

The heat goes on

Breakdowns at gas and coal plants in NSW, 2018

In 2018 there were 27 major breakdowns at gas and coal power stations in NSW. Every coal power station experienced at least one breakdown. The Tallawarra gas power station experienced three breakdowns. Aging plants Liddell and Vales Point experienced the most breakdowns.

Discussion paper

Mark Ogge

Bill Browne

Rod Campbell

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Level 1, Endeavour House, 1 Franklin St
Canberra, ACT 2601
Tel: (02) 61300530
Email: mail@tai.org.au
Website: www.tai.org.au
ISSN: 1836-9014

Summary

This year, The Australia Institute’s Gas & Coal Watch identified 27 major breakdowns at gas and coal power stations in New South Wales (NSW), each one removing hundreds of megawatts of capacity from the system, sometimes for hours at a time.

Gas and coal plants can break down in the heat, and older coal plants are particularly vulnerable. In addition, extreme heat drives high demand, meaning that the fossil fleet is most likely to break down at times when people need it most.

The breakdowns at coal and gas plants were not only at NSW’s old coal power plants, but also at the “state-of-the-art” Tallawarra plant, which is less than a decade old.

There were 24 breakdowns at black coal power plants and three at the Tallawarra gas plant. This is the equivalent of more than one breakdown every fortnight through the year.

NSW felt the consequences of unreliable gas and coal power in early June 2018, when three breakdowns at coal plants, combined with other outages at gas and coal plants to reduce gas and coal generation to less than half its registered capacity and push electricity prices up to 24 times higher than average.

Figure 1: Overall breakdowns (NSW, 2018)

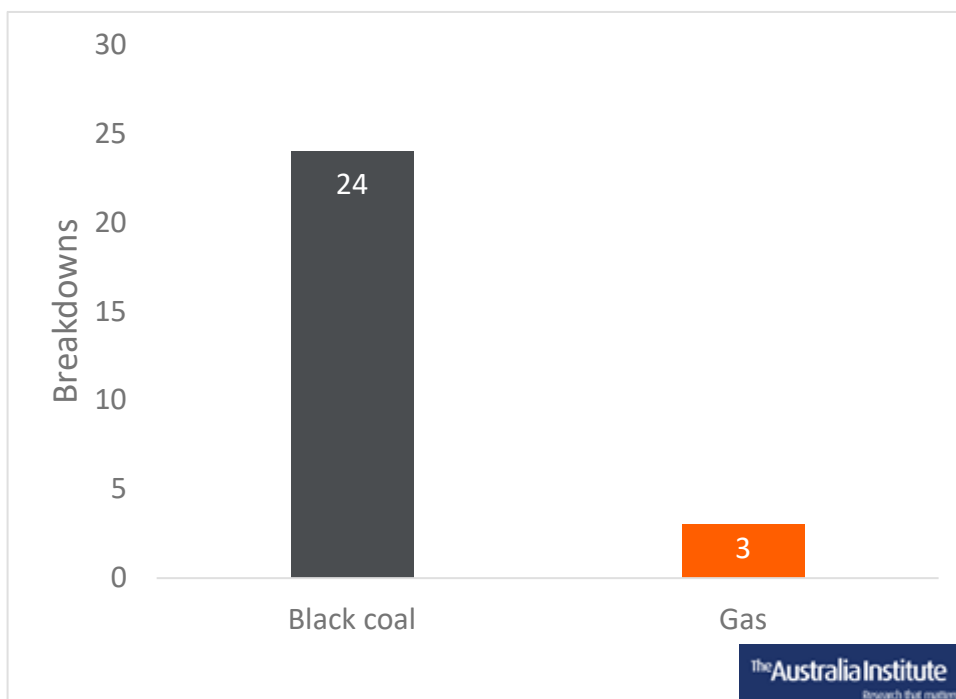


Figure 2: Breakdowns per GW of capacity (NSW, 2018)

