

SYSTEM EVENT REPORT NEW SOUTH WALES, 10 FEBRUARY 2017

REVIEWABLE OPERATING INCIDENT REPORT FOR THE
NATIONAL ELECTRICITY MARKET
INFORMATION AS AT 9.00 AM, MONDAY 20 FEBRUARY 2017

Published: 22 February 2017





IMPORTANT NOTICE

Purpose

AEMO has prepared this report in accordance with clause 4.8.15(c) of the National Electricity Rules, using information available as at the date of publication, unless otherwise specified.

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1. INTRODUCTION

This report provides information on the operation of the National Electricity Market (NEM) and national power grid in New South Wales on Friday 10 February 2017, during a heatwave in eastern Australia.

On Friday 10 February 2017, the eastern Australian states of South Australia, New South Wales, Victoria, and Queensland all experienced high summer temperatures. Temperature forecasts for New South Wales were overall lower during this day than actual temperatures.

New South Wales operational demand (energy demand provided from the grid) peaked at 1630 hours (hrs) at 14,181 megawatts (MW).¹ The New South Wales record peak operational demand was on 1 February 2011, and was 14,744 MW.

The New South Wales Government publicly encouraged customers to reduce electricity use. AEMO observed demand reductions of approximately 200 MW below forecast at the time of peak demand on 10 February 2017, which may have been due to customer responses. However, AEMO cannot measure or verify the extent of the response.

Coincident with the peak of demand for the day, the following also occurred on 10 February:

- The forced outage of Tallawarra generators (408 MW) due to a fault in the gas turbine.
- Colongra units unable to start (600 MW), due to low gas pressure in the fuel supply lines.
- A number of thermal generators reducing output (details in Table 1).
- Reducing wind and solar photovoltaic (PV) generation of approximately 300 MW between 1700 hrs and 1800 hrs (approximately in line with forecasts).

These factors, all coinciding at approximately 1700 hours, combined to overload the New South Wales interconnections with Queensland and Victoria, creating an insecure operating state.

With no further generation available to serve the demand and relieve the overloading interconnectors, as a last resort at 1658 hrs AEMO instructed TransGrid to reduce demand at the Tomago aluminium smelter (290 MW) to restore the power system in New South Wales to a secure operating state. The instruction was issued to restore load one hour later.

The sequence of events and data relating to the period are detailed in this report.

All times in this report are market time (Australian Eastern Standard Time (AEST)). In February, New South Wales local time is market time plus 60 minutes.

Based on information at the time of this report, AEMO has assessed the adequacy of the provision and response of facilities and services. In addition, AEMO has also assessed the appropriateness of actions taken to restore or maintain power system security.

AEMO has found generally that all actions and responses of facilities and services were adequate (operated as expected). AEMO intends to consider further whether plant capabilities during extreme conditions are accurately reflected in bid and availability information.

¹ Based on the 5-minute dispatch interval ending at 1635 hrs. The peak demand over a 30-minute trading interval on 10 February was 14,087 MW for the trading interval ending 1700 hrs.

2. SEQUENCE OF EVENTS

Table 1 shows the sequence of events that led to the requirement for AEMO to issue an instruction for load shedding in New South Wales on 10 February 2017.

Table 1 Timeline of events leading up to and on 10 February 2017

Date/Time	Events/Comment
07/02/2017 15:11	Short-Term (ST) Projected Assessment of System Adequacy (PASA) indicates a forecast lack of reserve Level 1 (LOR 1) in NSW 1630–1900 hrs on 10/02/17, deficit = 316 MW. Market Notice (MN) 57258 issued.
08/02/2017 15:15	ST PASA indicates a forecast LOR 1 in NSW 1430–1730 hrs on 10/02/17, deficit = 572 MW. MN 57274 issued.
08/02/2017 23:09	ST PASA indicates a forecast LOR 2 in NSW 1530–1630 hrs on 10/02/17, deficit = 55 MW. MN 57294 issued.
09/02/2017 04:37	ST PASA indicates a forecast LOR 1 in NSW: <ul style="list-style-type: none"> • 1200–1400 hrs on 10/02/17, deficit = 583 MW. • 1730–1900 hrs on 10/02/17 deficit = 624 MW. MN 57296 issued.
09/02/2017 04:42	ST PASA indicates a forecast LOR 2 in NSW: <ul style="list-style-type: none"> • 1400–1600 hrs on 10/02/17, deficit = 644 MW. • 1630–1730 hrs on 10/02/17, deficit = 587 MW. MN 57297 issued.
09/02/2017 04:43	ST PASA indicates a forecast LOR 3 in NSW 1600–1630 hrs on 10/02/17, deficit = 19 MW. MN 57298 issued.
09/02/2017 09:00	Responsible Officer (R/O) teleconference is held. ² It is noted that: <ul style="list-style-type: none"> • LOR 3 is identified in NSW for 1630 hrs on 10/02/2017, deficit = 29 MW. • NSW generation capacity is limited due to long-term outages. • The NSW Minister has publicly encouraged customers to reduce electricity consumption.
09/02/2017 12:57	Pre-Dispatch (PD) PASA indicates a forecast LOR 3 in NSW 1500–1700 hrs on 10/02/17, deficit = 264 MW. MN 57311 issued.
09/02/2017 13:34	PD PASA indicates forecast LOR 1 in NSW: <ul style="list-style-type: none"> • 1200–1400 hrs on 10/02/17, deficit = 663 MW. • 1830–2030 hrs on 10/02/17, deficit = 636 MW. MN 57314 issued.
09/02/2017 13:35	PD PASA indicates forecast LOR 2 in NSW: <ul style="list-style-type: none"> • 1400–1500 hrs on 10/02/17, deficit = 466 MW. • 1700–1830 hrs on 10/02/17, deficit = 556 MW. MN 57315 issued.
09/02/2017 17:15	PD PASA indicates forecast LOR 1 in NSW: <ul style="list-style-type: none"> • 1130–1330 hrs on 10/02/17, deficit = 627 MW. • 1900–2030 hrs on 10/02/17, deficit = 634 MW. MN 57337 issued.
09/02/2017 17:16	PD PASA indicates forecast LOR 2 in NSW: <ul style="list-style-type: none"> • 1300–1500 hrs on 10/02/17, deficit = 542 MW. • 1730–1900 hrs on 10/02/17, deficit = 677 MW. MN 57338 issued.
09/02/2017 17:17	PD PASA indicates forecast LOR 3 for NSW 1500–1730 hrs on 10/02/17, deficit = 419 MW. MN 57339 issued.

² These teleconferences are initiated when there is a power system issue which is affecting, or has the potential to affect, multiple jurisdictions within the NEM. The Responsible Officers (R/O) are nominated by each NEM jurisdiction to act as the emergency contact point for AEMO during major incidents.



