



GREENHOUSE INDICATOR SERIES
ELECTRICITY GENERATION
REPORT 2009

THE °CLIMATE GROUP

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INTRODUCTION

This report is part of The Climate Group's Greenhouse Indicator Series. It examines electricity generation and the associated greenhouse gas emissions in Australia's five eastern states, Victoria, New South Wales, Queensland, South Australia, and Tasmania, in 2009 and compares them with the previous year.

All scheduled fossil fuel and renewable energy power stations that contribute to the National Electricity Market (NEM) are included, as well as renewable energy power stations registered to create Renewable Energy Certificates (RECs) or Victorian RECs (VRECs). The report does not include generation from non-scheduled power stations, renewable energy generated from small solar systems on private homes, or from power stations not registered to create RECs.

Please note that not all the power produced in each state is consumed in each state, as states regularly export and import electricity via the National Electricity Market. For more information on the report's methodology see Annex 1.

OVERVIEW

Fossil fuel-fired power stations in Australia's five eastern states produced a total of 181.5 million tonnes of greenhouse pollution and 189.1 million MWh in 2009, a decrease from 2008 of 2.4 per cent and 2.1 per cent respectively. Over the same period, this decline in generation was matched by a similar fall in demand of 2 per cent.¹

On top of fossil-fuel generation, renewable electricity generation contributed 19.4 million MWh, representing an increase of 11 per cent on the previous year. This

¹ See The Climate Group, Jan 2010, 'Greenhouse Indicator Annual Report 2009'

increase was primarily the result of growth in both Victorian and South Australian wind generation.

Despite significantly stronger growth than fossil fuel generation, the renewable sector remains a minority contributor at 9 per cent of total generation. The 11 per cent growth in renewable generation from 2008 - 2009 will only displace approximately 2.0 million tonnes of CO₂e pollution annually, or one per cent of total generation emissions across the eastern states if the electricity were to be produced by fossil fuels.

Australia's eastern states relied on coal-fired power stations for the vast majority of their electricity in 2009. Coal provided 82 per cent of electricity generation, a decline of almost two per cent in market share on 2008. In terms of absolute generation, coal generation declined by three per cent in 2009. The high carbon intensity of coal generation – on average 1 tonne of CO₂e per MWh – saw coal produce 95 per cent of the total greenhouse emissions from electricity generation. The largest coal-fired power stations across the five states remain some of the most carbon intensive in Australia.

The amount of electricity generated from gas-fired power stations grew by 8 per cent across the five states in 2009, accounting for 8 per cent of total electricity generation. Given a lower average carbon intensity of 0.57 tonnes of emissions per MWh, gas-fired power stations contributed only 5 per cent of total greenhouse gas emissions.

Of the power stations that emitted the most greenhouse gas emissions in 2009, the top three were in Victoria: Log Yang A, Hazelwood and Yallourn W. The next two biggest emitters were Bayswater and Eraring power stations, both in New South Wales. The most greenhouse intensive power station in the country (on a generated basis) was Playford B in South Australia, just ahead of Hazelwood in Victoria,

although Hazelwood produced 13 times the total emissions of Playford B.

States

Emissions from fossil fuel power stations declined in 2009 in all five states, except for Victoria. Tasmania and South Australia showed the largest declines in emissions, recording falls of 36 per cent and 7.5 per cent respectively.

New South Wales generated the most electricity and emitted the most greenhouse gases of the five states – some 64.2 million tonnes or 34 per cent of the five states' combined total. This represents a 3.1 million tonne (4.7 per cent) emissions reduction compared to 2008. A reduction of 4.2 million tonnes of emissions from coal in NSW in 2009 was the major contributor to overall state and national emissions reductions.

In total emissions, Victoria was close behind New South Wales with 62.5 million tonnes of CO₂e released in 2009, a rise of 0.7 per cent on 2008. Its coal-fired power stations are the most carbon intensive of any of the five eastern states due to their reliance on brown coal compared with the black coal used in the other states.

Collectively, Victoria's power stations produced 1.15 tonnes of greenhouse gas pollution for every MWh of electricity generated. This compares with 0.86 tonnes in New South Wales, 0.80 tonnes in Queensland, 0.64 tonnes in South Australia, and only 0.05 tonnes in the predominantly hydroelectric-powered Tasmania.

Overall carbon intensity of electricity generation in the five eastern states improved by 1.5 per cent, declining from 0.88 to 0.87 tonnes for every MWh in 2009.

Renewable energy

Renewable power stations produced 19.4 million MWh of electricity in 2009 across the five states, up 11 per cent from 17.5 million MWh in 2008. Growth in renewables occurred in all states except Queensland and New South Wales, with Victoria and South Australia showing the largest increases.

Hydroelectricity was the largest renewable sector, accounting for almost two thirds of emissions-free electricity. Nine out of ten of the highest generating renewable energy power stations across the five states were hydroelectric. The Murray Hydroelectric Station in NSW, first among all renewable generators, produced 1.8 million MWh in 2009, followed by the Reece hydroelectric station of Tasmania, generating 1.0 million MWh.

Bioenergy generated 2.5 million MWh in 2009, recording growth of 7.0 per cent on the previous year. Queensland has the largest bioenergy sector of any state, accounting for nearly half of this total. It has more than 40 bioenergy stations, the biggest generator being the Pioneer Mill at 0.24 million MWh in 2009.

With a 40 per cent increase across the five states, wind energy saw the strongest growth of any renewable energy class in 2009. Wind power generated 4.1 million MWh over the year, increasing its share of total renewable energy to 21 per cent, from 17 per cent the previous year.

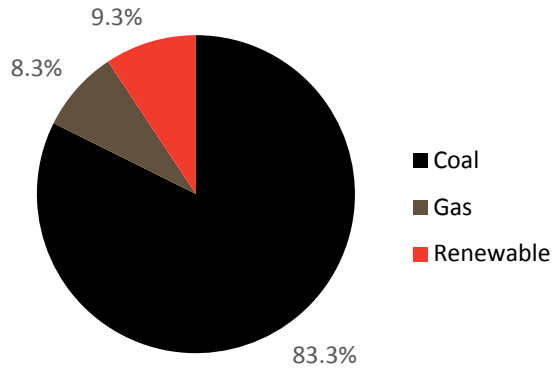
The growth in wind energy was driven primarily by increasing generation of the new Waubra Wind Farm, and Cape Nelson in Victoria, as well as Snowtown and Hallett wind farms in South Australia. New South Wales also began its first commitment to large scale wind farms, with the new Capital and Cullerin wind farms coming online to deliver over 211,000 MWh in 2009.

