Reliability Forecasting Methodology

Industry briefing on AEMO's responses to submissions to its Issues Paper

21 June 2019

Agenda

1. Overview of feedback
2. Reliability gap calculations
3. Assumptions and inputs – Demand side
4. Assumptions and inputs – Supply side
5. Assumptions and inputs – Forced outages
6. Summary and next steps

The consultation process

Deliverables	Dates
Issues Paper published	Wednesday 17 April 2019
Industry Workshop	Thursday 9 May 2019
Submissions due on Issues Paper	Wednesday 22 May 2019
Industry briefing	Friday 21 June 2019
AEMO response	Friday 28 June 2019

Feedback received

- AEMO has received submissions from 13 organisations:

Organisation	
Australian Energy Council (AEC)	Meridian Energy Australia (MEA) / Powershop
AGL	Major Energy Users (MEU)
Energy Queensland	Public Interest Advocacy Centre (PIAC)
EnergyAustralia	Queensland Electricity Users Network (QEUN)
ERM Power	Sliger & Associates
Energy Users' Association of Australia (EUAA)	Snowy Hydro
Flow Power	

- The submissions are available at:
  https://www.aemo.com.au/Stakeholder-Consultation/Consultations/Reliability-Forecasting-Methodology-Issues-Paper

Reliability gap calculations

Existence of a reliability gap

- Forecast reliability gap and its materiality (RRO Draft Rules clause 4.A.A.2):

> For the purposes of section 14G(1) of the *National Electricity Law*, a *forecast reliability gap* occurs in a *region* in a *financial year* if identified in a *reliability forecast* and is *material* if it exceeds the *reliability standard*.
>
> Note
>
> Section 14G(1) of the *National Electricity Law* states –
>
> > A *forecast reliability gap* occurs when the amount of electricity forecast for a *region*, in accordance with the *Rules*, does not meet the *reliability standard* to an extent that, in accordance with the *Rules*, is material.

- The assessment of whether the reliability standard is met is described in the Reliability standard Implementation Guidelines (RSIG) and includes weighting of 10% and 50% POE demand outcomes to derive expected unserved energy.
- The ESOO may assess whether the standard is met against multiple scenarios.
- A reliability gap that triggers a reliability instrument request will however always be based on AEMO's central (most likely) scenario.

Existence of a reliability gap

- Some submissions questioned the use of weighted USE outcomes that use results from the 10% POE, 50% POE and 90% POE simulations in the assessment against the reliability standard.
  - AEMO considers that the calculation of expected USE was never intended to be revised as part of the RRO.
  - Using only the 50% POE demand forecast would be entirely unsuitable for forecasting expected USE. AEMO will continue to forecast expected USE by applying the methodologies set out in the RSIG.

- It was pointed out that a small breach can cause significant compliance costs.
  - AEMO's view is that the RRO is binary, either it is triggered or not and any design will have that feature. By declaring it at T-3, the hope is that it is indeed gone by T-1 as the market responds.

Determining the reliability gap period and likely trading intervals

Key issues raised:

- That the use of LOLP thresholds inconsistent with the reliability standard
- That the approach is subjective and not based on a cost-benefit assessment or economic trade-off
- Conservatism, particularly with regards to the T-3 thresholds.

ERM proposed an alternate approach that was supported by a number of submissions:

- used thresholds based on estimating what would occur under conditions where the reliability standard was just met
- this was **found to be unworkable** and would results in a wider reliability gap period than the method proposed by AEMO.

Determining the reliability gap period and likely trading intervals

AEMO's RESPONSE: increase threshold. No other change warranted.

- An approach which identifies periods based on the probability of lost load does not represent any change in the reliability standard
  - existence of the gap remains tied to the expected USE in comparison to the standard.
- If the gap period is too wide this could lead to over-contracting, and increases costs to the market.
  - But: the cost to market of over-contracting is unknown, making it impossible to perform a cost-benefit assessment to strike the right balance between risk and cost.
- One approach would be to use all periods where USE occurred in simulations where the reliability standard was breached.
  - This would be based directly on modelling results, but could include outages with small likelihood of occurring
- Applying a threshold helps **filter out periods where USE less likely to occur.**
  - Based on feedback, AEMO proposes to increase its threshold to 10% probability of loss of load which captures approximately 90% of intervals where USE occurred in simulations.

Determining the reliability gap period

Issue raised: AEMO's suggestion of only splitting the reliability gap period if two consecutive months do not meet the threshold was questioned, and it was suggested to rather declare multiple reliability instruments.

AEMO's RESPONSE: be more specific about relevant trading intervals within a reliability gap period. No other change warranted.

- Multiple requests would require multiple opt-in registers, and could be overly burdensome and confusing.
- AEMO will maintain the proposed methodology whereby multiple reliability gaps are declared only if there is a 2-month gap between months where the probability of lost load threshold is exceeded.
- AEMO will also use judgement, based on likelihood of lost load, in determining whether additional periods should be excluded through the identification of likely trading intervals.
  - This would remove the need for contracting in these low risk periods (such as holiday periods).

Determining the reliability gap period

Issue raised: that the use of whole months might result in the reliability gap period being unnecessarily and excessively extended.

AEMO's RESPONSE: agree – in these instances, AEMO will consider narrowing gap period, at its discretion.

- Approach now adjusted to allow AEMO to subjectively tighten the gap period (there will be no ability to subjectively extend the period).
  - For example, if all the risk in the simulations occurs in the first week of March and March is above the threshold the end date of the gap period could be set as 10 March

Outline of final approach

- Declaration of a material gap is based on weighted average USE > Reliability standard.

- Reliability gap period:
  - Start-date and end-date based on months where the probability of lost load is above 10%.
    - Any two month gap between months that exceed the threshold triggers a separate instrument request.
    - Periods can be subjectively tightened if the load shedding risks are concentrated towards the start or end of a month.
  - Within each gap period, likely trading intervals based on time-of-day and weekend inclusion based on a 10% threshold on the probability of lost load.
    - Holiday periods and any other periods (e.g. single months with low load shedding risk) can be excluded based on AEMO's judgement.

- For any reliability gap period, the reported 1-in-2 year peak demand forecast will be for the season in which the reliability gap occurs.

Reliability gap period example – start- and end-dates

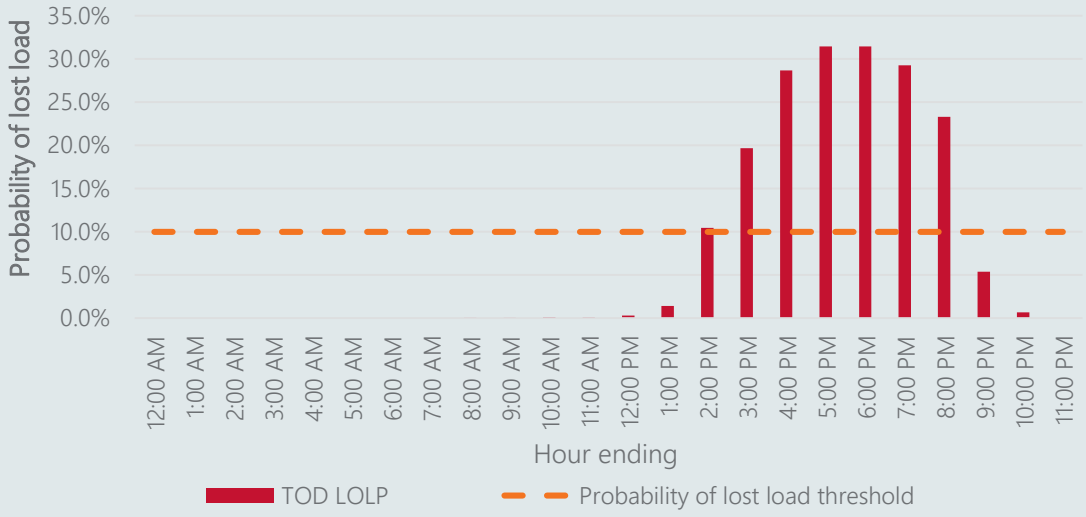
- In this example (NSW 2024-25) only January and February are above the 10% threshold.