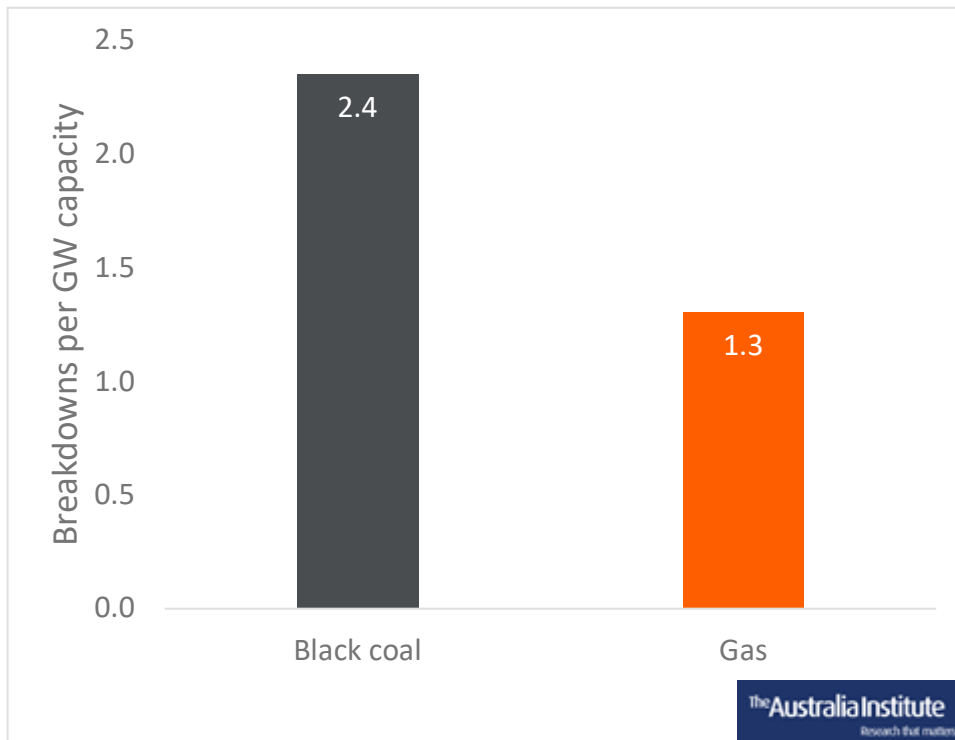


Table 1: Breakdowns by fossil fuel type, share of capacity

Group	Capacity	Share of NSW	Breakdowns	Share of breakdowns	Breakdowns per GW
Black coal	10.2 GW	60%	24	89%	2.4
Gas	2.3 GW	14%	3	11%	1.3
Fossil fuels	12.5 GW	74%	27		2.2
NSW capacity	17.0 GW				



Note: The remaining capacity in NSW is mostly from renewables.

Introduction

The Australia Institute founded Gas & Coal Watch in December 2017 to monitor the National Energy Market's fossil fuel power plants for breakdowns, particularly during high heat when generating units are vulnerable.

This report summarises the results for NSW from Gas & Coal Watch between 1 January and 31 December 2018. It identifies 27 breakdowns, including 25 unit trips. A unit trip is one of a power plant's generating units being taken off the grid suddenly (and typically without warning). Two breakdowns in 2018 were in the form of sharp, sudden decreases in electricity output that did not involve a unit being taken totally offline.

Three-quarters of NSW's electricity generation capacity consists of fossil fuel generators: five black coal plants and five main gas plants.¹

The heat particularly affects thermal electricity generation because the efficiency of thermal generation depends on temperature extremes between input and output. Closed-system generators typically use water for cooling, and during periods of extreme heat power stations can fail if the water from the cooling tower is too warm, if access to water is limited, or if the discharged water being pumped out of the cooling tower is too hot.² About two-thirds (65 per cent) of generating capacity in the NEM depends on water for cooling coal and gas fired power stations.³ Air-cooled plants are less efficient overall, and lose efficiency in the heat.

As global warming results in more hot days, this vulnerability exacerbates. This is compounded by increased demand for electricity on hot days.

¹ There is about 0.3 GW of gas generation not covered by the nameplate capacity of the five main gas plants: AEMO (2018) *Generation Information Page*, <https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Generation-information>

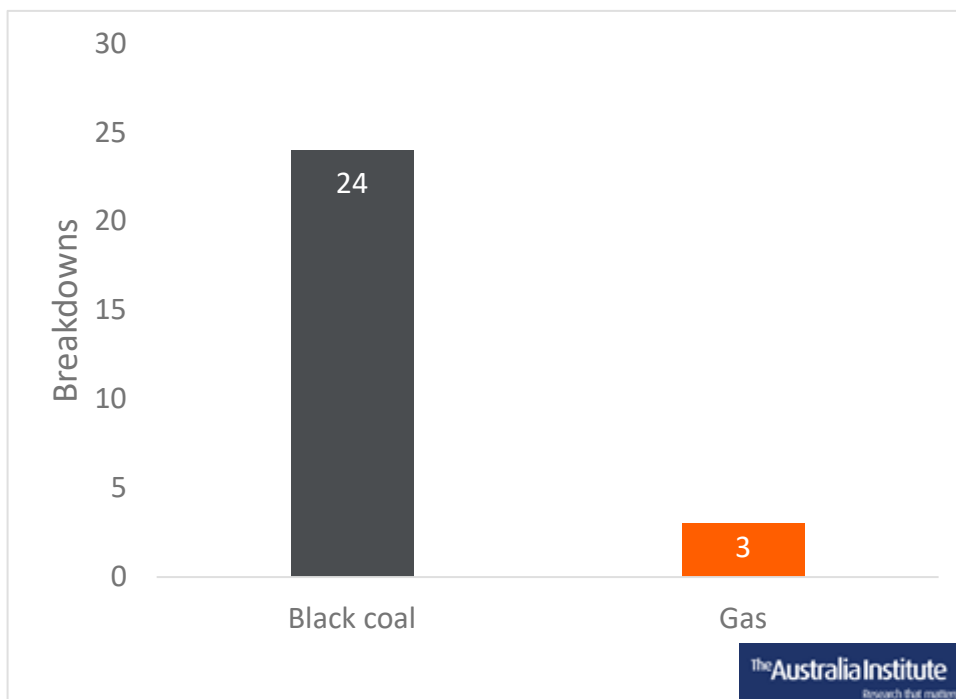
² Union of Concerned Scientists (2011) *Energy and Water in a Warming World: Freshwater Use by US power plants*, http://www.ucsusa.org/clean_energy/our-energy-choices/energy-and-water-use/freshwater-use-by-us-power-plants.html#.WfEcCohx3IU

