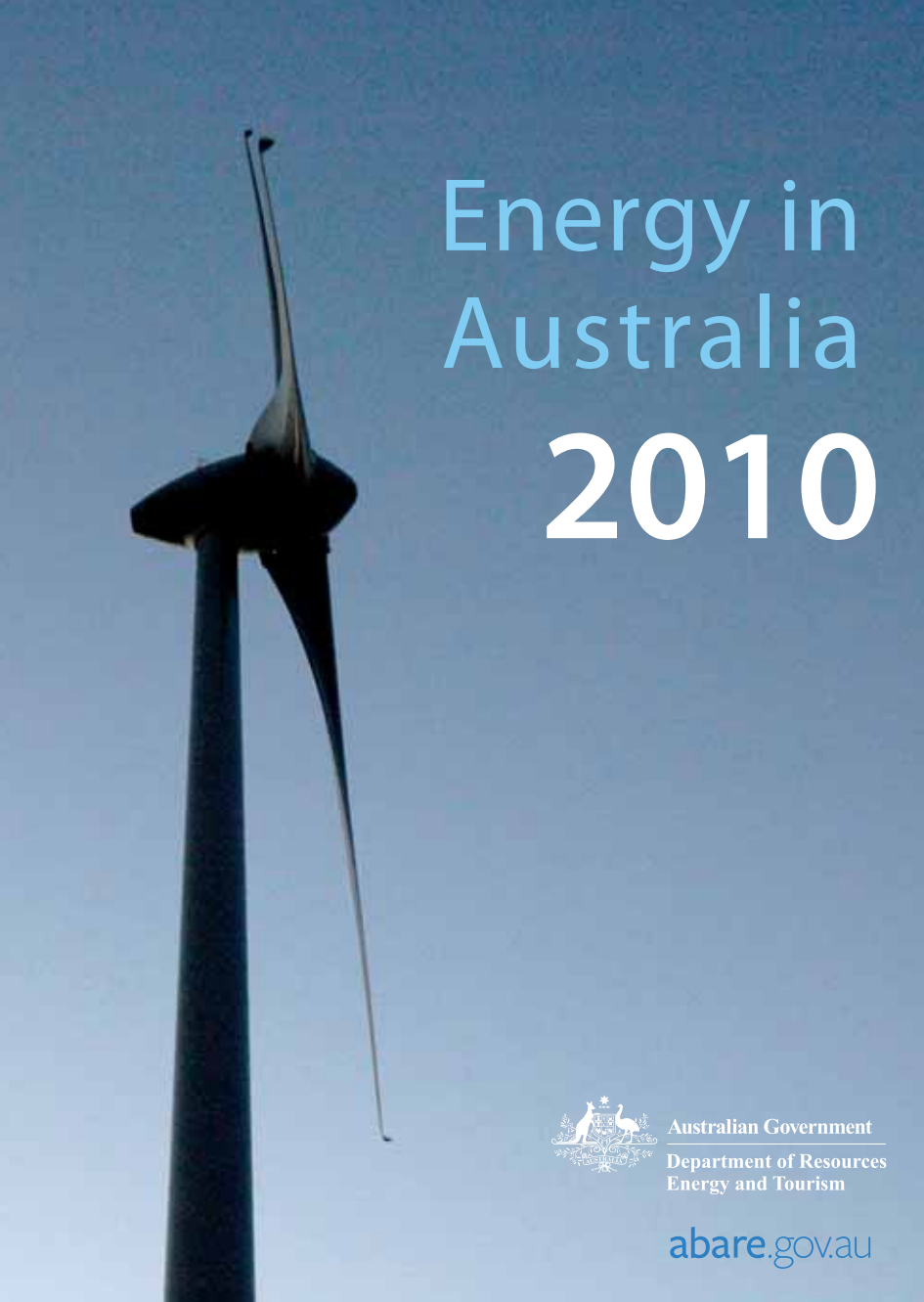

Energy in Australia 2010

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Department of Resources Energy and Tourism

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Foreword

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.

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

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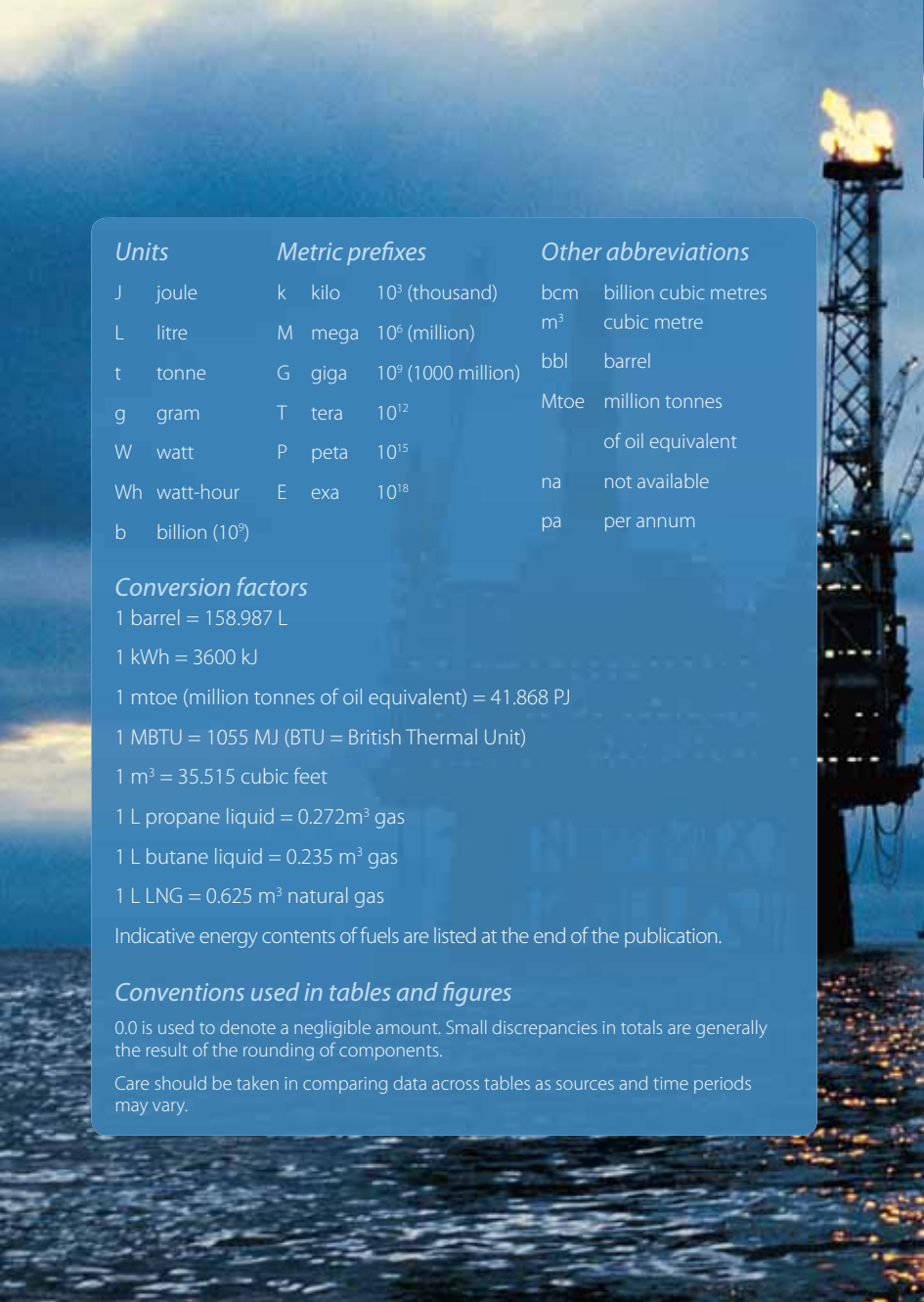
ABARE	www.abare.gov.au
Australian Bureau of Statistics	www.abs.gov.au
Australian Energy Market Operator	www.aemo.com.au
Australian Financial Markets Association	www.afma.com.au
Australian Institute of Petroleum	www.aip.com.au
BP Statistical Review of World Energy	www.bp.com
Clean Energy Council	www.cleanenergycouncil.org.au
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-roam 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 m^3 = 35.515 cubic feet

