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Dear Martin,

Review of 2018/19 Margin Values error correction

AEMO has engaged Robinson Bowmaker Paul (RBP) to review certain aspects of the 2018/19 Margin_Peak and Margin_Off-peak (margin values) modelling undertaken by Jacobs. The purpose of the review is to:

- Provide assurance that errors discovered by Jacobs during sensitivity analysis have been corrected in the latest 2018/19 model and report; in particular that the 2018/19 margin values are based on corrected inputs.
- Form a view of the impact of these errors with respect to the 2018/19, 2017/18 and 2016/17 margin values modelling.

The errors referred to above are described in more detail in the body of this letter.

Regulatory context and background

Clause 3.13.3A(a) of the Wholesale Electricity Market Rules (the WEM Rules) require AEMO to propose annually Margin_Peak and Margin_Off-peak values that are used in the calculation of spinning reserve payments to Synergy:

(a) by 30 November prior to the start of the Financial Year, AEMO must submit a proposal for the Financial Year to the Economic Regulation Authority:

- for the reserve availability payment margin applying for Peak Trading Intervals, Margin_Peak, AEMO must take account of:*

1. *the margin Synergy could reasonably have been expected to earn on energy sales forgone due to the supply of Spinning Reserve Service during Peak Trading Intervals; and*
 2. *the loss in efficiency of Synergy's Scheduled Generators that System Management has scheduled (or caused to be scheduled) to provide Spinning Reserve Service during Peak Trading Intervals that could reasonably be expected due to the scheduling of those reserves;*
- ii. *for the reserve availability payment margin applying for Off-Peak Trading Intervals, Margin_Off-Peak, AEMO must take account of:*
1. *the margin Synergy could reasonably have been expected to earn on energy sales forgone due to the supply of Spinning Reserve Service during Off-Peak Trading Intervals; and*
 2. *the loss in efficiency of Synergy's Scheduled Generators that System Management has scheduled (or caused to be scheduled) to provide Spinning Reserve Service during Off-Peak Trading Intervals that could reasonably be expected due to the scheduling of those reserves[.]*

Clause 9.9.2(f) of the WEM Rules prescribes the calculation for the availability payment to be made to Synergy in a given trading interval, which includes the margin values and the balancing price in that interval as inputs:

$$\begin{aligned}
 &SR_Availability_Payment(t) = \\
 &0.5 \times \text{Margin}(t) \times \text{Balancing_Price}(t) \\
 &\times \max(0, SR_Capacity(t) - LF_Up_Capacity(t)) \\
 &- \text{Sum}(c \in CAS_SR, ASP_SRQ(c, t)) \\
 &+ \text{Sum}(c \in CAS_SR, ASP_SRPayment(c, m) / TITM)
 \end{aligned}$$

The various terms in the equation above are defined in Clause 9.9.2 of the WEM Rules.

Clause 9.9.2(f) is relevant because Jacobs:

- Simulate the market to model the availability cost and balancing price under different reserve provision scenarios
- Use the equation in 9.9.2(f) to back-calculate the margin values given the modelled availability cost, modelled balancing price and other inputs.

Scope of the review

Our review is restricted to:

- Ensuring the errors detailed in the section below have been corrected for the 2018/19 margin value exercise.

- Forming a view on the impact these errors on the 2018/19, 2017/18 and 2016/17 analyses.

Our scope excludes review of:

- The overall methodology used
- Modelling outputs not related to the errors described below. In particular, in reviewing model outputs we have focussed on verifying that the identified errors have been corrected, as opposed to looking for other errors. Where manifest errors are noted, we would notify AEMO; however, we have not detected any manifest errors during our review.

Approach

We have conducted our review by:

- Reviewing Jacobs' report on the 2018/19 Margin Value analysis
- Reviewing pertinent provisions of the WEM Rules
- Discussing the nature of the errors with AEMO and Jacobs
- Undertaking a walkthrough of the market model use by Jacobs to model margin values
- Examining selected model outputs¹ and availability cost spreadsheet outputs.

To facilitate this review, AEMO has exercised clause 10.2.6(d) of the WEM Rules and provided us confidential information obtained by AEMO during the margin value consultation process. Therefore, we are unable to provide detailed descriptions of our review without breaching confidentiality provisions. For this reason, this letter of comfort presents a high level overview of our review. We have, however, provided to AEMO a detailed addendum that describes in greater detail our review.