³ Smart and Aspinall (2009) *Water and the electricity generation industry*, Australian Water Commission

Overall breakdowns

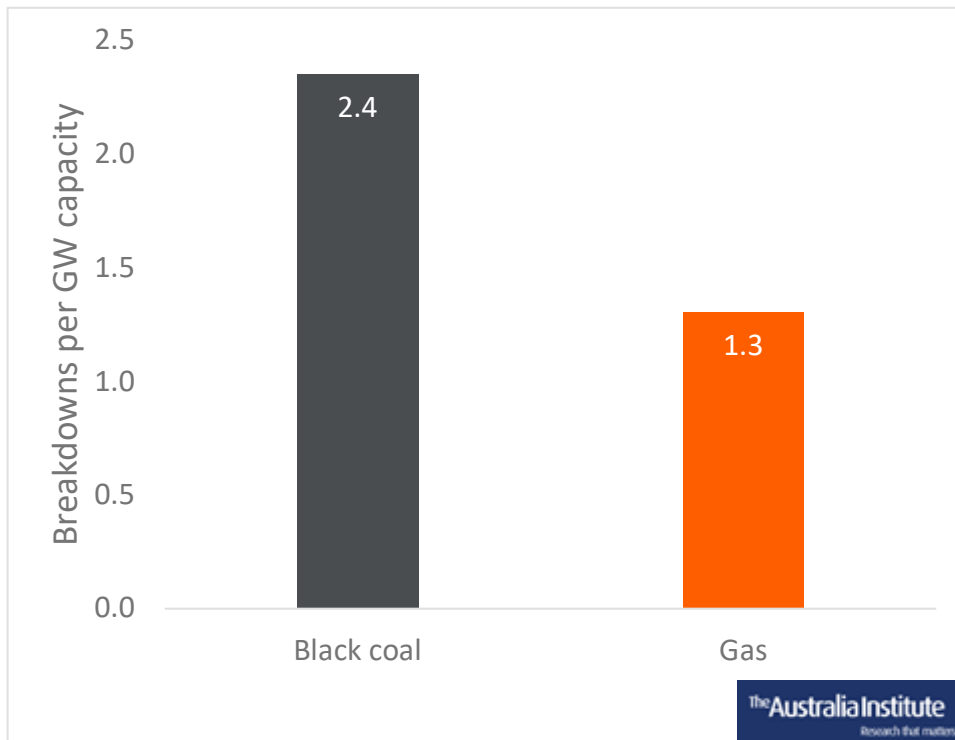
Black coal was the worst performer in NSW, breaking down 21 times in 2018. The Tallawarra gas plant was the only gas plant to break down – but it broke down three times. Together, this represents a gas or coal breakdown more than once a fortnight through the year 2018.

Figure 3: Overall breakdowns (NSW, 2018)



Absolute figures can be misleading, because black coal in NSW contributes more than five times the capacity of gas. Taking capacity into account, black coal still performed worse, with 2.1 breakdowns per GW of capacity. Gas had 1.3 breakdowns per GW capacity.

Figure 4: Breakdowns per GW of capacity (NSW, 2018)



The table below shows the full details of breakdowns by fossil fuel group and share of capacity.

Table 2: Breakdowns by fossil fuel type, share of capacity

Group	Capacity	Share of NSW	Breakdowns	Share of breakdowns	Breakdowns per GW
Black coal	10.2 GW	60%	24	89%	2.4
Gas	2.3 GW	14%	3	11%	1.3
Fossil fuels	12.5 GW	74%	27		2.2
NSW capacity	17.0 GW				



Note: The remaining capacity in NSW is mostly from renewables.

