by 124 per cent from the previous year because of higher volumes shipped and record contract prices. Earnings from metallurgical coal exports are estimated to have increased by 129 per cent to \$36.7 billion and thermal coal export earnings by 114 per cent to \$17.9 billion. A detailed outlook for the metallurgical and thermal coal industries can be found in ABARE's quarterly journal *Australian commodities*.

20 Australian exports of coal 2008-09 dollars

| | | 2004-05 | 2005-06 | 2006-07 | 2007-08 | 2008-09 |
|---|------|---------|---------|---------|---------|---------|
| Metallurgical coal, high quality | | | | | | |
| Volume | Mt | 80.73 | 77.48 | 82.81 | 83.65 | 79.63 |
| Value | \$m | 8 713 | 13 395 | 11 742 | 11 189 | 25 253 |
| Unit value | \$/t | 107.93 | 172.87 | 141.79 | 133.75 | 317.12 |
| Metallurgical coal, excluding high quality | | | | | | |
| Volume | Mt | 44.19 | 42.99 | 49.15 | 53.27 | 45.62 |
| Value | \$m | 3 474 | 5 269 | 4 297 | 5 355 | 11 464 |
| Unit value | \$/t | 78.61 | 122.55 | 87.42 | 100.53 | 251.31 |
| Total metallurgical coal | | | | | | |
| Volume | Mt | 124.92 | 120.48 | 131.97 | 136.92 | 125.25 |
| Value | \$m | 12 186 | 18 664 | 16 039 | 16 543 | 36 717 |
| Unit value | \$/t | 97.56 | 154.92 | 121.54 | 120.82 | 293.15 |
| Thermal coal | | | | | | |
| Volume | Mt | 106.40 | 110.82 | 111.62 | 115.07 | 136.35 |
| Value | \$m | 7 177 | 7 910 | 7 207 | 8 629 | 17 889 |
| Unit value | \$/t | 67.46 | 71.37 | 64.57 | 74.99 | 131.19 |

Source: ABARE, *Australian commodity statistics*.

Prices

Contract negotiations for the Japanese Fiscal Year (JFY) 2009 (1 April 2009 to 31 March 2010) resulted in prices for metallurgical (hard) coal declining by between 57 per cent and 62 per cent. Thermal coal contract prices decreased by 44 per cent. Despite these falls, when compared with JFY 2005, real unit prices of hard and semi-soft metallurgical coal have increased by 287 per cent and 331 per cent, respectively. Over the same period, real unit thermal coal prices have increased by 105 per cent.

The fall in contract prices for JFY 2009 can be attributed to the global economic downturn which has led to falling demand in most major importing countries.

21 Coal prices ^a

| | 2004-05 | 2005-06 | 2006-07 | 2007-08 | 2008-09 |
|---|---------|---------|---------|---------|---------|
| Metallurgical coal, hard | | | | | |
| Nominal US\$/t | 125.00 | 115.00 | 98.00 | 300.00 | 120.00 |
| Real A\$/t | 87.84 | 184.16 | 161.22 | 117.59 | 340.74 |
| Metallurgical coal, semi-soft ^b | | | | | |
| Nominal US\$/t | 80.00 | 56.00 | 64.00 | 240.00 | 90.00 |
| Real A\$/t | 63.18 | 117.86 | 78.51 | 76.79 | 272.60 |
| Thermal coal | | | | | |
| Nominal US\$/t | 52.50 | 52.50 | 55.50 | 125.00 | 70.00 |
| Real A\$/t | 69.35 | 77.35 | 73.60 | 66.59 | 141.98 |

^a Australian-Japanese prices. Japanese fiscal year beginning 1 April. Real prices are in 2009-10 Australian dollar terms. ^b Based on Australian/Japanese contract settlements.

Source: ABARE.



L N G

Natural gas is becoming increasingly important for Australia, both as a source of export income and as a domestic energy source. Around 50 per cent of Australia's gas production is exported. In 2008-09, the value of Australian LNG exports was \$10.1 billion, which was an increase of 72 per cent from 2007-08. Natural gas is the third largest source of Australia's primary energy consumption, following coal and petroleum products. Since 1997-98, natural gas consumption has increased at an average annual rate of 4 per cent a year, compared with an average rate of 1 per cent for coal and 1 per cent for petroleum products.

Production

Around 96 per cent of Australian conventional gas production is sourced from three petroleum basins—the Gippsland Basin (Victoria), the Cooper-Eromanga Basin (central Australia) and the Carnarvon Basin (north-west Western Australia).

Western Australia is the largest producer of gas in Australia, accounting for 64 per cent of national production in 2008-09. The Carnarvon Basin accounts for 99 per cent of state gas production, with the North West Shelf accounting for a significant proportion of the Carnarvon Basin production. In total, Western Australian gas production was 1095 petajoules in 2008-09, which was an increase of 9 per cent on the previous year. Gas production in Western Australia has grown at an average annual rate of 4 per cent over the past seven years.

In 2008-09, Victoria, the second largest gas producing state, accounted for around 17 per cent of Australia's natural gas production, or 294 petajoules. The majority (75 per cent) is sourced from the offshore Gippsland Basin. The offshore Otway and Bass Basins in south-west Victoria supply the remaining 25 per cent of gas production into the Victorian market. Gas production in Victoria has been increasing at an annual average rate of 2 per cent over the past seven years.

In the Northern Territory, gas production totalled 33 petajoules in 2008-09. All of this production was sourced from the onshore Amadeus Basin in central

22 Australian gas production ^a by state

| | 2002 -03 | 2003 -04 | 2004 -05 | 2005 -06 | 2006 -07 | 2007 -08 | 2008 -09 |
|--|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| | PJ | PJ | PJ | PJ | PJ | PJ | PJ |
| Queensland | | | | | | | |
| Conventional | 26 | 25 | 28 | 26 | 22 | 20 | 16 |
| Coal seam methane | 26 | 33 | 37 | 57 | 81 | 122 | 143 |
| Total | 52 | 58 | 65 | 83 | 104 | 142 | 159 |
| Victoria | | | | | | | |
| | 253 | 301 | 301 | 288 | 298 | 340 | 294 |
| South Australia | | | | | | | |
| | 220 | 164 | 159 | 153 | 145 | 132 | 124 |
| Western Australia | | | | | | | |
| | 837 | 853 | 1 020 | 1 074 | 1 129 | 1 009 | 1 095 |
| Northern Territory ^b | | | | | | | |
| | 18 | 17 | 19 | 20 | 22 | 33 | 33 |
| New South Wales | | | | | | | |
| Coal seam methane | 8 | 8 | 8 | 10 | 10 | 5 | 5 |
| Total Australia | 1 389 | 1 402 | 1 572 | 1 629 | 1 708 | 1 661 | 1 710 |

^a Data converted from volume to energy content using average conversion factors as detailed in Appendix 2. Conversion factor of 0.037 PJ per gigalitre has been used for all coal seam methane production. ^b Timor Leste gas used in Darwin LNG not included.
Sources: Energy Quest; ABARE.

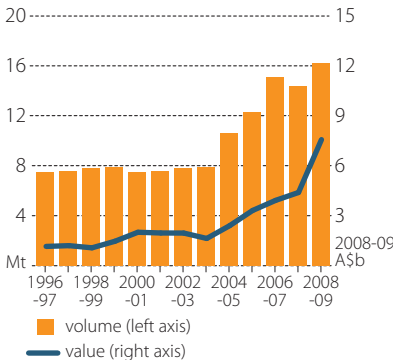
Australia. Gas production from this Basin has been increasing at 9 per cent a year over the past seven years. Until 2005-06, all of the gas produced in the Northern gas market was consumed locally. Following the development of the Darwin LNG plant, gas has also been exported as LNG. In September 2009, the offshore Blacktip gas field in the Petrel sub-basin of the Bonaparte Basin came on stream with gas being piped onshore to a processing plant at Wadeye and then to the Amadeus Basin-Darwin pipeline.

Production of coal seam gas (CSG) has increased significantly in the past seven years with its share of total Australian gas production increasing from 2 per cent in 2002-03 to 9 per cent in 2008-09. CSG is only produced in Queensland and New South Wales, accounting for around 90 per cent and 100 per cent of total gas production, respectively. Production of CSG is expected to continue to grow with two projects planned in Queensland and another four in New South Wales.

Trade

The geographical distance between Australia and its key natural gas export markets prevents trade by conventional pipeline transport. Instead, by cooling the gas to -161 degrees Celsius so it becomes a liquid known as liquefied natural gas (LNG), its volume is reduced and this enables storage and transport. Australia's two producing LNG projects are the North West Shelf Joint Venture and the Darwin LNG project.

Australian LNG exports



Source: ABARE, *Australian commodity statistics, Australian commodities*.

Australia's major LNG trading partners include Japan (our first LNG customer), China and the Republic of Korea. With future expansions to Australia's LNG capacity, there is expected growth in these LNG export markets, along with new export opportunities to India, Thailand, Singapore and Chinese Taipei. In September 2009, Chevron announced plans to proceed with the development of the 15 million tonne Gorgon LNG project, which when completed will be one of the largest natural gas projects in the world.

Prices

Domestic gas prices on the east coast, Australia's largest gas market, have increased significantly over the past eight years as demand for gas from households and power generators has increased. Over this period, wholesale gas prices on the Victorian spot market have risen at a real annual average rate of 6 per cent. The rise in domestic gas prices has been particularly significant since 2005-06 as water scarcity reduced the amount of electricity generated from coal-fired power plants, increasing demand for gas used in the generation of electricity.

23 Gas prices 2008-09 dollars

| | 2001 -02 | 2002 -03 | 2003 -04 | 2004 -05 | 2005 -06 | 2006 -07 | 2007 -08 | 2008 -09 |
|----------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Natural gas a \$A/GJ | 2.16 | 2.34 | 2.50 | 2.59 | 2.71 | 3.34 | 3.72 | 3.32 |
| LNG b \$A/t | 428.17 | 402.49 | 324.32 | 348.10 | 401.94 | 376.29 | 428.63 | 620.71 |
| LNG b \$A/GJ | 7.87 | 7.40 | 5.96 | 6.40 | 7.39 | 6.92 | 7.88 | 11.41 |

a Financial year average of daily spot prices in the Victorian gas market. b Export unit value.

Sources: ABARE, Australian commodity statistics; AEMO.

