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## Improving the accuracy of intermittent generation forecasts

Transpower appreciates the opportunity to respond to the Authority's issues paper *Improving the accuracy of intermittent generation forecasts* published 14 June 2023.

Transpower supports the Authority investigating options to improve the accuracy of intermittent generation (IG) offers. The current arrangements for IG participation are likely to soon be inadequate for supporting short-term security on the power system. We expect this work will be the start of an ongoing need to evolve the inclusion of IG resources into the market and operational processes as the proportion of IG on the supply side increases<sup>1</sup>. We look forward to collaborating with the Authority on continuous improvement of IG forecasting through the Future Security and Resilience project, other market development initiatives, and the upcoming renegotiation of the SO service provider contract.

Transpower has recently taken steps to improve its forecasting capabilities. It has:

- completed a tender for a load-forecast-as-a-service,
- sourced a wind generation forecast for System Operations use, and
- engaged with weather forecast providers in relation to both.

We expect lessons learned from these developments will be valuable should the Authority choose to progress with a centralised forecasting model. We also strongly recommend Authority staff engage directly with AEMO's Operational Forecasting team to learn from their experiences of IG forecasting models.

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<sup>1</sup> For instance, [AEMO's centralised solar and wind energy forecast model](#) has evolved to comprise two weather forecast vendors, two IG forecast vendors, and is supported by a team of 14 curating the forecasts and their implications for the market and power system operations. Reflective of the increasingly central role IG plays in both the Australian power system and the NEM.

Transpower makes the following general observations arising from the issues paper:

*Impact analysis only focuses on economic costs not operational risk*

The Authority's impact analysis focusses on the economic cost impact of inaccurate IG offers and only gives a 'light-touch' to the operational risk caused by the same inaccuracies. Most notably, inaccurate IG offers were a significant contributor to the events of 9 August 2021. As increasing IG resources are added to the power system the operational risks associated with inaccurate IG offers will also increase, both in frequency and severity. These risks are uncorrelated in that at times a 300MW IG forecast error may result in a small impact to price and no operational risks at other times it may result in scarcity pricing and load-shed occurring.

*No connection between operational risks and meeting winter peaks*

Transpower notes the analysis makes no distinct connection between the operational risks inaccurate IG offers present and the Authority's ongoing winter peak demand work in this paper. The Authority's paper *Driving efficient solutions to promote consumer interests through winter 2023*<sup>2</sup> identified inaccurate IG offers as a contributor to the difficulties of managing winter peak demand. While it may be difficult to quantify the exact improvements in IG offer accuracy from any of the changes proposed by the Authority there are also wider benefits which should be considered across the Winter 2023 initiatives and those initiatives deferred for pre-winter 2024 consideration. For example, the quantity of the new product "Option F: Introduce a new integrated ancillary service to offset increased uncertainty in net demand" will be partly dependent on the ongoing inaccuracy of IG offers. Ideally, the Authority should assess whether the long term benefit of consumers is best served by less efficient scheduling of the new ancillary service or increased costs of improving IG offers (enabling more efficient scheduling of the new ancillary service).

*Decentralised v centralised arrangements*

Under a decentralised arrangement it is almost certain the system operator (SO) would seek to retain a centralised IG forecast as a means of retaining situational awareness and as a checkpoint on IG offers submitted.

Under a centralised arrangement the Authority should consider the benefits of having a second centralised forecast as a comparator. The SO may seek to contract for a second IG forecast to act as a comparator to the official IG forecast. This could also increase the resilience of a central forecast solution whereby the SO's IG forecast could be a back-up to the official IG forecast.

If the Authority is the procurer of a centralised forecast the confidence intervals and underlying forecast information should be made available to the SO. Having this information available from the IG forecast the SO has sourced now adds greatly to the richness of the information available for situational awareness.