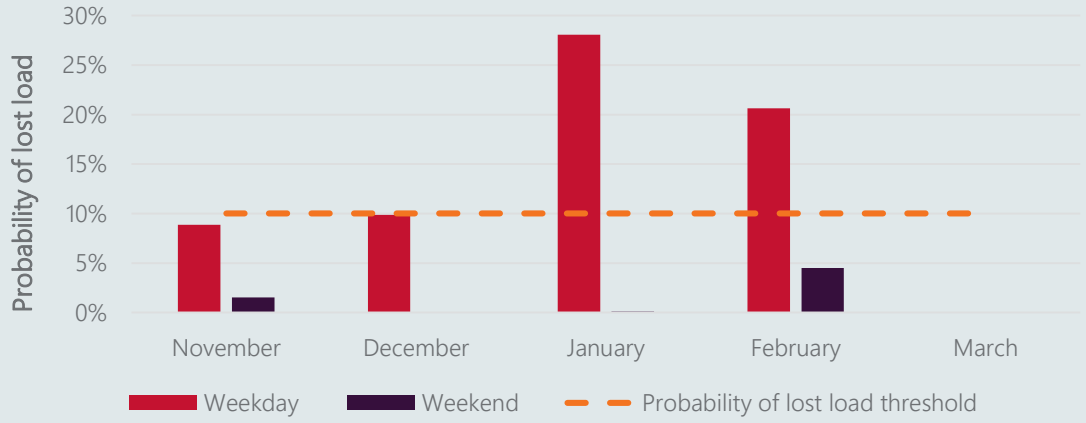
Start date: 1 January

End date: 28 February

Reliability gap period example – likely trading intervals

- Likely trading intervals include intervals between 1 to 8 PM.
- Weekends are excluded in all months.
- Further analysis could result in other exclusions, e.g. 1 January.





Size of the reliability gap

Issue raised: AEMO's proposal to determine the size of the gap assuming availability only during gap period was questioned.

- was argued this would artificially increase size of gap as does not take into account contribution to supply adequacy outside gap period.

AEMO's RESPONSE: disagree – the intention of the RRO is to encourage sufficient contracting within the period where compliance is enforced. To assume any additional MW are available at all other times to improve supply adequacy would be to assume a certain response (eg new generation) which would not be technology neutral.

- AEMO will maintain its proposed approach of assessing the additional MW of capacity required to reduce USE to be at the reliability standard, when applied to periods within the reliability gap period only.
  - The MW gap is equivalent to capacity assumed to be fully firm and reliable over these periods only.

Questions on reliability gap methodology?

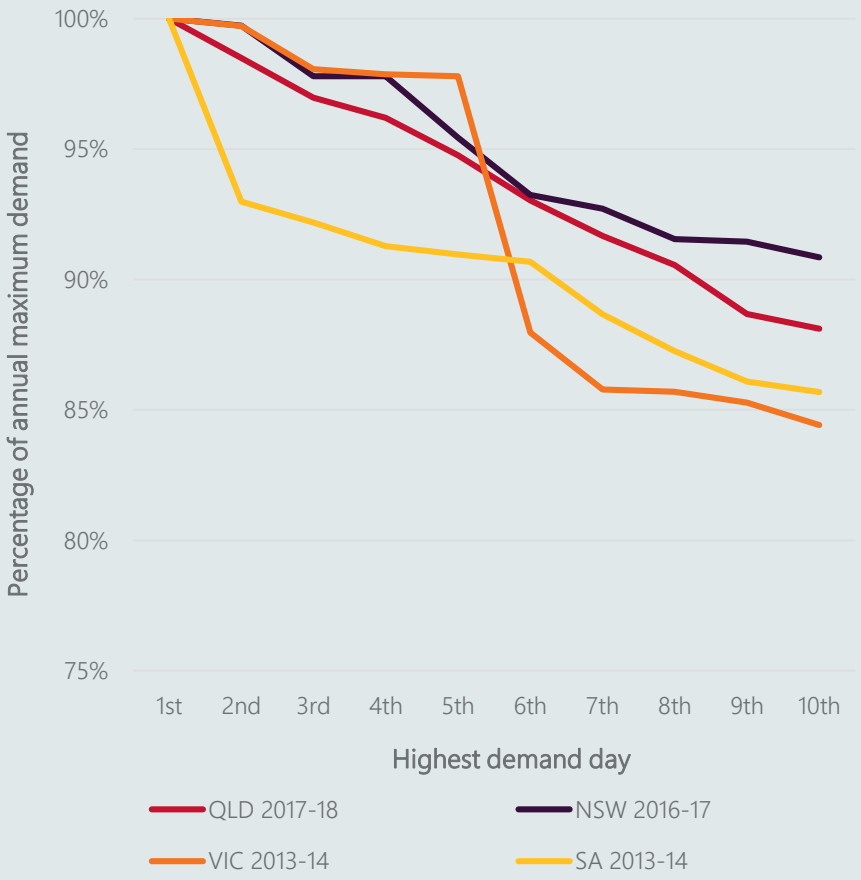
Assumptions and inputs – Demand side

Scaling of demand traces to 10POE

- **Issue raised:** the scaling of benign reference year demand to meet 10% POE targets may create distortions.

AEMO's RESPONSE: agree. AEMO will now only scale up four days in these instances to match shape leading up to, and after, a 10POE maximum demand.

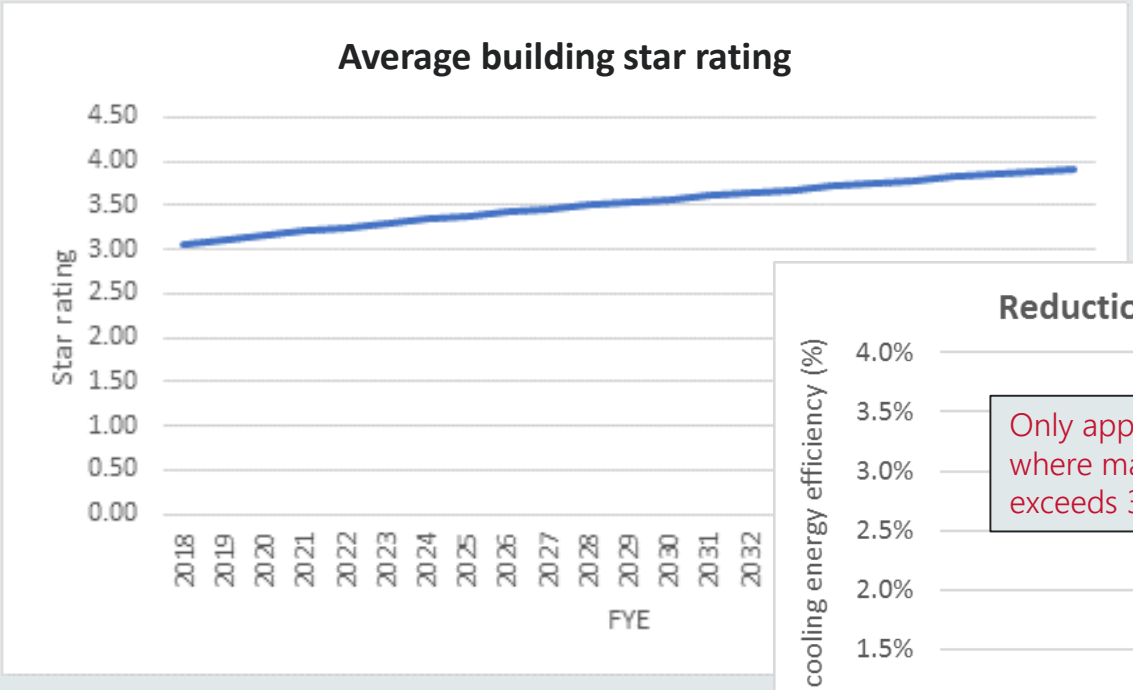
  - broadly consistent with the number of days near to extreme peaks that have been observed historically in New South Wales (2016-17), Victoria (2013-14), South Australia (2013-14) and Queensland (2017-18).
  - No peak days in November will be scaled to Summer max demand levels.