Coal

Australia's 16 coal plants are responsible for almost half (48%) of the NEM's capacity, or 30 GW. Coal is even more overrepresented in NSW, where it consists of 60% of generation capacity to gas' 14%.

Table 3 shows breakdowns at each NSW coal power station during 2018. All coal plants experienced breakdowns.

Table 3: Coal power station breakdowns, NSW 2018

Name	Breakdowns	Capacity (MW)	Breakdowns per GW capacity
Bayswater	3	2,640	1.1
Eraring	4	2,880	1.4
Liddell	11	2,000	5.5
Mt Piper	1	1,320	0.8
Vales Point	5	1,320	3.8
Total	21	10,160	

Liddell and Vales Point experienced the most breakdowns (11 and five respectively) and the most breakdowns per GW of capacity (5.5 and 3.8 respectively). They are also the two plants that federal politicians have proposed extending beyond their normal operating life.

In late 2017, then Prime Minister Malcolm Turnbull called on AGL to keep the aging Liddell Power Station open.⁴ Then Treasurer Scott Morrison, now Prime Minister, had said earlier that it was "very important" to keep Liddell open.⁵ Former Prime Minister Tony Abbott said that the government should compulsorily acquire Liddell as part of plans to keep it open.⁶ After the change in Prime Minister to Scott Morrison, new Energy Minister Angus Taylor warned that the Federal Government might force AGL to

⁴ Yaxley and Lowrey (2017) *Malcolm Turnbull in talks with AGL to keep Liddell coal power station operating beyond 2022*, <https://www.abc.net.au/news/2017-09-05/turnbull-in-talks-with-agl-keep-liddell-coal-power-station-open/8874874>

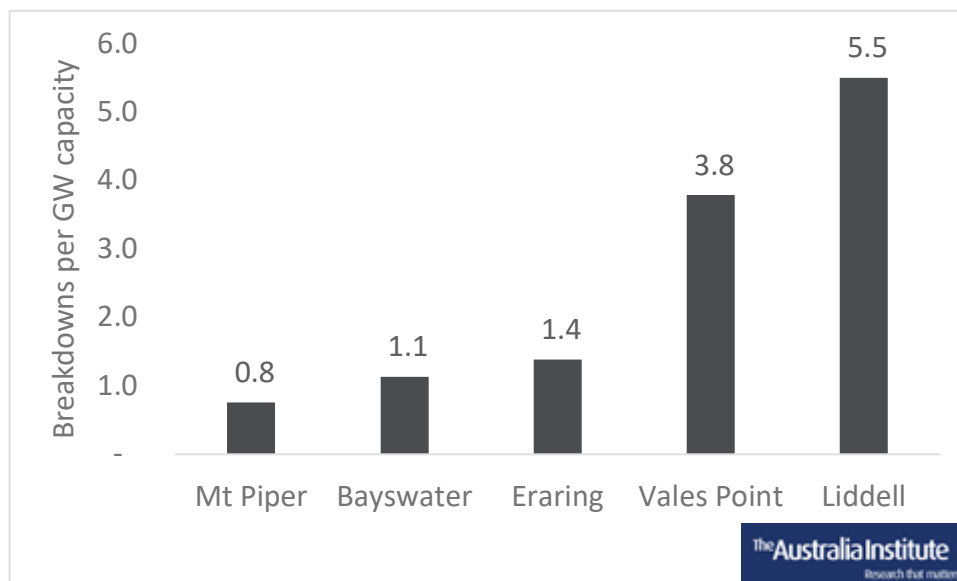
⁵ Slezak and Knaus (2017) *Liddell power station: five extra years could give government \$1bn rehab bill*, <https://www.theguardian.com/australia-news/2017/sep/08/liddell-power-station-five-extra-years-could-give-government-1bn-rehab-bill>; Grattan (2017) *Government leans on AGL over Liddell ahead of meeting*, <https://theconversation.com/government-leans-on-agl-over-liddell-ahead-of-meeting-83778>

⁶ Murphy (2018) *AGL rejects Alinta's bid for Liddell power plant, confirming its closure*, <https://www.theguardian.com/australia-news/2018/may/21/agl-rejects-alintas-bid-for-liddell-power-plant-confirming-its-closure>

sell Liddell to prevent its closure.⁷ Despite changes in its executive, AGL has consistently said that it will close Liddell in 2022.⁸

Owner Delta Electricity is considering extending the life of Vales Point by 20 years, from its current closure date of 2029 to the early 2030s or even 2049.⁹ Energy insiders speculate that it would be the likely target of a government-underwriting proposal.¹⁰

Figure 5: Breakdowns per GW capacity, by plant



Liddell and Vales Point are also the oldest coal plants in NSW, with their current generators being commissioned in 1971 (for Liddell) and 1978 (for Vales Point). There is a clear trend with the older plants experiencing more breakdowns (per GW capacity) than the newer plants.