Date/Time	Events/Comment
09/02/2017 18:30	<p>Responsible Officer (R/O) teleconference is held.</p> <p>LOR 3 is identified in NSW 1500–1730 hrs on 10/02/2017, deficit = 396 MW.</p> <p>It is noted that:</p> <ul style="list-style-type: none"> • AEMO has been in contact with all NSW generators. • The NSW Minister has publicly encouraged customers to reduce electricity consumption.
10/02/2017 06:30	<p>AEMO and TransGrid discuss the likely conditions for the day – high temperatures and high demand, reserve conditions, and the potential for load shedding.</p> <p>TransGrid advises that all Distribution System Operators and Tomago Aluminium Smelter will be advised re potential load shedding.</p> <p>AEMO and TransGrid discuss the possibility of re-rating of the Bannaby – Sydney West 330 kV transmission line as constraints were indicated to restrict flow later in the day.</p>
10/02/2017 07:00	<p>Responsible Officer (R/O) teleconference is held.</p> <p>LOR 3 conditions are forecast for five trading intervals (1500–1730 hrs).</p> <p>It is noted that:</p> <ul style="list-style-type: none"> • According to the current forecast demand outlook there is a maximum of 327 MW (may change) of supply shortfall in the NSW region. • The 327 MW shortfall factors in the support provided by VIC and QLD via the interconnectors. • All generators in NSW have been contacted by AEMO to confirm capacity and / or potential availability for direction if required. • There are currently no threats to the transmission system. • All planned outages and routine maintenance have been cancelled for the day. • Consistent with AEMO load shedding guidelines, interruptible load at a smelter will be the first load to be shed for up to 1 hour which will alleviate 290 MW of the shortfall. • The NSW Minister has publicly encouraged customers to reduce electricity consumption.
10/02/2017 10:36	<p>PD PASA indicates forecast LOR 1 in NSW:</p> <ul style="list-style-type: none"> • 1200–1430 hrs on 10/2/2017, deficit = 620 MW. • 1830 –2030 hrs on 10/2/2017, deficit = 509 MW. • MN 57355 issued.
10/02/2017 10:36	<p>PD PASA indicates forecast LOR 2 in NSW:</p> <ul style="list-style-type: none"> • 1430-1600 hrs on 10/02/17, deficit = 650 MW. • 1700-1830 hrs on 10/2/2017, deficit = 362 MW. <p>MN 57356 issued.</p>
10/02/2017 10:36	<p>PD PASA indicates forecast LOR 3 in NSW 1600–1700 hrs on 10/02/17, deficit = 77 MW.</p> <p>MN 57357 issued.</p>
10/02/2017 10:36	<p>Update forecast LOR 3 today 1600–1700 hrs, min reserve 77 MW. MN 57356.</p>
10/02/2017 10:36	<p>Update forecast LOR 1 today 1200–2030 hrs, min reserve 780 MW. MN 57355.</p>
10/02/2017 10:36	<p>Update forecast LOR 2 today 1430–1830 hrs, min reserve 338 MW. MN 57356.</p>
10/02/2017 10:40	<p>Demand forecast for NSW is reviewed. Forecast increased by 150 MW until 1900 hrs.</p>
10/02/2017 11:00	<p>Responsible Officer (R/O) teleconference is held.</p> <p>It is noted that:</p> <ul style="list-style-type: none"> • The situation in NSW/ACT is improving. • LOR 3 conditions are forecast for four trading intervals (1600–1730 hrs) with tight LOR 2 conditions forecast 1430–1830 hrs. • According to the current forecast demand outlook, there is a maximum of 150 MW (may change) of supply shortfall in the NSW region at the peak. • AEMO has continued to keep in contact with all generators in NSW to confirm capacity and / or potential availability for direction if required. • There currently remain no threats to the transmission system. • Interruptible load at a smelter will be the first load to be shed, which will alleviate 290 MW of the shortfall. • Wind output could significantly change the situation. • The peak demand forecast is currently approximately 14,700 MW. • The NSW Minister has publicly encouraged customers to reduce electricity consumption.

Date/Time	Events/Comment
10/02/2017 11:05	Origin Energy advises the availability of Eraring generating units: <ul style="list-style-type: none"> • Unit 1: 670 MW – plant temperature issues. • Unit 2: 655 MW – plant temperature issues. • Unit 3: 400 MW – minor boiler tube leak. • Unit 4: 670 MW – plant temperature issues. The units are not available for direction above these limits. EPA license conditions are currently under review. Origin will advise of any further limitations.
10/02/2017 12:01	Origin Energy advises that Environment Protection Authority (EPA) limits will restrict units 1, 2, and 4 to 603 MW each (reduction of 186 MW). The Eraring units would however respond to a Direction from AEMO to full technical availability – 670 MW for units 1 and 4 and 655 MW for unit 2.
10/02/2017 12:50	AEMO informs TransGrid of actual LOR 1 declared in NSW. PD PASA is indicating from 1250 hrs – NSW actual LOR 1 = 1,330 MW (2 X biggest units 675 + 670 = 1,345 MW). MN 57359 issued.
10/02/2017 13:00	PD PASA indicates actual LOR 1 in NSW 1250–2000 hrs, deficit = 484 MW. MN 57359 issued.
10/02/2017 13:16	PD PASA indicates forecast LOR 2 in NSW: <ul style="list-style-type: none"> • 1430–1600 hrs, deficit = 658 MW. • 1700-1830 hrs, deficit = 606 MW. • Intervention by 1430 hrs. MN 57360 issued.
10/02/2017 13:28	PD PASA indicates forecast LOR 3 in NSW on 10/02/17 1600-1700 hrs deficit = 189 MW. MN 57361 issued.
10/02/2017 13:55	Origin Energy advised AEMO that due to a change in their license agreement the revised maximum capability of Eraring units is: <ul style="list-style-type: none"> • Unit 1: 640 MW. • Unit 2: 630 MW. • Unit 3: 650 MW.
10/02/2017 14:10	AEMO observes that Tomago potlines 2 and 3 have reduced load by 20 MW each from approximately 1400 hrs. AEMO did not request any reduction in load.
10/02/2017 14:10	AEMO discussed with TransGrid: <ul style="list-style-type: none"> • High temperature, high demand day for NSW. • Reserves LOR 1, LOR 2 and LOR 3 and possibilities of directions and load shedding in NSW.
10/02/2017 14:35	TransGrid advises AEMO that, based on advice they received from AGL Macquarie, Tomago potline 1 (290 MW) will be taken out of service from 1440 hrs. AEMO did not request any reduction in load.
10/02/2017 15:10	Origin Energy advises that Eraring unit 3 will come slowly to 550 MW – improvement in plant situation. Rebid to follow.
10/02/2017 15:20	AEMO contacts AGL Macquarie to confirm if Tomago potline 1 is to be returned to service. AGL Macquarie trader informs AEMO that: <ul style="list-style-type: none"> • Tomago potline 1 was taken out of service and will remain out of service for 1 hr and 15 min. • When Tomago potline 1 is returned to service, Tomago potline 2 will be taken out of service for 1 hr and 15 min. • When Tomago potline 2 is returned to service, Tomago potline 3 will be taken out of service for 1 hr and 15 min. AEMO advises TransGrid.
10/02/2017 16:09	Delta advises that the Vales Point units are within one degree of reaching their absolute outlet temperature limit. They will remain available for 660 MW for up to 1.5 hrs, but will bid with the intention to generate 600 MW or less.
10/02/2017 16:19	MN 57382 – forecast LOR 3 in NSW is cancelled.
10/02/2017 16:22	Tallawarra generating unit tripped from 408 MW. The unit was bid unavailable until 1830 hrs.
10/02/2017 16:30	Constraint equations to manage thermal limits in southern NSW and transient stability limits between Queensland and NSW start violating. The flow on the Queensland – NSW interconnector (QNI) is up to 276 MW over the limit. The Victoria – NSW interconnector is up to 297 MW over the limit. The Terranora interconnector is up to 126 MW over the limit. The power system is not in a secure operating state. AEMO must take all reasonable actions, including intervention if necessary, to return the power system to a secure operating state within 30 minutes.