TABLES AND GRAPHS

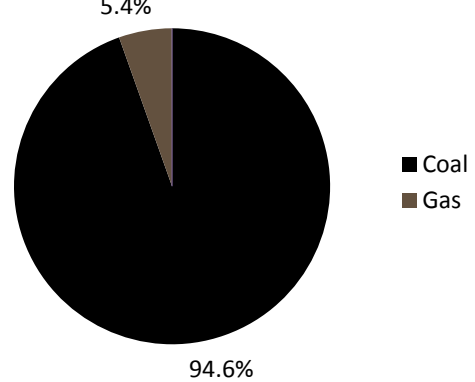
Victoria, New South Wales, Queensland, South Australia and Tasmania

Electricity generation and emissions, 2009

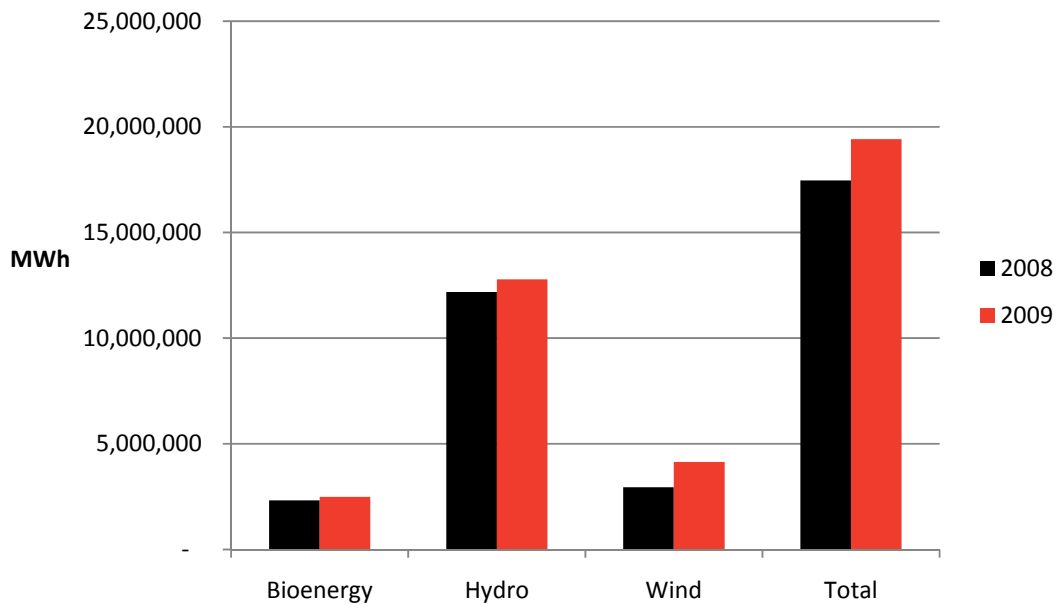
Combined electricity generation by fuel source



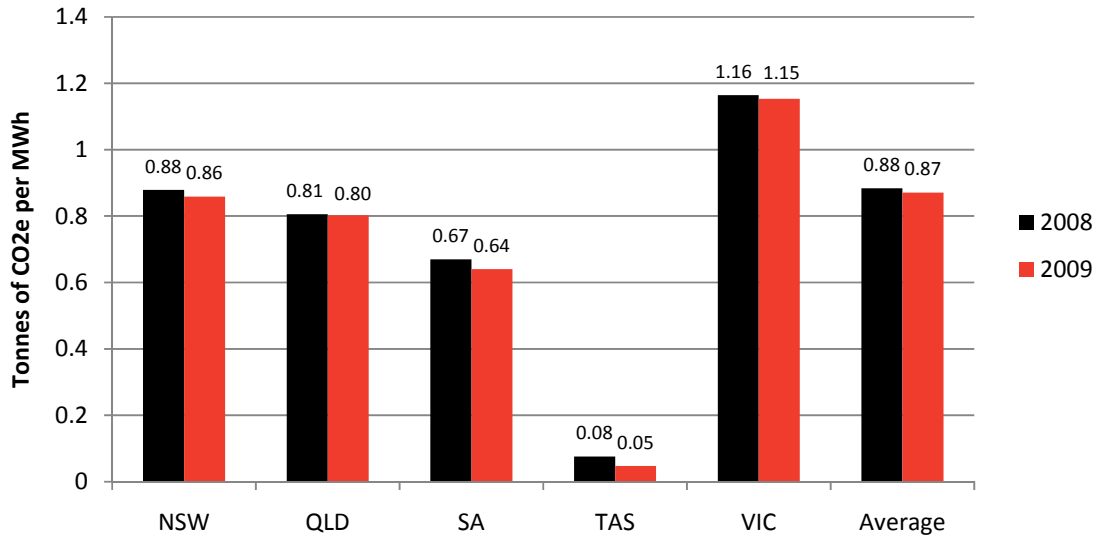
Combined greenhouse gas emissions by fuel source



Renewable energy generation by sector, 2008 & 2009



Overall carbon intensity of electricity generation by state, 2008 & 2009



Emissions* and generation by sector in 2009

Sector	Emissions (million tonnes CO ₂ e)	Generation (MWh)	Generation growth on 2008	Emissions growth on 2008	Emissions Intensity (tCO ₂ e / MWh)
Coal-fired generation	171.61	171,685,000	-3.0%	-2.7%	1.00
Gas-fired generation	9.84	17,381,000	8.1%	3.8%	0.57
Liquid fuel-fired generation	0.04	44,000	-23.1%	-22.3%	0.89
Renewable generation	0	19,417,000	11.2%	N/A	0
Total Fossil Fuel	181.48	189,110,000	-2.1%	-2.4%	0.96
Total All Generation	181.48	208,527,000	-0.91%	-2.4%	0.87

* see methodology for more information on calculation of emissions factors

Top 20 power stations* by CO₂e emissions in 2009

Ranking	Power Station	State	Emissions (million tonne CO ₂ e)	Generation MWh	Change in generation/emissions on 2008	Emissions Intensity (tCO ₂ e / MWh)
1	Loy Yang A	VIC	18.81	17,071,000	1.0%	1.10
2	Hazelwood	VIC	16.25	11,862,000	3.4%	1.37
3	Yallourn W	VIC	15.00	11,620,000	2.6%	1.29
4	Bayswater	NSW	14.92	16,298,000	1.2%	0.92
5	Eraring	NSW	13.96	15,225,000	-3.8%	0.92
6	Liddell	NSW	10.65	10,552,000	-13.3%	1.01
7	Loy Yang B	VIC	9.80	8,553,000	-3.5%	1.15
8	Vales Point B	NSW	8.01	8,535,000	-8.1%	0.94
9	Stanwell	QLD	7.44	8,886,000	3.9%	0.84
10	Mt Piper	NSW	7.19	8,247,000	-13.6%	0.87
11	Tarong	QLD	7.07	8,333,000	38.6%	0.85
12	Gladstone	QLD	6.85	7,604,000	-9.0%	0.90
13	Wallerawang C	NSW	5.35	5,629,000	21.4%	0.95
14	Millmerran	QLD	4.98	5,862,000	-12.5%	0.85
15	Callide C	QLD	4.86	5,631,000	-0.9%	0.86
16	Kogan Creek	QLD	3.97	4,744,000	-8.3%	0.84
17	Callide B	QLD	3.57	4,111,000	-15.2%	0.87
18	Northern Power	SA	3.35	3,754,000	-7.2%	0.89
19	Swanbank B	QLD	1.98	2,006,000	-4.5%	0.99
20	Tarong North	QLD	1.85	2,290,000	-33.7%	0.81