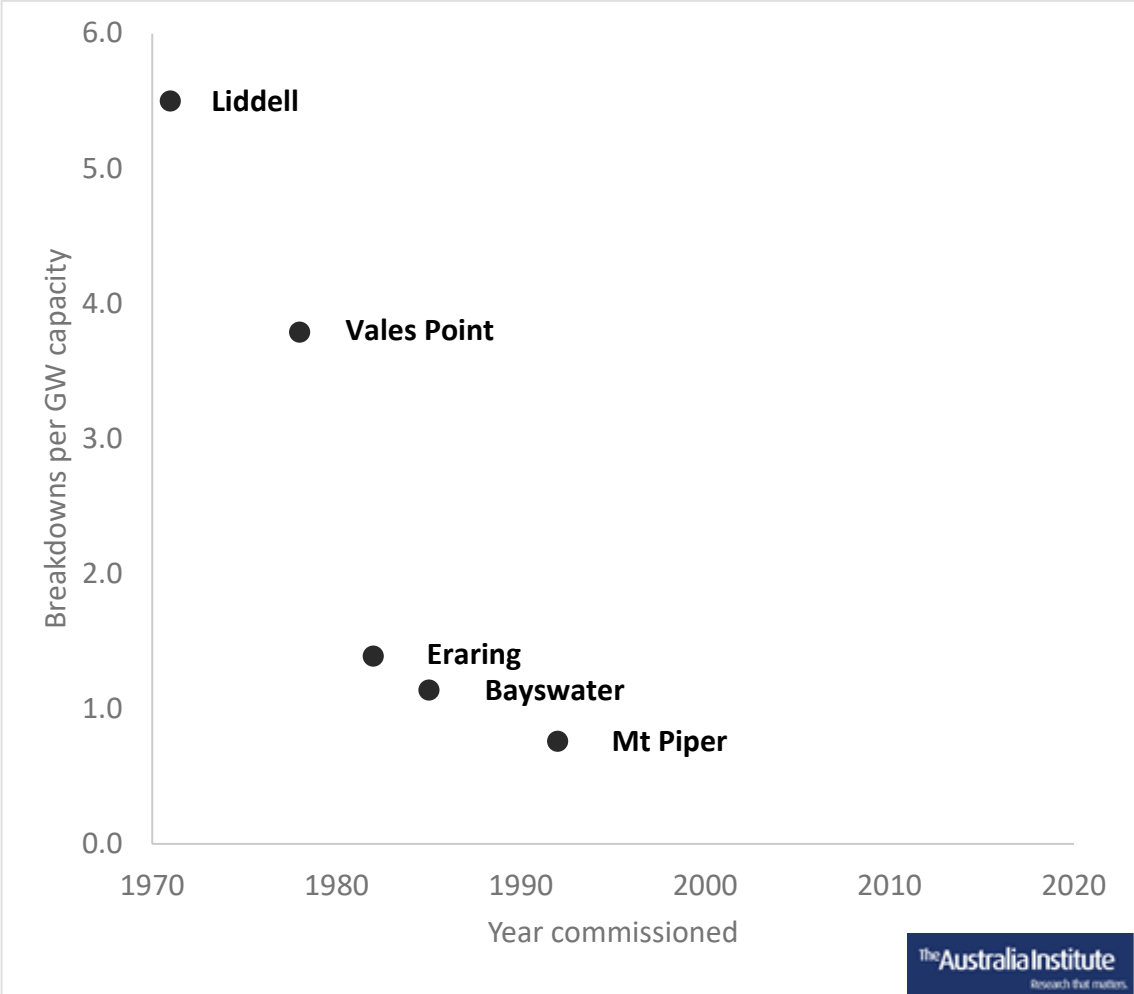
⁷ McCarthy (2018) *The power station offloaded by the NSW Government for \$1 million suddenly has a future*, <https://www.theherald.com.au/story/5632203/powering-on-delta-electricitys-plan-for-a-70-year-old-vales-point-power-station/>

⁸ Latimer (2018) *AGL says it remains committed to closing Liddell power plant in 2022*, <https://www.smh.com.au/business/companies/agl-tells-shareholders-it-will-close-liddell-power-plant-in-2022-20180926-p50633.html>