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[https://www.ea.govt.nz/documents/1630/Driving\\_efficient\\_solutions\\_to\\_promote\\_consumer\\_interests\\_through\\_winter\\_2023.pdf](https://www.ea.govt.nz/documents/1630/Driving_efficient_solutions_to_promote_consumer_interests_through_winter_2023.pdf)

A centralised arrangement will only be deliverable by winter 2024 if the IG forecast results are sent to IG owners for inclusion in their offers, which would be submitted in the usual way. A solution which required the marrying of IG forecast results with IG owner submitted offer prices and plant availability within the SO's market system may also require changes to WITS and would not be achievable by winter 2024.

#### *Forecasting ability*

Both solar and wind generation are included in the definition of IG in the Code. Forecasting solar generation and forecasting wind generation are distinct skill sets. The Authority may wish to consider separate IG forecast providers for solar and wind under a centralised forecasting arrangement. It would be a sub-optimal outcome should a centralised IG forecast vendor be chosen who specialises in wind generation forecasting because it is currently the dominant form of IG.

For all IG forecasting arrangements the Authority will need to consider how it can fairly assess accuracy without a comparator IG forecast. Comparing forecasts with actual generation will assess the accuracy of the forecasts but not how accurate the forecasts could possibly have been at the time they were submitted.

Confidence intervals for IG forecasts, or the range of IG forecasts, is critical information for the SO and useful information for the market. The market may get greater utility from sensitivity schedule information<sup>3</sup> which shows the market impact of variation in the supply and demand, avoiding the need for market participants to estimate the impacts themselves.

Transpower recommends the Authority progresses with a hybrid forecasting model (Option 3) for both wind and solar forecasting. While the SO would seek to retain a centralised forecast for its security assessment capability (assessing probability of insufficiency, for instance), we recognise each participant has valuable forecast information which, when taken with a centralised forecast, will provide the best assessment of operational risks related to IG uncertainty. Given the accelerating increase in IG we further recommend the Authority progress analysis of an operating reserve capacity ancillary service to provide for times when all forecasts are inaccurate (Driving efficient solutions to promote consumer interests through Winter 2023 - option F<sup>4</sup>) and consider whether the current methodology for the existing Frequency Keeping ancillary service should allocate costs to exacerbators of forecast uncertainty (Ancillary service review signalled in the Authority's Annual Corporate Plan 2023/2024<sup>5</sup>).

We feel that our recent experience in assessing, procuring, and implementing forecasting solutions, and our role in market operation of IG, could offer significant value to the

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<sup>3</sup> Potentially an enhancement to sensitivity schedules would be to reflect the IG forecast confidence intervals in the scenarios solved.

<sup>4</sup>

[https://www.ea.govt.nz/documents/1630/Driving\\_efficient\\_solutions\\_to\\_promote\\_consumer\\_interests\\_through\\_winter\\_2023.pdf](https://www.ea.govt.nz/documents/1630/Driving_efficient_solutions_to_promote_consumer_interests_through_winter_2023.pdf)

<sup>5</sup> [https://www.ea.govt.nz/documents/3467/Annual\\_Corporate\\_Plan\\_202324.pdf](https://www.ea.govt.nz/documents/3467/Annual_Corporate_Plan_202324.pdf) pg 12

progression of this work. We would be happy to discuss this issue further with the Authority to aid progression of this important initiative prior to winter 2024.

Yours faithfully,

A handwritten signature in black ink, appearing to be 'S Jay', written in a cursive style.