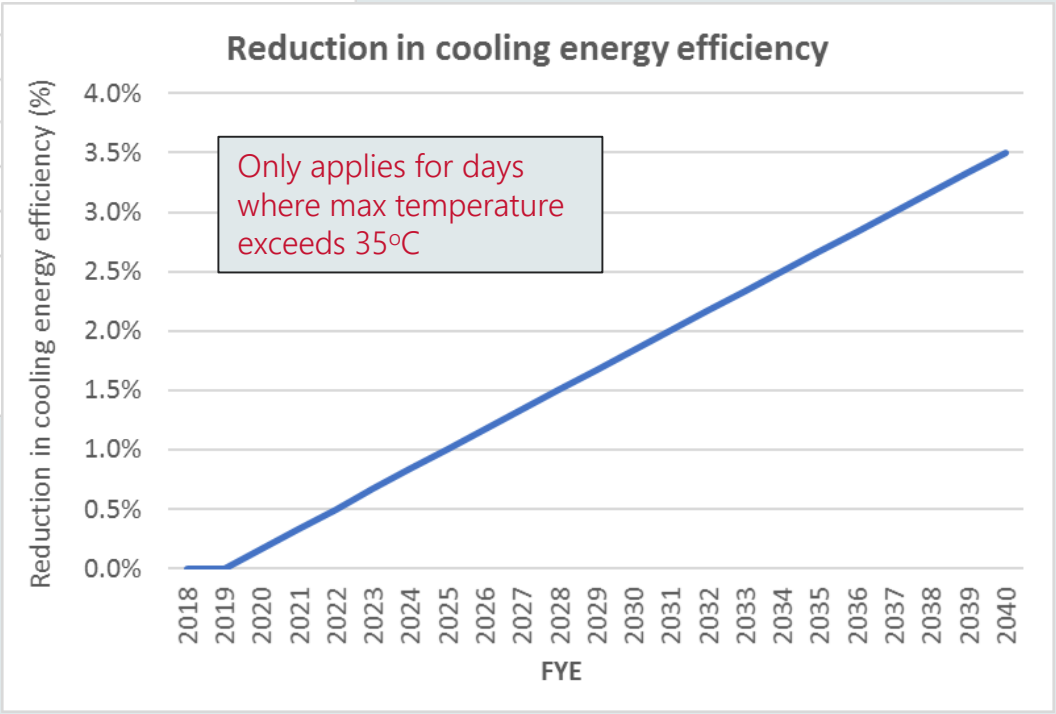


Energy Efficiency
– clarifications sought on assumed reduction in effectiveness during extreme temperatures

- Engaged Energy Efficient Strategies to undertake thermal modelling of a range of building types, air conditioning appliance efficiencies and climate conditions
- Found **improved building insulation had less impact on cooling needs on extreme days than average days.**
  - The effect from the existing building stock is already captured in the existing maximum demand forecast, so no adjustments should be done in the initial year.
  - Based on building stock changes out to 2040, AEMO has calculated 3.4% reduction in cooling efficiency on extreme days and AEMO's model will gradually reach this level.

Energy Efficiency – impact during extreme temperatures





Demand Side Participation

- **Issues raised**:
  - Why only 50% of network reliability programs??
    - Any supply option can fail at time of peak and AEMO does not degrade those by 50%.

AEMO's RESPONSE: accepted counter-argument. AEMO will assume these are 100% available.

  - Why only assuming 50% of historical observed DSP

AEMO's RESPONSE: not proposing to use 50% of historical DSP, but rather uses the 50th percentile of historical response as the best estimate of likely DSP, noting that DSP, like other supply options, is not 100% reliable at all times.

Demand Side Participation

- A number of other DSP issues were also raised, including:
  - Clarification if responses from large industrial loads are captured?
    - Yes, these are also included
  - How does AEMO use the DSP potential provided by participants through the DSP portal?
    - AEMO validate forecast based on historical response against the reported "potential DSP".
  - Why is AEMO not capturing expected growth in DSP from various rules changes?
    - For the 2019 ESOO, it will maintain a current estimated level of DSP, consistent with other supply options, which are only included if committed.
    - AEMO will reconsider adding future growth that is communicated as qualifying contract through its DSP information portal.

Distributed Energy Resources - questions of clarification

- A submission called for improved data capture for DER installations
  - AEMO is getting improved data now from the CER including ESS and non-scheduled PV (previously AEMO only got rooftop PV).
  - The data collection will improve further with the establishment of the DER register at the end of 2019.
  - EV data is also being sought as part of a wider collaboration efforts with industry.
- Further information on how non-scheduled PV is forecast
  - Current installations are based on data provided by the CER along with the Australian PV Institute. Checks are also performed against other sources.
  - Forecasts are procured by consultants and their methodologies have been published.
- It was noted that consultants do have different views and questioned what AEMO would do with different consultant forecasts.
  - AEMO has reviewed the different consultant forecasts, discussed them with industry and selected the projections that align best with the scenario narratives.

Questions on demand assumptions?

Assumptions and inputs – Supply side

Supply forecasts – new entrant generation

- **Issue raised:** opposed AEMO's proposal to exclude Com* projects from the reliability forecast. Requested more clarity on the reasons for this assumption.

- Various alternatives were proposed:
  - ERM: additional criteria in generator status methodology and to include advanced projects where construction has commenced and completion is expected within the T-3 period.
  - MEA/Powershop: At least in T-3 forecast to use a proportion of Com* projects.

AEMO's RESPONSE: will include Com* in T-3, but tighten criteria.

- AEMO's proposal to not include Com* was to ensure that the Reliability Forecast does not make too many assumptions around future improvements in reliability that are not certain.
- Prior to 2018, the ESOO only included committed generation. AEMO has extended this to include plant that are progressing towards meeting the commitment criteria.

Supply forecasts – new entrant generation

- Proposed new Com* criteria:
  - projects that have "started construction" and
  - are "advanced" (i.e. have met all AEMO's commitment criteria other than either the planning or components criteria).

