

# Fossil fails in the Smart State

## Gas and coal power plant breakdowns in Victoria

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*Victorian brown coal-fired power plants are some of the worst performing stations in the National Electricity Market. With hot and dry conditions forecast for the rest of this summer, Victoria is at risk of further breakdowns of aging coal generators, insufficient supply and blackouts.*

Discussion paper

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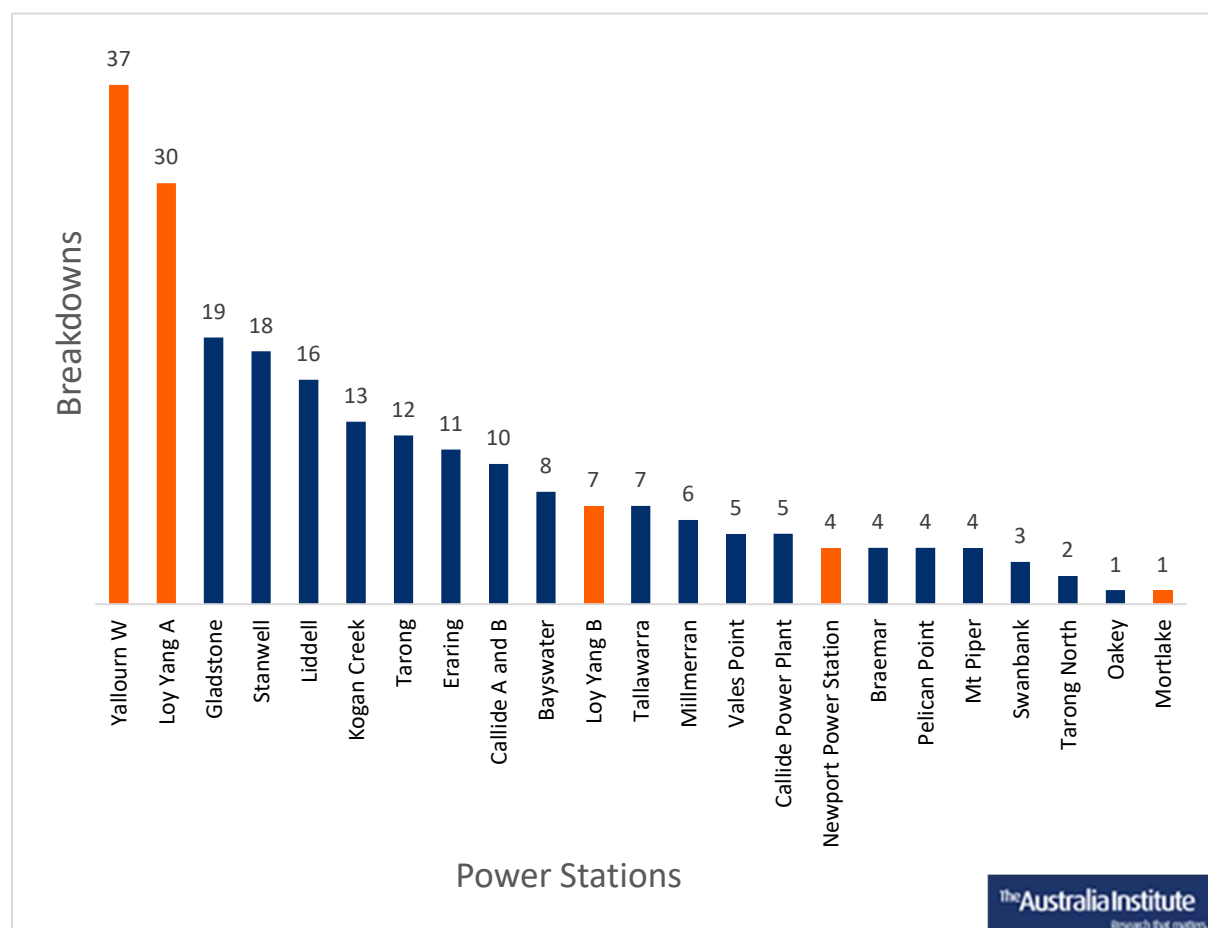
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# Summary

Victoria's ageing fleet of coal fired power stations are breaking down more often than power stations anywhere else in the National Energy Market (NEM). The Australia Institute's Gas & Coal Watch found over a two-year period from 13 December 2017 to 31 December 2019, Victorian gas and coal power plants broke down 79 times (see Figure 1). This represents a little more than one third of all breakdowns in the last two years (there were 227 total breakdowns in the NEM.)