* all are coal-fired

Top 10 gas-fired power stations by CO₂e emissions in 2009

Ranking	Power Station	State	Emissions (million tonnes CO ₂ e)	Generation (MWh)	Change in generation/emissions on 2008	Emissions Intensity (tCO ₂ e / MWh)
1	Pelican Point Power Station	SA	1.63	3,165,000	-3.9%	0.51
2	Torrens Island Power Station B	SA	1.46	1,837,000	-19.9%	0.80
3	Braemar	QLD	1.19	1,801,000	-0.8%	0.66
4	Tallawarra*	NSW	0.87	1,892,000	New	0.46
5	Swanbank E	QLD	0.85	2,025,000	-14.2%	0.42
6	Osborne Power Station	SA	0.68	1,194,000	-7.3%	0.57
7	Newport Power Station	VIC	0.64	1,097,000	-19.1%	0.59
8	Braemar 2 Total Generation**	QLD	0.62	940,000	New	0.66
9	Townsville Gas Turbine (Yabulu)	QLD	0.59	1,371,000	21.3%	0.43
10	Smithfield Energy Facility	NSW	0.56	1,026,000	1.8%	0.55

* Tallawarra commissioned in March 2009

** Braemar 2 commissioned in August 2009

Top 10 power stations* by emissions intensity in 2009

Ranking	Power Station	State	Emissions (million tonnes CO ₂ e)	Generation (MWh)	Emissions Intensity (tCO ₂ e / MWh)
1	Playford B	SA	1,239,000	901,000	1.38
2	Hazelwood*	VIC	16,248,000	11,863,000	1.37
3	Yallourn W	VIC	15,001,000	11,620,000	1.29
4	Morwell	VIC	1,591,000	1,260,000	1.26
5	Loy Yang B	VIC	9,797,000	8,553,000	1.15
6	Loy Yang A	VIC	18,813,000	17,071,000	1.10
7	Redbank	NSW	1,147,000	1,047,000	1.10
8	Anglesea Power	VIC	1,317,000	1,215,000	1.08
9	Collinsville	QLD	512,000	476,000	1.08
10	Munmorah	NSW	1,231,000	1,168,000	1.05

* all are coal-fired

** Hazelwood is the most carbon intensive power station in terms of 'sent out' electricity

Top 20 renewable energy power stations by generation in 2009

Ranking	Power Station	Technology	State	Generation (MWh)	Change in generation on 2008
1	Murray 1	Hydro	NSW	1,801,000	22%
2	Reece	Hydro	TAS	1,035,000	27%
3	Catagunya & Liapootah & Wayatinah	Hydro	TAS	866,000	19%
4	Tumut 1 & 2	Hydro	NSW	723,000	-13%
5	John Butters	Hydro	TAS	618,000	53%
6	Gordon	Hydro	TAS	575,000	-20%
7	Tarraleah	Hydro	TAS	568,000	15%
8	Tungatinah	Hydro	TAS	487,000	31%
9	Kareeya	Hydro	QLD	476,000	-4%
10	Waubra Wind Farm*	Wind	VIC	407,000	New
11	Cethana	Hydro	TAS	402,000	23%
12	Lemonthyme & Wilmot	Hydro	TAS	401,000	22%
13	Tumut 3	Hydro	NSW	396,000	-62%
14	Mackintosh	Hydro	TAS	395,000	27%
15	Bastyan	Hydro	TAS	394,000	26%
16	Trevallyn	Hydro	TAS	386,000	51%
17	Poatina	Hydro	TAS	383,000	-53%
18	Snowtown Wind Farm**	Wind	SA	369,000	90%
19	Murray 2	Hydro	NSW	361,000	3.5%
20	Hallet Wind Farm	Wind	SA	355,000	37%

* Waubra commissioned in July 2009

** Snowtown commissioned in Nov 2008

VICTORIA

Total greenhouse gas emissions from Victoria's power stations were 62.5 million tonnes in 2009. This was a rise of 0.7 per cent from the previous year due to an increase in coal-fired power generation, and occurred despite growth in electricity generation from renewable sources.

Electricity generation in Victoria continued to be dominated by large-scale brown coal power stations. The state produced the most carbon intensive electricity of any of the five states in 2009, with every MWh of electricity producing 1.15 tonnes of greenhouse gas emissions.

Among the five eastern states, the top three biggest emitting power stations in absolute terms in 2009 were located in Victoria. Loy Yang A power station tops the list with emissions totalling more than 18.8 million tonnes for the year, almost 15.8 per cent more than the second placed Hazelwood station (also in Victoria), which produced 16.2 million tonnes. Hazelwood is the primary contributor to the high emissions intensity of Victorian electricity generation, with 1.37 tonnes of CO₂e emissions per MWh – the most carbon intensive of any large power station. Yallourn W is the third most polluting power station, emitting 15 million tonnes. Total generation and emissions from all three power stations increased during 2009.

Coal accounted for 98.3 per cent of emissions and 93 per cent of the electricity generated in Victoria. Emissions from coal rose by 1.4 per cent, or 0.8 million tonnes, on the previous year. Gas accounted for the remaining 1.7 per cent of emissions in 2009 and 3 per cent of the electricity generated. Gas-fired power stations generated 27 per cent less electricity than the previous year, marking the second year in a row that Victoria has significantly reduced its gas-fired generation.

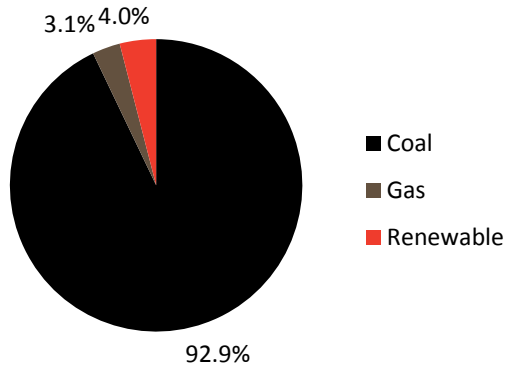
The amount of electricity generated from renewable sources in Victoria rose by 49 per cent in 2009. Renewable sources accounted for 4 per cent of Victoria's electricity generation, making 2009 the first year that renewable sources supplied more electricity than gas-fired power stations. Victorian renewable generation represented 11 per cent of the total renewable energy generated in the five states.

Wind became Victoria's largest source of renewable energy, generating almost 1.1 million MWh in 2009 and accounting for half of the state's renewable energy. Victoria is home to the largest wind farm in Australia, Waubra Wind Farm, which produced around 407,000 MWh in 2009. Bioenergy and hydroelectricity accounted for 25 per cent of the state's renewable energy each, both contributing 0.5 million MWh to the electricity grid. In terms of growth from 2008 to 2009, wind energy increased by 76 per cent, with bioenergy and hydroelectricity up by 12 and 51 per cent respectively.