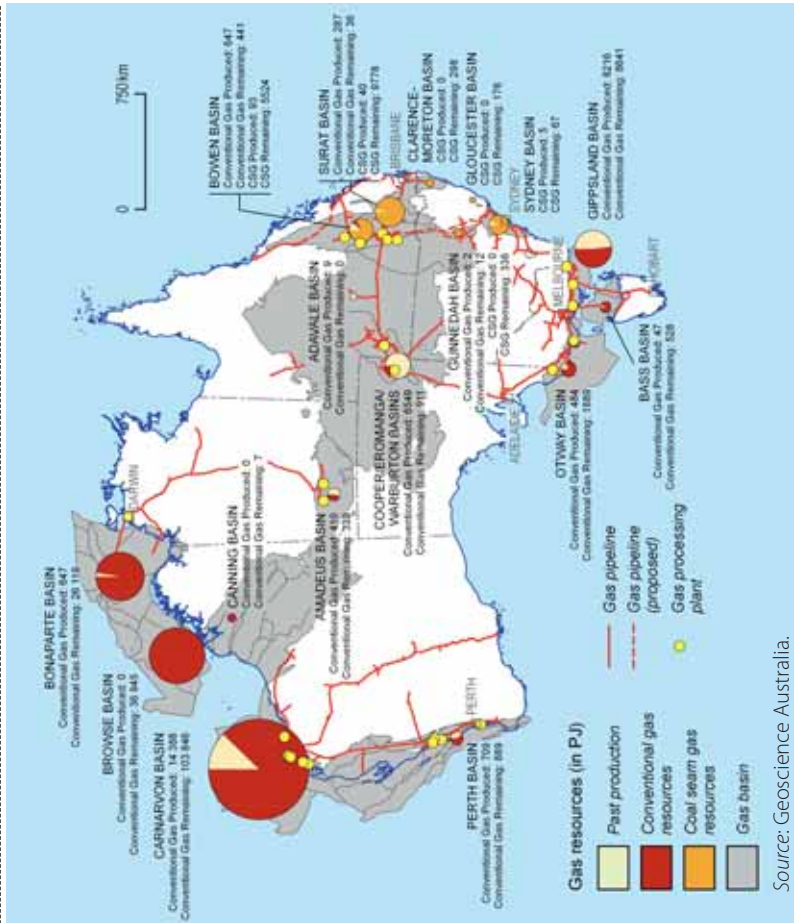
LNG contract prices are generally linked to world oil prices and also include the cost of processing and transport. In Europe, LNG prices are starting to be linked to natural gas spot and futures market prices. In the Asia Pacific region, Japanese crude oil prices have historically been used as the basis for setting the price of LNG under long-term contracts. Reflecting higher oil prices, LNG import prices have increased significantly over the past four years, with the prices of LNG imports in Japan and the Republic of Korea undergoing average annual growth of 23 per cent and 19 per cent, respectively. Higher world LNG prices have led to a corresponding increase in Australia's average LNG export price. Between 2004-05 and 2008-09, Australian export prices increased by an average of 12 per cent a year. Despite this, the average Australian export price declined in 2006-07 reflecting increased shipments under lower priced contracts.

24 Asia Pacific LNG and natural gas prices, 2008

| | average | \$US/tonne |
|--------------------------------|------------------|------------|
| Australia exports | all destinations | 371 |
| Japan imports | from Australia | 602 |
| | all origins | 651 |
| Republic of Korea imports | all origins | 729 |
| United States imports | all origins | 507 |
| United States pipeline imports | all origins | 417 |

Sources: International Energy Agency; ABARE.

Australian gas resources



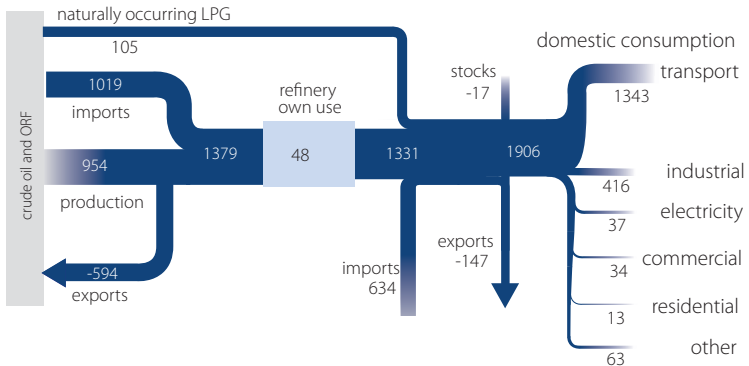
Source: Geoscience Australia.



Petroleum production and trade

Australia's crude oil production was equivalent to 69 per cent of refinery feedstock (in energy content terms) in 2007-08, meaning Australia is a net importer of crude oil. Around 70 per cent (in energy content terms) of Australia's refined product consumption is sourced from domestic refineries. However, around 60 per cent of Australia's crude oil production is exported, resulting in 74 per cent of refinery feedstock being sourced from imports. In contrast, Australia is a net exporter of LPG, exporting 46 per cent of its total production in 2007-08.

Australian oil and LPG flows, 2007-08
units: petajoules



Source: ABARE, Australian energy statistics.

Production

In 2008-09, Australia's production of crude oil and condensate increased to 27.8 gigalitres, which was an increase of 8 per cent compared with 2007-08. LPG production decreased slightly by 1 per cent in 2008-09 to 3929 megalitres, after falling by 13 per cent the previous year.

25 Australian production of primary petroleum by basin

| | 2003-04 | 2004-05 | 2005-06 | 2006-07 | 2007-08 | 2008-09 |
|-------------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | ML | ML | ML | ML | ML | ML |
| Crude oil | | | | | | |
| Adavale | 0 | 0 | 0 | 0 | 0 | 0 |
| Amadeus | 136 | 132 | 53 | 55 | 50 | 55 |
| Bonaparte | 3 037 | 1 868 | 1 403 | 1 470 | 826 | 812 |
| Bowen–Surat | 28 | 24 | 23 | 21 | 16 | 19 |
| Canning | 3 | 2 | 2 | 2 | 4 | 7 |
| Carnarvon | | | | | | |
| Barrow Island | 502 | 448 | 390 | 390 | 356 | 728 |
| North West Shelf | 8 564 | 7 859 | 4 524 | 5 850 | 4 063 | 2 961 |
| Other | 3 688 | 3 831 | 5 854 | 7 044 | 7 202 | 8 307 |
| Cooper–Eromanga | | | | | | |
| Queensland | 387 | 529 | 432 | 791 | 901 | 854 |
| South Australia | 445 | 401 | 489 | 1 116 | 1 354 | 2 025 |
| Gippsland | 6 019 | 4 647 | 3 681 | 3 850 | 3 392 | 3 922 |
| Otway | 0 | 0 | 0 | 0 | 0 | 0 |
| Perth | 387 | 517 | 395 | 816 | 668 | 418 |
| Total | 23 198 | 20 259 | 17 247 | 21 405 | 18 832 | 20 109 |
| Condensate | | | | | | |
| Adavale | 0 | 0 | 0 | 0 | 0 | 0 |
| Amadeus | 0 | 0 | 0 | 0 | 0 | 0 |
| Bonaparte | 46 | 307 | 394 | 394 | 33 | 0 |
| Bowen–Surat | 15 | 23 | 20 | 21 | 19 | 21 |
| Canning | 0 | 0 | 0 | 0 | 0 | 0 |
| Carnarvon | | | | | | |
| Barrow Island | 203 | 120 | 0 | 8 | 0 | 0 |
| North West Shelf | 5 840 | 5 041 | 5 265 | 5 692 | 5 572 | 6 436 |
| Other | 142 | 250 | 202 | 134 | 143 | 44 |
| Cooper–Eromanga | | | | | | |
| Queensland | 242 | 270 | 205 | 167 | 163 | 163 |
| South Australia | 176 | 221 | 208 | 239 | 193 | 176 |
| Gippsland | 836 | 813 | 770 | 744 | 804 | 738 |
| Otway | 13 | 7 | 3 | 2 | 28 | 99 |
| Perth | 1 | 1 | 2 | 3 | 2 | 2 |
| Total | 7 515 | 7 052 | 7 069 | 7 404 | 6 957 | 7 680 |

continued...

25 Australian production of primary petroleum by basin *continued*

| | 2003-04 | 2004-05 | 2005-06 | 2006-07 | 2007-08 | 2008-09 |
|--------------------------------|--------------|--------------|--------------|--------------|--------------|--------------|
| | ML | ML | ML | ML | ML | ML |
| Liquefied petroleum gas | | | | | | |
| Adavale | 0 | 0 | 0 | 0 | 0 | 0 |
| Amadeus | 0 | 0 | 0 | 0 | 0 | 0 |
| Bonaparte | 0 | 0 | 0 | 0 | 0 | 0 |
| Bowen–Surat | 20 | 24 | 23 | 24 | 24 | 24 |
| Canning | 0 | 0 | 0 | 0 | 0 | 0 |
| Carnarvon | | | | | | |
| Barrow Island | 0 | 0 | 0 | 0 | 0 | 0 |
| North West Shelf | 1 817 | 1 963 | 2 160 | 2 067 | 1 500 | 1 582 |
| Other | 0 | 0 | 0 | 0 | 0 | 0 |
| Cooper–Eromanga | | | | | | |
| Queensland | 0 | 0 | 0 | 0 | 0 | 0 |
| South Australia | 827 | 663 | 597 | 551 | 557 | 560 |
| Gippsland | 1 976 | 1 977 | 1 942 | 1 908 | 1 883 | 1 628 |
| Otway | 0 | 0 | 0 | 0 | 6 | 136 |
| Perth | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 4 639 | 4 628 | 4 722 | 4 550 | 3 971 | 3 929 |

Source: ABARE, *Australian commodity statistics*.

Australia's largest petroleum producing basins are the Carnarvon Basin in north-western Australia and the Gippsland Basin in the Bass Strait. While production from the Carnarvon Basin is mostly exported, production from the Gippsland Basin in south-eastern Australia is predominantly used in domestic refining. The Carnarvon Basin currently accounts for 63 per cent of Australia's production of crude oil, condensate and LPG. Production from the Gippsland Basin peaked in the mid-1980s and has declined steadily since. The Gippsland Basin now constitutes 20 per cent of Australia's total production of crude oil, condensate and LPG.