1 L propane liquid = 0.272m^3 gas

1 L butane liquid = 0.235 m^3 gas

1 L LNG = 0.625 m^3 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.

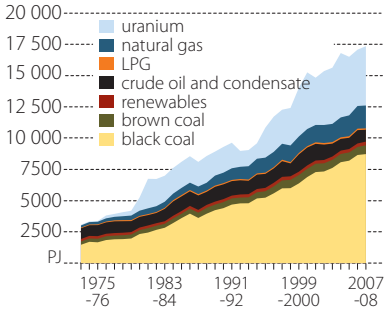
Australia's energy supply

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

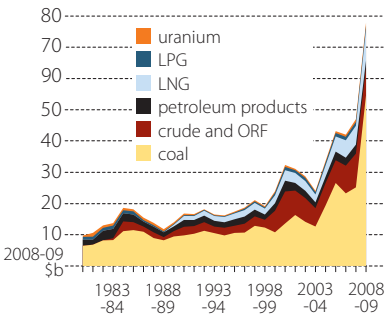
Sources: Australian Bureau of Statistics, *Australian Industry*, cat. no. 8155; *Australian System of National Accounts*, cat. no. 5204; *Australian Labour Market Statistics*, cat. no. 6105.

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 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.

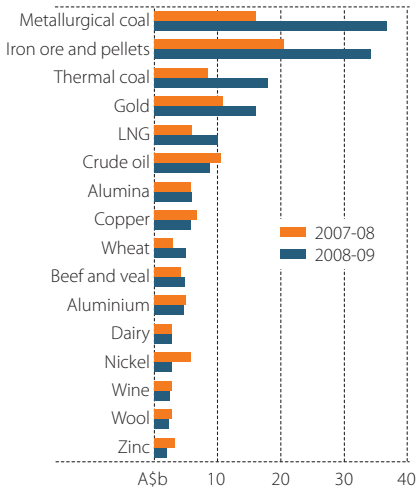
Since 1988-89, the value of Australia's energy exports (in 2008-09 Australian dollars) has increased at an average rate of 10 per cent a year. In 2008-09, energy export earnings increased by 66 per cent to $78 billion.

Australian energy exports



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

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.

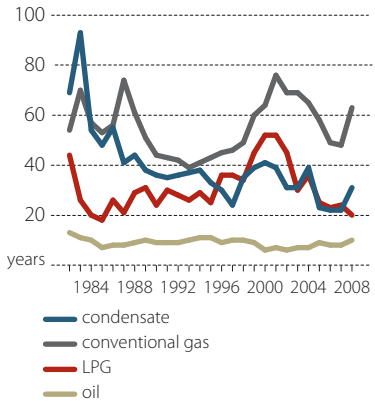
Sources: Geoscience Australia 2009, *Australia's Identified Mineral Resources 2009, Oil and Gas Resources of Australia 2008*; BP 2009, *BP Statistical Review of World Energy*.

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.

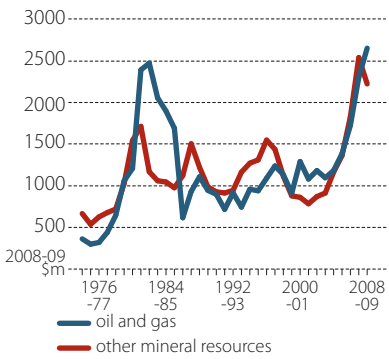
At current rates of production, Australia's energy resources are expected to last for many more decades. The proportion of economic demonstrated reserves (EDR) to current production is estimated at 490 years for brown coal,

Reserves to production ratios



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

Private energy and minerals exploration expenditure



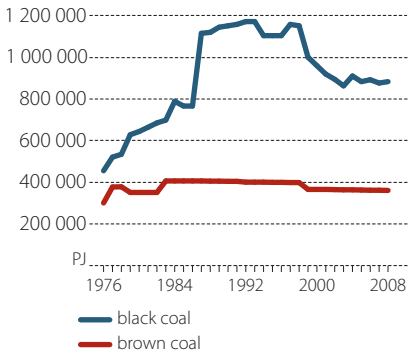
Source: ABARE, *Australian commodity statistics 2009.*

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.

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

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

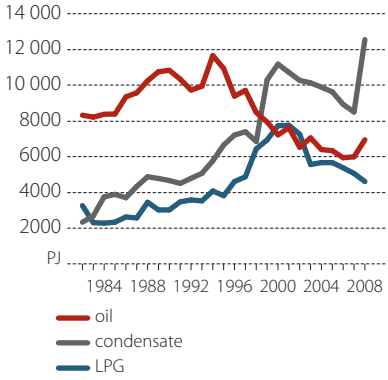
Australia's resources of crude oil and condensate represent a small proportion of world resources. Resources of crude oil, condensate

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

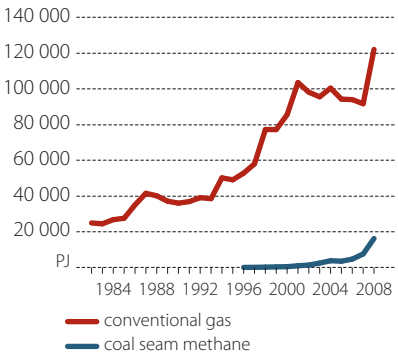
a Economic demonstrated resources as at 1 January 2009.
Sources: Geoscience Australia 2008, *Oil and gas resources of Australia, 2008*.