Date/Time	Events/Comment
10/02/2017 16:30	AEMO contacts Colongra power station. Colongra personnel confirm they had seen the start signal for the units and were intending to synchronise the 4 units. Snowy confirms the units would be started and were expected to synchronise within 13 minutes.
10/02/2017 16:35	AEMO advises TransGrid an actual LOR 2 now exists for NSW. All Colongra generating units received a signal to start.
10/02/2017 16:44	Actual LOR 2 in NSW 1635–1730 hrs, deficit = 105 MW. MN 57387 issued.
10/02/2017 16:50	AEMO contacts Colongra power station and is advised all 4 Colongra units had failed to start. The units were being started on fuel oil as the units had run on gas earlier in the day and gas supply was very low. Personnel are attempting to get at least one unit started on gas and then switch over to fuel oil as there is two unit hours of gas in the pipe. If this is successful, another unit will be started in a similar manner.
10/02/2017 16:50	AEMO advises TransGrid an actual LOR 3 now exists in NSW. All Colongra generating units failed to start.
10/02/2017 16:56	Snowy Hydro contacts AEMO in relation to the Colongra units. Had tried to start on diesel and all 4 tripped, now attempting to start on gas and switch to diesel. On diesel they can get 15 MW more output. Very tight with gas supply. It will take some time as all 4 cannot start on gas at once. Risk of a trip again on the diesel switch over.
10/02/2017 16:58	AEMO issues a direction to TransGrid in accordance with Section 116 of the National Electricity Law and Clause 4.8.9 of the National Electricity Rules to maintain power system security. AGL Macquarie trader is informed. In accordance with procedures TransGrid is directed to shed Tomago potline 3 (290 MW). MN 57397 issued. The direction is expected to stay in place until 1800 hrs on 10/02/2017.
10/02/2017 17:00	Concurrent to the actions taken at 16:58, a Responsible Officer (R/O) teleconference is held. It is noted that: <ul style="list-style-type: none"> • The Tomago aluminium smelter reduced load at 1400 hrs. • A total of 290 MW of load is being shed for 1 hour and 15 minutes on one potline at a time. This will rotate between the three potlines. This was not instructed by AEMO. • At 1620 hrs, a total of 400 MW of generation was lost in NSW. No additional generation could be started. • No residential load shedding has been instructed by AEMO, and AEMO continues to monitor the situation closely. • Demand is currently lower than forecast. • The NSW Minister has publicly encouraged customers to reduce electricity consumption.
10/02/2017 17:05	NSW dispatch price is set to market price cap for duration of load shedding (National Electricity Rules clause 3.9.2(e)).
10/02/2017 17:06	Tomago potline 3 is out of service. The power system returns to a secure operating state.
10/02/2017 17:10	AEMO advises TransGrid that Tomago potline 2 (which was out of service) may be returned to service. Potline 3 to remain out of service under the direction.
10/02/2017 17:15	Colongra unit 4 in service.
10/02/2017 17:17	Tomago potline 2, which had been out of service, returns to service.
10/02/2017 17:20	Actual LOR 3 in NSW from 1650–1800 hrs, 290 MW load interrupted. MN 57396.
10/02/2017 17:20	Colongra units 2 and 3 in service.
10/02/2017 17:43	MN 57397 issued to advise the market of AEMO's load shedding direction that occurred at 1658 hrs.
10/02/2017 17:45	Energy Australia advises AEMO that Tallawarra tripped on start-up – could be an hour before they can synch.
10/02/2017 18:01	Following end of declared LOR 3 condition in NSW region TransGrid is directed to restore Tomago potline 3 to service.
10/02/2017 18:07	Tomago potline 3 is returned to service.
10/02/2017 18:08	Snowy Hydro advises AEMO that Colongra unit 4 has been started and transitioned to fuel oil. Will try other units.
10/02/2017 18:10	TransGrid advises AEMO that ACTEW AGL shed 11 MW of load – not requested by TransGrid. AEMO advises TransGrid that the shed load should be restored.
10/02/2017 18:10	NSW dispatch price no longer set to market price cap.
10/02/2017 18:12	MN 57399 – Direction to TransGrid to restore Tomago load



Date/Time	Events/Comment
10/02/2017 18:26	MN 57400 – Actual LOR 3 in NSW cancelled.
10/02/2017 18:33	Tallawarra generating unit returned to service
10/02/2017 18:37	Snowy trader advises AEMO that Colongra units 3 and 4 successfully transitioned to fuel oil but the gas ran out before units 2 and 1 could be changed over. They advise there is 6 to 8 hours of fuel oil available, more fuel oil is ordered for tomorrow, and there will be more gas available tomorrow. Units 1 and 2 will be bid available but will have to start on fuel oil – there is concern whether the units will start.
10/02/2017 18:38	PD PASA indicates an actual LOR 1 in NSW 1830–1900 hrs on 10/02/2017. Deficit = 497 MW. MN 57402 issued.
10/02/2017 19:05	NSW Reserves: LOR 1 cleared at 1905 dispatch interval.

3. ELECTRICITY SUPPLY

Electricity in New South Wales is supplied by a combination of

- Generation in New South Wales, comprising coal, gas, hydro, wind, utility-scale solar, and rooftop solar.
- Imports from Victoria and Queensland via interconnections (the Victoria–NSW, QNI, and Terranora interconnectors).

Table 2 shows the supply mix for the 5-minute dispatch interval ending 1700 hrs on 10 February, just prior to AEMO issuing an instruction to shed load. The net import was above the available import capacity by 463 MW.

Table 2 Generation contribution to demand in New South Wales at 1700 hrs on 10 February

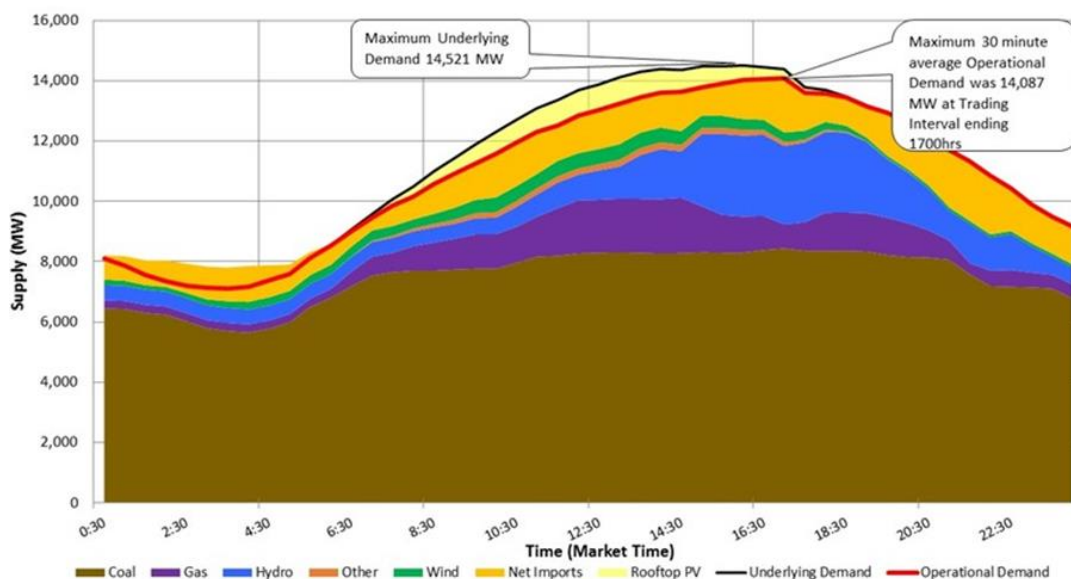
Supply source	Contribution to peak demand (MW) at 1700 hrs	Available capacity (MW) at 1700 hrs	Installed capacity (MW) ^A
Net imports	1,745	1,282	2,888
Wind	284	284	651
Large-scale solar	132	132	211
Hydro	2,619	2,689	2,525
Thermal	9,245	9,408	12,458
Total	14,025	13,795	18,733
Rooftop PV (estimated)	291	291	1,218
Total including rooftop PV	14,316	14,086	19,951

^A Based on the registered capacity of each generating unit. Some generating units may operate above this value for short periods.