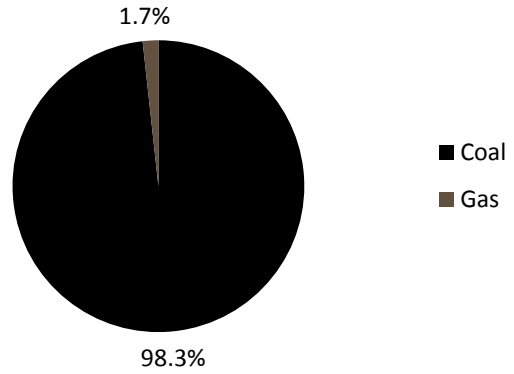
VICTORIA: TABLES AND GRAPHS

Electricity generation and emissions in Victoria, 2009

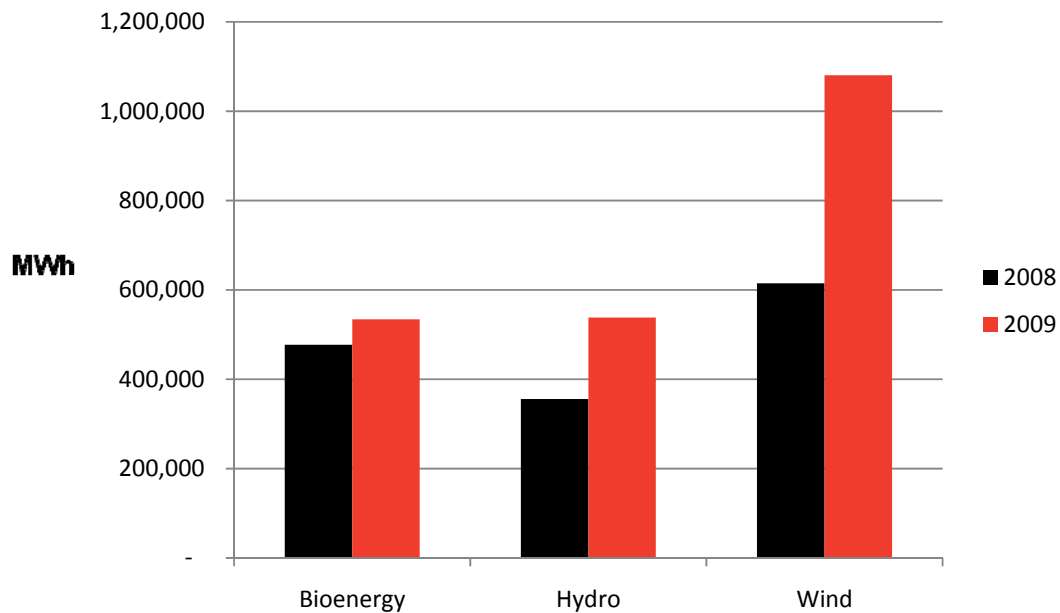
Combined electricity generation by fuel source



Combined emissions by fuel source



Victoria's renewable generation by sector in 2008 & 2009



Victoria's emissions and generation by sector 2009

Sector	Emissions (million tonnes CO ₂ e)	Generation (MWh)	Generation growth on 2008	Emissions growth on 2008
Coal-fired generation	61.45	50,367,000	1.3%	1.4%
Gas-fired generation	1.08	1,672,000	-26.7%	-27.7%
Renewable generation	0	2,153,000	49%	0

Top five power stations in Victoria by emissions in 2009

Ranking	Power Station	Emissions (million tonnes CO ₂ e)	Generation (MWh)	Generation/emissions growth on 2008	Emissions Intensity (tCO ₂ e / MWh)
1	Loy Yang A Power Station	18.81	17,071,000	1.0%	1.10
2	Hazelwood Power Station	16.25	11,862,000	3.4%	1.37
3	Yallourn W Power Station	15.00	11,620,000	2.6%	1.29
4	Loy Yang B Power Station	9.80	8,553,000	-3.5%	1.15
5	Morwell (Energy Brix)	1.59	1,260,000	7.0%	1.26

Top gas-fired power stations by emissions in Victoria in 2009

Ranking	Power Station	Emissions (million tonnes CO ₂ e)	Generation (MWh)	Generation/emissions growth on 2008
1	Newport Power Station	0.64	1,097,000	-19.1%
2	Jeeralang B Power Station	0.11	129,000	-41.1%
3	Laverton Power Station	0.08	122,000	-26.8%

Top five renewable stations by generation in Victoria in 2009

Ranking	Power stations	Technology	Generation (MWh)	Generation growth on 2008
1	Waubra Wind Farm*	Wind	407,000	New
2	Maryvale Mill	Black Liquor	200,000	16%
3	Cape Bridgewater Wind	Wind	189,000	83%
4	West Kiewa	Hydro	148,000	28%
5	Cape Nelson South Wind**	Wind	140,000	New

* Waubra commissioned in July 2009

** Cape Nelson South commissioned in May 2009

NEW SOUTH WALES

Total greenhouse gas emissions from New South Wales' power stations were 64.2 million tonnes in 2009, the largest total of any Australian state. This represented a reduction of 4.7 per cent on the previous year, and was due primarily to a reduction of 4.2 million tonnes of emissions from coal-fired power stations.

Electricity generation in New South Wales is dominated by black-coal generators. Five of the top 10 biggest emitting power stations across all five states in 2009 were located in NSW. Bayswater power station was the fourth most polluting power station across all five states, emitting 14.9 million tonnes in 2009, closely followed by Eraring and Liddell stations, which produced 13.9 and 10.7 million tonnes respectively.

2009 has seen a small shift from coal to gas-fired generation in New South Wales. Emissions from coal declined by 4.2 million tonnes or 6.3 per cent, with coal accounting for 97.3 per cent of emissions from electricity generation in New South Wales and 89 per cent of the electricity generated (compared with 99 per cent and 93 per cent the previous year). With an increase of 191 per cent in 2009, the contribution of gas to total generation rose from 1.5 per cent in 2008 to more than 4 per cent in 2009.

Electricity in New South Wales was the second most carbon intensive of the five states, behind Victoria. On average, every MWh of electricity generated in 2009 produced 0.86 tonnes of greenhouse gases.

The amount of electricity generated from renewable sources in New South Wales was 4.7 million MWh, which represents a decline of 0.7 per cent on the previous year. Only New South Wales and Queensland showed a decline in renewable electricity generation in 2009. New South Wales is third of the five states in renewables as a percentage of total generation, with renewable sources accounting for 6.3 per cent of the state's electricity generation in 2009.

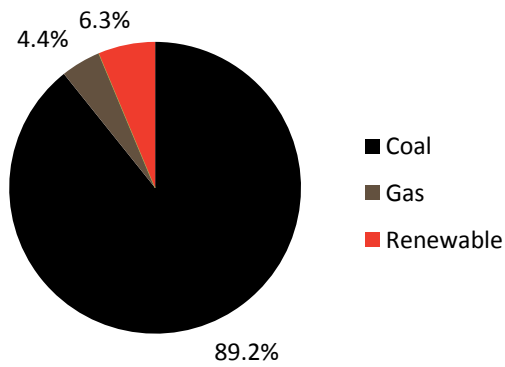
Hydroelectricity was by far the largest source of renewable energy in New South Wales, and its negative growth rate was responsible for the overall decline in renewable generation in the state. Despite a decline in their output, hydroelectric dams produced 79 per cent of the state's renewable electricity.

Bioenergy grew by almost 17 per cent in 2009 to provide 16 per cent of New South Wales' renewable electricity. In 2009, the state began strengthening its contribution to wind generation as the Capital and Cullerin Range wind farms came online, achieving a growth rate of 733 per cent in the sector. However, given the low level of wind power in New South Wales, this still only represents 5 per cent of its total renewable electricity generation or 0.3 per cent of total electricity generation.