**Figure 1: Breakdowns by power plant 13 Dec 2017- 31 Dec 2019 (Victorian plants in orange)**



Source: OpenNEM

The poor performance of Victoria's three brown coal power plants means Victorians suffer a disproportionately higher number of breakdowns compared to other states. Victorian gas and coal power plants make up 21% of NEM gas and coal capacity but deliver 35% of its gas and coal breakdowns.

Victoria hosts the two worst performing power plants in the entire NEM, 'Loy Yang A' and 'Yallourn W', suffering 67 breakdowns between them, on average almost three breakdowns a month. Each breakdown removed hundreds of megawatts of capacity from the system, sometimes for hours at a time.

Comparing the individual generation units across the NEM (noting there can be multiple units in a single power plant), Victorian gas and coal units account for over half the top 10 worst performing ones in the NEM.

The Australian Energy Market Operator has warned that Victoria may face summer reliability issues due to ageing brown coal units and extended outages at coal and gas fired generators. During 2019 there were two significant extended outages, at Loy Yang Unit 2 and gas-fired Mortlake power stations.

As the Victorian Government plans for the next decade of electricity generation, including achieving its 50% renewable energy target, it will need to take into account the unreliability of its current fleet of gas and coal power plants.

# Introduction

The Australia Institute founded Gas & Coal Watch in December 2017 to monitor the National Electricity Market's (NEM) fossil fuel power plants for breakdowns.

Gas & Coal Watch is based on a database of unit trips which have been identified and verified in collaboration with OpenNEM (<https://opennem.org.au/>).

A new “breakdown” is logged in Gas & Coal Watch when an unscheduled outage is identified by OpenNEM at a coal or gas unit in the National Electricity Market. Most coal and gas power plants consist of multiple units.

Unscheduled outages are either full unit trips where generation from a unit falls to zero or partial unit trips where generation from a unit drops significantly. Unscheduled outages are checked manually to confirm that the drop in generation is significant in absolute terms (currently a threshold of 100 Megawatts or above per unit is used) and relative terms (a judgement call based on the unit’s dispatch target).

The Australian Energy Market Operator (AEMO) also records unplanned outages. While its exact criteria are not known, they appear to be less conservative than those used by The Australia Institute.<sup>1</sup>

If multiple units at a plant experience an unscheduled outage, a separate breakdown is recorded for each unit in most cases. If there are partial unit trips across all units at a plant then these are recorded as a single breakdown for that plant.

This special report summarises the breakdowns at Victoria’s brown coal and gas power stations over the period 13 December 2017 to 31 December 2019 and compares them to the rest of the NEM.

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<sup>1</sup> AEMO (2019) *Network Outages*, <https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/nem-events-and-reports/network-outages>