- **Com* projects will be included beyond the T-1 forecast**. Any project that has a proposed start-date within the T-1 window will be delayed until after the end of the T-1 financial year.
  - The exclusion from the T-1 window is based on observations that a number of Com* projects from the 2018 ESOO were delayed, and in general the ESOO overestimated renewable capacity available in the 2018-19 summer
- Some submissions suggested observing historical performance to inform assumptions re inclusion of Com*.
  - This is challenging as Com* is a relatively new category.
  - AEMO will monitor the performance of Com* projects and may adjust the approach moving forward.
- AEMO will look to formalise the approach through a change to the RSIG.

Supply forecasts – dispatchable generation availability

- **Issue raised:** use of a single summer capacity based on the regional reference temperature across the entire summer period.

- A number of submissions proposed using a de-rating vs temperature relationship.
- The MEA/Powershop submission proposed a new approach.
  - In high demand/temperature days and days which immediately follow, the summer reference temperature capacity will be used.
  - In other days during summer, an alternative (potentially higher) capacity will be used.

AEMO's RESPONSE: will explore development of this approach, informed by historical analysis, in future ESOOs and MTPASAs.

- This approach is not able to be applied in time for the 2019 Reliability Forecast. The change is unlikely to have a material effect on USE as the vast majority of USE occurs in the top 3 days within any year of the forecast.
- Some submissions questioned the approach to partial outages and temperature deratings. AEMO does not believe this is an issue as the partial outages submitted by participants should not include temperature deratings.

Questions on supply assumptions?

Generator forced outages

2018 ESOO forecast accuracy review

- The following slides show a comparison of generator availability from the 2018 ESOO simulations compared to the previous two years of actual outcomes.

- Historical data is based on four hours from the top 10 hottest temperature days within each region. The four hour period is based on the time of maximum temperature during that day.

- Forecast data is based on four hours of data from simulations of 10 summer days. The range shows the availability from the highest to lowest for the 2.5th and 97.5th percentiles.

Victorian Brown Coal

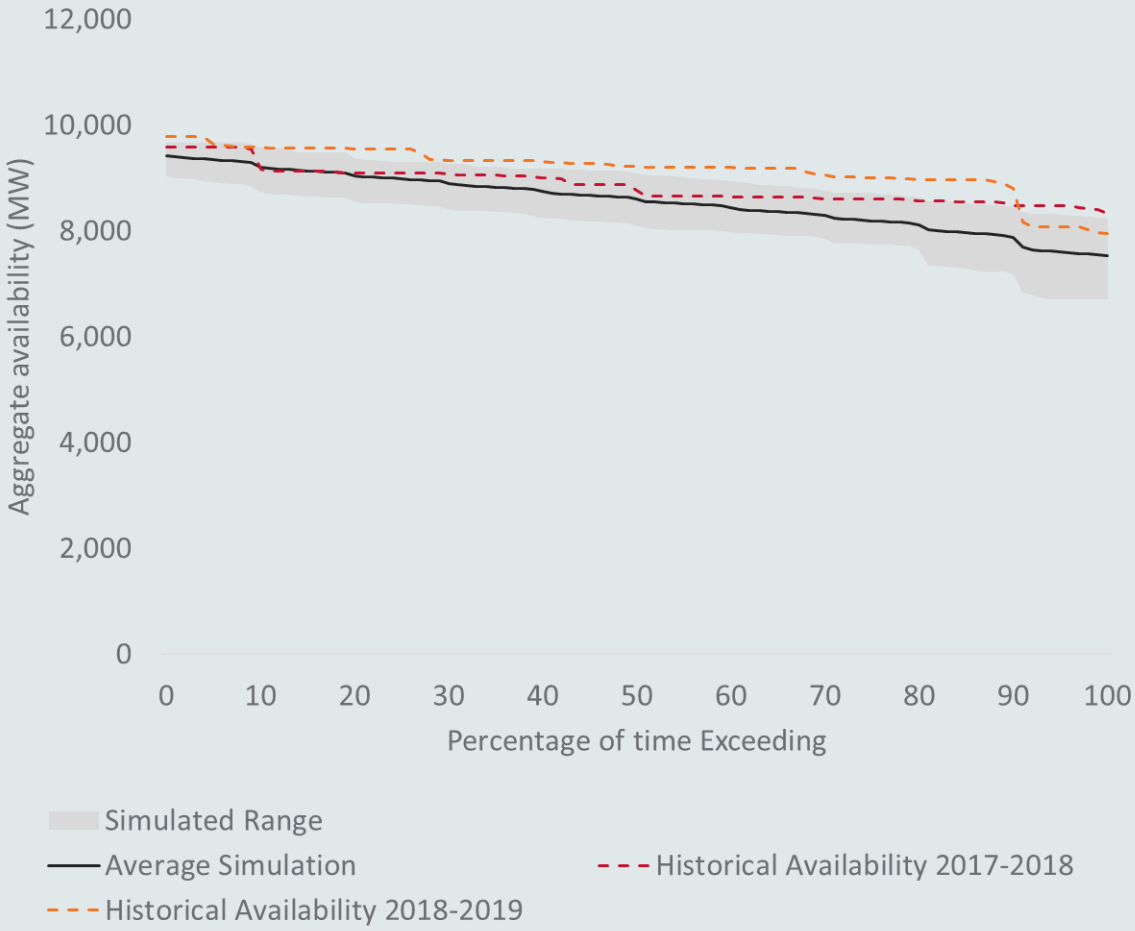
Dotted line is adjusted for planned maintenance.

Planned maintenance events are not considered in the modelling as they are normally conducted in low risk periods

NSW Black Coal

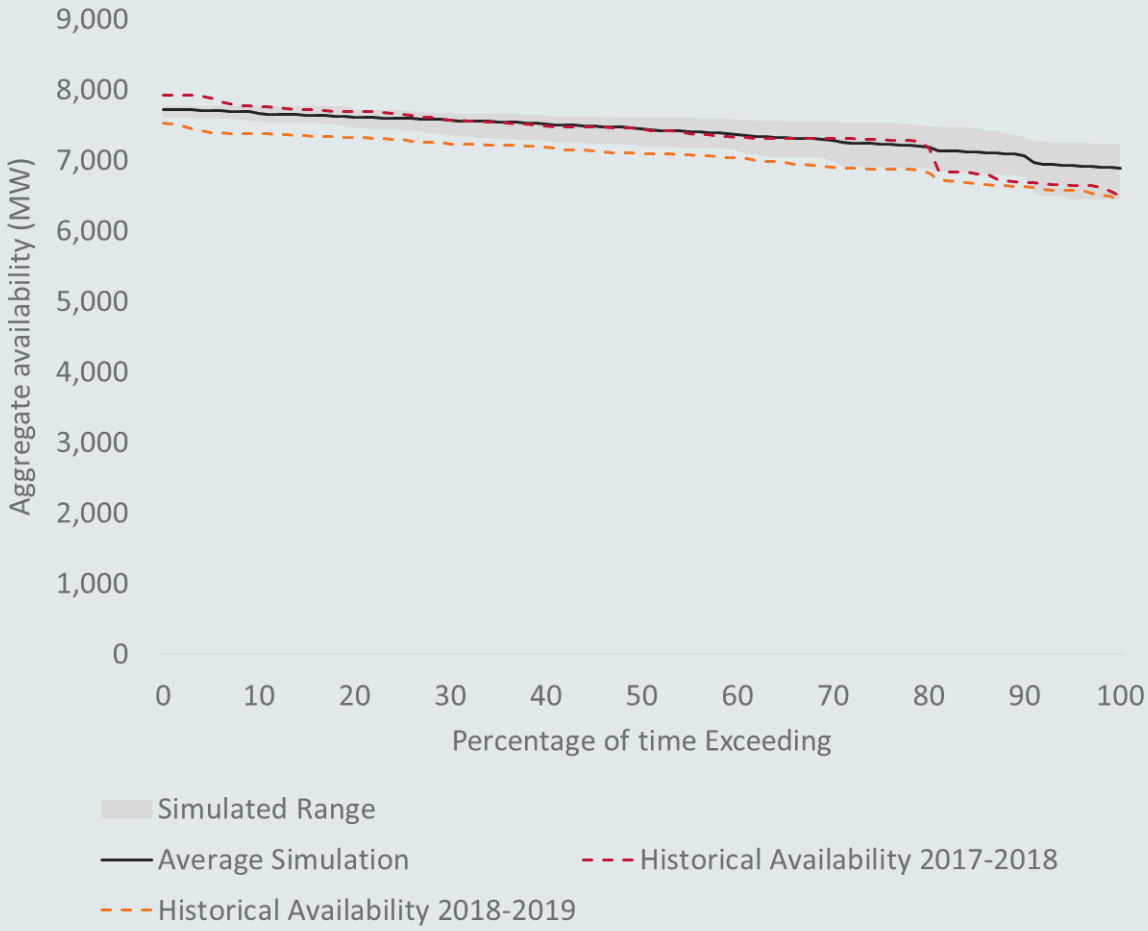
The capacity values from history that exceed the range are due to generators operating above their rated summer capacities; and the effective outage rate during the high temperature periods was lower than average outage rates throughout the year.