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

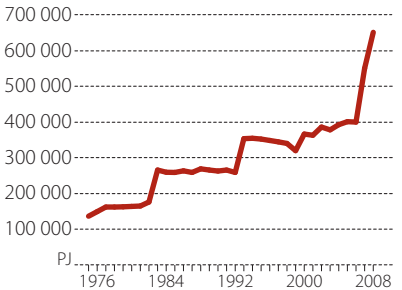
Australia's identified conventional gas resources have increased threefold over the past 20 years. Around 90 per cent of estimated recoverable reserves of conventional gas are located off the west and north-west coast of Australia.

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

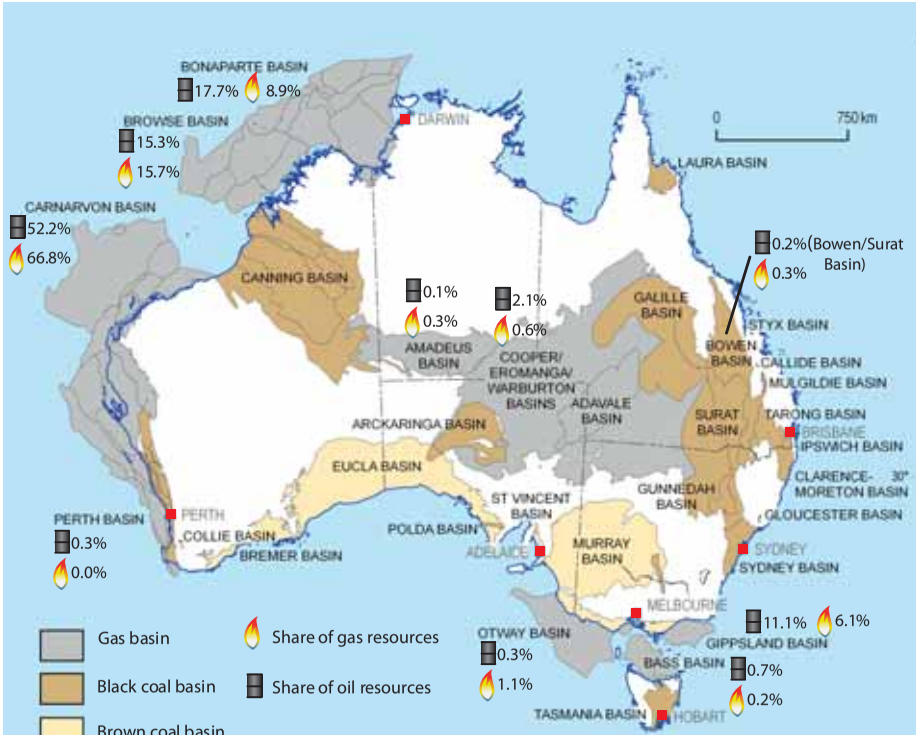
Australia's economic demonstrated resources of uranium



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



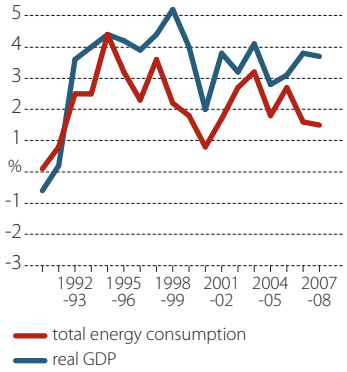
Source: Geoscience Australia.

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.

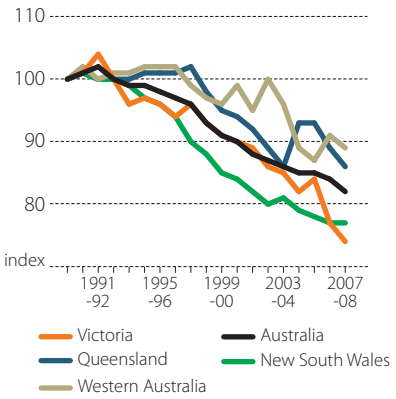
Annual growth in primary energy consumption in Australia



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 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*.

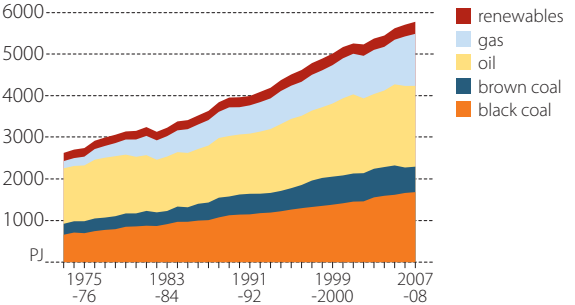
(34 per cent), natural gas (22 per cent) and renewables (5 per cent). The share of natural gas in Australian energy consumption has increased in the past 30 years and this trend is likely to continue in the longer term.

5 Australian energy consumption by fuel

	2003-04 PJ	2004-05 PJ	2005-06 PJ	2006-07 PJ	2007-08 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.*

Primary energy consumption in Australia, by fuel



Source: ABARE, *Australian energy statistics.*

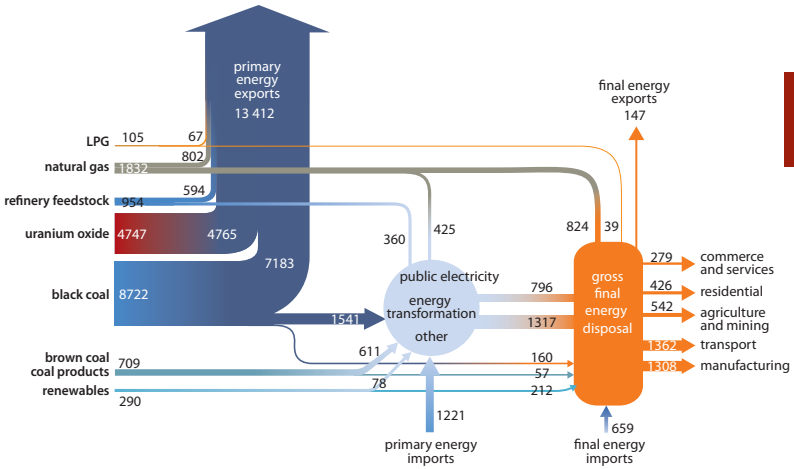
Energy consumption, by industry

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 PJ	1979-80 PJ	1989-90 PJ	1999-00 PJ	2007-08 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
plus all imports		202.2	1 019.0	24.8	633.9	
less all exports	7 183.4	802.4	594.3	66.5	146.9	
less 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
less 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_3O_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
plus all imports							1 879.9
less all exports						4 765.3	13 558.8
less stock changes and discrepancies						–18.1	0.0 –91.6
Total domestic availability	207.9	14.2	6.9	43.4			5 772.8
less 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 ML	2005-06 ML	2006-07 ML	2007-08 ML	2008-09 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 specialty feedstocks. **c** Some petroleum products are produced from the conversion of other petrochemical products.