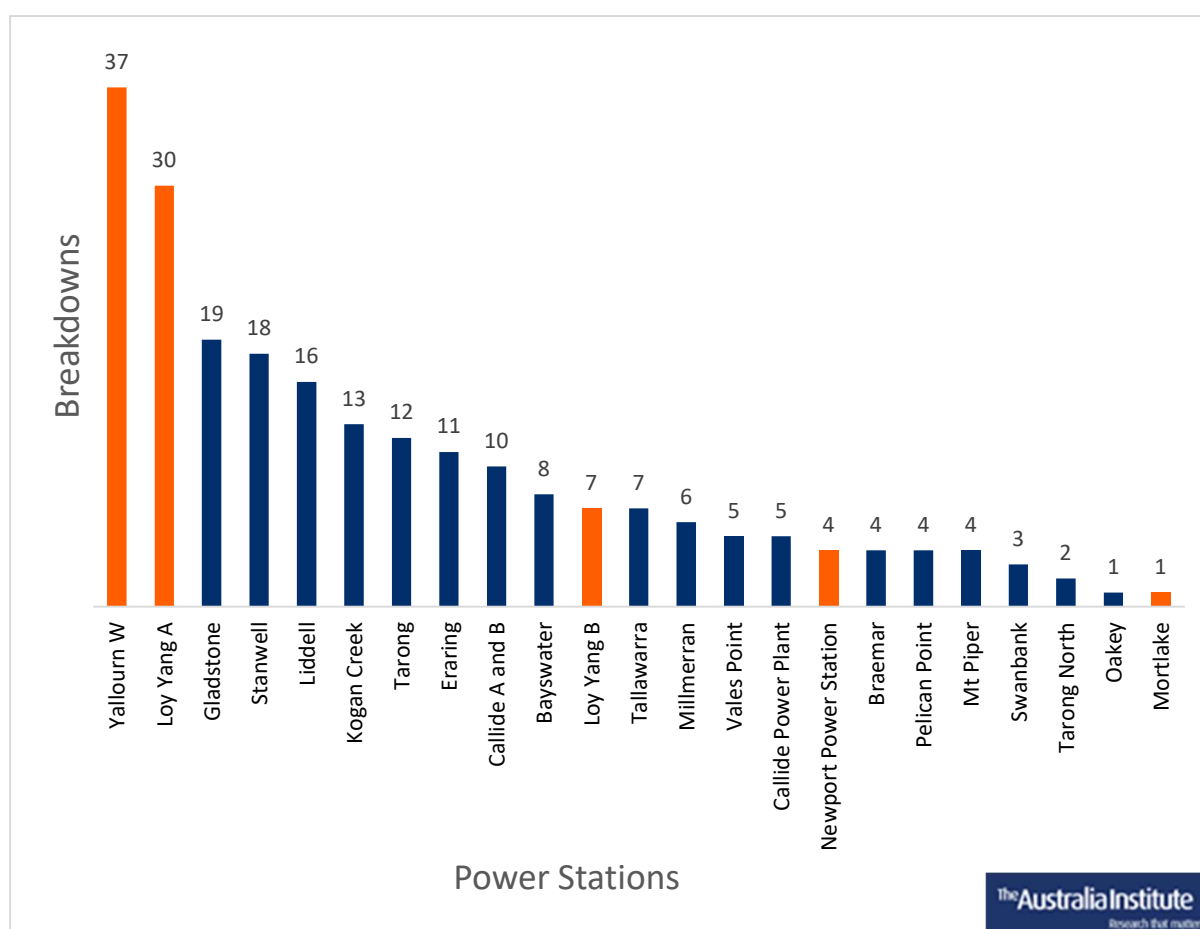
# Breakdowns

Since Gas & Coal Watch began monitoring in 13 December 2017 up to 31 December 2019, there have been 227 breakdowns at gas and coal plants. 79 were at Victorian gas and coal plants:

- 37 at Yallourn W (brown coal)
- 30 at Loy Yang A (brown coal)
- 7 at Loy Yang B (brown coal)
- 4 at Newport Power Station (gas)
- 1 at Mortlake Power Station (gas)

Loy Yang A and Yallourn W are the least reliable coal plants in the National Electricity Market (NEM) by number of breakdowns.