⁹ McCarthy (2018) *The power station offloaded by the NSW Government for \$1 million suddenly has a future*, <https://www.theherald.com.au/story/5632203/powering-on-delta-electricitys-plan-for-a-70-year-old-vales-point-power-station/>; Latimer (2018) *Power grab: Rich lister eyes partner's share in coal power station*, <https://www.smh.com.au/business/companies/power-grab-rich-lister-eyes-partner-s-share-in-coal-power-station-20180703-p4zp7r.html>

¹⁰ Murphy (2018) *Underwriting coal power exposes taxpayers to billions, industry group says*, <https://www.theguardian.com/australia-news/2018/nov/16/underwriting-coal-power-exposes-taxpayers-to-billions-industry-group-says>

Figure 6: Breakdowns at coal plants by age



Gas

About 40 gas plants in NSW, Victoria, Queensland, SA and Tasmania contribute 11.6 GW to the NEM, 24.0% of its total generation capacity.¹¹ Gas provides a smaller share of NSW capacity, just 14%.

In 2018, one gas plant – Tallawarra – experienced three breakdowns. Since the other gas plants did not experience breakdowns, this means gas in NSW experienced fewer breakdowns than coal by plant and by capacity.

However, Tallawarra’s breakdowns make it the least reliable plant in NSW, with 7.1 breakdowns per GW of capacity – greater than Liddell’s 5.5 or Vales Point’s 3.8.

Described as “state-of-the-art” with “fast-start capability”, the Tallawarra plant was only commissioned in 2009.¹² Tallawarra uses the new Combined Cycle Gas Turbine (CCGT) technology that allows it to be used for bulk electricity supply as well as dispatchable energy.

As well as failing three times this year, Tallawarra failed in Summer 2016–17 with dramatic consequences outlined in our report *Can’t stand the heat*.¹³

Table 4: Gas power station breakdowns, NSW 2018

Name	Breakdowns	Capacity (MW)	Breakdowns per GW capacity
Tallawarra	3	420	7.1

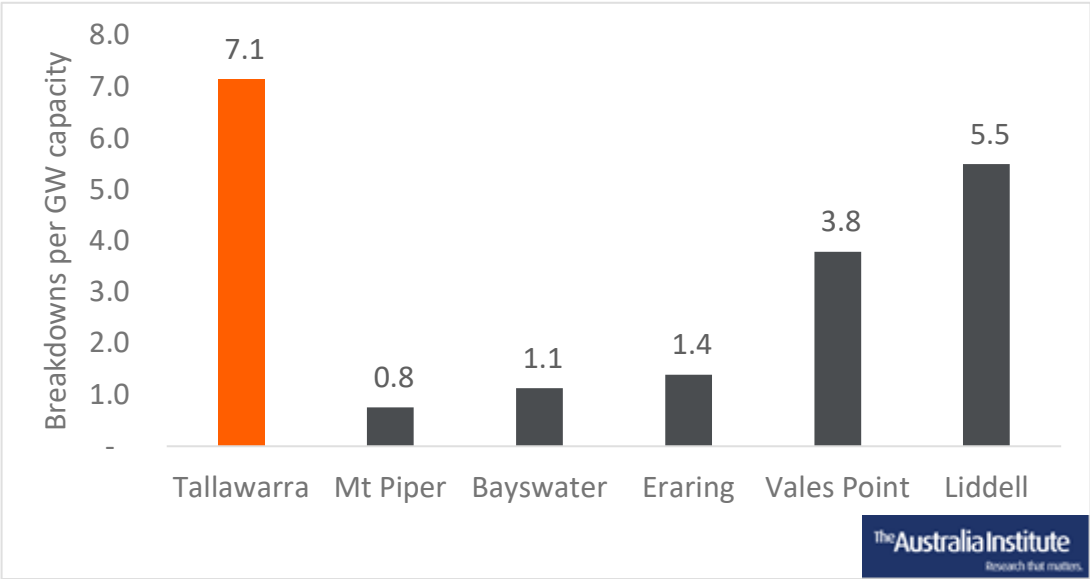
Note: This table only shows the gas station that had a breakdown. There are about five gas stations in NSW, depending on classification.

¹¹ Total NEM coal capacity 22,916 MW minus Victorian brown coal capacity 4,630 MW = 18,286 MW. Total existing generation capacity is 48,352 MW. AEMO (2018) *Generation Information Page*, <https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Generation-information>

¹² Energy Australia website, Tallawarra Power Station, Accessed 23/04/18, <https://www.energyaustralia.com.au/about-us/energy-generation/tallawarra-power-station>

¹³ Ogge (2017) *Can’t stand the heat*, <http://www.tai.org.au/content/coal-and-gas-reliability-liability-heat-report>