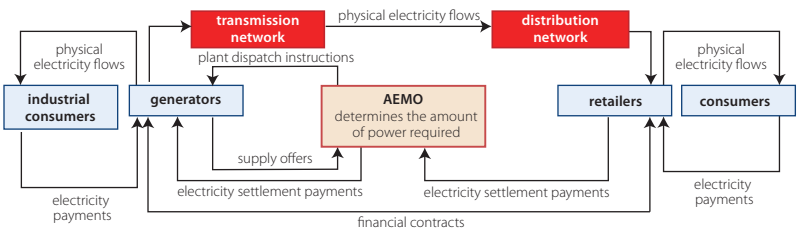
Sources: RET, *Australian petroleum statistics.*

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.

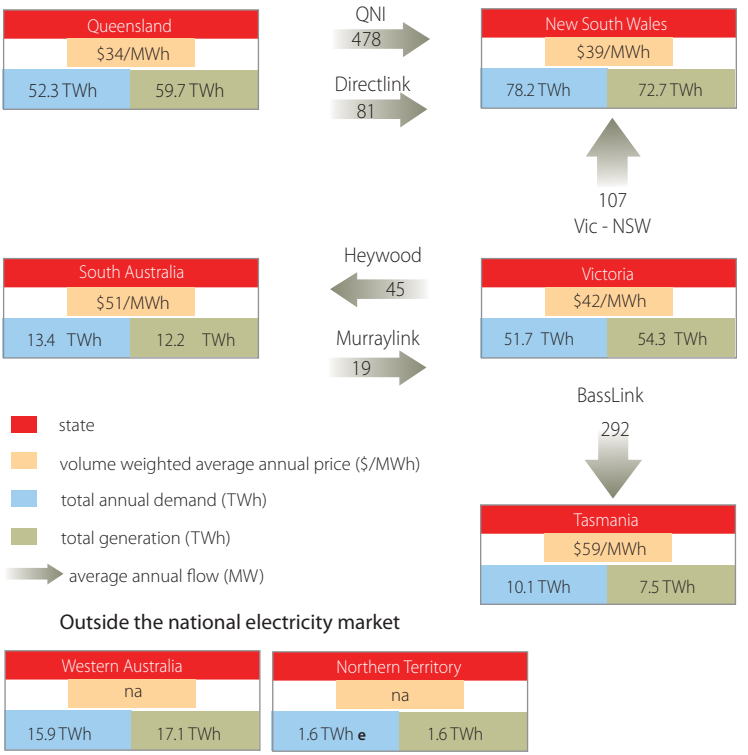
Industry structure

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



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*.

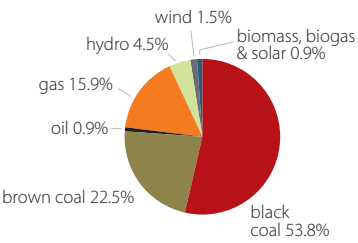
also contract with generators through financial markets to better manage any price risk associated with trade in the spot market.

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

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 TWh	2004-05 TWh	2005-06 TWh	2006-07 TWh	2007-08 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 capability MW	reverse 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		**overhead**	**underground**
length (km)		779 917	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

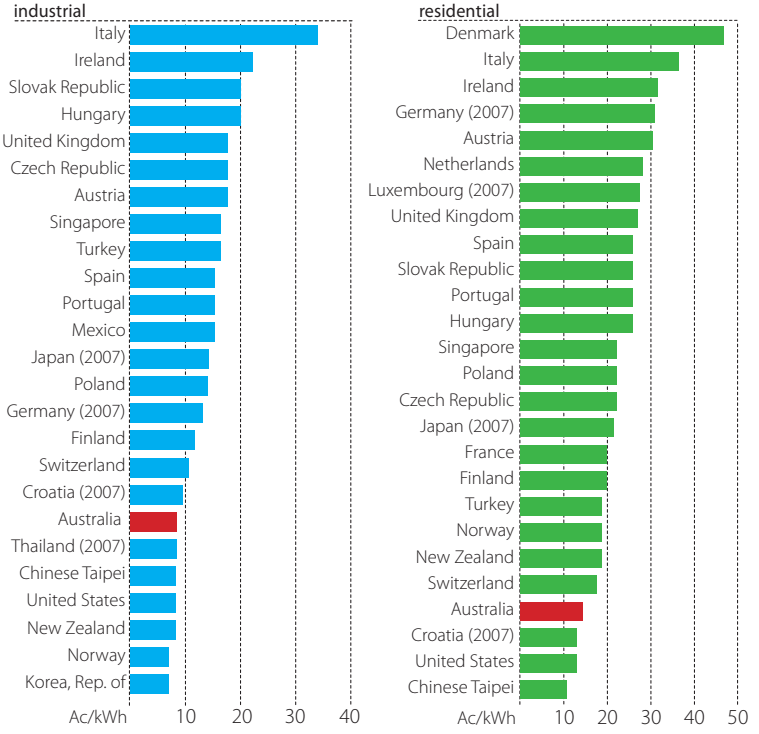
region	project details	start-up
Queensland	Installation of a 200 MVAr capacitor bank at Tarong; a fifth 200 MVAr capacitor bank at Greenbank; and a 120 MVAr capacitor bank at the Mt England and South Pine 275 kV substations.	Summer 2009-10
New South Wales	Upgrade of the Tamworth-Armidale 330 kV line 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 Tungkillo switching station.	Winter 2015

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

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.