Stephen Jay  
GM Operations

## Appendix A – Transpower response to questions

	<b>Questions</b>	<b>Transpower (as system operator) response</b>
<b>1</b>	Do you agree with the Authority's problem definition? If not, why not?	Yes, noting as above market efficiency issues are also often operational issues.
<b>2</b>	Do you agree that a new forecasting arrangement should apply to all grid-connected intermittent generators that are required to submit offers	Yes, and to distribution-connected intermittent generators who are required to submit offers.
<b>3</b>	Note this question is referring specifically to generators who have thermal assets: For all trading periods between 1 November 2019 and 31 October 2022, how often do you think you made the incorrect decision whether to start or stop your thermal unit(s)? Please provide reasons why this occurred	N/A
<b>4</b>	What else, if anything, should be considered when assessing the relative advantages and disadvantages of the four forecasting arrangements the Authority has identified?	The resilience of each arrangement should be an issue with the primary forecasting source. Additionally, consideration should be given to whether arrangements are more or less likely to increase the diversity of weather forecast information from which the IG forecasts are based. IG forecasts are only as good as the underlying weather forecasts. While possible for the Authority to require IG owners to engage with multiple weather forecasts under a decentralised regime, such a requirement may be more practical under a centralised regime.
<b>5</b>	What other types of forecasting arrangements, if any, should be considered to improve the issue of inaccurate and unreliable forecasts?	None. The options presented cover the range of possibilities. Within each arrangement there are, however, multiple decisions to be made prior to implementation. For example, the source of weather forecasts (per Q4), back-up requirements, the circumstances in which the SO may substitute decentralised IG offers, whether parties must source multiple forecasts to improve diversity and the likelihood of forecast accuracy etc AEMO has advised for their central forecast they procure two weather forecasts and two IG forecasts. They are currently moving from only using the

	<b>Questions</b>	<b>Transpower (as system operator) response</b>
		consensus weather forecast to assessing the impacts of the range of weather forecasts as IG output changes become increasingly material to the operation of the Australian power system and the NEM.
<b>6</b>	Do you agree with the proposed evaluation criteria? If not, what is your view and why? Are there other criteria that the Authority should consider?	<p>Yes.</p> <p>The Authority should consider the ability for a solution to address multiple issues and developments under consideration by the Authority. The Authority should reassure itself it has considered the wider benefits of options before foreclosing.</p> <p>For example, an ahead market may deliver benefits in demand side participation, managing winter peaks, and the orderly exit of thermal generation. Assessing the benefits of an ahead market in the narrow confines of each issue requiring solving is unlikely to deliver a positive cost-benefit analysis but if considered as a totality may deliver the best outcome for the long-term benefit of consumers.</p>
<b>7</b>	Do you agree with the Authority's assessment of each forecasting arrangement above? If not, why not?	<p>Yes.</p> <p>Transpower notes that for either centralised forecast option the timeliness, value for money, and implementation scores would all return lower scores if implementation is via integration with the system operator's market system.</p>
<b>8</b>	The Authority has not weighted the criteria based on importance. Are there particular criteria that you consider to be more important than the others?	From an operational perspective Transpower would weight effectiveness and reliability most highly. However, Transpower agrees with the outcome of the Authority's assessment process.
<b>9</b>	Are there additional criteria that the Authority should be considering?	A resilience or back-up functionality criteria is applicable to all options. What obligations or incentives would exist under each option to provide resilience and redundancy in IG forecasts?
<b>10</b>	How frequently do you think intermittent generation forecasts should be updated, and how often do you think intermittent generators should be required to revise their offers to reflect updated forecasts?	As noted by the Authority IG forecasts only change when the underlying weather forecast changes. Consequently, it makes sense to align the obligations around the frequency of updates with availability of new weather forecasts.