Figure 7: Breakdowns per GW capacity, by plant – including Tallawarra



June 2018 electricity shortage

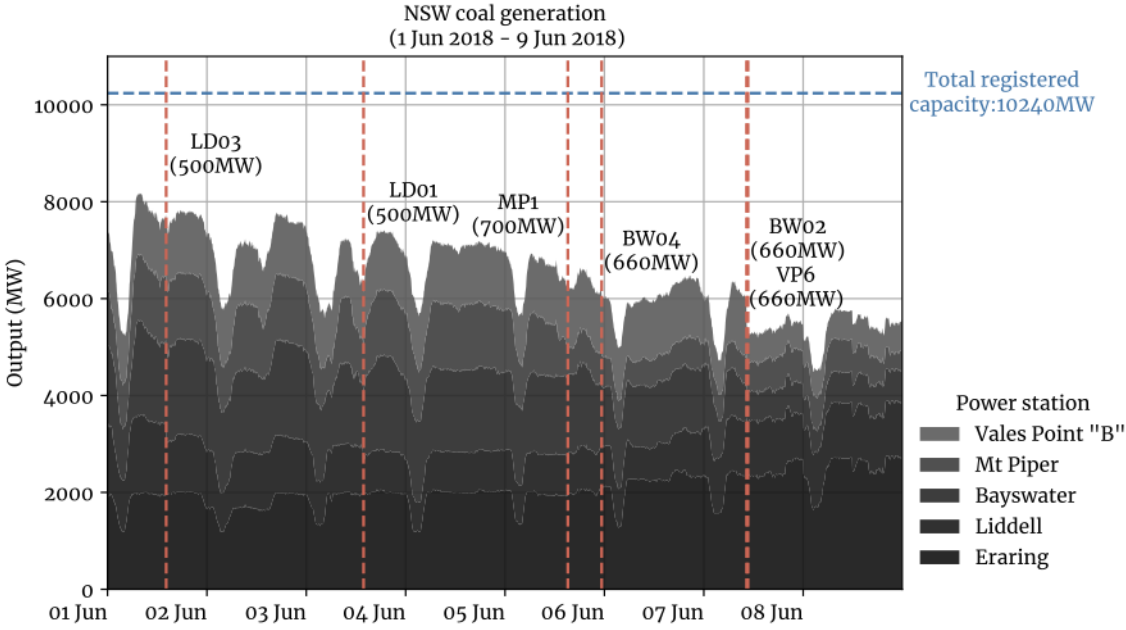
In early June 2018, New South Wales experienced what some commentators described as an “energy crisis”. An otherwise unremarkable and mild week in winter saw coal output drop steeply and wholesale electricity prices exceed \$2,400 per MW h five times.

In the four days 5th to 8th June, up to 52% (6.4 GW) of the state’s gas and coal generation capacity was idle or unavailable following a number of scheduled and unscheduled outages (i.e., breakdowns), including up to 48% (4.8 GW) of coal generation capacity.

A series of unresolved breakdowns at Liddell and Vales Point coal power stations were primarily responsible. Figure 8 demonstrates the outages that – between them – took coal output from around 8 GW (80% of registered capacity) to a low of 5.3 GW (52% of registered capacity). These include unit trips at Liddell (1 June, 3 June) and Vales Point (7 June), as well as scheduled outages at other plants. Figure 9 shows the five peaks where prices exceeded \$2,400 per MW h. The average price per MW h for NSW in June was \$101.¹⁴