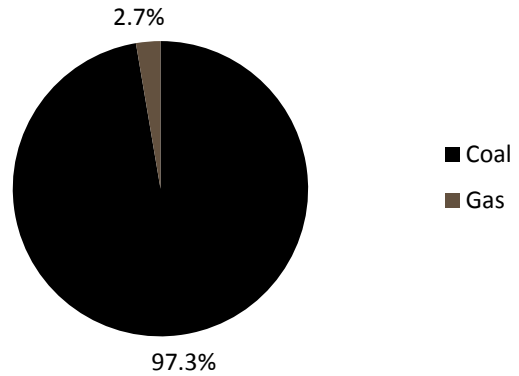
NEW SOUTH WALES: TABLES AND GRAPHS

Electricity generation and emissions in New South Wales, 2009

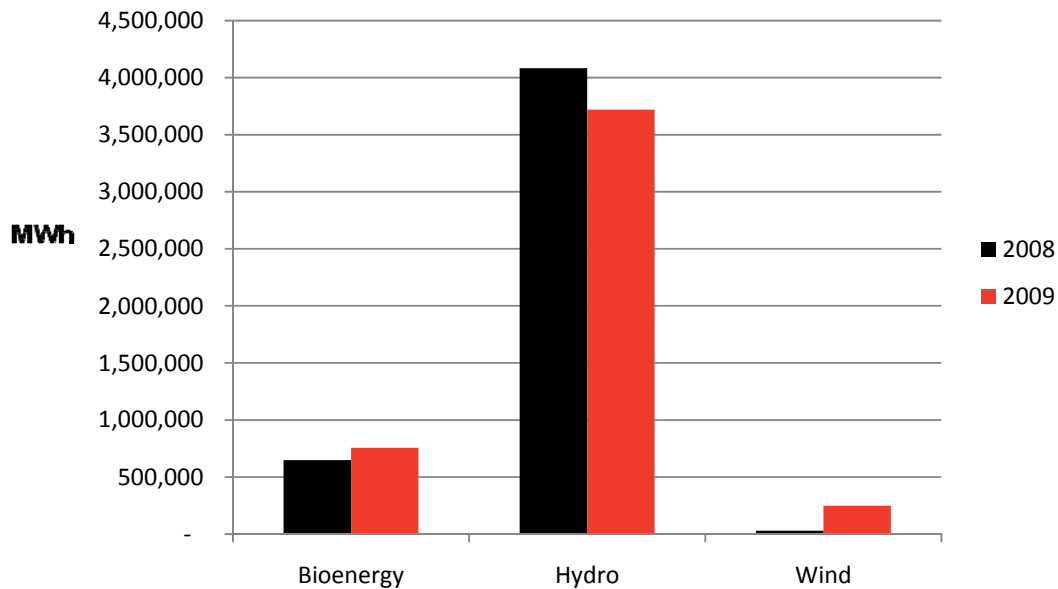
Combined electricity generation by fuel source



Combined emissions by fuel source



New South Wales' renewable generation by sector in 2008 & 2009



New South Wales' emissions and generation by sector in 2009

Sector	Emissions (million tonnes CO ₂ e)	Generation (MWh)	Generation growth on 2008	Emissions growth on 2008
Coal-fired generation	62.47	66,701,000	-6.1%	-6.3%
Gas-fired generation	1.71	3,318,000	191.2%	176.6%
Renewable generation	0	4,724,000	-0.7%	0

Top five power stations* by emissions in New South Wales, 2009

Ranking	Power Station	Emissions (million tonnes CO ₂ e)	Generation (MWh)	Generation/emissions growth on 2008	Emissions Intensity (tCO ₂ e / MWh)
1	Bayswater	14.92	16,298,000	1.2%	0.92
2	Eraring Power Station	13.96	15,225,000	-3.8%	0.92
3	Liddell	10.65	10,552,000	-13.3%	1.01
4	Vales Point B Power Station	8.01	8,535,000	-8.1%	0.94
5	Mt Piper Power Station	7.19	8,247,000	-13.6%	0.87

* all are coal-fired

Top gas-fired power stations by emissions in New South Wales, 2009

Ranking	Power Station	Emissions (million tonnes CO ₂ e)	Generation (MWh)	Generation/emissions growth on 2008
1	Tallawarra*	0.87	1,893,000	New
2	Smithfield Energy Facility	0.56	1,026,000	1.8%
3	Uranquinty**	0.20	277,000	New

* Tallawarra was commissioned in March 2009

** Uranquinty was commissioned in December 2008

Top five renewable stations by generation in New South Wales, 2009

Ranking	Power stations	Technology	Generation (MWh)	Generation growth on 2008
1	Murray 1	Hydro	1,801,000	22%
2	Tumut 1 & 2	Hydro	723,000	-13%
3	Tumut 3	Hydro	396,000	-62%
4	Murray 2	Hydro	361,000	3.5%
5	Capital Wind Farm*	Wind	145,000	New

* Capital Wind Farm was commissioned in October 2009

QUEENSLAND

Total greenhouse gas emissions from Queensland's power stations were 45.4 million tonnes in 2008, a decrease of 1.6 per cent on the previous year. This was largely due to a three per cent reduction in coal-fired power generation spread across a number of its power stations, facilitated by a 37 per cent increase in gas-fired generation.

Coal accounted for 95 per cent of emissions and 88 per cent of the electricity generated in Queensland in 2009. Emissions from coal dropped by 3 per cent or 1.3 million tonnes from 2008 levels. With 16 per cent growth in 2009, gas-fired generation rose to represent 11 per cent of total electricity – up from 10 per cent in 2008. Greenhouse emissions from gas generation accounted for 5 per cent of total Queensland generation emissions.

Queensland's electricity was the third most carbon intensive of the five states with every MWh generated producing an average of 0.80 tonnes of greenhouse gases. Despite showing no change from the previous year, Queensland's carbon intensity is still lower than the five state average of 0.85 tonnes per MWh.

Nine of the 10 biggest generators of electricity in Queensland were coal-fired. Stanwell power station produced the most emissions in the state in 2009, with 7.4 million tonnes. This was followed closely by Tarong, Gladstone, Millmerran, and Callide C Power Stations. The combined output of these five power stations was more than 31 million tonnes, or around 69 per cent of the emissions from all of Queensland's electricity generation. Queensland's coal-fired power stations are generally less emissions intensive than those of New South Wales and Victoria, with its most intensive power station, Gladstone, releasing 0.90 tonnes of greenhouse emissions per MWh.

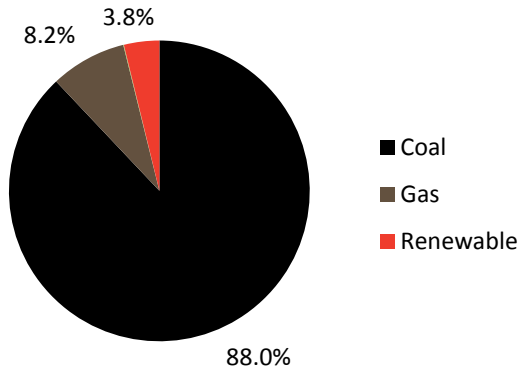
Queensland's renewable power stations are mostly powered by bioenergy (predominantly sugar cane waste). These bioenergy generators produced more than 1.1 million MWh in 2009, a small increase of 1.3 per cent from 2008. The next largest source of renewable energy was hydroelectricity, generating 0.82 million MWh in 2009. Combined, these two sources made up 99 per cent of renewable energy generation in Queensland.

Renewable sources account for just 3.8 per cent of Queensland's electricity generation in 2009, producing 2.2 million MWh of electricity. Queensland was one of two states to have registered negative growth in its renewable energy sector for 2009, albeit only a 0.1 per cent decline. This trend was unique to Queensland in the previous reporting period, with the state showing a decrease in renewables generation of nearly 1 per cent from 2007 to 2008.