Figure 1 shows the actual generation and import mix, and operational and underlying demand, for Friday 10 February 2017, based on the average values for each 30-minute trading interval.

The 30-minute peak operational demand in New South Wales on Friday 10 February was 14,087 MW at 1700 hrs.

Figure 1 New South Wales electricity supply mix on 10 February 2017^A



^A Maximum underlying demand includes all generation behind the meter (on customers' premises), including but not only from rooftop PV.



The following graphs show each source of supply through Friday 10 February in New South Wales. The dotted lines show the period for which AEMO instructed reduction of load at Tomago smelter.

Figure 2 Wind generation in New South Wales, 10 February

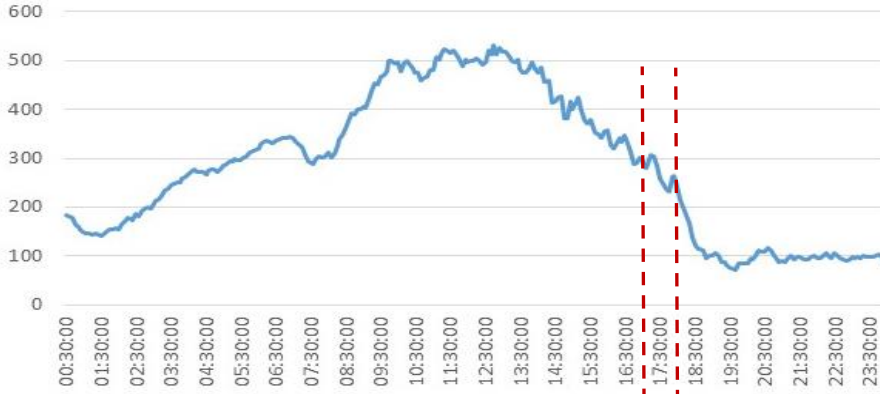


Figure 3 Large-scale solar generation in New South Wales, 10 February

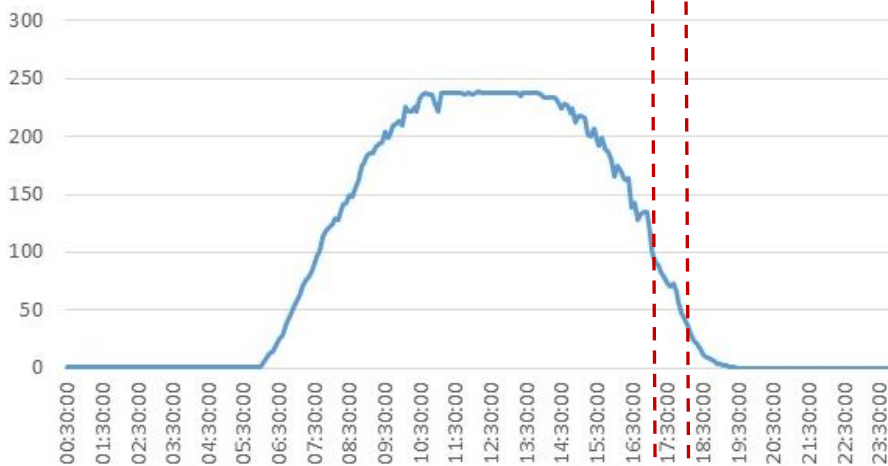


Figure 4 Thermal (coal and gas) generation in New South Wales, 10 February

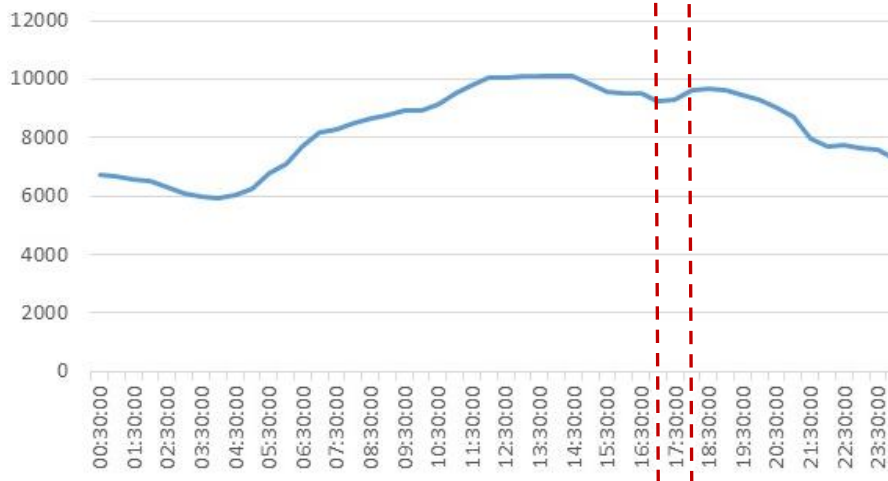


Figure 5 Hydro generation in New South Wales, 10 February

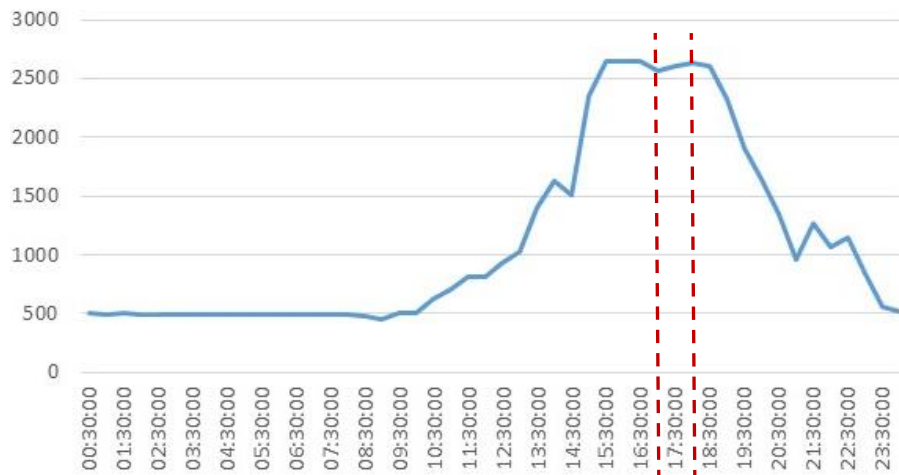


Figure 6 Generation imports into New South Wales, 10 February



Figure 7 Estimated rooftop solar generation in New South Wales, 10 February

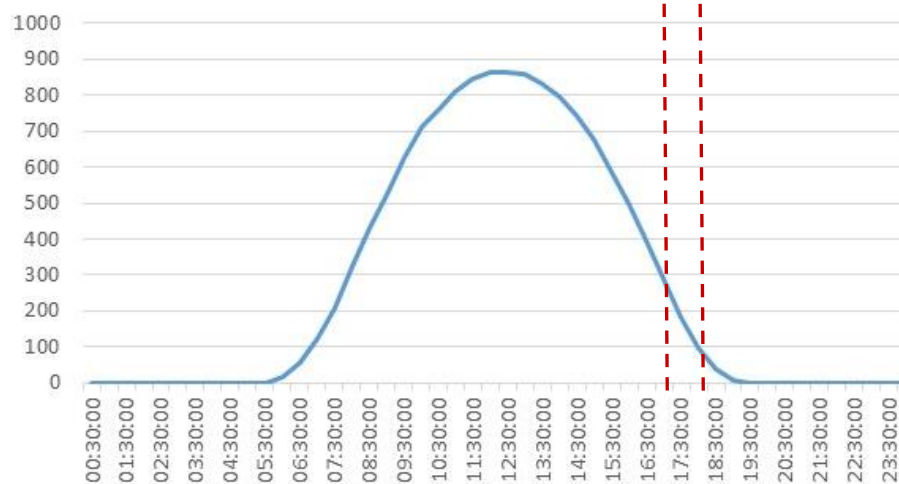
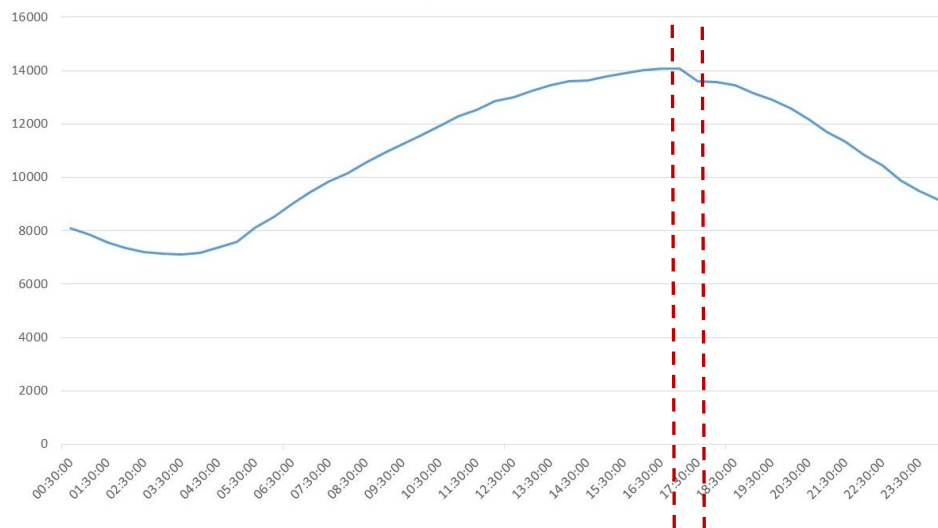


Figure 8 New South Wales operational demand, 10 February


3.1 Available generation