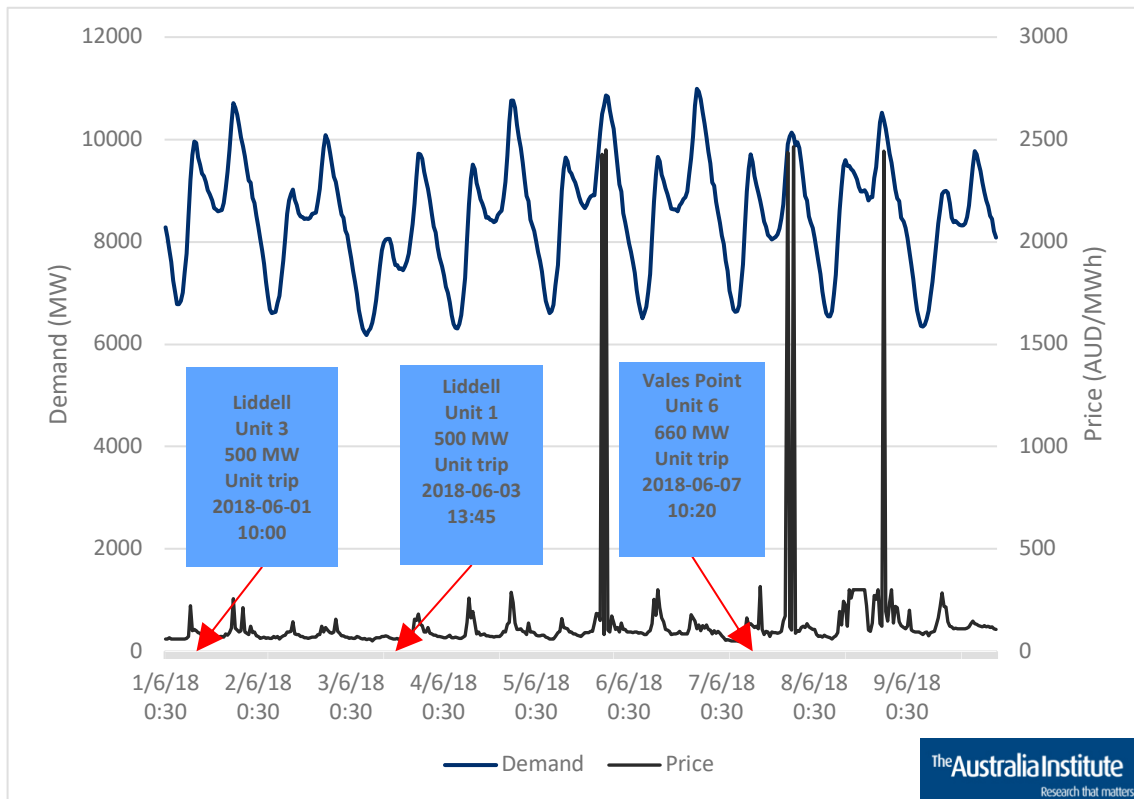
¹⁴ Australian Energy Market Operator (2019) *Data Dashboard*,
<https://aemo.com.au/Electricity/National-Electricity-Market-NEM/Data-dashboard>

Figure 8: NSW coal generation, 1–9 June 2018



Source: OpenNEM

Figure 9: NSW demand, price and coal breakdowns, 1–6 June 2018



Source: OpenNEM

During the 7:00–7:30pm price peak on the 7th of July, gas and coal output was at its lowest ebb in the week: only 48% of nameplate capacity. Colongra and Tallawarra gas plants were outputting no electricity, and black coal plants Bayswater, Liddell, Mt Piper and Vales Point were all operating well below capacity.

Table 5: Output from NSW gas and coal generators June 7, 2018, 19:00-19:30

Power Station	Technology	Registered Capacity (MW)	Average Output (MW)	Difference (MW)
Bayswater	Black coal	2,640	649.7	1,990
Colongra	Gas OCGT	724	0	724
Eraring	Black coal	2,880	2,370.0	510
Liddell	Black coal	2,000	1,132.5	868
Mt Piper	Black coal	1,400	676.7	723
Smithfield Energy Facility	Gas CCGT	170.9	108.4	63
Tallawarra	Gas CCGT	440	0	440
Uranquinty	Gas OCGT	664	319.8	344
Vales Point "B"	Black coal	1,320	583.1	737
Total (gas)	<i>Gas</i>	<i>1,999</i>	<i>428.2</i>	<i>1,571</i>
Total (coal)	<i>Coal</i>	<i>10,240</i>	<i>5,412.1</i>	<i>4,828</i>
Total	<i>All</i>	<i>12,239</i>	<i>5,840.3</i>	<i>6,399</i>

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Source: OpenNEM

NSW's unreliable gas and coal plants contributed to a week of "energy crisis" in 2018 in which three breakdowns at coal plants combined with other outages to put half of all gas and coal out of operation.

The full details of the events of 5–8 June 2018 are reported in The Australia Institute's *Coalapse* report, released September 2018.¹⁵

¹⁵ Ogge (2018) *Coalapse! The New South Wales winter "energy crisis,"*
<http://www.tai.org.au/content/coalapse-new-south-wales-winter-energy-crisis>

Conclusion

Gas and coal power stations broke down more than once a fortnight on average in 2018. Coal plants broke down more often than gas plants, with the two oldest plants – Liddell and Vales Point – breaking down the most. These are the plants that politicians have proposed keeping open beyond their scheduled closure dates.

While gas outperformed coal overall, the “state-of-the-art” Tallawarra plant is the single worst performing plant in NSW, with 7.1 breakdowns per GW of capacity – more than Liddell or Vales Point.

Tallawarra was out of action in the first week of June 2018, as were multiple units at NSW’s coal plants, when NSW experienced an “energy crisis” with multiple electricity price peaks and gas and coal output dropping below 50% of its capacity.

Gas and coal have been tested, and they have been found wanting. As climate change worsens, there will be more heatwaves, putting more pressure on fossil fuel generation.

If NSW is to have reliable electricity generation, heat-sensitive gas and coal plants should be phased out in favour of renewable energy and storage.