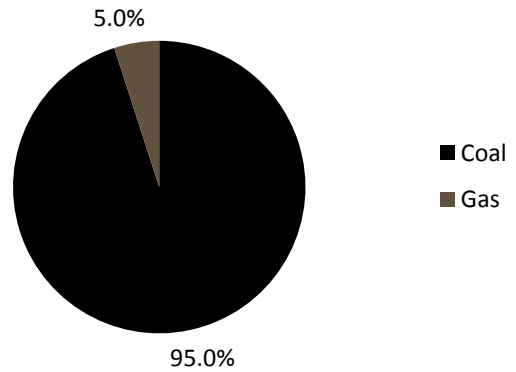
QUEENSLAND: TABLES AND GRAPHS

Electricity generation and emissions in Queensland, 2009

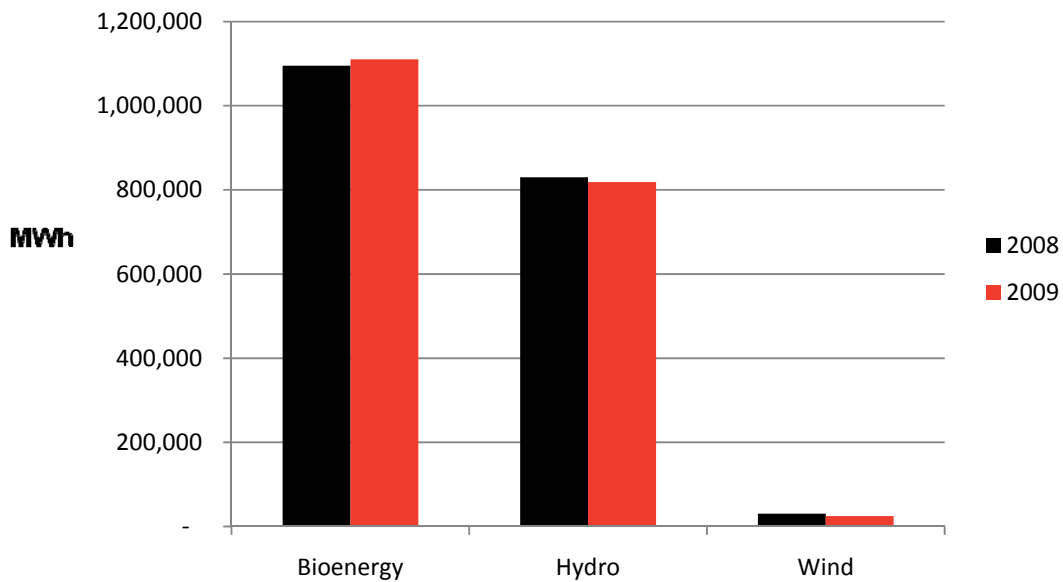
Combined electricity generation by fuel source



Combined emissions by fuel source



Queensland's renewable generation by sector in 2008 & 2009



Queensland's emissions and generation by sector in 2009

Sector	Emissions (million tonnes CO ₂ e)	Generation (MWh)	2008/09 Generation growth	Emissions growth on 2008
Coal-fired generation	43.10	49,960,000	-3.0%	-3.0%
Gas-fired generation	2.26	6,447,000	15.9%	37.7%
Renewable generation	0	1,952,000	-0.1%	0

Top five power stations by emissions in Queensland, 2009

Ranking	Power Station	Emissions (million tonnes CO ₂ e)	Generation (MWh)	Generation/emissions growth on 2008	Emissions Intensity (tCO ₂ e / MWh)
1	Stanwell Power Station	7.44	8,886,000	3.9%	0.84
2	Tarong Power Station	7.07	8,333,000	38.6%	0.85
3	Gladstone	6.85	7,604,000	-9.0%	0.90
4	Millmerran Power Plant	4.98	5,862,000	-12.5%	0.85
5	Callide C Power Station	4.86	5,631,000	-0.9%	0.86

* all are coal-fired

Top gas-fired power stations by emissions in Queensland, 2009

Ranking	Power Station	Emissions (million tonnes CO ₂ e)	Generation (MWh)	Generation/emissions growth on 2008
1	Braemar	1.19	1,801,000	-14.2%
2	Swanbank E	0.85	2,026,000	-0.8%
3	Braemar 2 Total Generation	0.62	940,000	21.3%

Top five renewable stations by generation in Queensland, 2009

Ranking	Power stations	Technology	Generation (MWh)	Generation growth on 2008
1	Kareeya	Hydro	476,000	-4%
2	Barron Gorge	Hydro	258,000	-7%
3	Pioneer Mill	Bagasse co-generation	240,000	19%
4	Rocky Point Sugar Mill	Wood waste, bagasse	165,000	22%
5	Invicta Mill	Bagasse co-generation	134,000	-11%

SOUTH AUSTRALIA

South Australia's fossil fuel power stations produced 8.9 million tonnes of greenhouse pollution in 2009. This was a decrease of 7.5 per cent from the previous year, the second year in a row that South Australia's fossil fuel emissions have fallen by this magnitude. Fossil fuels accounted for 83 per cent of electricity generation in the state, with the decrease in emissions primarily the result of an 11.5 per cent reduction in gas-fired generation.

Electricity produced in South Australia was the second least carbon intensive of the five states, with its carbon intensity decreasing by 4.5 per cent to 0.64 tonnes of greenhouse gases per MWh of electricity. This was due to substantial increases in renewable energy production in the state and the decline in generation from fossil fuels.

Northern Power Station, one of two coal-fired power stations in South Australia, produced the single largest volume of emissions in 2009 in South Australia. Producing 3.3 million tonnes of greenhouse gases, it was South Australia's only power station in the top 20 emitters across all five states. Playford B power station, the state's only other major coal-fired generator, was once again the most carbon intensive of any of the five major states on a generation basis². It has an emissions intensity of 1.38 tonnes per MWh, just above that of Victoria's Hazelwood power station. This is due to a combination of poor thermal efficiency and the low energy-to-carbon ratio of the coal that fuels the station.

These two coal-fired power stations accounted for more than 50 per cent of South Australia's emissions, despite providing just 33 per cent of the state's electricity. Nine gas-fired generators make up the remaining 50 per cent. In 2009, Pelican Point power station produced the largest volume of greenhouse gases of any gas-fired power station across all five states, but with a comparatively efficient emissions intensity of 0.51 tonnes of greenhouse gases per MWh. Torrens Island power station B, however, generated almost as much energy as Pelican Point but with the highest greenhouse gas intensity in Australia for a large gas-fired power station – reaching nearly 0.80 tonnes per MWh.

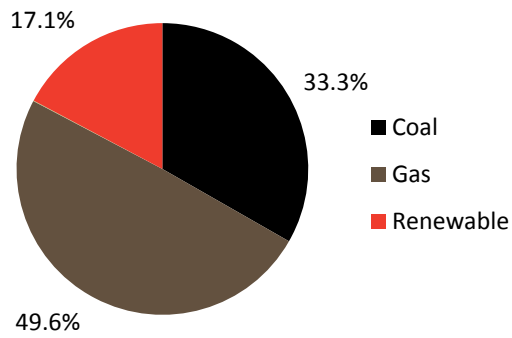
Renewable sources in South Australia produced 2.4 million MWh in 2009, a growth of 25 per cent on 2008. Renewable generation accounted for 17 per cent of total electricity generation in South Australia, the second largest proportion of renewable generation among the five states. The increase in renewable generation was entirely due a rise of 26 per cent in electricity produced from wind power, which generated 2.3 million MWh in 2009 and accounted for 97 per cent of the state's total renewable energy. South Australia produced more wind power than any other state in 2009, with its share of total wind across the five states at 56 per cent.