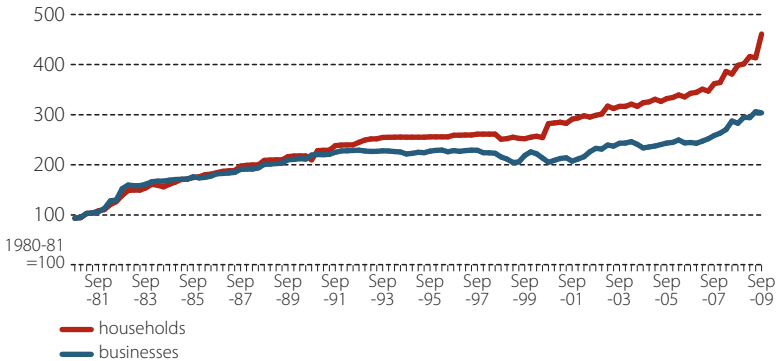
World electricity prices, selected countries, 2008 a



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



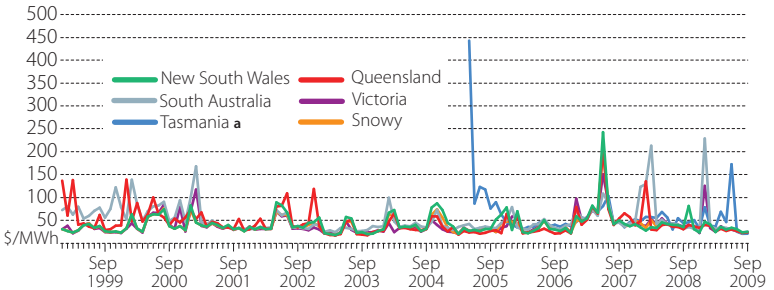
Source: ABS, cat. no. 6427.0 Producer Price Indexes Australia, cat. no. 6401.0 Consumer Price Index Australia.

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.

Spot market prices in the National Electricity Market

average monthly wholesale, in 2008-09 dollars



a Tasmania joined the National Electricity Market in 2005.

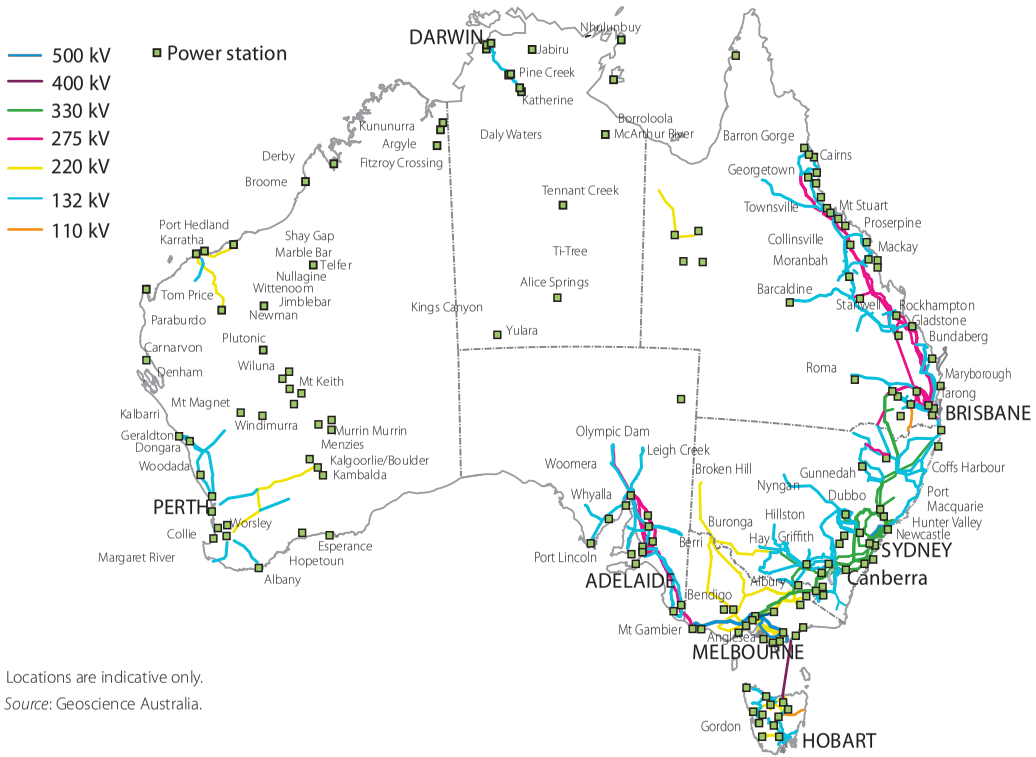
Source: AEMO, www.aemo.com.au

14 Principal generation businesses in Australia, 2008-09

	generation GWh	share of NEM generation %
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 *continued*		
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.

Renewable energy

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 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

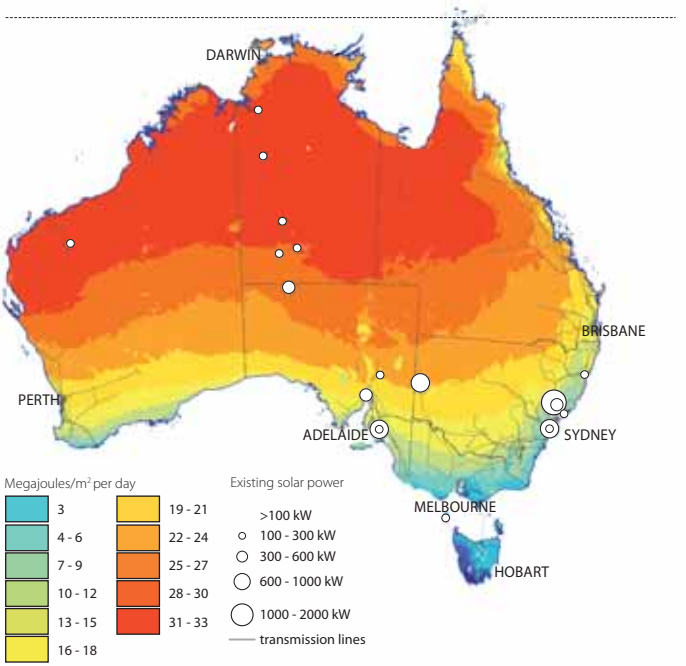
	annual increase		1997 baseline generation
	GWh	share of increase %	GWh
Bagasse	553	6.4	497
Black liquor	100	1.2	154
Hydro	241	2.8	15 629
Landfill gas	675	7.8	264
Sewage gas	83	1.0	5
Solar electricity	400	4.6	0.01
Solar hot water	3 229	37.5	0
Wind	3 125	36.3	5
Woodwaste	108	1.3	33
Other b	98	1.1	0.1
Total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