Table 3 shows the output of the generating units in New South Wales at 1700 hrs on Friday 10 February, compared to the bid capacity at the time and the registered capacity of each unit.

Table 3 Generation in New South Wales at 1700 hrs, 10 February

Unit	Output	Bid capacity	Registered capacity
Blowering	70	70	80
Boco Rock WF	103	104	113
Broken Hill SF	33	35	53
Bayswater 1	657	660	660
Bayswater 2	676	670	660
Bayswater 3	634	630	660
Bayswater 4	671	670	660
Colongra 1	0	0	181
Colongra 2	0	0	181
Colongra 3	0	0	181
Colongra 4	0	164	181
Eraring 1	629	630	720
Eraring 2	620	620	720
Eraring 3	549	550	720
Eraring 3	640	640	720
Gullerin Range WF	56	44	166
Gunning WF	23	27	47
Guthega	66	67	60
Hume	39	39	50
Hunter Valley GT	15	15	50
Liddell 1	439	440	500
Liddell 2	0	0	500

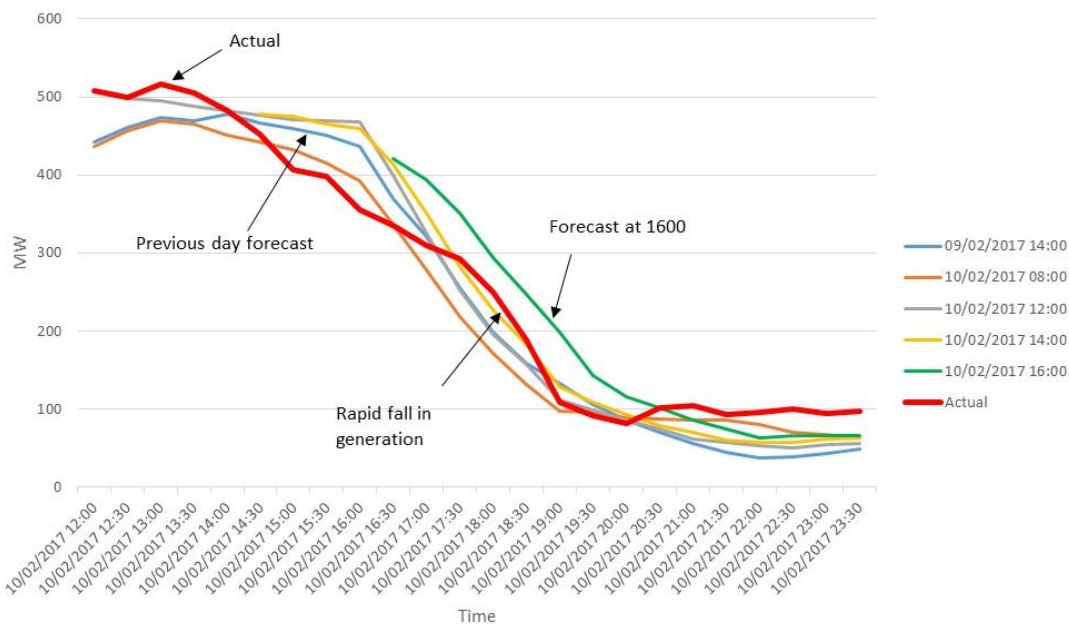
Unit	Output	Bid capacity	Registered capacity
Liddell 3	429	430	500
Liddell 4	0	0	500
Moree SF	47	53	57
Mount Piper 1	670	670	700
Mount Piper 2	622	625	700
Nyngan SF	41	43	102
Shoalhaven	156	160	240
Sithe	158	160	160
Tallawarra	0	0	440
Taralga WF	28	26	106
Lower Tumut	1,696	1,713	1,500 ^A
Upper Tumut	476	640	616
Uranquinty 1	156	157	166
Uranquinty 2	160	160	166
Uranquinty 3	158	158	166
Uranquinty 4	159	159	166
Vales Point 5	613	600	660
Vales Point 6	617	600	660
Woodlawn WF	21	21	48
	12,126	12,449	15,516

A Although generating units have a registered capacity, they may have the ability to exceed this value for short periods.

3.2 Wind generation

Figure 9 shows the actual wind generation in New South Wales, and the forecast wind generation, for Friday 10 February.