In general, temperatures were relatively mild in NSW in summer 2018-19.



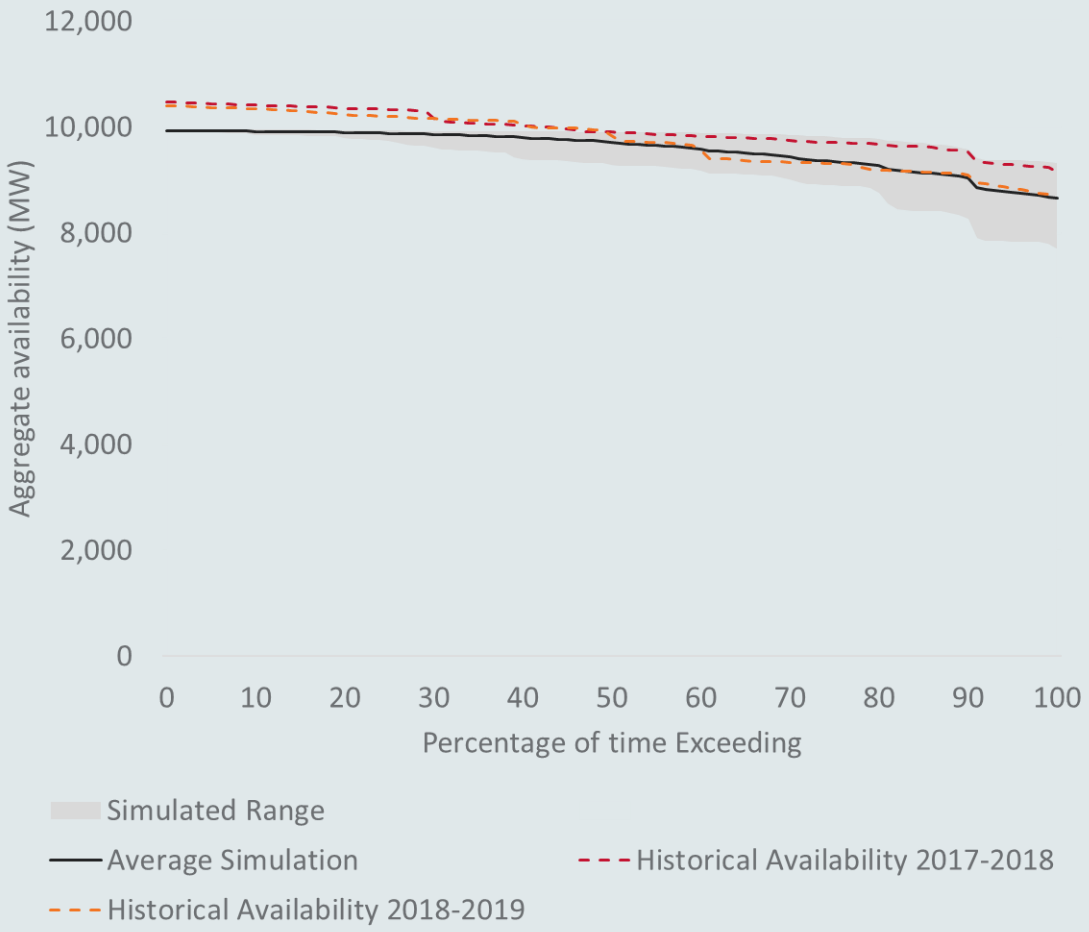
Queensland Black Coal

Queensland has a surplus of available capacity relative to maximum demand, so there are periods where capacity may not be offered as available, as it was not required despite the extreme temperature.



Gas & Liquid

The main reason observed availabilities are higher than simulated outcomes is that many generators outperformed their rated summer capacity



Insights from 2018-19 analysis

- There is no systematic bias that is resulting in an overestimation of the likelihood of high levels of unavailable capacity in summer periods, but there is variability within technologies.
- No evidence of a consistent bias towards higher or lower reliability during hot temperatures, and therefore no need for temperature dependent forced outages.
- An enhanced approach to modelling summer capacity where summer ratings corresponding to peak demand temperatures are applied for a subset of the summer period could improve modelling accuracy. AEMO is looking at additional data that will be required from participants to implement this approach.
- An approach which captures the greater level of year-to-year variability in generator performance would assist in better modelling the range of outcomes that occur during high temperature periods.

Forced Outage Rates – data collection

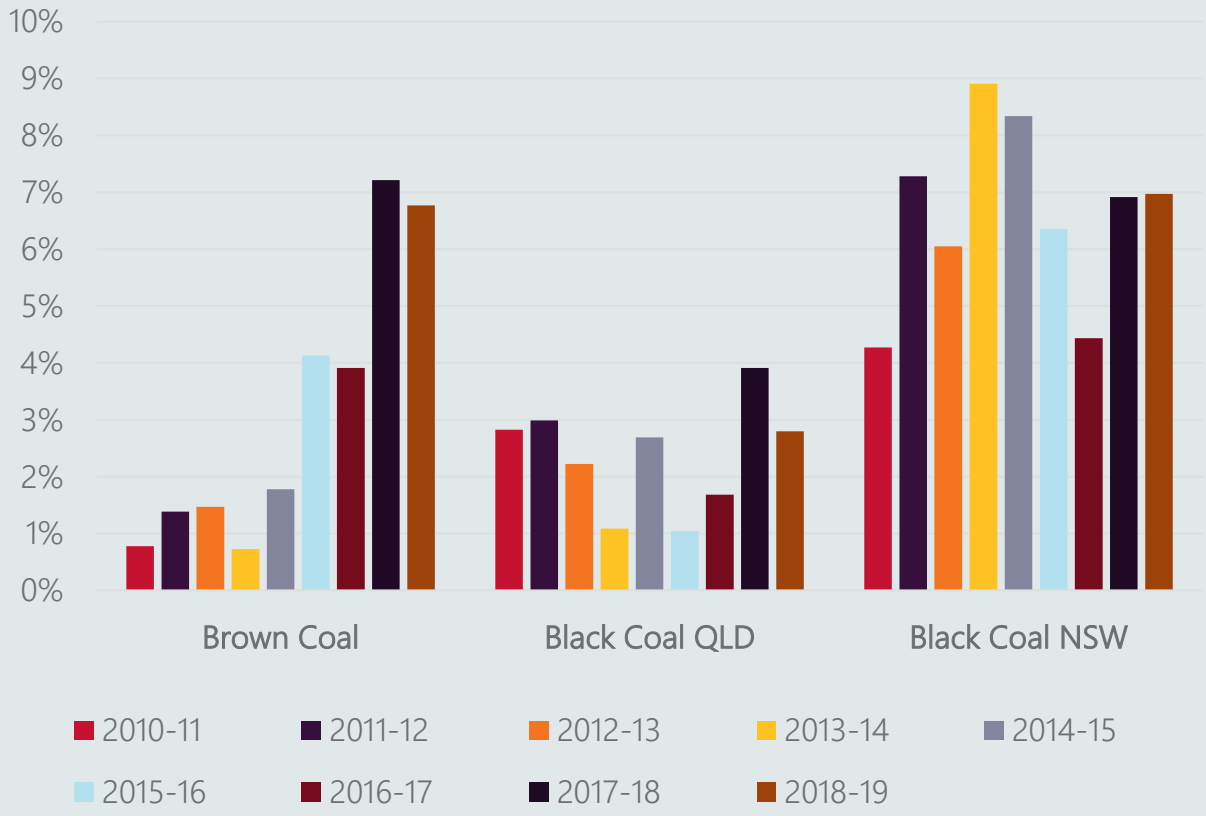
- Market participants are required to submit to AEMO 'Forced Outage' data every year for each generator unit.