Trade

Australia is a net importer of crude oil and refined petroleum products but a net exporter of LPG. In 2008-09, Australia imported 24 303 million litres of

26 Major Australian listed oil and gas companies and their resources

| company | ASX code | market | proved |
|----------------------|----------|--------------------|---------------|
| | | capitalisation | plus probable |
| | | February 2010 A\$b | mboe |
| BHP Billiton | BHP | 139.3 | 897 |
| Woodside | WPL | 32.6 | 170 |
| Origin | ORG | 14.2 | 771 |
| Santos | STO | 11 | 1 013 |
| Oil Search | OSH | 7.1 | 67 |
| Arrow Energy | AOE | 2.7 | 704 |
| Australian Worldwide | | | |
| Exploration | AWE | 1.5 | 69 |
| Beach Petroleum | BPT | 0.8 | 66 |
| Karoo | KAR | 1.2 | na |
| Roc Oil | ROC | 0.3 | 24 |
| Nexus Energy | NXS | 0.3 | 122 |
| AED Oil | AED | 0.1 | na |

na Not available.

Source: Annual reports of listed companies.

refinery feedstock (crude oil and condensate). The high proportion of imports as a share of total production reflects a significant proportion of Australia's oil production being located off the north-west coast, which is closer to Asian refineries than domestic refineries on the east coast. Conversely, the majority of refinery capacity is located close to the major consumption markets on the east coast in Queensland, New South Wales and Victoria.

Since the mid-1990s, Australia's imports of crude oil from the Middle East have been gradually declining. Instead, crude oil has been increasingly sourced from South-East Asia. Vietnam is currently the largest source for Australian crude oil and condensate imports, accounting for around 22 per cent of refinery feedstock imports, followed by Malaysia (18 per cent) and Indonesia (15 per cent).

Despite being a net importer, Australia also exports significant quantities of crude oil and condensate, which reflects the proximity of oil production from Australia's north-west coast to Asian refineries. Australia's crude oil exports are

27 Australian imports of petroleum by source

| | 2003-04 | 2004-05 | 2005-06 | 2006-07 | 2007-08 | 2008-09 |
|---|---------------|---------------|---------------|---------------|---------------|---------------|
| | ML | ML | ML | ML | ML | ML |
| Crude oil and other refinery feedstock | | | | | | |
| Indonesia | 4 012 | 3 328 | 3 929 | 3 391 | 3 289 | 3 667 |
| Malaysia | 4 073 | 4 761 | 3 976 | 3 730 | 4 103 | 4 461 |
| New Zealand | 708 | 663 | 638 | 635 | 1 974 | 2 313 |
| Other Middle East | 42 | 158 | 199 | 118 | 43 | 40 |
| Papua New Guinea | 1 189 | 1 717 | 2 386 | 2 059 | 2 190 | 1 349 |
| Qatar | 0 | 77 | 0 | 106 | 0 | 0 |
| Saudi Arabia | 1 517 | 3 101 | 1 602 | 1 151 | 573 | 775 |
| Singapore | 597 | 652 | 830 | 841 | 713 | 555 |
| United Arab Emirates | 2 207 | 1 917 | 863 | 2 971 | 3 660 | 2 918 |
| Vietnam | 5 778 | 6 560 | 6 708 | 6 677 | 6 318 | 5 278 |
| Other | 3 376 | 3 122 | 3 287 | 3 665 | 3 360 | 2 947 |
| Total | 23 499 | 26 056 | 24 418 | 25 345 | 26 223 | 24 303 |
| Refined products | | | | | | |
| Indonesia | 281 | 162 | 98 | 17 | 11 | 45 |
| Korea, Rep. of | 279 | 237 | 961 | 821 | 785 | 1 704 |
| Malaysia | 97 | 93 | 220 | 8 | 316 | 184 |
| Middle East | 1 036 | 588 | 691 | 642 | 1 044 | 1 050 |
| New Zealand | 3 | 4 | 84 | 96 | 40 | 215 |
| Singapore | 5 905 | 7 339 | 8 452 | 7 681 | 10 215 | 10 217 |
| United States | 434 | 423 | 456 | 378 | 421 | 476 |
| Other | 3 370 | 2 334 | 2 926 | 3 099 | 3 961 | 4 385 |
| Total | 11 405 | 11 179 | 13 887 | 12 742 | 16 794 | 18 276 |

Source: ABARE, Australian commodity statistics.

typically of a higher value type of oil, characterised by its low sulphur and wax content. In 2008-09, Australia exported 16 588 million litres of crude oil and condensate. More than 70 per cent of this was exported to the Asian region, mostly to the Republic of Korea, Singapore and Japan. Japan is Australia's largest market for LPG, accounting for nearly 60 per cent of Australia's LPG exports. Australia's exports of refined petroleum products are less significant, amounting to 1134 million litres in 2008-09. Around 36 per cent of these exports were destined for New Zealand and another 34 per cent were destined for Singapore.

28 Australian exports of petroleum ^a by destination

| | 2003-04 | 2004-05 | 2005-06 | 2006-07 | 2007-08 | 2008-09 |
|---|---------------|---------------|---------------|---------------|---------------|---------------|
| | ML | ML | ML | ML | ML | ML |
| Crude oil and other refinery feedstock | | | | | | |
| China | 2 389 | 732 | 404 | 518 | 972 | 1 009 |
| Chinese Taipei | 125 | 916 | 346 | 446 | 343 | 403 |
| Japan | 2 079 | 1 927 | 2 201 | 1 957 | 2 280 | 2 485 |
| Korea, Rep. of | 3 778 | 2 787 | 2 725 | 3 873 | 3 701 | 4 395 |
| New Zealand | 722 | 1 425 | 465 | 1 045 | 600 | 321 |
| Singapore | 3 948 | 2 861 | 3 110 | 3 752 | 3 089 | 3 543 |
| United States | 1 808 | 1 154 | 297 | 190 | 1 157 | 1 421 |
| Other | 2 677 | 3 929 | 3 478 | 4 183 | 3 833 | 3 011 |
| Total | 17 526 | 15 731 | 13 026 | 15 965 | 15 975 | 16 588 |
| Liquefied petroleum gas | | | | | | |
| China | 696 | 598 | 393 | 308 | 465 | 354 |
| Japan | 2 109 | 2 081 | 2 142 | 1 821 | 1 587 | 1 474 |
| Korea, Rep. of | 0 | 81 | 0 | 384 | 178 | 292 |
| Other | 111 | 84 | 264 | 311 | 359 | 380 |
| Total ^b | 2 916 | 2 844 | 2 800 | 2 824 | 2 589 | 2 500 |
| Refined products | | | | | | |
| Fiji | 122 | 7 | 62 | 4 | 3 | 2 |
| Japan | 29 | 53 | 74 | 84 | 71 | 56 |
| New Zealand | 828 | 1 113 | 716 | 872 | 837 | 407 |
| Singapore | 127 | 471 | 771 | 576 | 505 | 390 |
| Other Pacific | 776 | 156 | 274 | 131 | 275 | 256 |
| United States | 123 | 0 | 37 | 6 | 3 | 0 |
| Other | 468 | 45 | 148 | 81 | 113 | 25 |
| Total | 2 474 | 1 846 | 2 082 | 1 752 | 1 807 | 1 134 |

^a Does not include LNG exports or ships and aircraft stores. ^b Includes confidential exports.

Source: ABARE, Australian commodity statistics.

29 Value of Australian trade in petroleum

| | 2003-04 | 2004-05 | 2005-06 | 2006-07 | 2007-08 | 2008-09 |
|------------------------------|---------|---------|---------|---------|---------|---------|
| | \$m | \$m | \$m | \$m | \$m | \$m |
| Exports | | | | | | |
| Automotive gasoline | 280 | 339 | 419 | 468 | 444 | 168 |
| Diesel fuel | 292 | 166 | 238 | 188 | 363 | 225 |
| Aviation turbine fuel | 172 | 108 | 80 | 74 | 120 | 71 |
| Fuel oil | 21 | 51 | 215 | 84 | 130 | 96 |
| Aviation gasoline | 20 | 26 | 54 | 69 | 73 | 45 |
| Kerosene | 0 | 0 | 0 | 0 | 0 | 0 |
| Lubricants | 100 | 112 | 139 | 157 | 152 | 146 |
| Other products | 33 | 41 | 52 | 57 | 41 | 34 |
| Total refined products | 918 | 844 | 1 195 | 1 098 | 1 323 | 785 |
| Liquefied petroleum | | | | | | |
| gas | 647 | 804 | 1 002 | 1 038 | 1 182 | 1 043 |
| Bunkers | 696 | 951 | 1 322 | 1 295 | 1 457 | 1 537 |
| Crude oil and other refinery | | | | | | |
| feedstock | 5 055 | 6 330 | 6 638 | 8 317 | 10 484 | 8 755 |
| Liquefied natural gas | 2 174 | 3 199 | 4 416 | 5 222 | 5 854 | 10 086 |
| Imports | | | | | | |
| Automotive gasoline | 1 168 | 1 463 | 2 342 | 1 872 | 2 719 | 2 784 |
| Diesel fuel | 1 134 | 1 933 | 4 071 | 3 466 | 6 155 | 6 317 |
| Aviation turbine fuel | 220 | 483 | 527 | 668 | 1 505 | 1 393 |
| Fuel oil | 313 | 364 | 569 | 536 | 831 | 867 |
| Lubricants | 206 | 288 | 418 | 495 | 477 | 629 |
| Liquefied petroleum | | | | | | |
| gas | 166 | 143 | 198 | 261 | 436 | 381 |
| Other products | 387 | 447 | 635 | 1 285 | 1 331 | 2 927 |
| Total refined products | 3 594 | 5 122 | 8 760 | 8 583 | 13 454 | 15 297 |
| Crude oil and other refinery | | | | | | |
| feedstock | 6 595 | 9 996 | 12 822 | 13 360 | 17 149 | 14 721 |

Source: ABARE, Australian commodity statistics.

Petroleum production and trade

Despite slightly higher export volumes, lower oil prices resulted in a fall in the value of crude oil and condensate exports of 26 per cent in 2008-09. The value of refined petroleum products exports decreased by 16 per cent in 2008-09, reflecting both lower export volumes and lower prices.

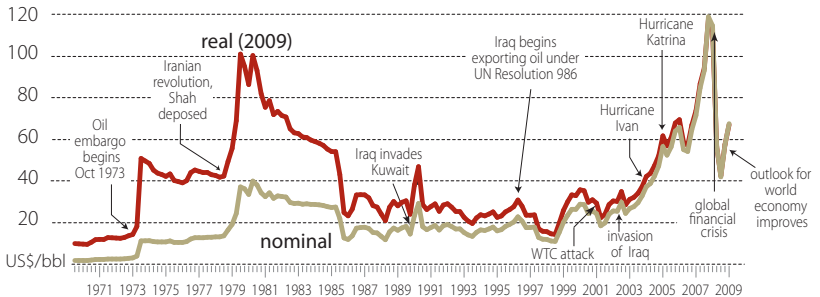
Prices

From 1986 to 2003, oil prices were traded within a range of US\$20-30 a barrel (in real terms). However, the loss of crude oil production from Venezuela and Iraq in 2003 combined with growing demand in the United States and Asia caused oil prices to increase. Continued political instability in a number of oil producing countries, the increasing demand in Asia, particularly China, and speculative demand drove oil prices to peak at \$147 a barrel in July 2008.