Figure 9 Forecast and actual wind generation in New South Wales, 10 February



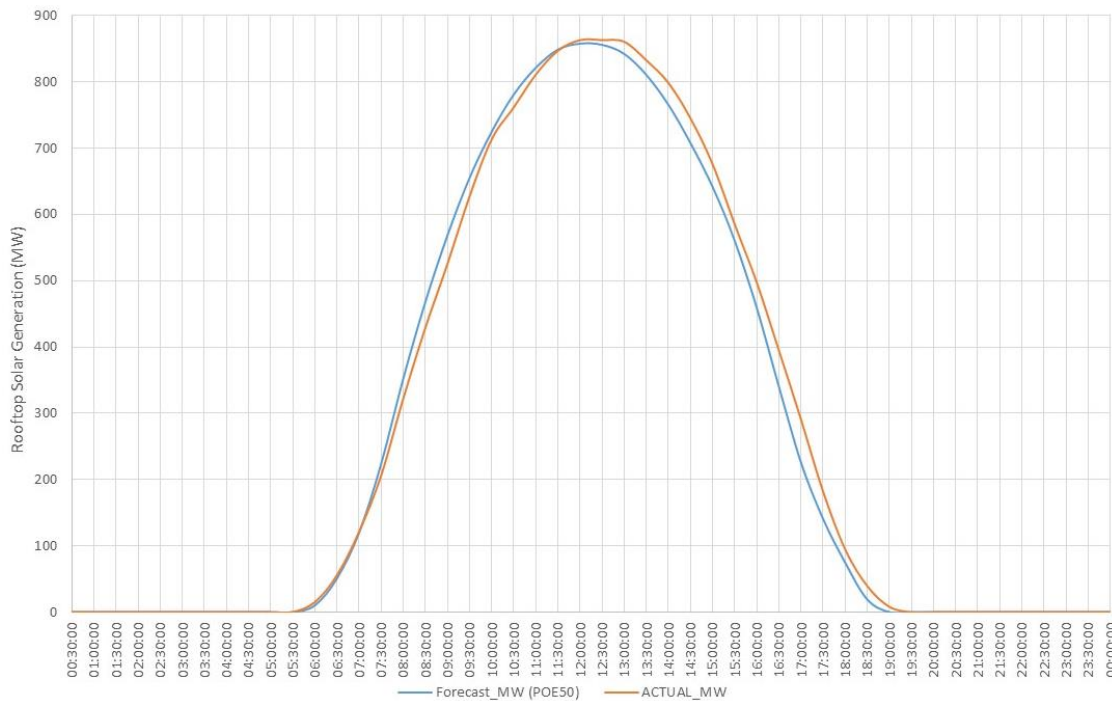
Prior to 1600 hrs, wind generation was below forecast. From 1600 hrs the forecast indicated a rapid reduction in wind generation, and the actual wind generation fell rapidly from 1630 hrs onwards. At 1600 hrs the forecast wind generation at 1700 hrs was 394 MW. The actual wind generation at 1700 hrs was 309 MW.

3.3 Rooftop solar generation

Figure 10 shows the forecast for rooftop solar generated at 0130 hrs on Friday 10 February, and the estimated actual rooftop solar generation for Friday 10 February based on AEMO’s Australian Solar Energy Forecasting System Phase 2 (ASEFS2).

This shows that estimated actual rooftop solar generation was close to the forecast in the morning and slightly above forecast in the afternoon. Rooftop solar generation peaked at 863 MW at 1230 hrs and reduced to approximately 290 MW at 1700 hrs. Solar generation continued to decline to 0 MW at 1930 hrs.

Figure 10 Forecast and actual rooftop solar generation in New South Wales, 10 February



3.4 Transmission network flows

There were two planned transmission outages on 10 February that had the potential to limit imports into New South Wales from Queensland:

- Outage of the Coffs Harbour – Koolkhan 132 kV transmission line. This outage commenced on 10 January 2017. The constraint equations associated with this outage did not bind on 10 February so had no impact on actual imports from Queensland.
- Outage of one of the three cables comprising Directlink, the DC connection from Terranora to Mullumbimby, which commenced on 23 January 2017. This outage may reduce the capacity of the Terranora interconnector by up to 60 MW, depending on power system conditions at the time.

3.4.1 Interconnectors

There are three interconnections to New South Wales³:

- Queensland – NSW interconnector (QNI) which has a nominal capacity of 1,030 MW for flow from Queensland to New South Wales.
- Terranora interconnector (between Queensland and New South Wales) which has a nominal capacity of 224 MW for flow from Queensland to New South Wales.
- Victoria – NSW interconnector which has a nominal capacity of (3,220 – generation at Tumut) MW.

The flow on interconnectors cannot be precisely controlled and a degree of variation above and below limits is normal.

Figure 11 shows that QNI was operating at or near its limit prior to 1630 hrs. The flow into New South Wales on QNI was restricted by AEMO to less than the nominal rating to manage potential overloading of transmission lines in New South Wales (constraint equation $N_{>>N-NIL_S}$). From 1630 hrs, the flow on QNI was above limits by up to 276 MW.

Figure 12 shows that the Terranora interconnector was operating at or near its limit prior to 1630 hrs. The flow into New South Wales on the Terranora interconnector was restricted by AEMO to less than the nominal rating to manage potential overloading of transmission lines in New South Wales (constraint equation $N_{>>N-NIL_S}$). From 1630 hrs, the flow on the Terranora interconnector was above limits by up to 126 MW.

Figure 13 shows that the Victoria – NSW interconnector was operating at or near its limit prior to 1630 hrs. The flow into New South Wales was restricted by AEMO to manage potential overloading of transmission lines in New South Wales (constraint equation $N_{>>N-NIL_B_15M}$). From 1630 hrs, the flow on the Victoria – NSW interconnector was above limits by up to 297 MW.

The three interconnectors to New South Wales were above their limits from approximately 1630 hrs, due to the combination of the loss of the Tallawarra generating unit (408 MW) at 1622 hrs and the failure of the Colongra generating units to start. This meant the power system was not in a secure operating state. AEMO must take all reasonable actions to return the power system to a secure operating state as soon as practicable and in any event within 30 minutes, that is, by 1700 hrs.

Figure 11 QNI interconnector flow

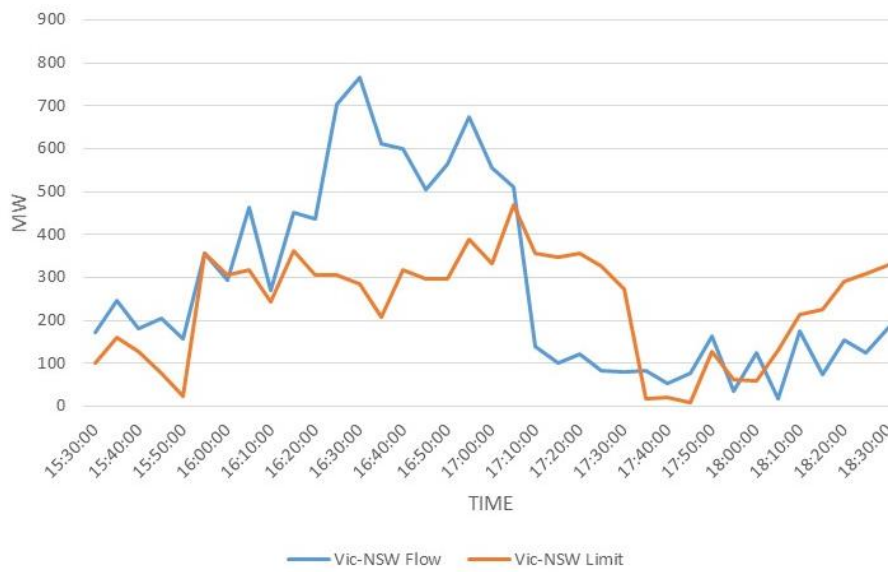


³ The actual capacity of any interconnector is highly dependent on the power system conditions and may be below the values listed here.