**Figure 2: Breakdowns by power plant 13 Dec 2017- 31 Dec 2019 (Victorian plants in orange)**



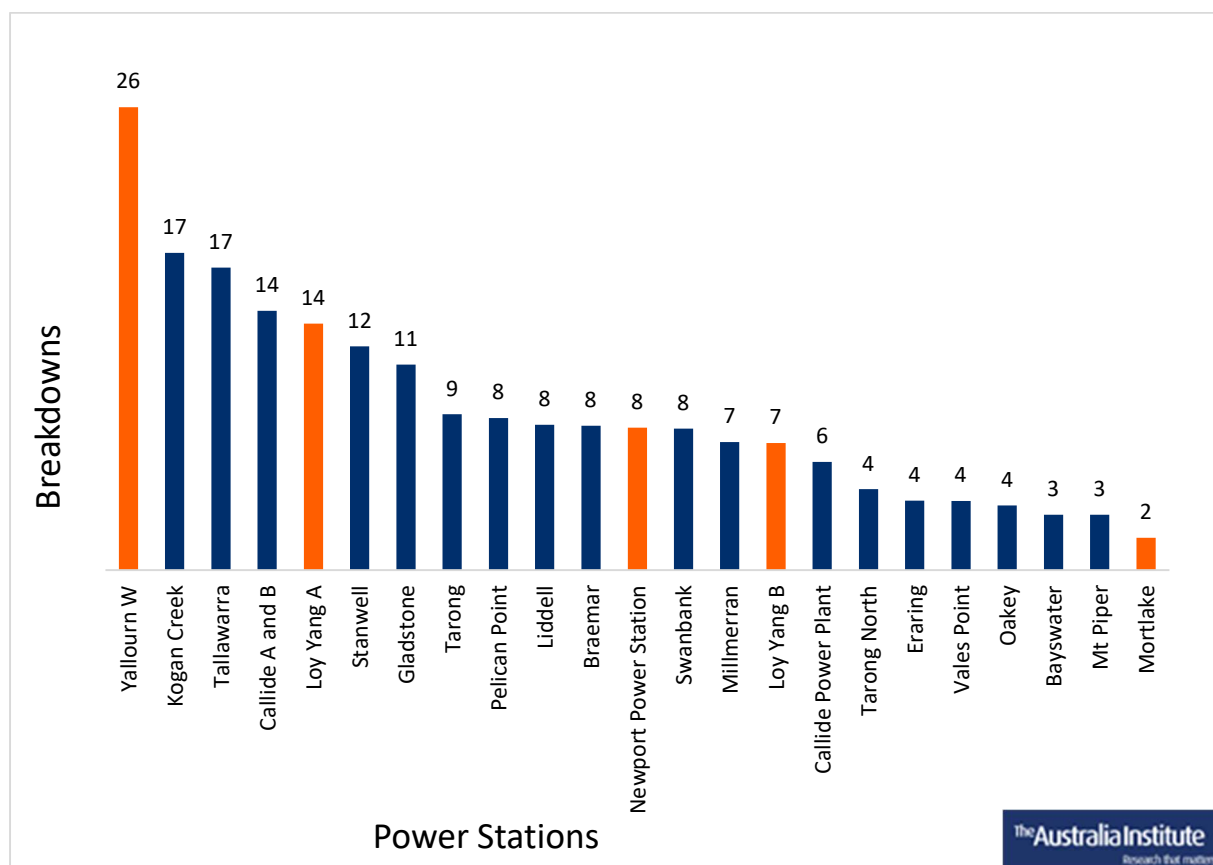
Source: OpenNEM

## BREAKDOWNS PER GW

The Australia Institute's Gas & Coal Watch also measure breakdowns by Gigawatt of capacity, to reflect that some plants are much larger than others.

- Yallourn W had 26 breakdowns per GW
- Loy Yang A had 14 breakdowns per GW
- Newport Power Station had 8 breakdowns per GW
- Loy Yang B had 7 breakdowns per GW
- Mortlake Power Station had 2 breakdowns per GW

**Figure 1: Breakdowns per Gigawatt, 13 December 2017- 31 December 2019 (Victorian plants in orange)**



Source: OpenNEM

## INDIVIDUAL UNITS

Gas & Coal Watch also measures breakdowns by individual unit. Victorian gas and coal units are 6 of the top 10 worst performing units (by number of breakdowns) in the NEM.