- AEMO use this historic data to calculate 'Forced outage rates', 'Partial outage rates', 'Partial derating' and 'Mean times to repair' which are used in both ESOO and MTPASA models.

- AEMO requested outage information in April and have processed the latest data.

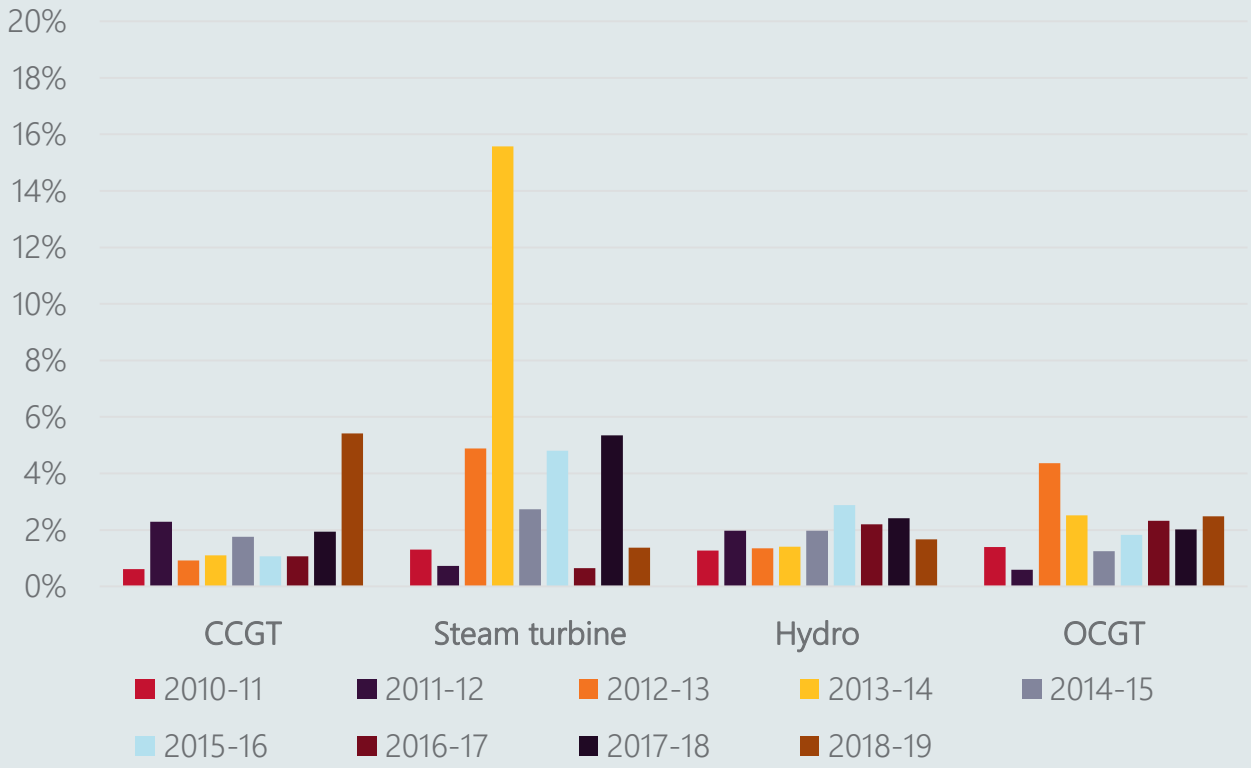
Forced Outage Rates – outcomes

- We see an upward trend in brown coal outage rates.
- A standard t-test with full unplanned outage rates sampled for 2010-11 to 2014-15 and 2015-16 to 2018-19 indicates less than 1% probability that the two samples are from the same population.