Figure 12 Terranora interconnector flow



Figure 13 Victoria – NSW interconnector flow



4. DEMAND FORECASTS

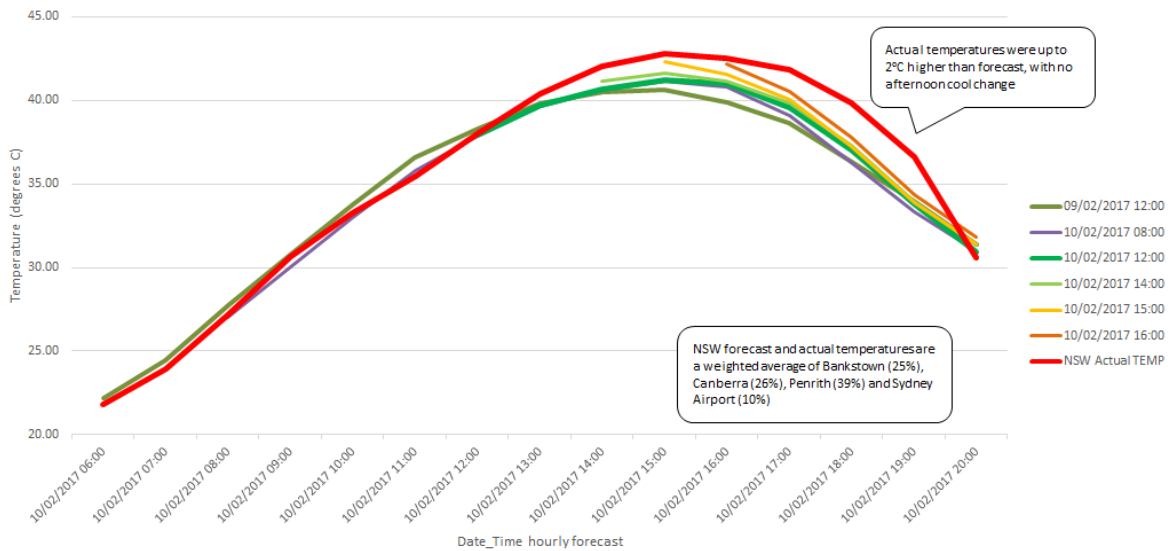
4.1 Temperature

Energy use in summer is highly dependent on ambient temperatures, with increased energy use for cooling increasing actual and forecast demand.

For New South Wales demand forecasting, AEMO uses an equal weighted average of hourly weather forecasts provided by WeatherZone and Telvent⁴ based on measurements taken at Bureau of Meteorology (BoM) weather stations at Bankstown, Canberra, Penrith, and Sydney Airport. The averages for each location are then weighted before use in AEMO’s demand forecasting models: Bankstown (25%), Canberra (26%), Penrith (39%), and Sydney Airport (10%). Temperatures quoted in this report are calculated based on these averages.

These forecasts are updated hourly and were used to forecast the operational demand for Friday 10 February. Figure 14 shows the evolution of the temperature forecast during the day.

Figure 14 Forecast and actual temperature in New South Wales, 10 February

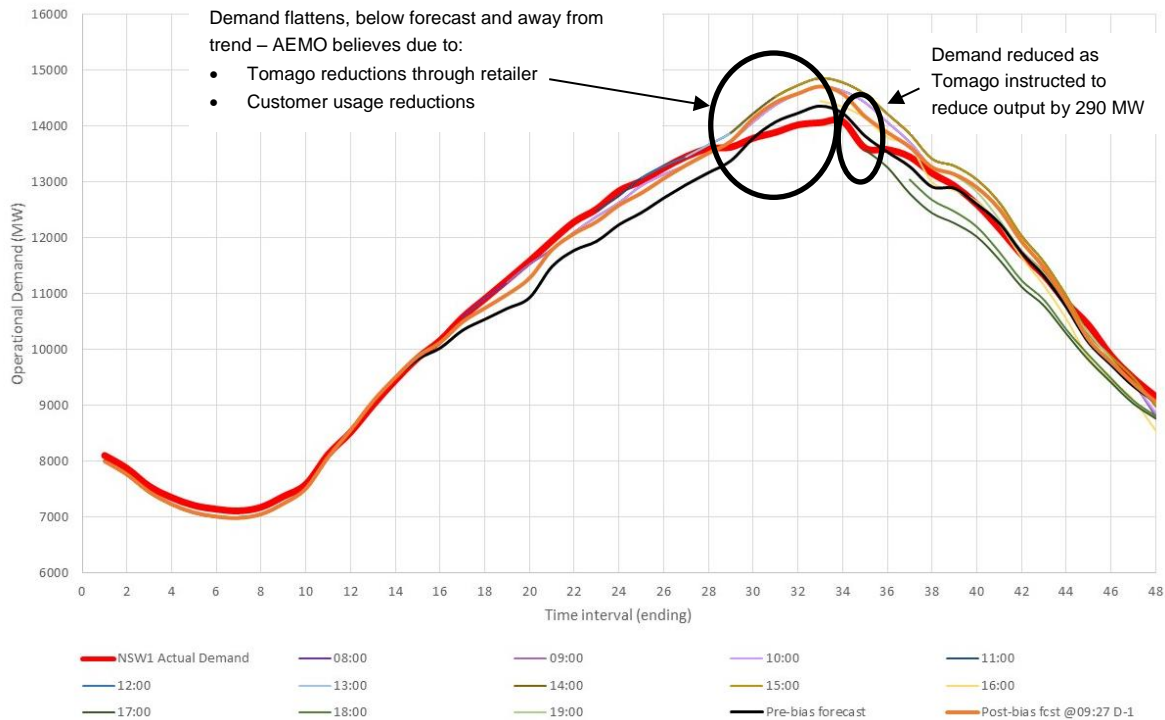


⁴ Telvent and Weatherzone use actual temperatures from the BoM as one of the inputs in their modelling to produce the temperature forecasts published to AEMO.

4.2 Demand

Based on the hourly temperature forecasts, AEMO forecast the expected demand for Friday 10 February. The forecasts and updates throughout the day are shown in Figure 15, along with actual demand.

Figure 15 Demand forecasts and actual demand for New South Wales, 10 February



4.2.1 Customers in New South Wales encouraged to reduce electricity consumption on 10 February

The New South Wales Government initiated a media campaign on 9 February to advise customers of potential electricity shortages on 10 February and encourage customers to reduce electricity consumption where possible. This may include setting thermostats for air-conditioners at 26 degrees, and ensuring lights or other electrical appliances are turned off when not required.

AEMO believes this initiative may have resulted in demand being approximately 200 MW lower across the peak afternoon period (see demand flattening in Figure 15), however, AEMO cannot measure or verify the impact of the initiative or differentiate it from response of loads due to high spot market prices.



5. SUPPLY INTERRUPTION

After the trip of the Tallawarra generating unit at 1622 hrs, the power system was not in a secure operating state due to breaching limits on the interconnectors which filled the 408MW gap left by Tallawarra tripping and were carrying all reserves. The four Colongra generating units received an instruction to start generating at 1625 hrs, but all four generating units failed to start and were bid unavailable at 1640 hrs.

At 1658 hrs, AEMO directed TransGrid to shed the No. 3 potline at the Tomago aluminium smelter (290 MW). This was in accordance with jurisdictional load shedding procedures.