Since peaking in July 2008, oil prices fell by more than 70 per cent to around US\$35 a barrel in February 2009. The rapid fall in oil prices was caused by falling demand as a result of the global financial crisis, which led to slower economic growth in most developing countries and recession in many developed countries. However, by the end of June 2009, oil prices had doubled to around US\$70 a barrel and increased to \$80 a barrel in October 2009. The increase in oil prices over the second half of 2009 reflects market expectations of higher oil demand in late 2009 and 2010 associated with an improvement in economic conditions.

Oil price

World average trade weighted prices, quarterly, ended December 2009



Source: ABARE, Australian commodity statistics.

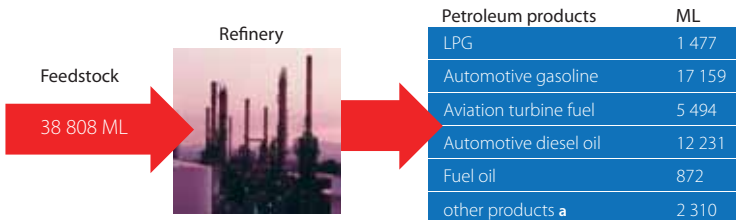
Liquid fuels refining and pricing

In 2008-09, Australia's consumption of refined liquid fuels totalled around 50 614 million litres. Domestic production of refined liquid fuels totalled around 39 546 million litres (around 78 per cent of consumption), while imports totalled 18 276 million litres. Australian exports of refined liquid fuels were around 1134 million litres in 2008-09, equal to about 3 per cent of production. Australian consumption of refined petroleum products has increased at an average rate of 2 per cent a year over the past 10 years, driven by growth in the transport sector, which accounts for the vast majority of refined liquid consumption.

Production

The petroleum refining industry in Australia produces a wide range of petroleum products such as gasoline, diesel, aviation turbine fuel and LPG, which are derived from crude oil and condensate feedstock. In 2008-09, Australian refineries consumed 38 808 million litres of crude oil and condensate, of which imports accounted for around 80 per cent (72 per cent of Australia's crude oil and condensate production is exported). From 2007-08 to 2008-09, Australian refinery production decreased by only 0.1 per cent to 39 544 million litres.

Refinery input and production, 2008-09



^a Includes aviation gasoline, kerosine, industrial and marine diesel, lubricating oils, greases and basestock, bitumen, refinery fuels and other products.

Source: RET, Australian petroleum statistics.

30 Australian production of refined petroleum products

| | 2003-04 | 2004-05 | 2005-06 | 2006-07 | 2007-08 | 2008-09 |
|--------------------------------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | ML | ML | ML | ML | ML | ML |
| Automotive gasoline | 17 375 | 17 913 | 16 528 | 17 732 | 17 079 | 17 159 |
| Automotive diesel oil | 12 544 | 12 822 | 10 154 | 11 055 | 12 177 | 12 231 |
| Aviation turbine fuel | 4 964 | 5 325 | 5 216 | 5 332 | 5 182 | 5 494 |
| Fuel oil | 1 105 | 1 092 | 1 048 | 942 | 979 | 872 |
| Liquefied petroleum gas | 1 062 | 995 | 1 125 | 1 387 | 1 515 | 1 477 |
| Industrial and marine diesel fuel | 84 | 22 | 31 | 21 | 3 | 13 |
| Bitumen | 678 | 1 091 | 831 | 1 356 | 1 452 | 1 294 |
| Lubricants | 259 | 202 | 163 | 146 | 121 | 114 |
| Aviation gasoline | 114 | 144 | 119 | 119 | 119 | 105 |
| Heating oil | 118 | 106 | 102 | 86 | 102 | 69 |
| Other products ^a | 821 | 977 | 946 | 616 | 844 | 716 |
| Total products | 39 124 | 40 688 | 36 262 | 38 793 | 39 574 | 39 544 |

^a Includes byproducts of petrochemical downstream processing.

Source: RET, Australian petroleum statistics.

Capacity

There are seven major petroleum refineries currently operating in Australia, which are managed by four companies – BP, Caltex, Mobil and Shell. These seven refineries have a combined capacity of 42 500 million litres a year. The largest of these are BP's Kwinana refinery in Western Australia and Caltex's Kurnell refinery in New South Wales.

Fuel standards

Fuel quality standards have been progressively improved in Australia with the aim of reducing the adverse effects of motor vehicle emissions on air quality and human health, and to enable Australia to effectively adopt new vehicle engine and emission control technologies. In 2008, gasoline standards requiring a maximum sulphur content of 50 parts per million for premium unleaded petrol were implemented. The standard grade unleaded petrol remains at a maximum sulphur content of 150 parts per million. A grade of standard unleaded petrol with 10 per cent ethanol (E10) is also offered as an alternative

31 Australian refinery capacity

| | operator | year commissioned | capacity MLpa |
|--------------------------|-------------|----------------------|------------------|
| New South Wales | | | |
| Clyde | Shell | 1928 | 4 930 |
| Kurnell | Caltex | 1956 | 7 320 |
| Queensland | | | |
| Bulwer Island | BP | 1965 | 5 110 |
| Lytton | Caltex | 1965 | 6 270 |
| Victoria | | | |
| Altona | Exxon Mobil | 1949 | 4 530 |
| Geelong | Shell | 1954 | 6 380 |
| Western Australia | | | |
| Kwinana | BP | 1955 | 7 960 |
| Total | | | 42 500 |

Sources: Australian Institute of Petroleum, *Downstream Petroleum 2007*; Company media releases.

32 Fuel standards
end of 2009

| | sulphur content (ppm) | |
|-------------|-----------------------|--------|
| | gasoline | diesel |
| Australia | 50 | 10 |
| New Zealand | 50 | 10 |
| Japan | 10 | 10 |
| Singapore | 50 | 50 |
| Malaysia | 500 | 500 |
| Thailand | 150 | 350 |
| Indonesia | 500 | 500 |
| China | 150 | 350 |
| India | 150 | 50 |

Sources: Australian Institute of Petroleum, *Downstream petroleum 2007*; RET.

to unleaded petrol. The automotive diesel quality standard has been revised as of 1 January 2009 to a maximum sulphur content of 10 parts per million. From 1 March 2009, the diesel quality standard was revised to allow up to 5 per cent biodiesel fuel without a labelling requirement. Australian refineries have been progressively undertaking capital upgrades to meet these standards.

In the Asia Pacific region, many countries have also implemented stricter fuel quality standards in response to environmental concerns which have resulted from rapidly

increasing gasoline and diesel consumption. For example, China, India and Thailand reduced maximum sulphur levels in gasoline to 150 parts per million during 2008 from more than 500 parts per million. From 1 January 2009, New Zealand reduced maximum sulphur levels in diesel to 10 parts per million.

Non-conventional liquid fuels

Coal to liquids (CTL) and gas to liquids (GTL) are two alternatives to petroleum fuels that are currently being considered in Australia. CTL is the process of converting coal, by either a hydrogenation or carbonisation process, into a liquid fuel. Coal can also be converted into a liquid fuel by first converting it into a gas (syngas) and then converting the syngas into a hydrocarbon which is processed into a liquid fuel. GTL is the process of converting either natural gas or refineries' waste gas into liquid fuels.

Liquid biofuels, comprising fuel ethanol and biodiesel, are another alternative to petroleum fuels. There are currently three major fuel ethanol production facilities in Australia with a combined capacity of just more than 330 million litres a year. These facilities produce ethanol primarily from wheat starch, grain sorghum and molasses.

There are three major biodiesel production facilities in Australia, with additional facilities producing small quantities. Total biodiesel operating capacity is 265 million litres a year. Biodiesel facilities in Australia use a range of vegetable oils and animal fats as feedstocks, which are selected according to price and availability. The limited availability of low priced feedstocks led to the closure of several biodiesel plants in 2008.

Prices

The pre-tax component of Australian gasoline prices remains among the lowest in the OECD and the tax-inclusive gasoline price is the fifth lowest, following Mexico, the United States, Canada and New Zealand.

Australian wholesale gasoline and diesel prices closely follow movements in Singapore prices. Around 56 per cent of Australia's imports of refined petroleum products are sourced from Singapore. In 2008-09, the Singapore gasoline spot price decreased by 16 per cent (in real terms) to average

A\$0.63 a litre, reflecting the effect of the slowdown in global economic activity on demand for petroleum products. Similarly, the world trade weighted average price of crude oil decreased by 17 per cent in 2008-09.

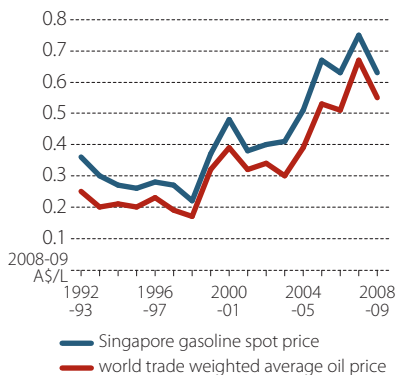
33 Liquid biofuels production facilities in Australia, 2009

| location | capacity ML/yr | feedstocks |
|--|-------------------|--|
| Fuel ethanol | | |
| Manildra Group, Nowra, NSW | 180 | Waste wheat starch, some low grade grain |
| CSR Distilleries, Sarina, Qld (North Queensland) | 60 | Molasses |
| Dalby Biorefinery, Dalby, Qld | 90 | Sorghum |
| Biodiesel | | |
| <i>In production</i> | | |
| Biodiesel Industries Australia, Maitland, NSW | 15 | Used cooking oil, vegetable oil |
| Biodiesel Producers Limited, Wodonga, Vic | 60 | Tallow, used cooking oil |
| Smorgon Fuels, Melbourne, Vic | 100 | Dryland juncea (oilseed crop), tallow, used cooking oil, vegetable oil |
| Various small producers | 5 | Used cooking oil, tallow, industrial waste, oilseeds |
| <i>Limited production</i> | | |
| Australian Renewable Fuels, Adelaide, SA | 45 | Tallow |
| Australian Renewable Fuels, Picton, WA | 45 | Tallow |
| <i>Not in production</i> | | |
| Eco-Tech Biodiesel, Narangba, Qld | 30 | Tallow, used cooking oil |

Source: RET.