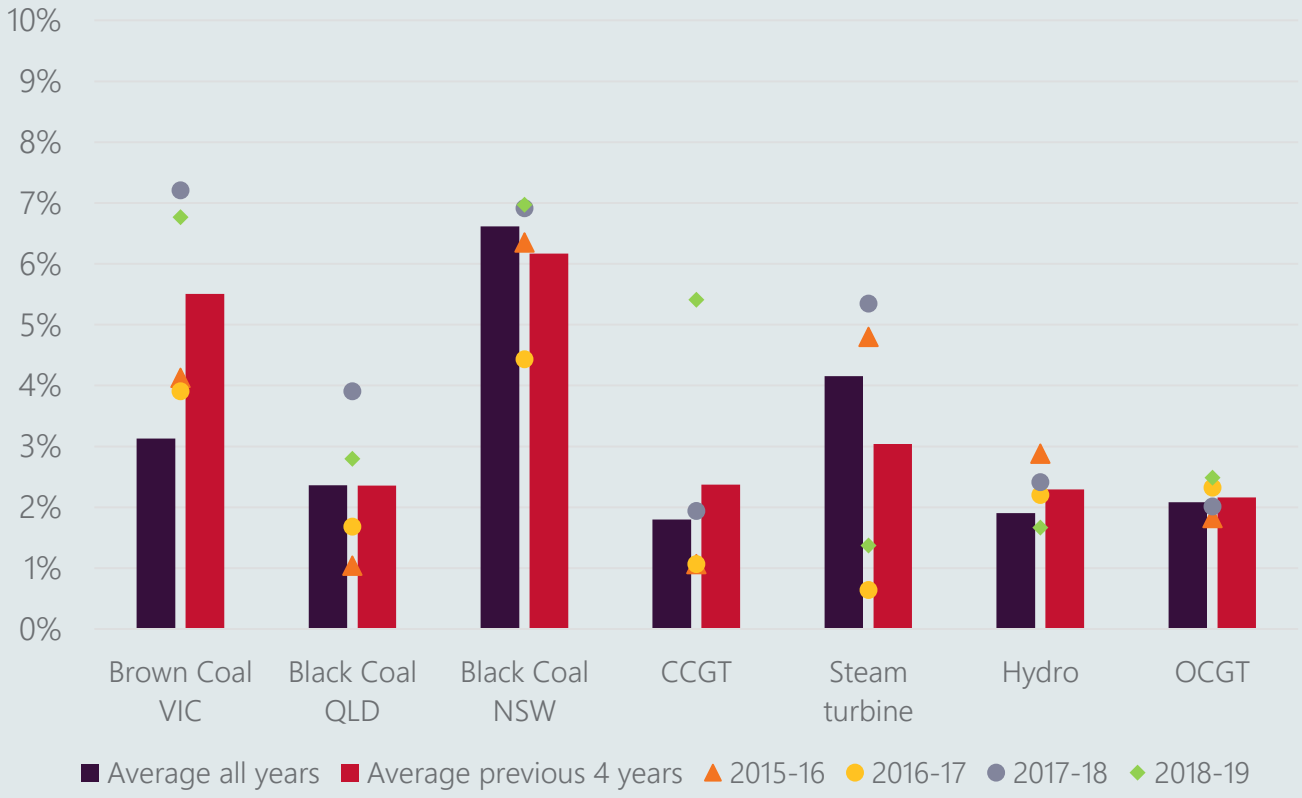
Forced Outage Rates – outcomes

- 2018-19 a mild outlier for CCGT due to the poor performance of a number of CCGT units, possibly because of changes in operating regimes.
- Steam turbine the most volatile aggregation, but also has relatively few stations.
- No consistent trends in these aggregates.



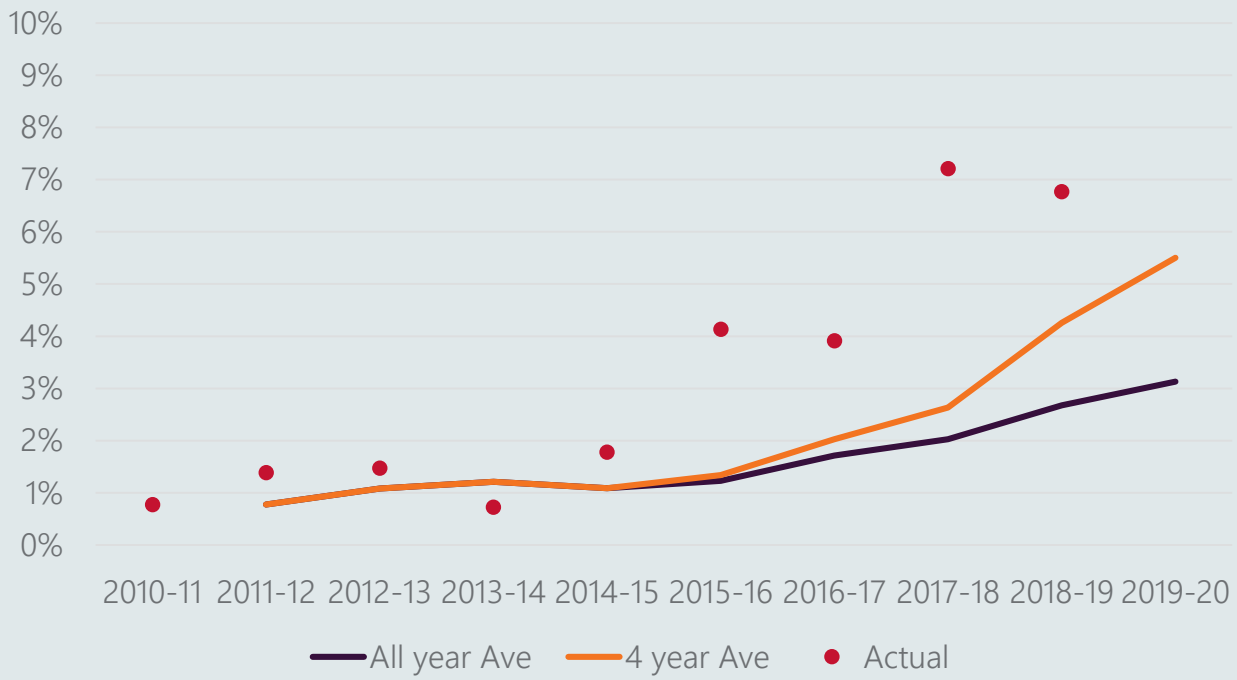
Forced Outage Rates – outcomes

- Chart shows average of all years vs average of 4 years
- Biggest change is in VIC Brown coal. The previous four years of observed outages are all well above the all year average
- All other aggregates are relatively similar.



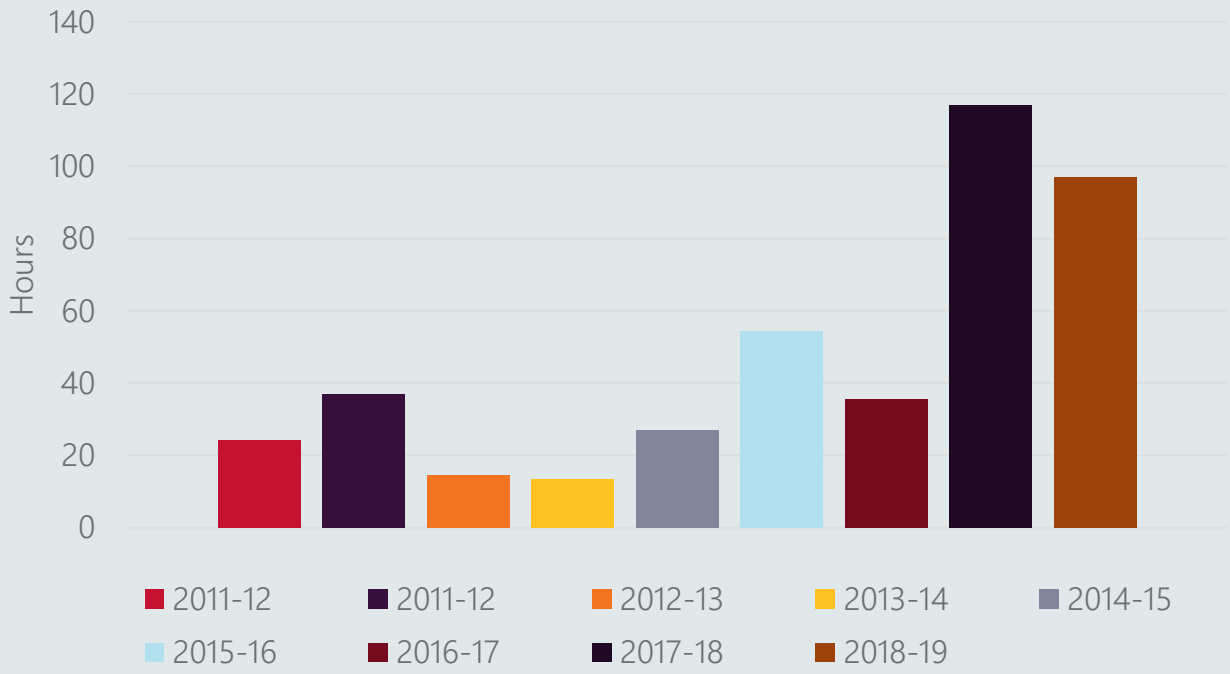
Brown coal Forced Outage Rates – outcomes

- Figure shows the relative performance of a rolling 4-year average compared to using all available years.
- Clearly shows the 4-year average performance would have performed better in all years.



Brown coal MTTR chart

- Main driver for increase in Brown coal FOR is the mean time to repair, i.e. when outages occur the units are taking longer to be brought back online.