² On a 'sent out' basis, Hazelwood is slightly more emissions intensive than Playford B

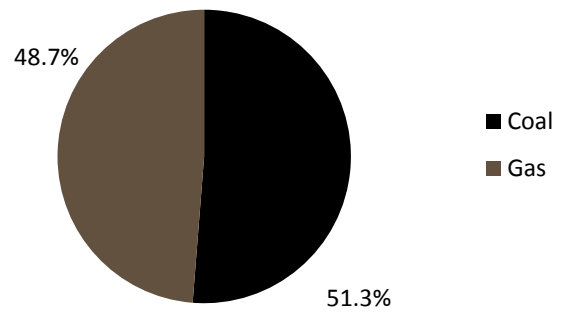
SOUTH AUSTRALIA: TABLES AND GRAPHS

Electricity generation and emissions in South Australia, 2009

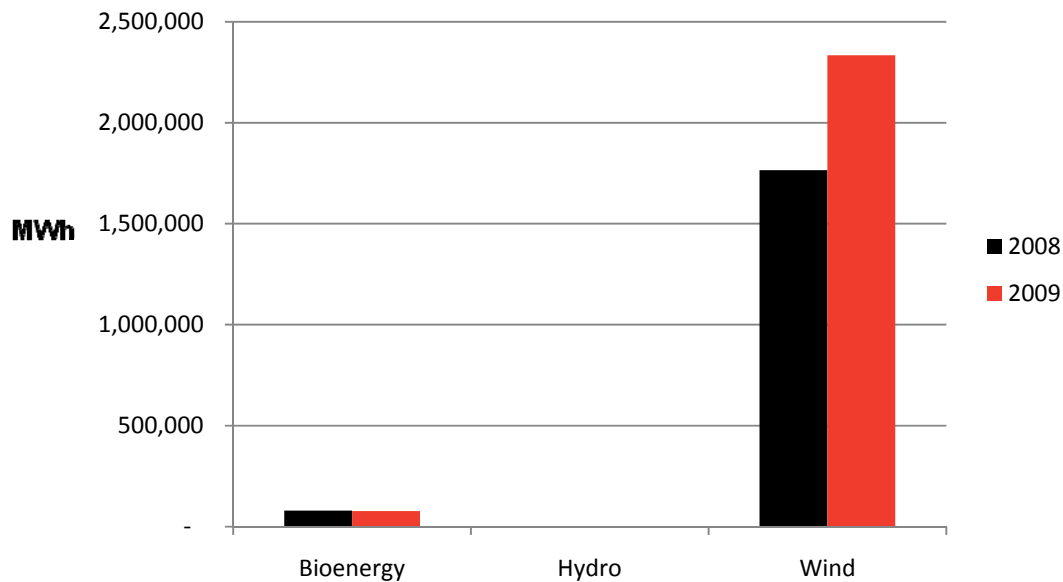
Combined electricity generation by fuel source



Combined emissions by fuel source



South Australia's renewable generation by sector in 2008 & 2009



South Australia's emissions and generation by sector in 2009

Sector	Emissions (million tonnes CO ₂ e)	Generation (MWh)	Generation growth on 2008	Emissions growth on 2008
Coal-fired generation	4.59	4,655,000	-2.8%	-0.9%
Gas-fired generation	4.36	6,917,000	-11.5%	-13.6%
Renewable generation	0	2,385,000	30.7%	0

Top five power stations by emissions in South Australia, 2009

Ranking	Power Station	Fuel	Emissions (million tonnes CO ₂ e)	Generation (MWh)	Generation/emissions growth on 2008	Emissions Intensity (tCO ₂ e / MWh)
1	Northern Power Station	Coal	3.35	3,754,000	-7.2%	0.89
2	Pelican Point Power Station	Gas	1.63	3,165,000	-3.9%	0.51
3	Torrens Island Power Station B	Gas	1.46	1,837,000	-19.9%	0.80
4	Playford B Power Station	Coal	1.24	901,000	21.4%	1.38
5	Osborne Power Station	Gas	0.68	1,194,000	-7.3%	0.57

Top five renewable stations by generation in South Australia, 2009

Ranking	Power stations	Technology	Generation (MWh)	Generation growth on 2008
1	Snowtown Wind Farm*	Wind	370,000	90%
2	Hallett Wind Farm	Wind	356,000	37%
3	Lake Bonney Wind Farm Stage 2	Wind	331,000	-11%
4	Wattle Point Wind farm	Wind	246,000	-8%
5	Lake Bonney Wind Farm Stage 1	Wind	195,000	-2.4%

*Snowtown commissioned in November 2008

TASMANIA

Total greenhouse gas emissions from Tasmania's power stations were 0.4 million tonnes in 2009, or 0.2 per cent of total emissions from the five states. This represents a decline of 36 per cent from the previous year, due to a reduction in gas-fired generation and a concomitant increase in renewable power station output. Despite producing only 0.2 per cent of emissions across the states, Tasmania produced 4.2 per cent of the electricity.

These figures are reflected in the extremely low emissions intensity of Tasmania compared with all other states. After a decline of 38 per cent from the previous year, Tasmania produced less than 0.05 tonnes of greenhouse gases per MWh of electricity generated in 2009 – a figure more than 18 times less than the five-state average.

This low emissions intensity is the result of Tasmania's extensive use of renewable energy sources and minor use of gas. Tasmania is home to four gas-fired power stations, producing a total of 9 per cent of Tasmania's electricity with 0.83 million MWh generated. This figure is 24 per cent lower than in 2008.

The Tamar Valley Combined Cycle gas station was the primary contributor to gas-fired generation in 2009 at 0.44 million MWh. Combined cycle gas-fired power stations are thermally efficient, giving the Tamar Valley generator an emissions intensity of less than 0.42 tonnes per MWh (approximately half the intensity of South Australia's Torrens Island B gas-fired power station) and total emissions of just 0.18 million tonnes of greenhouse gases.

The remaining 91 per cent of electricity was produced from renewable sources. Within Tasmania's borders are 12 of the top 20 renewable generators, all of which are hydroelectric. The largest in 2009 was the Reece power station, producing more than 1 million MWh or 12 per cent of Tasmania's total electricity generation. This was followed by the Catagunya, Liapootah and Wayatinah hydro stations (these stations report combined generation through the grid), then John Butters, Gordon and Tarraleah hydro stations. Hydro power stations supply 94 per cent of Tasmania's renewable energy.

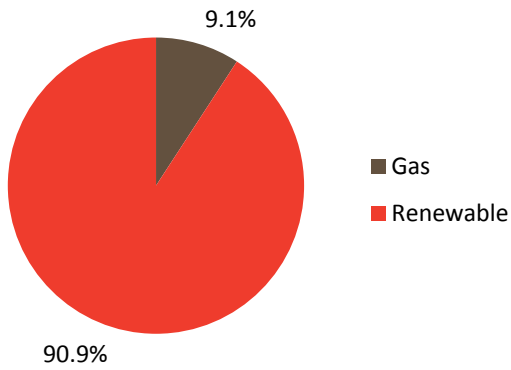
A lack of new sites for hydroelectric dams limits growth in this energy sector, but generation can increase or decline with efficiency improvements or changes in rainfall. In 2009, hydroelectric generation increased by 12 per cent, adding almost 0.8 million MWh on the previous year.