Liquid fuels refining and pricing

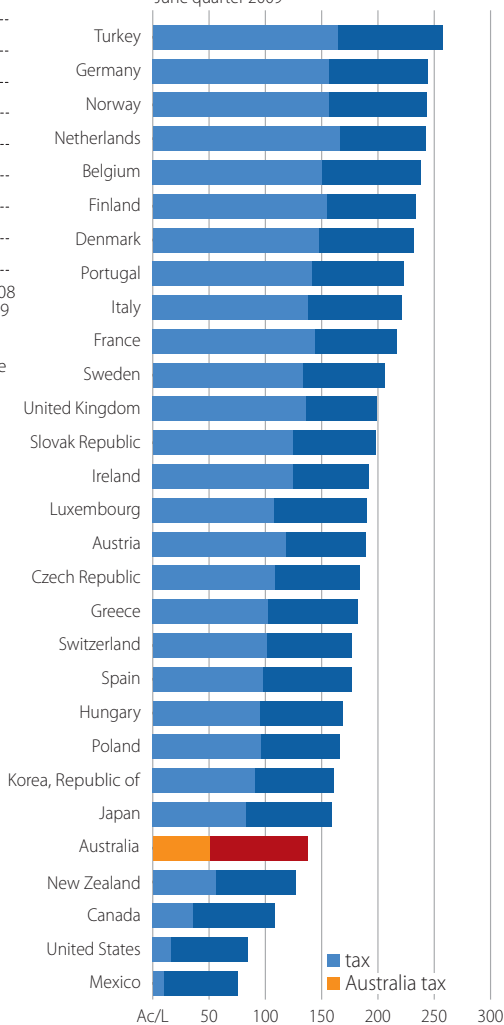
Petrol price indicators



Source: Energy Information Administration; ABARE, Australian commodity statistics

OECD gasoline prices

June quarter 2009



Source: RET, Australian petroleum statistics.

The transport sector is the largest user of final energy in Australia. Around 35 per cent of Australia's final energy use is employed in moving people and goods across the country. Being a large continent characterised by major population centres located along the coastline, goods in Australia are transported long distances. The transportation sector is the largest consumer of liquid fuels (including LPG and refined products), accounting for 68 per cent of Australia's total use in energy content terms.

Energy consumption

Road transport is the largest end user of energy in the transport sector, accounting for around three-quarters of the sector's fuel consumption. Average growth in road transport fuel consumption has eased steadily over the past 30 years, falling from less than 3 per cent a year in the 1980s to less than 1 per cent in the current decade.

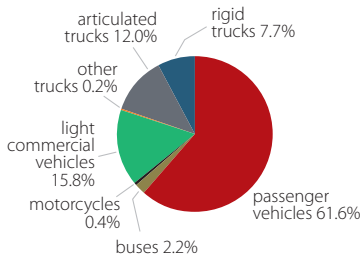
Passenger vehicles account for the majority of fuel consumption in the road transport sector. In 2006-07, almost 62 per cent of the fuel consumed

34 Energy consumption in the transport sector

| | 1979-80 | 1989-90 | 1999-00 | 2005-06 | 2007-08 |
|-------------------|--------------|----------------|----------------|----------------|----------------|
| | PJ | PJ | PJ | PJ | PJ |
| Road transport | 611.8 | 811.4 | 980.4 | 1 032.4 | 1 027.5 |
| Railway transport | 31.0 | 30.7 | 33.3 | 35.2 | 37.5 |
| Water transport | 97.6 | 55.6 | 55.6 | 58.4 | 70.6 |
| Air transport | 80.6 | 108.6 | 184.6 | 201.1 | 226.3 |
| Other | 3.6 | 6.2 | 12.8 | 23.7 | 25.6 |
| Total | 824.6 | 1 012.5 | 1 266.7 | 1 350.8 | 1 387.5 |

Source: ABARE, Australian energy statistics.

Australian road fuel consumption by type of vehicle, 2006-07



Source: Apelbaum Consulting Group, *Australian Transport Facts 2009*.

in the road transport sector was in passenger vehicles.

Air transportation has been the fastest growing mode of transport in Australia. However, while growth in the consumption of aviation fuels averaged 5 per cent a year during the 1990s, it has fallen to less than 3 per cent a year since 2000. Since 1987-88, international aviation has accounted for the majority of the air transportation sector's fuel consumption. The increase in international air transportation has been at the expense of international

sea transportation. As such, energy use in water transport has steadily declined over the past 30 years.

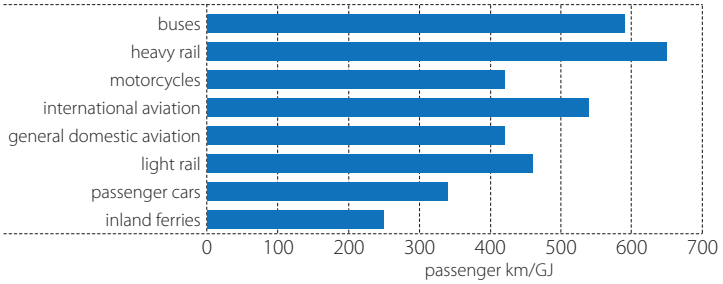
Automotive gasoline is the main fuel used in the transportation industry, accounting for around 48 per cent of total energy consumption in the sector. This reflects the large proportion of road transport's energy use of total consumption.

The phasing out of leaded automotive gasoline, starting in 1986 using pricing differential incentives, was completed in 2001. Over the same period, the consumption of automotive LPG, free of fuel excise tax, grew by an average of 13 per cent a year. LPG suffered a temporary decline in demand when a phasing in of taxes on excise exempt fuels was announced, but demand recovered with the reintroduction of subsidies on LPG conversions in the Australian Government's LPG Vehicle Scheme which was introduced to promote the use of cleaner burning fuels.

Fuel efficiency

Energy intensity for passenger travel, as measured by the passenger kilometres travelled with 1 gigajoule of energy, accounts for the fuel efficiency of the vehicle as well as the number of passengers in a vehicle.

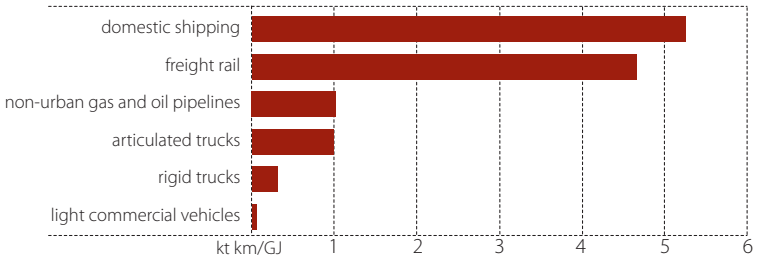
Passenger vehicle fuel efficiency in Australia, 2006-07
passenger kilometres travelled using 1 GJ of energy ^a



^a Full fuel cycle basis.

Source: Apelbaum Consulting Group, *Australian transport facts 2009*.

Freight fuel efficiency in Australia, 2006-07
kilometres travelled per thousand tonnes of cargo using 1 GJ of energy ^a



^a Full fuel cycle basis.

Source: Apelbaum Consulting Group, *Australian transport facts 2009*.

Cars were relatively energy intensive in 2006-07 compared with public transport, particularly rail and buses.

Within the freight transport sector, rail and shipping are amongst the least energy intensive transport modes to distribute goods and services within the economy. This is because they are able to carry large loads over long distances using less energy than other forms of transport, such as trucks.

Port capacities

The ability to import and export energy in Australia is heavily dependent on the capacity of major ports. Australia has nine major coal exporting terminals located in New South Wales and Queensland. In 2008-09, these ports had a combined capacity of more than 330 million tonnes and loaded around 255 million tonnes of coal. Australian ports did not operate at capacity in 2008-09 for a number of reasons including weather related incidents and the temporary closure of some capacity for expansion work.

Infrastructure capacity constraints, including for ports and rail, have limited the Australian coal industry's ability to respond to growing global demand over the past few years. However, recent additions to capacity together with more expansions planned over the short to medium term will help alleviate these constraints. As at October 2009, there were seven coal infrastructure projects at an advanced stage of development with a combined capital cost of around \$2.9 billion. The four advanced port infrastructure projects will add a combined 103 million tonnes to annual capacity. There were a further 18 projects at less advanced stages of planning (see Appendix 1).

35 Export loadings and capacity for major coal ports

| | loadings 2008-09 Mt | capacity 2008-09 Mtpa | capacity at end 2010 Mtpa | capacity at end 2015 Mtpa |
|-------------------------------|---------------------------|-----------------------------|---------------------------------|---------------------------------|
| New South Wales | | | | |
| Newcastle ^a | 84 | 102 | 143 | 143 |
| Port Kembla | 13 | 16 | 16 | 16 |
| Queensland | | | | |
| Abbot Point | 14 | 21 | 25 | 110 |
| Brisbane | 6 | 6 | 7 | 7 |
| Dalrymple Bay | 47 | 68 | 85 | 85 |
| Gladstone ^b | 56 | 75 | 75 | 100 |
| Hay Point | 35 | 44 | 44 | 55 |
| Balaclava Island ^c | – | – | – | 35 |

^a Includes Carrington and Kooragang Island. ^b Includes RG Tanna and Barney Point. ^c New project planned for 2014.
Sources: McCloskey, Ports Corporation of Queensland, Port Waratah Coal Services, Port Kembla Coal Terminal, Gladstone Ports Corporation.

36 Export loadings at major petroleum ports, 2007-08

| | Mt |
|--------------------------------------|------|
| Oil and petroleum^a | |
| Fremantle, WA | 2.37 |
| Brisbane, Qld | 2.20 |
| Geelong, Vic | 1.83 |
| Hastings, Vic | 1.10 |
| Sydney, NSW | 0.93 |
| Melbourne, Vic | 0.23 |
| Darwin, NT | 0.06 |
| Broome, WA | 0.03 |
| Cairns, Qld | 0.03 |
| Gas | |
| Dampier, WA | 4.55 |
| Hastings, Vic | 0.46 |
| Sydney, NSW | 0.17 |
| Brisbane, Qld | 0.05 |
| Fremantle, Qld | 0.05 |
| Melbourne, Vic | 0.01 |

^a Includes crude oil, oil products, condensate, petroleum products and refined petroleum.
 Source: Association of Australian Ports & Marine Authorities.