**Table 1: Worst performing units in the NEM by breakdowns, 13 December 2017- 31 December 2019**

Unit name	Place	Type	State	Breakdowns
Kogan Creek	Worst	Supercritical	Queensland	13
Yallourn W Unit 3	2 <sup>nd</sup>	Brown coal	Victoria	12
Yallourn W Unit 2	3 <sup>rd</sup>	Brown coal	Victoria	11
Loy Yang A Unit 2	4 <sup>th</sup>	Brown coal	Victoria	10
Loy Yang A Unit 1	5 <sup>th</sup>	Brown coal	Victoria	9
Stanwell Unit 4	6 <sup>th</sup>	Subcritical black	Queensland	8
Liddell Unit 2	7 <sup>th</sup>	Subcritical black	NSW	7
Yallourn W Unit 1	7 <sup>th</sup>	Brown coal	Victoria	7
Yallourn W Unit 4	7 <sup>th</sup>	Brown coal	Victoria	7
Callide B Unit 1	8 <sup>th</sup>	Subcritical black	Queensland	7

Source: OpenNEM



# Extended outages

## LOY YANG A

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Loy Yang A power station in the Latrobe Valley is the second worst performing power plant in the NEM by number of breakdowns, having experienced 30 breakdowns since December 2017. Loy Yang A Unit 2 is the fourth worst performing unit (see Table 1, above) despite being offline for 7 months and therefore unable to breakdown during that period.

Loy Yang A Unit 2 suffered an extended outage on 18 May 2019 following an electrical short (see Figure 4, below). The unit was expected to return to service before Christmas 2019. On 24 December the unit returned to service only to trip three days later, then remain offline due to “plant failure”.<sup>2</sup> The unit again returned to service on 20 January 2020.<sup>3</sup> It remains to be seen whether the unit will remain online without further disruption.

The long time frame required to repair the unit is largely a result of the unit’s unconventional history. The 500 MW turbine generator was originally intended to be used in the Newport gas power station. Plans for Newport power station were downgraded from a 1000 MW station comprised of two 500 MW generators, to a 500 MW single generator station, following air quality concerns. The left over generator was sent to Loy Yang A.

Loy Yang A power station is thus made up of three units manufactured by Kraftwerk Union and one unit manufactured by Brown Boveri Corp. The station carries back-up equipment suitable for the three Kraftwerk Union manufactured units, but not for Unit 2, the Brown Boveri Corp manufactured unit.<sup>4</sup>

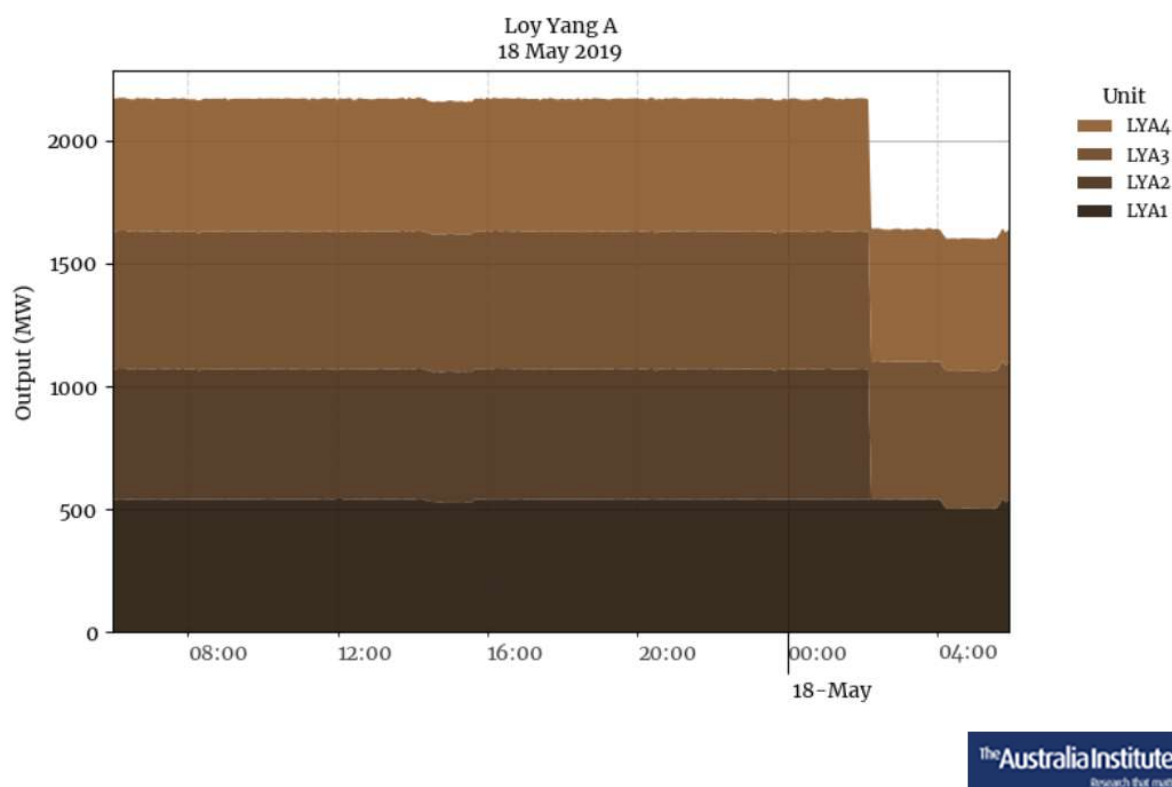
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<sup>2</sup> McArdle (2019) *Return-to-service of Loy Yang A2 hits a snag*,  
<http://www.wattclarity.com.au/articles/2019/12/return-to-service-of-loy-yang-a2-hits-a-snag/>