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

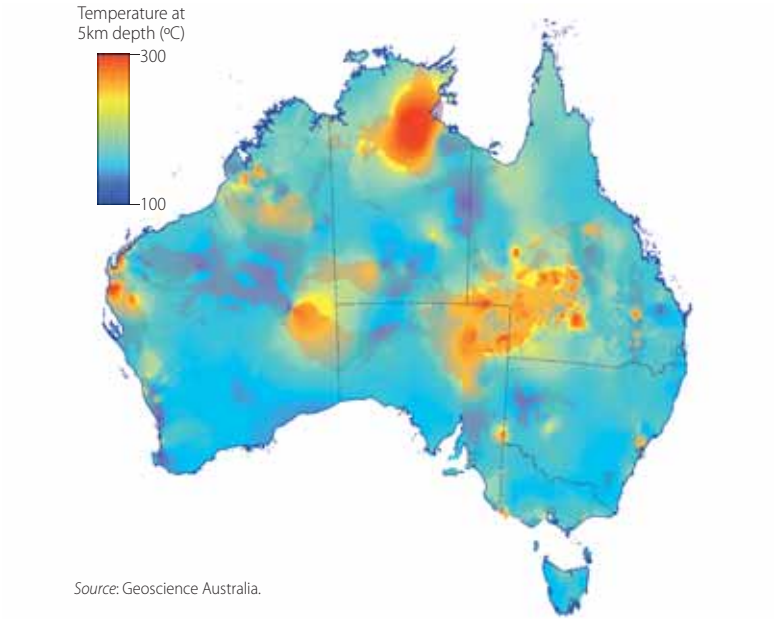
Annual average solar radiation



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.

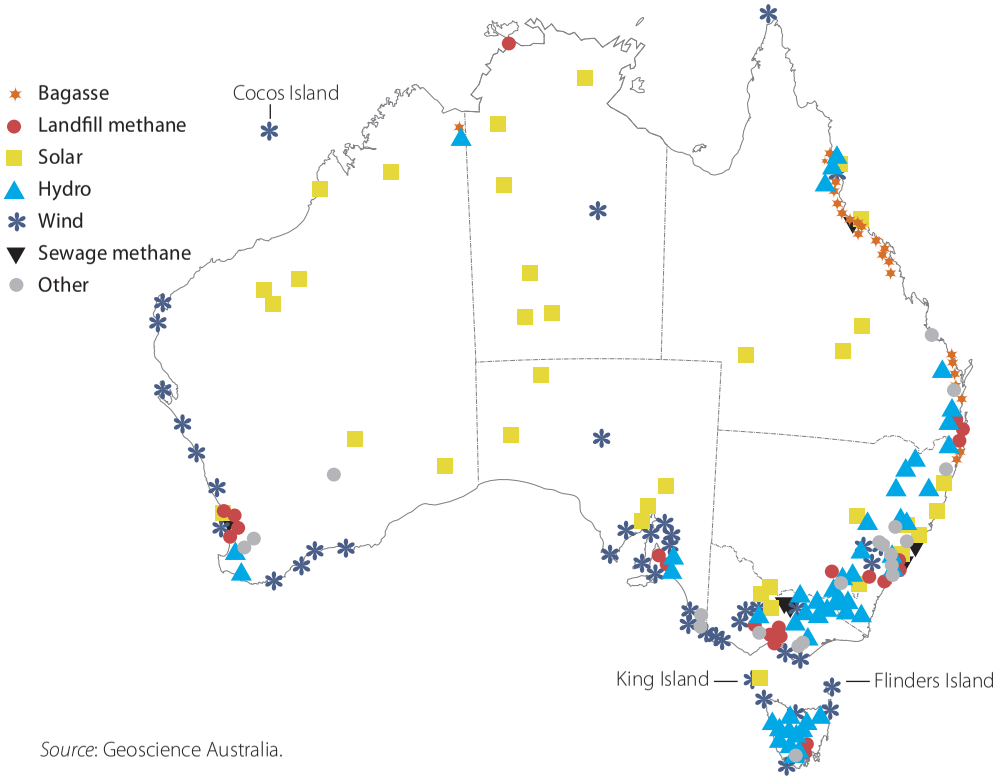
Australian geothermal energy potential



Source: Geoscience Australia.

Renewable energy generators

operating plants



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 Mt	2005-06 Mt	2006-07 Mt	2007-08 Mt	2008-09 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.

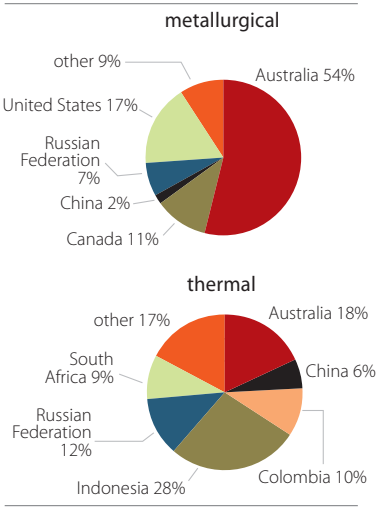
Sources: Coal Services Pty Ltd; Queensland Department of Mines and Energy; Victorian Department of Primary Industries; ABARE, *Australian commodities*.

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.

World coal trade, 2008-09



Source: ABARE, *Australian commodity statistics.*

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

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

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

Gas production and trade

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 PJ	2003-04 PJ	2004-05 PJ	2005-06 PJ	2006-07 PJ	2007-08 PJ	2008-09 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.

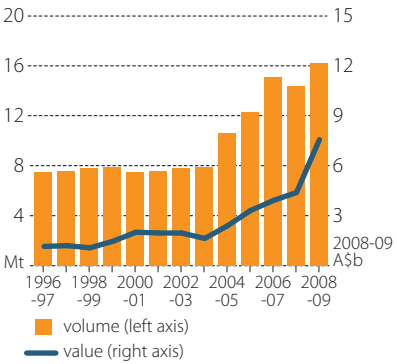
Australia. Gas production from this Basin has been increasing at 9 per cent a year over the past seven years. Until 2005-06, all of the gas produced in the Northern gas market was consumed locally. Following the development of the Darwin LNG plant, gas has also been exported as LNG. In September 2009, 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