Australia has 11 major deepwater ports that have facilities to export petroleum liquids. The ports at Fremantle and Dampier in Western Australia are Australia's largest exporting centres of oil and petroleum and gas, respectively. Australian exports of crude oil and condensate are increasingly sourced from the west coast while exports of refined product are largely sourced from the east coast.



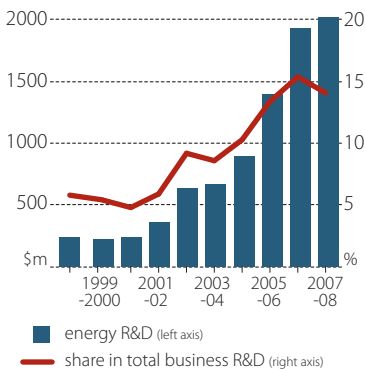
In Australia, the majority of research and development (R&D) in energy is undertaken by private businesses. Australian business expenditure on energy R&D, including both energy resources and energy supply, represented 90 per cent of total energy R&D expenditure in 2006-07 (2007-08 data for total energy R&D expenditure are not available). The remaining 10 per cent of energy R&D was undertaken by government, higher education organisations and non-profit private organisations. In 2006-07, government expenditure on energy R&D was around \$88 million, with an approximately even division of expenditure into energy resources and energy supply.

Business spending on energy R&D increased at an average rate of 27 per cent a year from 1998-99 to 2007-08, reaching around \$2 billion in 2007-08. Expenditure on energy R&D by Australian businesses represented 14 per cent of total business R&D expenditure in 2007-08. Although the share of energy R&D decreased slightly in 2007-08, from 15.5 per cent in 2006-07, an increasing proportion of business R&D expenditure has been devoted to

energy over the past nine years. In 1998-99, the share of energy R&D in total business R&D spending was around 6 per cent.

Of energy related industries, the coal mining industry had the largest R&D expenditure in 2007-08, with R&D spending of \$840 million. This was followed by the oil and gas extraction industry with \$682 million of R&D expenditure.

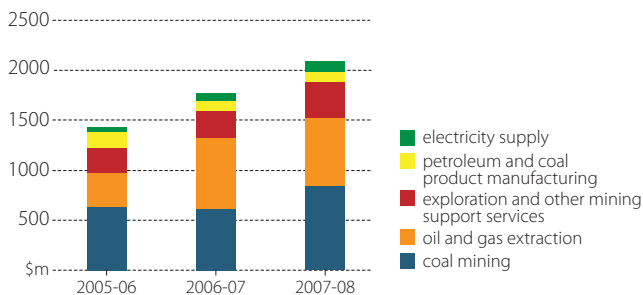
Business R&D in energy



Source: ABS, *Research and Experimental Development, Businesses, Australia*, cat. no. 8104.0

Energy research and development

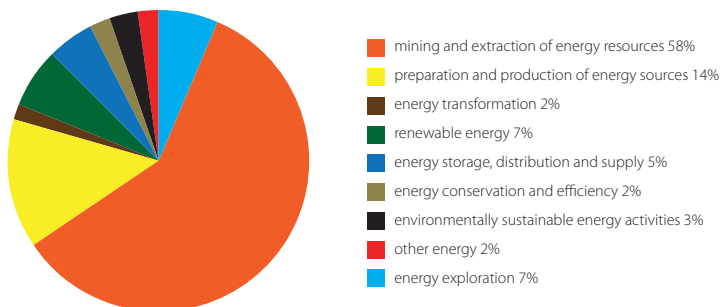
Business R&D by industry



Source: ABS, *Research and Experimental Development, Businesses, Australia*, cat. no. 8104.0

The majority of energy R&D expenditure by Australian businesses is devoted to the mining and extraction of energy resources, representing 58 per cent of energy R&D in 2007-08. Around 7 per cent of business R&D in energy was spent on renewable energy, while 2 per cent of spending had the objective of improving energy efficiency or conservation.

Business R&D by objective, 2007-08



Source: ABS, *Research and Experimental Development, Businesses, Australia*, cat. no. 8104.0

Current and proposed energy projects

37 Proposed new power stations and expansions ^a

| project | company | location | status | expected start-up | new capacity | capital expend. |
|----------------------|--------------------------------------|----------------------------|---------------------------------|-------------------|--------------|-----------------------|
| Black coal | | | | | | |
| Bluewaters stage 2 | Griffin Energy | 5 km NE of Collie, WA | Expansion, under construction | late 2009 | 208MW | \$400m |
| Earing | Earing Energy | 40 km SW of Newcastle, NSW | Expansion, committed | 2011 | 240MW | \$245m |
| CSM | | | | | | |
| Condamine | BG Group/ANZ Infrastructure Services | 8 km E of Miles, Qld | New project, under construction | 2010 | 140MW | \$170m |
| Darling Downs | Origin Energy | 40 km W of Dalby, Qld | New project, under construction | early 2010 | 630MW | \$951m (inc pipeline) |
| Gas | | | | | | |
| Colongra gas project | Delta Electricity | Munmorah, NSW | New project, under construction | late 2009 | 660MW | \$500m |
| Kwinana Swift | Perth Energy | 30 km S of Perth, WA | New project, under construction | mid-2010 | 120MW | \$120m |
| Mortlake Stage 1 | Origin Energy | 12 km W of Mortlake, Vic | New project, under construction | 2010 | 550MW | \$640m |
| Owen Springs | Power and Water Corporation | Alice Springs, NT | New project, under construction | 2010 | 22MW | \$130m |

continued...

37 Proposed new power stations and expansions ^a continued

| project | company | location | status | expected start-up | new capacity | capital expend. |
|------------------------------|-----------------------------------|-----------------------------|---------------------------------|-------------------|--------------|-----------------|
| Oil | | | | | | |
| Mount Stuart | Origin Energy | Townsville, Qld | Expansion, under construction | 2010 | 126MW | \$92m |
| Wind | | | | | | |
| Clements Gap | Pacific Hydro | 30 km S of Port Pirie, SA | New project, under construction | early 2010 | 57MW | \$135m |
| Crookwell 2 | Union Fenosa Wind Australia | 14 km SE of Crookwell, NSW | New project, under construction | 2011 | 92MW | \$238m |
| Hallett 2 | Energy Infrastructure Trust | 20 km S of Burra, SA | Expansion, under construction | late 2009 | 71MW | \$159m |
| Hallett 4 (North Brown Hill) | Energy Infrastructure Investments | 12 km SE of Jamestown, SA | Expansion, under construction | 2011 | 132MW | \$341m |
| Lake Bonney stage 3 | Infigen Energy | 2 km E of Lake Bonney, SA | New project, under construction | 2010 | 39MW | na |
| Musselroe | Roaring 40s | Cape Portland, Tas | New project, under construction | 2011 | 168MW | \$425m |
| Oaklands Wind Farm | AGL/Windlab Systems | 5 km S of Glenthompson, Vic | New project, under construction | 2011 | 63MW | \$200m |
| Waterloo stage 1 | Roaring 40s | 30 km SE of Clare, SA | New project, under construction | 2010 | 111MW | \$300m |
| Hydro | | | | | | |
| Bogong Power Development | AGL | 300 km NW of Melbourne, Vic | New project, under construction | late 2009 | 140MW | \$240m |

^a Summary of projects classified as committed. For proposed projects please refer to source.

Source: ABARE, *Electricity generation - major development projects, October 2009 listing*. Available at http://www.abare.gov.au/publications_html/energy/energy_09/energy_09.html

38 Renewable power generators in Australia, 2009

| | state | owner | capacity kW |
|--------------------|-------|--|----------------|
| Bagasse | | | |
| Pioneer 2 | Qld | CSR Sugar Mills | 63 000 |
| Invicta | Qld | Haughton Sugar Company | 50 000 |
| Broadwater | NSW | Sunshine Electricity | 35 000 |
| Condong | NSW | Sunshine Electricity | 30 000 |
| Rocky Point | Qld | National Power and Babcock and Brown JV | 30 000 |
| Tully | Qld | Independent Sugar North Ltd | 21 400 |
| Plane Creek | Qld | CSR Sugar Mills | 20 000 |
| Marian | Qld | Mackay Sugar Mills | 18 000 |
| Proserpine | Qld | Independent Sugar North Ltd | 16 000 |
| Farleigh | Qld | Mackay Sugar Mills | 13 000 |
| Inkerman | Qld | CSR Sugar Mills | 12 000 |
| Vic | Qld | CSR Sugar Mills | 11 800 |
| South Johnstone | Qld | Bundaberg Sugar Ltd | 11 500 |
| Mossman | Qld | Mossman Central Mill Co Ltd | 11 000 |
| Isis | Qld | Isis Central Sugar Mill Co Ltd | 10 700 |
| Mulgrave | Qld | Independent Sugar North Ltd | 10 500 |
| Racecourse | Qld | Mackay Sugar Mills | 10 500 |
| Pleystowe | Qld | Mackay Sugar Mills | 10 100 |
| Kalamia | Qld | CSR Sugar Mills | 9 000 |
| Broadwater | NSW | NSW Sugar Mills Co-Op | 8 000 |
| Other operators | | | 62 450 |
| Total | | | 463 950 |
| Biogas | | | |
| Woodlawn | NSW | Woodlawn Bioreactor Energy Pty Ltd | 25 560 |
| Carrum Downs 1 & 2 | Vic | Melbourne Water | 17 000 |
| Clayton | Vic | Energy Developments Ltd | 10 000 |
| Lucas Heights II | NSW | Energy Developments Ltd | 9 000 |
| Eastern Creek 2 | NSW | LMS Generation Pty Ltd | 8 800 |
| Werribee (AGL) | Vic | AGL | 7 800 |
| Sunshine | Vic | ABB | 7 500 |
| Broadmeadows | Vic | Energy Development Ltd | 7 000 |
| Springvale | Vic | Energy Developments Ltd | 7 000 |
| Werribee 2 | Vic | Melbourne Water | 7 000 |
| South Cardup | WA | Landfill Management Services Ltd | 6 000 |

continued...