<sup>3</sup> McArdle (2020) *Second time lucky? The return (again) of Loy Yang A2 unit*,  
<http://www.wattclarity.com.au/articles/2020/01/second-time-lucky-lya2-rts/>

<sup>4</sup> O’Neil (2019) *Extended outage of Loy Yang A unit 2 – reliability and forward price impacts*,  
<http://www.wattclarity.com.au/articles/2019/06/extended-outage-of-loy-yang-a-unit-2-reliability-and-forward-price-impacts/>

Figure 4: Loy Yang A Unit 2 breakdown 18 May 2019



## MORTLAKE

Mortlake gas-fired power station experienced an electrical fault at one of its two units on 8 July 2019, leading to an extended outage. Origin informed AEMO that the unit was expected to be repaired and back online by 20 December 2019, in time for the summer electricity demand peak.<sup>5</sup>

In early December Origin informed AEMO of a delay in the return to service of the damaged unit due in part to 'inclement weather' conditions, increasing the risk of supply shortages during the holiday period peak demand.<sup>6</sup>

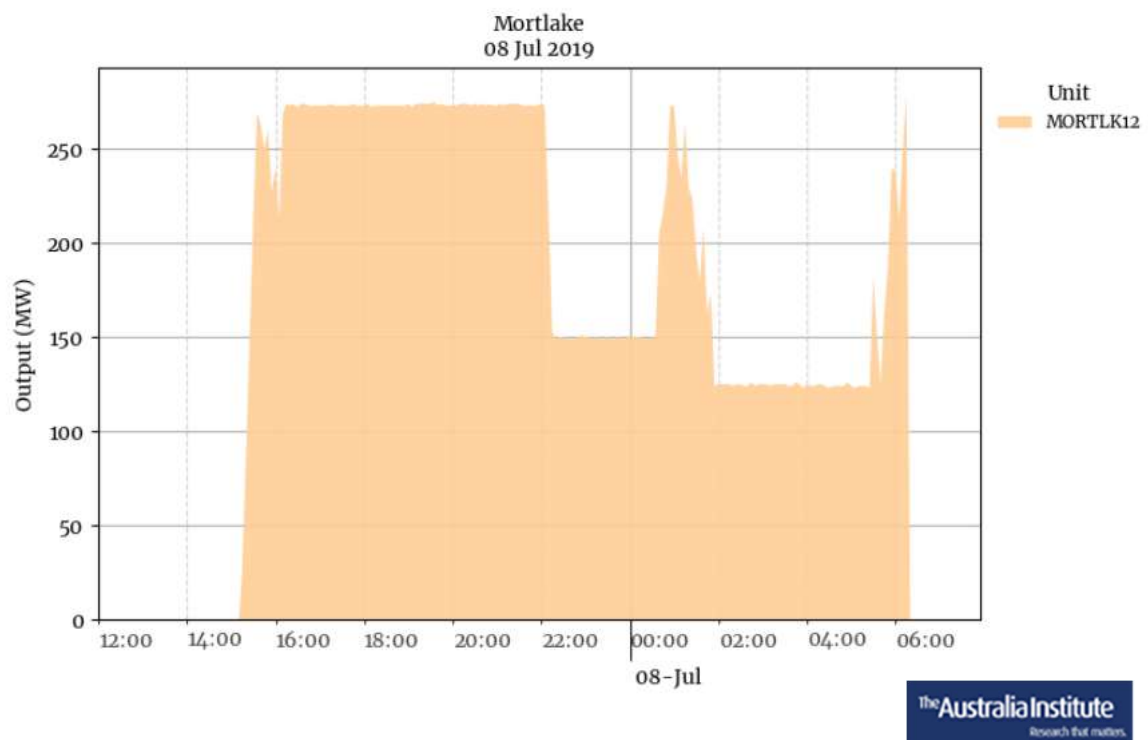
The unit returned to service in early January 2020, although initially at restricted output.<sup>7</sup>

<sup>5</sup> Origin Energy (2019) *9 July 2019: Statement on Mortlake Power Station*, [https://www.originenergy.com.au/about/investors-media/media-centre/statement\\_on\\_mortlake\\_power\\_station.html](https://www.originenergy.com.au/about/investors-media/media-centre/statement_on_mortlake_power_station.html)

<sup>6</sup> Origin Energy (2019) *2 December 2019: Statement on Mortlake Power Station*, [https://www.originenergy.com.au/about/investors-media/media-centre/statement\\_on\\_mortlake\\_power\\_station1.html](https://www.originenergy.com.au/about/investors-media/media-centre/statement_on_mortlake_power_station1.html)

<sup>7</sup> Highland (2020) *Mortlake Power Station back in business*, <https://utilitymagazine.com.au/mortlake-power-station-back-in-business/>