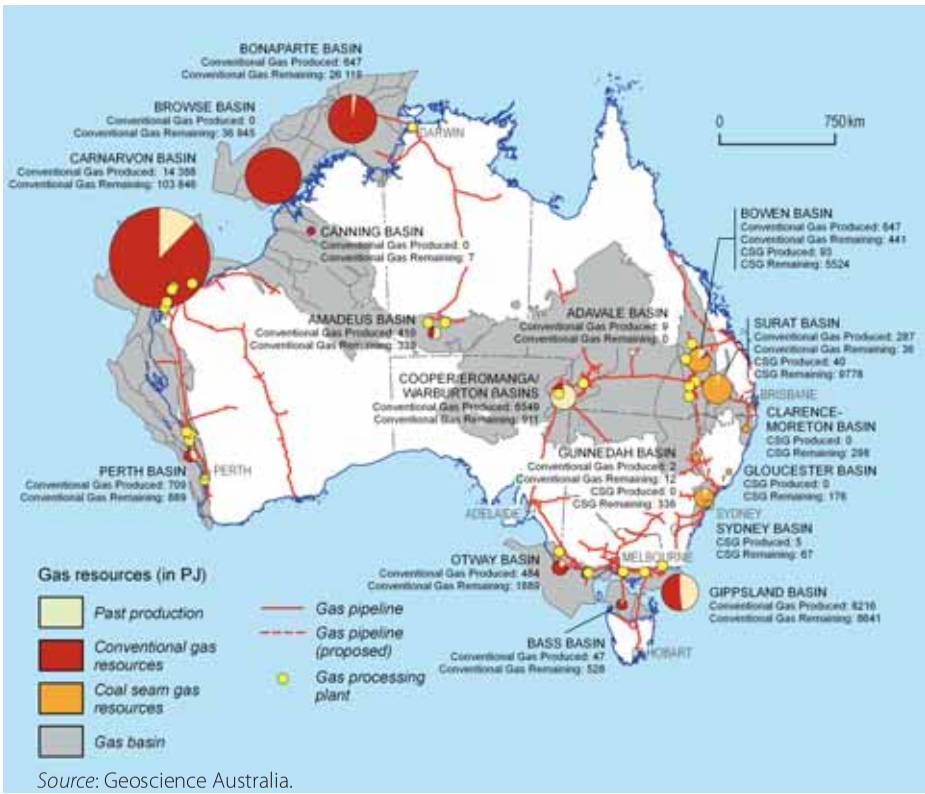
a Financial year average of daily spot prices in the Victorian gas market. **b** Export unit value.
Sources: ABARE, *Australian commodity statistics*; AEMO.

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.

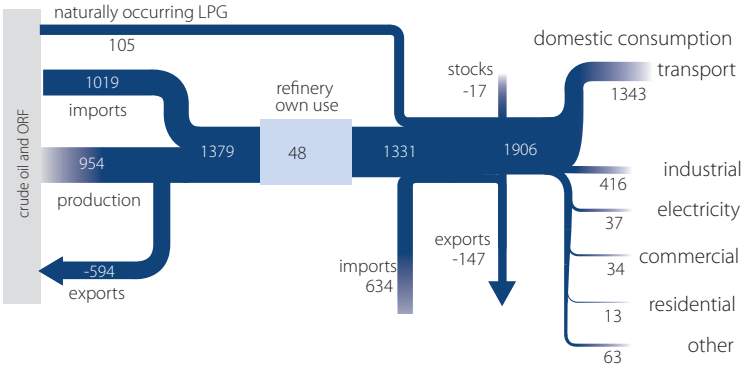


Source: Geoscience Australia.

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 ML	2004-05 ML	2005-06 ML	2006-07 ML	2007-08 ML	2008-09 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 ML	2004-05 ML	2005-06 ML	2006-07 ML	2007-08 ML	2008-09 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 capitalisation February 2010 A$b	proved plus probable 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
Karoon	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 ML	2004-05 ML	2005-06 ML	2006-07 ML	2007-08 ML	2008-09 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*.

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.

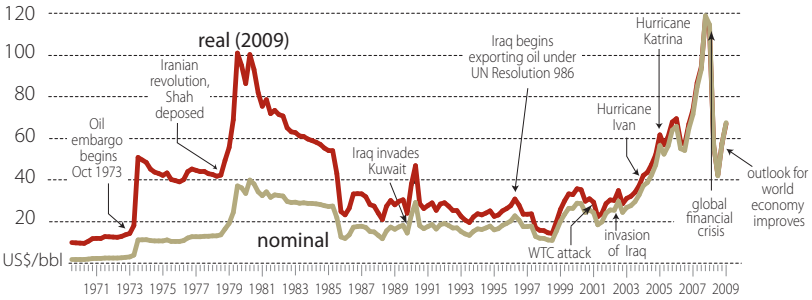
Prices

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.*

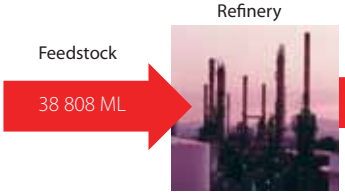
Liquid fuels refining and pricing

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



Petroleum products	ML
LPG	1 477
Automotive gasoline	17 159
Aviation turbine fuel	5 494
Automotive diesel oil	12 231
Fuel oil	872
other products **a**	2 310

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 ML	2004-05 ML	2005-06 ML	2006-07 ML	2007-08 ML	2008-09 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

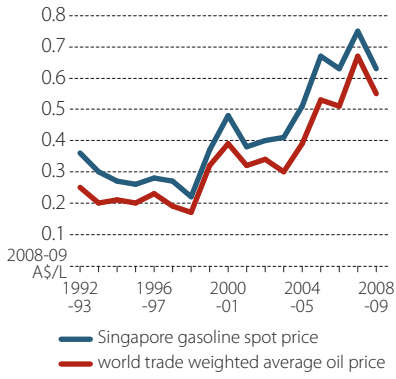
A$0.63 a litre, reflecting the effect of the slowdown in global economic activity on demand for petroleum products. Similarly, the world trade weighted average price of crude oil decreased by 17 per cent in 2008-09.

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		
In production		
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
Limited production		
Australian Renewable Fuels, Adelaide, SA	45	Tallow
Australian Renewable Fuels, Picton, WA	45	Tallow
Not in production		
Eco-Tech Biodiesel, Narangba, Qld	30	Tallow, used cooking oil

Source: RET.

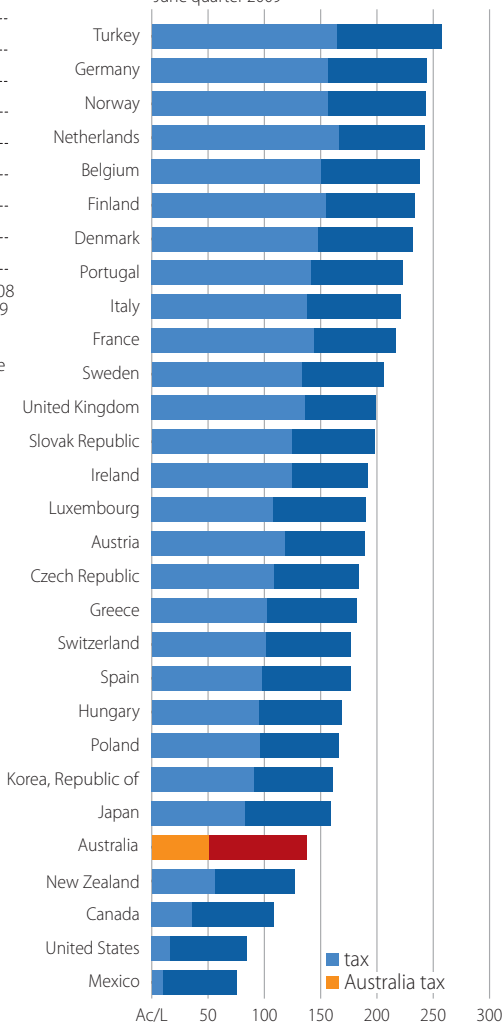
Petrol price indicators



Source: Energy Information Administration; ABARE, *Australian commodity statistics*

OECD gasoline prices

June quarter 2009



Source: RET, *Australian petroleum statistics.*

Transport and infrastructure

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.