38 Renewable power generators in Australia, 2009 *continued*

| | state | owner | capacity kW |
|-------------------|-------|--------------------------------|----------------|
| Wingfield I | SA | Energy Developments Ltd | 5 000 |
| Belrose | NSW | Energy Developments Ltd | 4 000 |
| Berwick | Vic | Energy Developments Ltd | 4 000 |
| Canningvale | WA | Landfill Gas and Power Pty Ltd | 4 000 |
| Lucas Heights I | NSW | Energy Developments Ltd | 4 000 |
| Other operators | | | 92 566 |
| Total | | | 226 226 |
| Geothermal | | | |
| Birdsville | Qld | Ergon Energy | 80 |
| Total | | | 80 |
| Hydro | | | |
| Tumut 3 | NSW | Snowy Hydro Ltd | 1 500 000 |
| Murray 1 | NSW | Snowy Hydro Ltd | 950 000 |
| Murray 2 | NSW | Snowy Hydro Ltd | 550 000 |
| Wivenhoe Dam | Qld | Tarong Energy | 500 000 |
| Gordon | Tas | Hydro Tas | 432 000 |
| Tumut 1 | NSW | Snowy Hydro Ltd | 330 000 |
| Poatina | Tas | Hydro Tas | 300 000 |
| Tumut 2 | NSW | Snowy Hydro Ltd | 286 000 |
| Reece | Tas | Hydro Tas | 231 200 |
| Kangaroo Valley | NSW | Eraring Energy | 160 000 |
| Dartmouth | Vic | Southern Hydro (owned by AGL) | 150 000 |
| John Butters | Tas | Hydro Tas | 144 000 |
| Eildon | Vic | Southern Hydro (owned by AGL) | 136 000 |
| Tungatinah | Tas | Hydro Tas | 125 000 |
| McKay Creek | Vic | Southern Hydro (owned by AGL) | 120 000 |
| Trevallyn | Tas | Hydro Tas | 95 000 |
| Tarraleah | Tas | Hydro Tas | 90 000 |
| Cethana | Tas | Hydro Tas | 85 000 |
| Liapootah | Tas | Hydro Tas | 83 700 |
| Tribute/Newton | Tas | Hydro Tas | 82 800 |
| Bendeela | NSW | Eraring Energy | 80 000 |
| Blowering | NSW | Snowy Hydro Ltd | 80 000 |
| Bastyan | Tas | Hydro Tas | 79 900 |

continued...

38 Renewable power generators in Australia, 2009 *continued*

| | state | owner | capacity kW |
|---------------------|-------|---|------------------|
| Mackintosh | Tas | Hydro Tas | 79 900 |
| Kareeya | Qld | Stanwell Corp | 79 000 |
| Other operators | | | 1 058 724 |
| Total | | | 7 808 224 |
| Ocean | | | |
| Port Kembla | NSW | Oceanlinx | 500 |
| San Remo | Vic | Atlantis Resource Corporation | 150 |
| Freemantle | WA | Carnegie Wave Power | 100 |
| Portland | Vic | Ocean Power Technologies and Powercor Aust | 20 |
| Total | | | 770 |
| Solar | | | |
| Liddell | NSW | Solar Heat and Power Pty Ltd | 2 000 |
| Broken Hill | NSW | Australian Inland Energy | 1 000 |
| Newington | NSW | Private | 665 |
| Newcastle - CSIRO | NSW | CSIRO | 500 |
| Singleton | NSW | Energy Australia | 400 |
| Ernabella | SA | Umuwa Community | 350 |
| Lajamanu | NT | Lajamanu Community | 288 |
| Kings Canyon | NT | NT PowerWater | 241 |
| Public Schools NSW | NSW | Integral Energy | 204 |
| Greater Melbourne | Vic | Private Homeowner/Citipower | 200 |
| Kogarah | NSW | Kogarah Council | 200 |
| Queen Vic Market | Vic | Melbourne City Council | 200 |
| Hermannsburg | NT | Hermannsburg Community | 192 |
| Yuendumu | NT | Yuendumu Community | 192 |
| Hamersley Iron | WA | Hamersley Iron | 151 |
| Olympic Boulevarde | NSW | Sydney Olympic Park Authority | 150 |
| Public Schools SA | SA | SA Government | 148 |
| Bridgewater | Vic | Solar Systems | 140 |
| Bradshaw | NT | Department of Defence | 113 |
| King Island - solar | Tas | Hydro Tas | 110 |
| Newcastle - CSIRO | NSW | CSIRO Energy Centre | 102 |
| Huntingwood 2 | NSW | Cadbury-Schweppes | 100 |
| Wilpena Pound | SA | AGL | 100 |

continued...

38 Renewable power generators in Australia, 2009 *continued*

| | state | owner | capacity kW |
|-------------------------------------|-------|--|----------------|
| Other operators and domestic use | | | 96 765 |
| Total | | | 104 510 |
| Wind | | | |
| Waubra | Vic | Acciona Energia/ANZ Energy Infrastructure Trust | 192 000 |
| Lake Bonney 2 | SA | Infigen Energy | 159 000 |
| Woolnorth | Tas | Roaring40s/Hydro Tas | 140 250 |
| Capital Wind Farm | NSW | Infigen Energy | 132 300 |
| Snowtown | SA | Wind Prospect and Trust Power | 98 700 |
| Hallett 1 | SA | AGL | 94 500 |
| Wattle Point | SA | ANZ Energy Infrastructure Trust/Wind Farm Developments | 91 000 |
| Alinta Wind Farm | WA | Infigen Energy | 90 000 |
| Lake Bonney 1 | SA | Infigen Energy | 80 500 |
| Emu Downs | WA | Transfield Services Infrastructure Ltd & Griffin Energy | 79 200 |
| Hallett 2 | SA | Energy Infrastructure Trust | 71 000 |
| Mount Millar | SA | Transfield Services Infrastructure Ltd | 70 000 |
| Cathedral Rocks 66000 | SA | Roaring40s/Hydro Tas & Acciona Energy | |
| Cape Bridgewater | Vic | Pacific Hydro | 58 000 |
| Challicum Hills | Vic | Pacific Hydro | 52 500 |
| Canunda | SA | International Power and Wind Prospect Pty Ltd | 46 000 |
| Starfish Hill | SA | Transfield Services Infrastructure Ltd | 34 000 |
| Yambuk | Vic | Pacific Hydro Ltd | 30 000 |
| Albany | WA | Verve Energy | 22 000 |
| Toora | Vic | Transfield Services Infrastructure Ltd | 21 000 |
| Codrington | Vic | Pacific Hydro | 18 000 |
| Windy Hill | Qld | Transfield Services Infrastructure Ltd | 12 000 |
| Wonthaggi | Vic | Origin Energy (previously Wind Power Pty Ltd) | 12 000 |
| Blayney | NSW | Eraring Energy | 9 900 |
| Other operators | | | 23 176 |
| Total | | | 1 703 026 |

38 Renewable power generators in Australia, 2009 *continued*

| | state | owner | capacity kW |
|---------------------------|-------|---|----------------|
| Woodwaste | | | |
| Tumut | NSW | Visy Paper | 17 000 |
| Gladstone A&B | Qld | Comalco/NRG | 10 000 |
| Mount Gambier | SA | Carter Holt Harvey | 10 000 |
| Bayswater | NSW | Macquarie Generation | 5 000 |
| Liddell | NSW | Macquarie Generation | 5 000 |
| Mount Piper | NSW | Delta Electricity | 5 000 |
| Muja | WA | Verve Energy | 5 000 |
| Stapylton | Qld | Green Pacific Energy | 5 000 |
| Vales Point B | NSW | Delta Electricity | 5 000 |
| Wallerawang C | NSW | Delta Electricity | 5 000 |
| Narrogin | WA | Verve Energy/Oil Mallee Co/ Enecon P/L | 1 000 |
| Other operators | | | 495 |
| Total | | | 73 495 |
| Other ^a | | | |
| Maryvale | Vic | Australian Paper | 24 000 |
| Hazelwood | Vic | International Power Hazelwood | 10 000 |
| Eastern Creek UR-3R | NSW | Global Renewables | 3 000 |
| Brisbane | Qld | Visy Paper | 2 000 |
| Gympie | Qld | Ergon Energy | 1 500 |
| Upper Chittering | WA | Rufftuff | 10 |
| Total | | | 40 510 |

^a Unspecified biomass and biodiesel

Sources: Geoscience Australia; Watt, M 2009, *National Survey Report of PV Power Applications in Australia 2008*.

39 Major new coal projects

| project | company | location | status | expected start-up | new capacity | capital expend. |
|---|--------------------------|--------------------------|---------------------------------|-------------------------------------|---|--------------------------------------|
| Black coal – mining projects – NSW | | | | | | |
| Blakefield South | Xstrata/ Nippon Steel | 16 km SW of Singleton | New project, under construction | 2010 | nil (replacement for Beltana) | \$375m |
| Mangoola (Anvil Hill opencut) | Xstrata Coal | 20 km SW of Muswellbrook | New project, under construction | 2012 | 8 Mt thermal | \$1b |
| Moolarben stage 1 | Felix Resources | near Mudgee | New project, under construction | 2010 (open cut) 2012 (under-ground) | 8 Mt opencut; up to 4 Mt underground (ROM, thermal) | \$405m (incl coal preparation plant) |
| Mount Arthur opencut (MAC20) | BHP Billiton | 5 km SW of Muswellbrook | Expansion, under construction | 2011 | 3.5 Mt thermal | US\$260m (A\$313m) |
| Narrabri Coal Project (stage 1) | Whitehaven | 20 km SE of Narrabri | New project, under construction | early 2010 | 1.5 Mt thermal | \$185m |
| Black coal – mining projects – Qld | | | | | | |
| Blackwater Creek Division | Wesfarmers | 200 km W of Rockhampton | Expansion, under construction | 2010 | nil (extension of Curragh mine life) | \$130m |
| Cameby Downs | Syntech Resources | 100 km NE of Dalby | New project, under construction | 2010 | 1.4 Mt thermal coal | \$250m |
| Carborough Downs longwall | Vale | 20 km NE of Moranbah | Expansion, under construction | 2011 | 4.2 Mt coking | US\$330m (A\$398m) |
| Clermont opencut | Rio Tinto | 11 km N of Clermont | New project, under construction | 2010 | 12 Mt thermal (replacing Blair Athol capacity) | US\$1.3b (A\$1.57b) |

continued...

39 Major new coal projects *continued*

| project | company | location | status | start-up | expected new capacity | capital expend. |
|--|---------------------------------------|--------------------------------|---------------------------------|-----------|---|---------------------|
| Curragh Mine | Wesfarmers | 200 km W of Rockhampton | Expansion, committed | 2011 | increase to 8.5 Mt | \$286m |
| Kestrel | Rio Tinto | 51 km NE of Emerald | Expansion, under construction | 2012 | 1.7 Mt coking | US\$991m (A\$1.19b) |
| New Acland (stage 3) | New Hope Coal | 150 km W of Brisbane | Expansion, under construction | late 2009 | 0.6 Mt thermal | \$36m |
| Black coal – infrastructure projects – NSW | | | | | | |
| Kooragang Island coal terminal expansion | Port Waratah Coal Services | Newcastle | Expansion, under construction | 2010 | Capacity increase of 11 Mtpa | \$456m |
| Minimbah Bank Third Rail Line (stage 1) | Australian Rail and Track Corporation | Minimbah to Whittingham (10km) | Expansion, under construction | 2010 | na | \$134m |
| NCIG export terminal (Newcastle Coal Infrastructure Group) | NCIG | Newcastle | New project, under construction | 2010 | Capacity of 30 Mtpa initially; ultimately 66 Mtpa | US\$1.1b (A\$1.3b) |

continued...