The load was shed by 1706 hrs and this action restored the power system to a secure operating state.

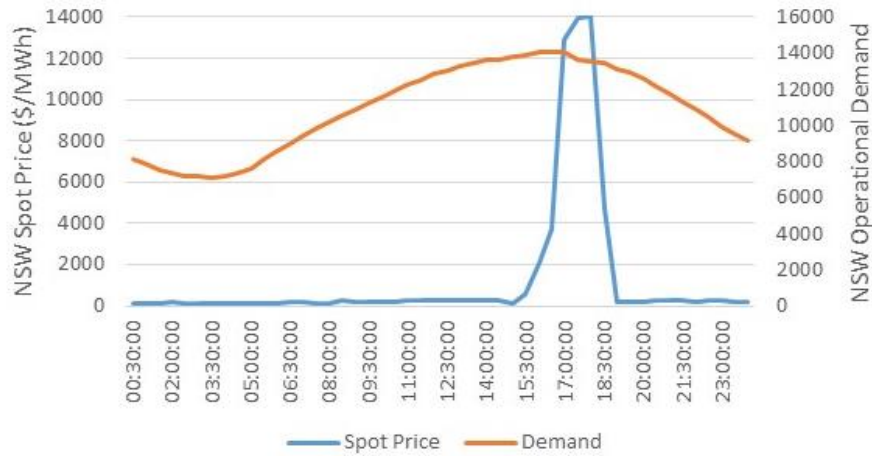
At 1801 hrs AEMO requested TransGrid to restore all load.

Figure 15 (in Section 4.2 above) shows the operational demand in New South Wales during this incident.

6. SPOT PRICES

The spot price for New South Wales reached \$14,000/MWh for the trading interval ending 1800 hrs.

Figure 16 New South Wales spot prices and operational demand, 10 February



7. SYSTEM RESERVES

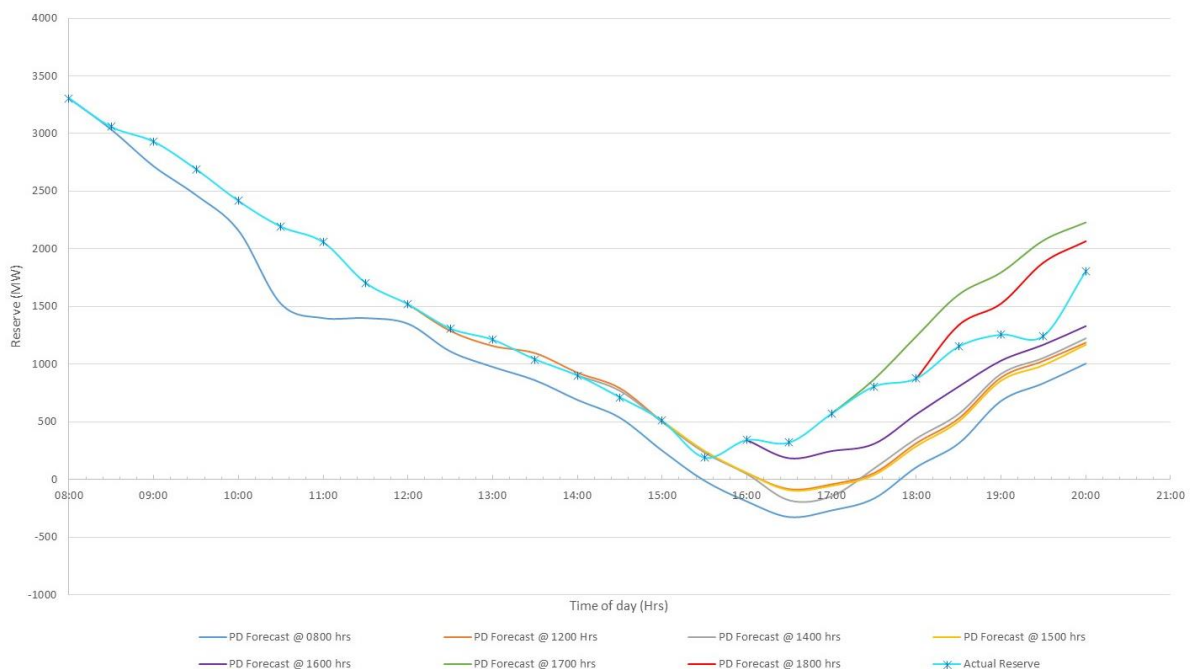
AEMO uses forecasts of available generation capacity and demand to calculate the reserve available in the power system. If there is insufficient reserve to maintain a secure and reliable power system, AEMO will take operational action to restore it.

AEMO notifies the market of lack of reserve conditions: LOR 1, LOR 2, and LOR 3. If reserves are at LOR 2 or LOR 3 levels, AEMO can intervene in the market to maintain power system security. Appendix A explains lack of reserve conditions and AEMO’s directions powers under the National Electricity Rules.

An actual LOR 2 condition occurred in New South Wales on 10 February at 1635 hrs, with the LOR 2 condition forecast to last until 1730 hrs. AEMO issued Market Notice 57387 to this effect at 1644 hrs. The progressive decline in reserve forecasts during the day is shown in Figure 17.

An actual LOR 3 condition occurred in New South Wales on 10 February at 1650 hrs until 1826 hrs.

Figure 17 Reserve forecasts and actual reserve, 10 February 2017



APPENDIX A. EXPLANATION OF RESERVE LEVELS AND DIRECTIONS

A.1 Lack of reserve (LOR) conditions

The 'capacity reserve' at any point in time is the surplus of available generation in the market. This is capacity notified to AEMO as available for dispatch, but not currently required to meet the level of forecast demand.

The 'contingency capacity reserve' is energy capacity and arrangements required under power system security standards, so power system security can be restored and maintained after one or more contingency events.

As the level of available capacity reserve reduces, 'lack of reserve' or 'LOR' conditions may arise. These are described in clause 4.8.4 of the National Electricity Rules. A simplified explanation is provided below.

Lack of reserve level 1 (LOR 1)

If a credible contingency event with the most significant potential impact on the power system (such as the loss of the largest generating unit, or the loss of an interconnector) was to occur, there may not be enough capacity reserve to restore the contingency capacity reserve.

Lack of reserve level 2 (LOR 2)

If the most significant credible contingency event was to occur, it's unlikely the amount of capacity reserve would be enough to prevent involuntary load shedding.

Lack of reserve level 3 (LOR 3)

Involuntary load shedding has commenced or is imminent to maintain or restore power system security.

A.2 Directions powers

Under the National Electricity Rules, AEMO can direct a generator to run if satisfied that the direction is necessary to maintain or re-establish a secure power system or reliability of supply.

The rules effectively require AEMO to be satisfied of two fundamental elements before issuing a direction:

- Direction is necessary to achieve the required security or reliability outcome. In other words, the market will not resolve the situation unless AEMO intervenes in this way.
- Any directed action will actually achieve the required outcome, either by itself or in conjunction with other measures, in the required timeframe.

In conditions that could ultimately result in AEMO issuing a direction (including declared LOR situations), the National Electricity Rules require AEMO to follow a process to call for a market response if time permits, and assess whether the condition is likely to subside without AEMO intervention.

If a contingency event results in potential or actual supply shortfalls, AEMO must issue the directions or instructions it considers necessary to restore the power system to a secure and reliable state as soon as is reasonably practicable.