Nature of the errors in modelling

Jacobs and AEMO have discovered three errors during the modelling of the 2018/19 margin values:

- *Fuel input error*: The error in the modelling was that one of the gas plants was modelled as only having access to contract gas and distillate, when it should have had access to non-contract gas as well. The consequence of this error is that in some circumstances the plant with the incorrect fuel input was incorrectly displaced or

¹ Fuel offtake, fuel cost and spinning reserve cleared.

constrained. Jacobs has addressed this issue by correcting the fuel inputs to ensure the plant with the input error has access to non-contract gas. We have verified this correction (our analysis is detailed in the *Findings* section).

- *Spreadsheet error in availability curve calculation.* Clause 9.92(f) of the WEM Rules, specifies Availability Cost as a function of the margin values and the balancing price (amongst other inputs). Availability cost is modelled under four reserve provision scenarios and the final availability cost used to back-calculate the margin values is a function of these modelled availability cost values. The error in the modelling was that the balancing price used to determine the availability cost in two of the reserve provision scenarios was incorrect. Jacobs has corrected this error for the 2018/19 margin values modelling and we have verified this correction (our analysis is detailed in the *Findings* section).
- *Spinning reserve error.* Jacobs allocated a non-Synergy plant significant spinning reserve capability when that plant should have been providing zero spinning reserve. The result of this error was that Synergy's spinning reserve provision was reduced along with its additional start-up and generation costs; the availability cost was correspondingly lower than it should have been (as were the margin values). Jacobs has corrected this error by assigning the plant zero spinning reserve capability in the latest model version. We have verified this correction (our analysis is detailed in the *Findings* section).

The first two errors have existed in previous models, while the third was introduced during the 2018/19 modelling exercise

Findings

Fuel input error

Based on our walkthrough of Jacobs' model and analysis of model data we note the following:

- For the 2018/19 model our analysis sought to check whether the fuel input error described in the previous section has been corrected:
 - Jacobs has corrected the fuel inputs in their market model to ensure the gas plant which previously had the input error has access to non-contracted gas.
 - The fuel offtake outputs indicate that the gas plant with the fuel input error now has access to non-contract gas.

- The fuel cost and fuel offtake outputs further confirm that the fuel price inputs have been specified as advised to us by Jacobs and as sighted by us during our walkthrough.
- For the 2016/17 and 2017/18 modelling our analysis sought to check whether the fuel price input would have had an impact on the modelling, and if so the potential impact of the error:
 - As above, we have back-calculated fuel price to confirm historical fuel price inputs and can confirm that the fuel price inputs have been specified as advised to us by Jacobs.
 - We have noted days where the fuel input error may have led to the plant with the input error being displaced or constrained. It is very difficult to quantify the exact impact of this error without rerunning the model. However, we can form an informed view about whether the error was likely to have a significant impact based on our understanding of the modelling and the model outputs that we have reviewed. Our review indicates that the plant with the input error never ran on the more expensive alternative fuel it had access to during the modelled years (indicating that there was sufficient gas plant to provide spinning reserve). We can therefore conclude the plant would have been substituted with another gas plant; noting that the model would attempt to minimise overall cost and therefore select the next cheapest plant. This, combined with other analysis we have conducted², suggests that the impact of the error (quantified by the difference in the marginal cost of the plant with the input error and the marginal cost of the substituting gas plant) is unlikely to be significant. We further note that the WEM Rules do not provide a mechanism for the ERA to revise published margin values³ nor for AEMO to use revised margin values in a settlement adjustment⁴.

Balancing Price Error

- For the 2018/19 modelling, we have reviewed the output spreadsheets:

² As noted above, we are unable to disclose the specific nature of the analysis due to confidentiality reasons.

³ Refer to clause 3.13.3A and 3.13.3B of the WEM Rules.

⁴ Refer to clause 9.19.1 of the WEM Rules.

- We have confirmed that the correct balancing price is used in all reserve provision scenarios and that the final availability cost and margin values are calculated correctly (given the modelling outputs).

We have recalculated availability cost in the two previously incorrect scenarios using the incorrect balancing prices to determine impact. The impact of the incorrect price on overall availability cost and margin values is minor (see Table 1).