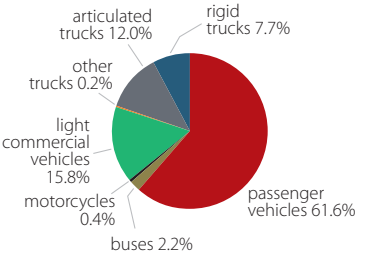
Passenger vehicles account for the majority of fuel consumption in the road transport sector. In 2006-07, almost 62 per cent of the fuel consumed

34 Energy consumption in the transport sector

	1979-80 PJ	1989-90 PJ	1999-00 PJ	2005-06 PJ	2007-08 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.

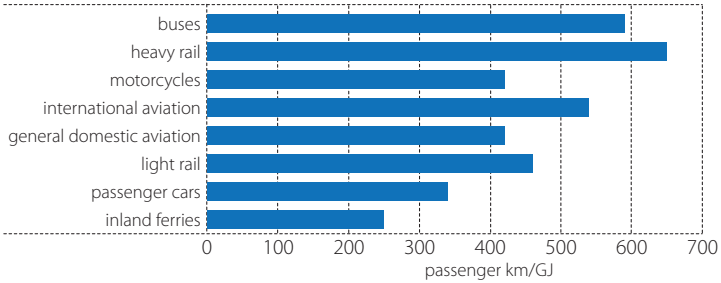
Automotive gasoline is the main fuel used in the transportation industry, accounting for around 48 per cent of total energy consumption in the sector. This reflects the large proportion of road transport's energy use of total consumption.

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.

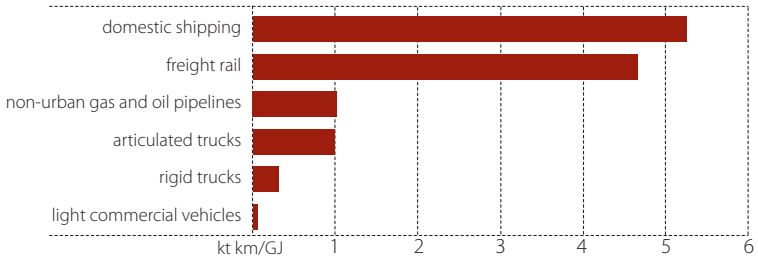
Passenger vehicle fuel efficiency in Australia, 2006-07
passenger kilometres travelled using 1 GJ of energy **a**



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.


JAPAN

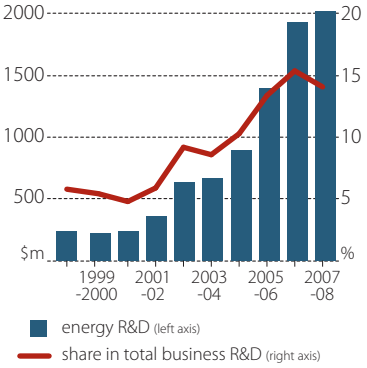
Energy research and development

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.

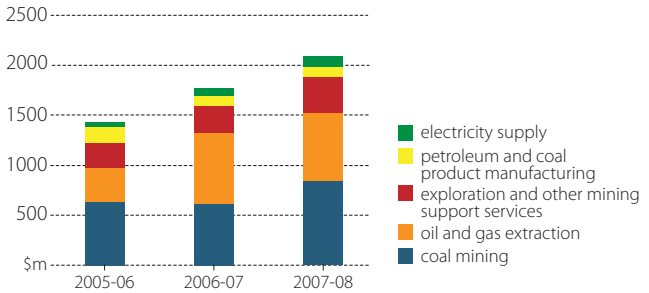
Of energy related industries, the coal mining industry had the largest R&D expenditure in 2007-08, with R&D spending of $840 million. This was followed by the oil and gas extraction industry with $682 million of R&D expenditure.

Business R&D in energy



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

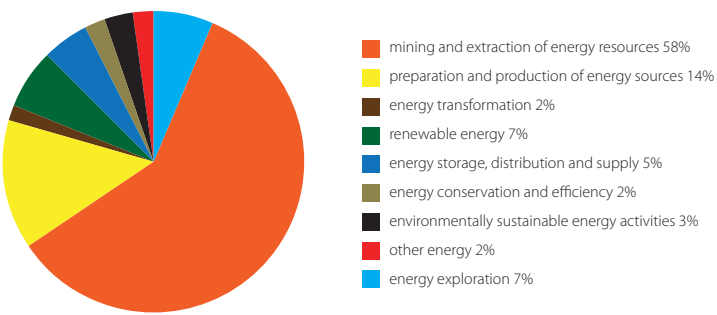
Business R&D by industry



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

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
Eraring	Eraring 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

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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	1500 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
Ernaballa	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

continued...

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 Diversion	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	expected start-up	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	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	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)	Apache Energy/ Santos	80 km NW of Dampier, Carnarvon Basin, WA	New project, committed	late 2011	40 PJ pa gas	US$744m (A$896m)
Turrum	ExxonMobil/ BHP Billiton	Bass St, Vic	New project, committed	2011	11 kpbd 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

Appendix 2
Energy content conversions

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 15º 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/m³
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 GJ/t
Black coal	
New South Wales	
Exports	
– metallurgical coal	29.0
– thermal coal	27.0
Electricity generation	23.4
Steelworks	30.0
Washed thermal coal	27.0
Unwashed thermal coal	23.9
Queensland	
Exports	
– metallurgical coal	30.0
– thermal coal	27.0
Electricity generation	23.4
Other	23.0
Black coal	
Western Australia	
Thermal coal	19.7
Tasmania	
Thermal coal	22.8
Lignite	
Victoria	9.8
Briquettes	22.1
South Australia	15.2
Other	
Coke	27.0
Wood (dry)	16.2
Bagasse	9.6