Application of forced outage rates

How historical rates are used by AEMO in modelling

Forced Outage Rates – outline of new approach

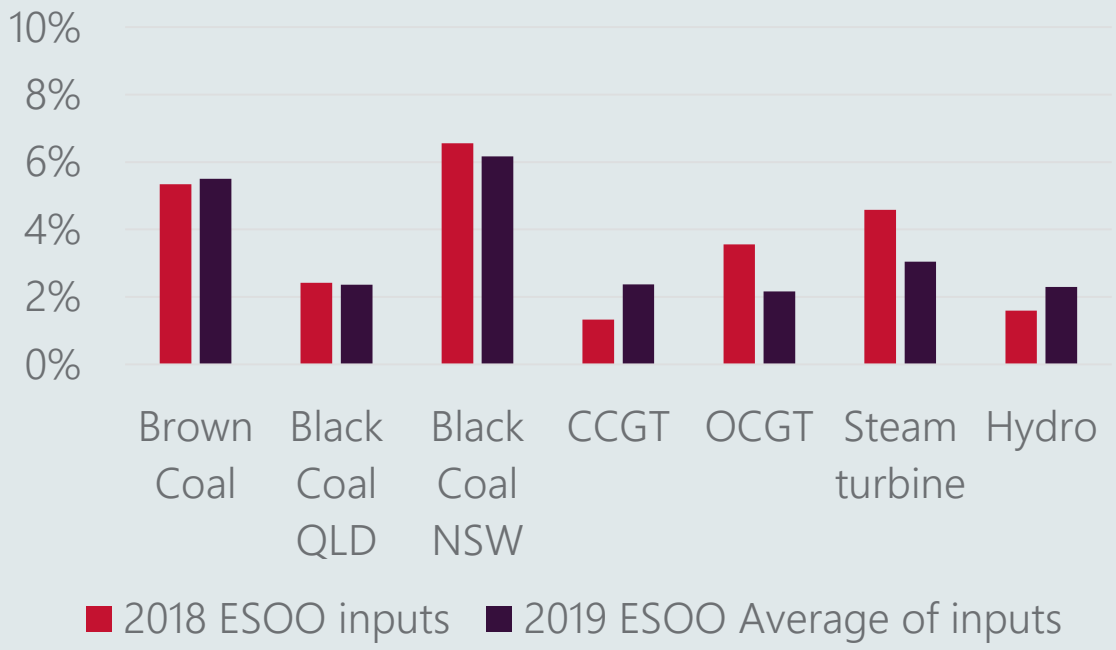
- Previously AEMO has used FOR data calculations based on aggregations by fuel types and averaged across multiple years of data.
- In the 2019 ESOO AEMO will be using FOR data based on 4 separate years and having large thermal generators use their station level rates.
- This will allow modelling to better capture the range of outcomes observed historically.
- To protect the confidentiality of this data, AEMO will only publish calculated outage parameters on a technology aggregation level.

Forced Outage Rates – 2018 vs 2019 ESOO

On average, outage rates are not changing significantly from the 2018 ESOO.

Key drivers:

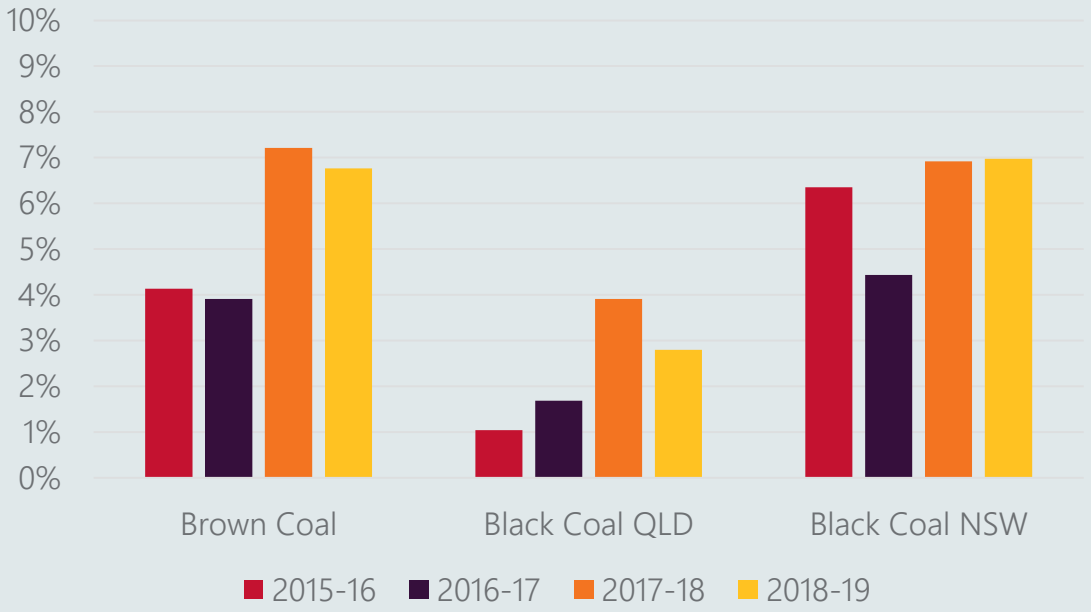
- Continued poor performance of brown coal.
- Relatively high 2018-19 outage rate for CCGT.
- Using 4 years for OCGT and steam turbine.



Forced Outage Rates – 2019 ESOO

Shows the aggregation values of the full outage rates that will be applied in the model.

Each station will have four values which will have equal weighting.



Brown Coal FOR Sample Outcomes

- Small range of outage outcomes when using only 1 rate
- 1 rate does not give the range of outcomes we see historically
- Significant difference between all years and last 4 years

Forced Outage Rates – revising calculated rates

- AEMO received all of the 2018-19 forced outage data.
- On 24 May, AEMO sent letters to all generators documenting the outage parameters and auxiliary rate that are to be applied to their power stations.
- All power stations had the opportunity to provide an alternative set of outage parameters and/or auxiliary rate.
- Only one generation company proposed alternative FORs, this proposal is currently under review.

Questions on forced outages?

Summary and next steps

General conservatism

- A number of submissions raised concerns about AEMO's approach being overly conservative.
- AEMO believes the proposed changes outlined today address concerns raised in the submissions.
- AEMO does note that the RRO is intended to be consistent with the ESOO calculation of USE, which is based on only including actions that have a firm commitment to proceed.
  - When considering reliability three years into the future there is inherently less confidence that other actions are likely to proceed. In our view this does not represent a conservative approach.
  - Inclusion of Com* projects in addition to those who fully meet the commitment criteria does already allow more supply than what has traditionally been assumed in the ESOO.
- AEMO also finds the current approach does not assume things will deteriorate, but rather AEMO will insure that modelling does not assume things will improve without reasonable grounds to believe so.

Other issues raised

- In addition to issues discussed in this briefing, a number of other issues has been raised.
- This includes discussion about forecast accuracy, process improvements and how to present information better.
- AEMO's published determination will include responses to those.

AEMO would like to thank all who has contributed with submissions and other feedback throughout the process

Next steps

- Wednesday 26 June – Presentation of final forecasts to FRG.
- Friday 28 June – Expected publication of Final Determination to the consultation of AEMO's Reliability Forecasting Methodology Issues Paper.
- August 2019 – Publication of 2019 ESOO, including the 2019 Reliability Forecast
- September/October 2019 – Consultation start on Interim Reliability Forecasting guidelines
- December 2019 – Publication of Interim Reliability Forecasting guidelines