**Figure 6: Mortlake breakdown 8 July 2019**



# Summer outlook

## RELIABILITY

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AEMO forecast that Victoria would fail to meet the current reliability standard over the Summer 2019/20 period, due largely to the unplanned and extended outages at Loy Yang A Unit 2 and Mortlake Unit 2. All other regions in the NEM are expected to meet the reliability standard.<sup>8</sup>

AEMO's reliability standard is a measure of the effectiveness of installed capacity to meet demand. The standard is currently set at 0.002% and defined as the maximum expected unserved energy (USE) – energy that is required by consumers but unable to be supplied – as a percentage of total energy in Gigawatt hours.

In other words, the reliability standard ensures that 99.998% of the expected energy demand within a region is met.<sup>9</sup>

AEMO specifically attribute Victoria's expected poor reliability standard to aging brown coal units and extended outages at coal and gas fired generators:

The assumed extended outages of either of these units, in combination with a number of other operating risks, including the continued deterioration of the reliability of aging brown coal units, result in Victoria having an expected USE of 0.0026% for the coming summer.<sup>10</sup>

AEMO's reliability forecast accounts for the potential delayed return to service of Loy Yang A Unit 2 and Mortlake. The model assumes a 30% probability that Loy Yang A Unit 2 remains out of service until 1 March 2020.<sup>11</sup> If either or both units are delayed, the expected USE would rise:

The modelling projects that, should both units experience delays that result in their capacity being unavailable during key summer months, then the expected level of USE would be dramatically in excess of the current reliability standard, at 0.0047%.<sup>12</sup>