39 Major new coal projects *continued*

| project | company | location | status | expected start-up | new capacity | capital expend. |
|---|-----------------------------|---------------|-------------------------------|-------------------|--|-----------------|
| Black coal – infrastructure projects – Qld | | | | | | |
| Abbot Point Coal Terminal X50 expansion | North Queensland Bulk Ports | Bowen | Expansion, committed | mid 2011 | Terminal capacity increase from 25 Mtpa to 50 Mtpa | \$818m |
| Abbot Point Coal Terminal yard refurbishment | North Queensland Bulk Ports | Bowen | Refurbishment, committed | mid 2011 | na | \$68m |
| Brisbane Coal Terminal expansion | Queensland Bulk Handling | Brisbane | Expansion, under construction | 2010 | 1 Mtpa | \$10m |
| Coppabella to Ingsdon rail duplication | Queensland Rail Ingsdon | Coppabella to | Expansion, committed | mid 2010 | 3 Mtpa | \$80m |

continued...

40 Major new oil and gas projects ^a

| project | company | location | status | expected start-up | new capacity | capital expend. |
|---|---|---|---------------------------------|-------------------|----------------------------------|---------------------|
| Coal seam gas | | | | | | |
| RTA development (Tallinga) | APLNG (Origin/Conoco Phillips) | 160 km E of Roma, Qld | Expansion, under construction | 2010 | 23 PJ pa | \$260m |
| Petroleum – oil and natural gas projects | | | | | | |
| Gorgon LNG | Chevron/Shell/ExxonMobil | Barrow Island, WA | New project, under construction | 2015 | 15 Mt LNG | \$43b |
| Henry gasfield | Santos/ AWE/Mitsui | 20 km offshore Otway Basin, Vic | New project, under construction | early 2010 | 11 PJ pa | \$275m |
| Kipper gas project (stage 1) | Esso/BHP Billiton/Santos | 42 km offshore Gippsland, Vic | New project, under construction | 2011 | 30 PJ pa gas, 10 kbpd condensate | US\$1.1b (A\$1.3b) |
| Longtom gas project | Nexus Energy | Bass St, Vic | New project, under construction | 2010 | 25 PJ pa gas (initially) | \$300m |
| Montara/Skua oilfield | PTTEP | Timor Sea, 650 km W of Darwin, NT | New project, under construction | na | 38 kbpd | US\$700m (A\$843m) |
| NWS CWLH | Woodside Energy/BHP Billiton/ BP/Chevron/ Shell/ Japan Australia LNG WA | 150 km NW of Dampier, Carnarvon Basin, WA | Expansion, under construction | 2011 | 60 kbpd of oil, 35 PJ pa gas | US\$1.47b (A\$1.8b) |
| NWS North Rankin B | Woodside Energy/ BHP Billiton/ BP/ Chevron/ Shell/ Japan Australia LNG WA | 150 km NW of Dampier, Carnarvon Basin, WA | New project, under construction | 2012 | 967 PJ pa | \$5.1b (A\$6.1b) |

continued...

40 Major new oil and gas projects ^a *continued*

| project | company | location | status | expected start-up | new capacity | capital expend. |
|---|--------------------------------|---|------------------------------------|--------------------------|------------------------------------|--|
| Pluto (train 1) | Woodside Energy | Carnarvon Basin/ Burrup Peninsula, WA | New project, under construction | late 2010 | 4.3 Mt LNG | \$12b (inc site works for train 2) |
| Pyrenees | BHP Billiton/ Apache Energy | 55 km N of Exmouth, Carnarvon Basin, WA | New project, under construction | early 2010 | 96 kbpd, 23 PJ pa gas | US\$1.68b (A\$2b) |
| Reindeer gas field/ Devil Creek gas processing plant (phase 1) Turrum | Apache Energy/ Santos | 80 km NW of Dampier, Carnarvon Basin, WA | New project, committed | late 2011 | 40 PJ pa gas | US\$744m (A\$896m) |
| | ExxonMobil/ BHP Billiton | Bass St, Vic | New project, committed | 2011 | 11 kbpd condensate, 75 PJ pa | US\$1.25b (A\$1.5b) |
| Van Gogh | Apache Energy/ Inpex | 50 km N of Exmouth, Carnarvon Basin, WA | New project, under construction | early 2010 | 38 kbpd | US\$546m (A\$658m) |

continued...

40 Major new oil and gas projects ^a continued

| project | company | location | status | expected start-up | new capacity | capital expend. |
|---|--------------|---|---------------------------------|-------------------|--------------|-----------------|
| Petroleum – gas pipeline projects | | | | | | |
| Dampier–Bunbury gas pipeline (DBNGP) expansion (Stage 5B) | DBP | Dampier to Bunbury, WA | Expansion, under construction | 2010 | 40 PJ pa gas | \$700m |
| Eastern Gas Pipeline | Jemena | Wollongong (NSW) to Longford (Vic) | Expansion, committed | 2010 | 20 PJ pa | \$41m |
| Moomba to Sydney | APA Group | Moomba (SA) to Sydney (NSW) | Expansion, under construction | 2010 | na | \$90m |
| Queensland Gas Pipeline | Jemena | Wallumbilla to Gladstone (550 km), Qld | Expansion, under construction | 2010 | 25 PJ pa | \$112m |
| South Gippsland natural gas pipeline | Multinet Gas | South Gippsland (250 km from Lang Lang to five regional towns), Vic | New project, under construction | 2010 | na | \$50m |

^a Summary of projects classified as committed, for proposed projects please refer to source.

Source: ABARE, *Minerals and Energy - major development projects, October 2009 listing*. Available at http://www.abare.gov.au/publications_html/energy/energy_09/energy_09.html



The factors listed in the following tables are used when converting individual types of fuel from volume or weight to energy equivalence, or vice versa. The values are only indicative because the quality of any fuel varies with factors such as location and air pressure. Values given here apply at a temperature of 15° Celsius and pressure of 1 atmosphere (101.3 kilopascals). The values are the gross energy content of the fuel—that is, the total amount of heat that will be released by combustion.

The usable energy content of uranium metal (U) is 0.56 petajoules a tonne, and for uranium oxide (U_3O_8) is 0.47 petajoules a tonne. The oxide contains 84.8 per cent of the metal by weight.

41 Energy content of gaseous fuels in Australia

| | Energy content MJ/m ³ |
|------------------------------------|-------------------------------------|
| Natural gas (sales quality) | |
| Victoria | 38.8 |
| Queensland | 39.5 |
| Western Australia | 41.5 |
| South Australia, New South Wales | 38.3 |
| Northern Territory | 40.5 |
| Ethane (average) | 57.5 |
| Town gas | |
| – synthetic natural gas | 39.0 |
| – other town gas | 25.0 |
| Coke oven gas | 18.1 |
| Blast furnace gas | 4.0 |

Sources: RET; BHP Billiton.

42 Energy content of liquid fuels

| | volume MJ/L | specific volume L/t | weight GJ/t |
|--|----------------|---------------------------|----------------|
| Aviation gasoline | 33.1 | 1 412 | 46.8 |
| Automotive gasoline | 34.2 | 1 360 | 46.4 |
| Power kerosene | 37.5 | 1 230 | 46.1 |
| Aviation turbine fuel | 36.8 | 1 261 | 46.4 |
| Lighting kerosene | 36.6 | 1 270 | 46.5 |
| Heating oil | 37.3 | 1 238 | 46.2 |
| Automotive diesel oil | 38.6 | 1 182 | 45.6 |
| Industrial diesel fuel | 39.6 | 1 135 | 44.9 |
| LPG | | | |
| – propane | 25.5 | 1 960 | 49.6 |
| – butane | 28.1 | 1 760 | 49.1 |
| – mixture | 25.7 | 1 890 | 49.6 |
| – naturally occurring (average) | 26.5 | 1 866 | 49.4 |
| Fuel oil | | | |
| – low sulfur | 39.7 | 1 110 | 44.1 |
| – high sulfur | 40.8 | 1 050 | 42.9 |
| Refinery fuel (fuel oil equivalent) | 40.8 | 1 050 | 42.9 |
| Naphtha | 31.4 | 1 534 | 48.1 |
| Lubricants and greases | 38.8 | 1 120 | 43.4 |
| Bitumen | 44.0 | 981 | 42.7 |
| Solvents | 34.4 | 1 229 | 44.0 |
| Waxes | 38.8 | 1 180 | 45.8 |
| Crude oil and other refinery feedstocks | | | |
| – indigenous (average) | 37.0 | 1 250 | 46.3 |
| – imports (average) | 38.7 | 1 160 | 44.9 |
| Orimulsion | | | 28.0 |
| Ethanol | 23.4 | 1 266 | 29.6 |
| Methanol | 15.6 | 1 263 | 19.7 |
| Tallow | | | 35.0 |
| Liquefied natural gas (north west shelf) | 25 | 2 174 | 54.4 |

Sources: BP; BHP Billiton; Mobil Exxon; Santos; Woodside Petroleum.

43 Energy content of solid fuels

| energy content | | energy content | |
|------------------------|------|--------------------------|------|
| | GJ/t | | GJ/t |
| Black coal | | Black coal | |
| New South Wales | | Western Australia | |
| Exports | | Thermal coal | 19.7 |
| – metallurgical coal | 29.0 | Tasmania | |
| – thermal coal | 27.0 | Thermal coal | 22.8 |
| Electricity generation | 23.4 | Lignite | |
| Steelworks | 30.0 | Victoria | 9.8 |
| Washed thermal coal | 27.0 | Briquettes | 22.1 |
| Unwashed thermal coal | 23.9 | South Australia | 15.2 |
| Queensland | | Other | |
| Exports | | Coke | 27.0 |
| – metallurgical coal | 30.0 | Wood (dry) | 16.2 |
| – thermal coal | 27.0 | Bagasse | 9.6 |
| Electricity generation | 23.4 | | |
| Other | 23.0 | | |