Table 1: Impact of balancing price error on 2018/19 results

	With error	Without error	Absolute difference	Relative error
Margin off-peak	38.0401%	37.5776%	-0.00462	-1.23%
Margin peak	28.1030%	27.5955%	-0.00508	-1.84%
Availability Cost (\$M)	10.31	10.06	-0.24	-2.43%

- For the 2016/17 and 2017/18 modelling we have recalculated availability cost in the two previously incorrect scenarios using the correct balancing prices and compared the results to the published historical results to determine impact. As above, the impact on overall availability cost and margin values is minor (see Table 2 and Table 3).

Table 2: Impact of balancing price error on 2016/17 results

	With error	Without error	Absolute difference	Relative error
Margin off-peak	38.0401%	37.5776%	-0.00462	-1.23%
Margin peak	28.1030%	27.5955%	-0.00508	-1.84%
Availability Cost (\$M)	10.31	10.06	-0.24	-2.43%

Table 3: Impact of balancing price error on 2017/18 results

	With error	Without error	Absolute difference	Relative error
Margin off-peak	63.9964%	64.3791%	0.00383	0.59%
Margin peak	35.5752%	36.1731%	0.00598	1.65%
Availability Cost (\$M)	13.15	13.36	0.21	1.56%

Spinning reserve error

Based on our walkthrough of Jacobs' model and analysis of model data we note the following:

- We have sighted the latest Plexos model and verified that inputs for the plant with the erroneous spinning reserve capability has now been updated to reflect zero spinning reserve capability.
- We have viewed model outputs showing the amount of spinning reserve cleared for the relevant plant in all half hour intervals (for scenarios where spinning reserve was activated) and have confirmed that no spinning reserve is cleared for the plant. We have also viewed (via screen share) the Plexos solution database showing that no reserve is cleared in 2018/19 for the plant.
- We have compared the latest availability cost and margin value outputs to those produced in the last iteration of modelling⁵ to see the impact of the error. The differences in results are summarised below. As expected, the availability cost in the latest iteration has increased as a result of Synergy providing more spinning reserve and incurring additional start up and generation costs (thereby increasing the availability cost and correspondingly the margin values⁶).

Table 4: Impact of spinning reserve error on availability cost and margin values

	Last iteration*	Latest iteration	Difference	% Difference
Margin off-peak	38%	71%	34%	89.82%
Margin peak	28%	34%	6%	22.12%
Availability cost (\$M)	10.15	13.15	3.00	29.56%
Off-Peak availability cost (\$M)	3.18	5.16	1.97	62.08%
Peak availability cost (\$M)	6.97	8.00	1.03	14.72%

⁵ In the last iteration, the fuel constraint and balancing price errors described above had already been corrected.

⁶ Note that the relative increase in margin values (90% for margin off-peak and 22% for margin peak) is greater than the relative increase in the availability cost (62% for peak and 15% for off-peak) as a result of the average peak and off-peak balancing prices decreasing in the latest model run.

Conclusion

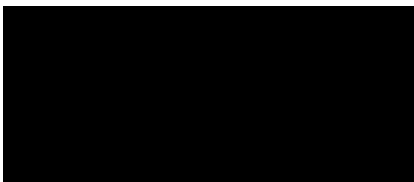
Based on our review we conclude:

- Jacobs has corrected the fuel input, balancing price and spinning reserve errors described in this letter for the 2018/19 margin values modelling.
- The impact of the fuel input error on the 2016/17 and 2017/18 modelling is unlikely to be significant.
- The impact of the balancing price error on the 2016/17 and 2017/18 modelling was minor as indicated in Table 2 and Table 3.
- The impact of the spinning reserve error (compared to the last iteration of modelling in which the fuel constraint and balancing price errors had been corrected) is summarised in Table 4 and is moderate (with margin values increasing by 22%-90% and availability cost by 15%-62% in relative terms).

Limitation of liability

This letter of comfort has been prepared by Robinson Bowmaker Paul Limited for the AEMO based on information supplied by AEMO and Jacobs. To the maximum extent permitted in law, Robinson Bowmaker Paul excludes all liability to any other persons for any loss or damage, whether direct or indirect and however caused (including through negligence) that may be suffered as a result of reliance on this letter by that third party.

Yours sincerely,



Sue Paul

Principal