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<sup>8</sup> AEMO (2019) *Electricity Statement of Opportunities*, [https://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning\\_and\\_Forecasting/NEM\\_ESOO/2019/2019-Electricity-Statement-of-Opportunities.pdf](https://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/NEM_ESOO/2019/2019-Electricity-Statement-of-Opportunities.pdf)

<sup>9</sup> AEMO (2017) *Reliability Standard Implementation Guidelines*, <https://www.aemo.com.au/-/media/Files/Electricity/NEM/Data/MMS/2018/Reliability-Standard-Implementation-Guidelines---MT-PASA-Final-May-2018.pdf>

<sup>10</sup> AEMO (2019) *Electricity Statement of Opportunities*, p 3

<sup>11</sup> Ibid, p 11

<sup>12</sup> Ibid, p 72

As discussed above, the return of both units was delayed, in the case of Loy Yang A by several weeks.

## WEATHER AND CLIMATE

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Australia is experiencing a summer of extreme heat and dry conditions that will put further strain on Victoria's aging coal and gas fleet. The Bureau of Meteorology (BoM) Climate Outlook forecast a drier than average December and January for parts of eastern Australia and above average daytime and night time temperatures.<sup>13</sup>

AEMO's Electricity Statement of Opportunities (ESOO)<sup>14</sup> warned that extreme weather, droughts and bushfires forecast for the 2019/20 Summer may threaten the power system, including up to 1.3 million Victorian households facing blackouts. The power station outages exacerbated this problem:

if both power station outages [Loy Yang A2 and Mortlake 2] were extended over the summer, and if no additional supply was secured, involuntary load shedding may be experienced in Victoria during extreme weather events, potentially over multiple events, equivalent to between 260,000 and 1.3 million households being without power for four hours.<sup>15</sup>

The AEMO Summer 2019/20 Readiness Plan was released in December 2019 to provide information on projected supply disruptions in the NEM over the high-demand summer period.<sup>16</sup> The Readiness Plan focused on the decreased reliability of thermal (coal and gas fired) generation and climate change and extreme weather events:

The risk of supply interruption is primarily driven by increased vulnerability to climatic events such as extended periods of high temperature, corresponding with low wind or solar availability and unplanned generation outages.<sup>17</sup>

AEMO's summer readiness plan notes the history of unreliability in thermal generators:

AEMO's supply forecasts take into account ... Changes in unplanned outages rates of thermal generation over recent history.

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<sup>13</sup> BoM (2019) *Climate outlooks-weeks, months and seasons*,

<http://www.bom.gov.au/climate/outlooks/#/temperature/summary>

<sup>14</sup> AEMO (2019) *Electricity Statement of Opportunities*

[https://aemo.com.au/-/media/Files/Electricity/NEM/Planning\\_and\\_Forecasting/NEM\\_ESOO/2019/2019-Electricity-Statement-of-Opportunities.pdf](https://aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/NEM_ESOO/2019/2019-Electricity-Statement-of-Opportunities.pdf)

<sup>15</sup> Ibid

<sup>16</sup> AEMO (2019) *Summer 2019-20 Readiness Plan*, <https://www.aemo.com.au/-/media/Files/Electricity/NEM/System-Operations/Summer-2019-20-Readiness-Plan.pdf>

<sup>17</sup> Ibid, p 16

The unreliability of aging thermal generators combined with forecast extreme heat leave Victoria vulnerable to electricity supply issues, particularly through the summer period.

# Conclusion

The NEM's aging fleet of thermal generators continue to experience numerous breakdowns and significant unplanned extended outages. Victoria's brown coal generators are amongst the worst performing units in the NEM.

The solution to the energy trilemma of reliability, price and pollution is more renewable energy and storage. Renewables bring down the peak demand during summer, are the cheapest new energy and are emissions-free. The renewable transition would meet global obligations under the Paris Agreement and state government efforts, like the Victorian Renewable Energy Target.

Without a national climate and energy strategy, planning the energy transition has primarily been left to the states. If there are blackouts this summer, it will very well be because Australia has fallen behind in planning the transition to renewable energy and storage.