Wind power produced 0.48 million MWh in 2009, growing by 8 per cent from the previous year. This represents 6 per cent of Tasmania's total renewable energy for 2009.

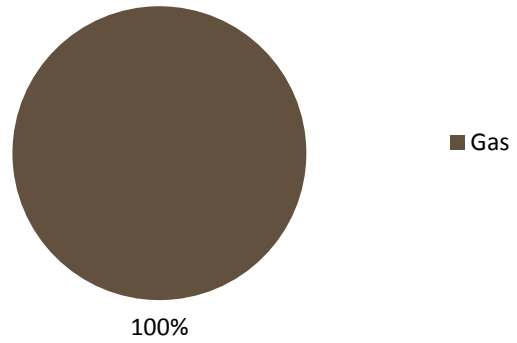
TASMANIA: TABLES AND GRAPHS

Electricity generation and emissions in Tasmania, 2009

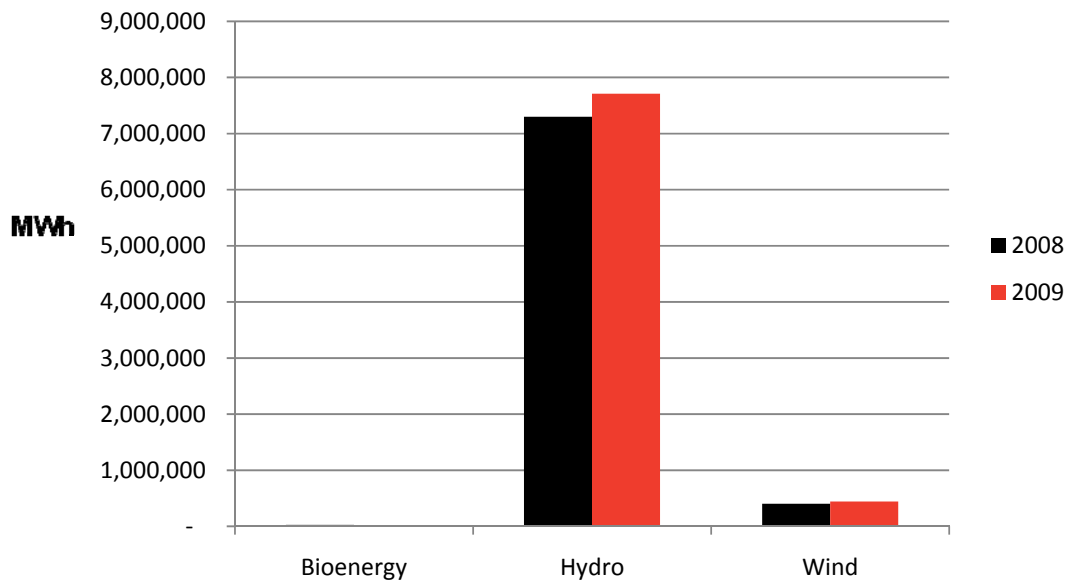
Combined electricity generation by fuel source



Combined emissions by fuel source



Tasmania's renewable generation by sector in 2008 & 2009



Tasmania's emissions and generation by sector in 2009

Sector	Emissions (million tonnes CO ₂ e)	Generation (MWh)	Generation growth on 2008	Emissions growth on 2008
Gas-fired generation	424,543	826,000	-24.2%	-36.4%
Renewable generation	0	8,202,000	5.7%	0

Top power stations* by emissions in Tasmania, 2009

Ranking	Power Station	Emissions (million tonnes CO ₂ e)	Generation (MWh)	Generation/ emissions growth on 2008	Emissions Intensity (tCO ₂ e / MWh)
1	Tamar Valley Combined Cycle Power Station**	0.18	443,000	New	0.41
2	Bell Bay Station	0.18	299,000	-71.8%	0.69
3	Tamar Valley Peaking Power Station***	0.05	76,000	New	0.69

*all gas-fired power stations

**Tamar Valley Combined Cycle commissioned in October 2009

***Tamar Valley Peaking Plant commissioned in June 2009

Top five renewable stations by generation in Tasmania, 2009

Ranking	Power stations	Technology	Generation (MWh)	Generation growth on 2008
1	Reece	Hydro	1,035,000	27%
2	Catagunya & Liapootah & Wayatinah	Hydro	866,000	19%
3	John Butters	Hydro	618,000	53%
4	Gordon	Hydro	575,000	-20%
5	Tarraleah	Hydro	568,000	16%

ANNEX 1: METHODOLOGY

As with the Weekly Greenhouse Indicator, this report uses actual data to determine the most accurate figure possible for electricity generation and the greenhouse gas emissions produced from all the power stations included.

The methodology for calculating weekly emissions from these fuels in Victoria, New South Wales, Queensland, South Australia and Tasmania is detailed below.

COAL

Emissions are calculated from the electricity generated by each coal-fired power station in the state using detailed market data from the National Electricity Market Management Company (NEMMCO). Emissions factors are based on the ACIL Tasman Report on NEM Generator Costs, prepared for Inter Regional Planning Committee (IRPC) and NEMMCO, 2010. Emissions data includes fugitive methane emissions released in the mining process.

NATURAL GAS

In Victoria, emissions are calculated using detailed gas market data from the Australian Energy Market Operator (AEMO), while in New South Wales, Queensland, South Australia and Tasmania, emissions are calculated using data from the National Gas Market Bulletin Board. The data on the gas bulletin board represents scheduled injections, while the Daily Gas Consumption data for Victoria represents gas withdrawals (i.e. end-use). The difference between methodologies only has a marginal impact on the end results. In both cases, emissions figures are based on the Department of Climate Change *June 2009 National Greenhouse Accounts (NGA) Factors*.

LIQUID FUEL

Emissions from electricity generation are calculated from the electricity generated from liquid fuel (i.e. diesel/distillate) power stations using detailed market data from the National Electricity Market Management Company (NEMMCO). Emissions factors are based on the ACIL Tasman, Report on NEM generator costs, prepared for Inter Regional Planning Committee (IRPC) and NEMMCO, 2010. Emissions only include direct emissions associated with the combustion of the fuel.

RENEWABLES

Generation from renewable energy is based on actual generation figures where available – i.e. for scheduled generators on the NEM. Generation from other power stations is estimated using data on Renewable Energy Certificate (REC) and Victorian REC (VREC) creation, ‘baselines’ for generators existing prior to the MRET scheme and marginal loss factors.

NOTES ON RENEWABLE CALCULATIONS:

- These calculations do not include auxiliary generation.
- For smaller renewable energy stations outlined in this report (i.e. those without scheduled generation), there may be an error margin of around five per cent due to transmission loss factors and other variables.
- For stations in which RECs have been used as part of the calculation, REC's created as of July 2010 have been used in these calculations.
- For renewable energy projects with no REC creation but with MRET baselines, electricity has been estimated at 50 per cent of their baseline generation (roughly 15 per cent of the renewable stations included).
- Renewable projects that are neither scheduled in the market, nor registered to create renewable energy certificates, are not included in these calculations. This accounts for a small number of stations with extremely low levels of generation.
- Generation from hydro pump storage has not been included in this report.

The Climate Group would like to acknowledge Green Energy Markets for its assistance in preparing this report.

For more information visit www.theclimategroup.org/indicator

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