	<b>Questions</b>	<b>Transpower (as system operator) response</b>
		<p>We note it is possible to get weather forecast updates more frequently than the 2 local providers currently deliver. A good IG forecast vendor would be sourcing multiple weather forecast updates, actual weather indications, and updating to provide half-hourly IG forecast updates. Half-hourly updates would likely be the preferred frequency for IG forecast updates.</p> <p>Note as it currently stands, outside of the temporary publication of the system operator's wind forecast for winter 2023, forecasts are not published anywhere or required to be shared. Translation of IG forecasts into offers is what gives visibility to all participants of expected IG output and the market outcomes therein.</p> <p>The answer to this question and the design of the (dis)incentive regimes are interwoven. It makes sense to co-design these elements.</p> <p>Taking this question at face-value raises the possibility of a breach of the information disclosure regime in the Code (cl. 13.2). Arising when a participant is in possession of an updated forecast which varies significantly to their previously submitted offers, but they do not submit revised offers.</p>
<b>11</b>	Do you think the Authority should implement accuracy standards? If not, please explain why	<p>Yes.</p> <p>The exact implementation will depend on whether a decentralised or centralised approach is progressed. Under a decentralised regime accuracy standards would form part of the Code and consequently be a compliance matter. Under a centralised regime accuracy standards would form part of the tender, tender assessment, and contract for provision of service. Consequently, under a centralised regime accuracy standards would be a commercial matter.</p>
<b>12</b>	If the Authority was to implement accuracy standards: do you think outcome process standards would be more effective? should there be a single standard or multiple standards across different timeframes? should the standard(s) be focused on ensuring actual generation is within 30 MW of the amount that was	<p>Outcome process standards risk restricting innovation and forecasting developments which do not align with the prescribed process. Persistence offers are a good example of process standards locking in a practice which went from 'best practice' to 'poor practice' over time.</p> <p>Accuracy standards should be based on percentages of installed capacity and absolute MW minima like the offer revision obligations for non-IG generation</p>

	<b>Questions</b>	<b>Transpower (as system operator) response</b>
	forecast, or should the MW compliance threshold be higher or lower? should the accuracy standards be based on the percentage of installed capacity rather than a certain amount of MW?	in the Code. The exact design of these accuracy standards should be tested against the wide range of installed capacity IG resources expected to occur in New Zealand to ensure robustness.
<b>13</b>	Following the 9 August 2021 grid emergency, reports from two investigations recommended that the Authority amend the Code to disallow persistence forecasting and require wind generations make more accurate offers to the system operator about supply. Do you agree that the Authority should amend the Code to disallow persistence forecasting?	<p>Yes. As well as masking predicted changes in output from wind generation, persistence offers are unsuitable for solar generation.</p> <p>When designing the replacement regime, the Authority should ensure either through accuracy incentives/standards or obligated offer update timings there are sufficient refreshes of IG offers approaching real-time.</p> <p>The system operator has visibility of IG in real-time from generator SCADA. The market can see actual wind generation (updated half-hourly) and offers via WITS.</p> <p>Currently, the actual wind generation is limited to the North Island because of concerns showing the South Island would reveal commercially sensitive data given there was only 1 wind farm in the South Island when the displays were set up. There are now 2 wind farms offered in the South Island and more are on the way. The Authority may wish to revisit the availability of South Island wind data with its WITS service provider.</p>
<b>14</b>	Do you think the Authority should implement accuracy incentives and/or penalties for non-compliance? If not, please explain why	<p>Yes. Well-designed incentives and penalties will deliver the best outcomes. As noted above a key aspect of the design of the incentives and penalties scheme will be having a suitable yardstick to measure accuracy will be important. The Authority has correctly noted there will be unavoidable inaccuracy in any forecasting exercise, therefore an incentive and penalty scheme could be based on comparison of forecasts with another forecast (rather than simply against actual outputs) e.g., what accuracy level was demonstrably possible? Under such an approach an alternate (centralised?) IG forecast would need to be available for the comparison to take place.</p>



	<b>Questions</b>	<b>Transpower (as system operator) response</b>
<b>15</b>	If the Authority was to implement a decentralised forecasting arrangement, do you have any suggestions for what type of incentives could be applied	Assigning ancillary service costs on a causer pays model is one option (Note a causer pays model would apply to all causers, not just IG.). This would apply to frequency keeping costs and to the proposed “new integrated ancillary service to offset increased uncertainty in net demand”. Costs could be allocated on a pro-rata causer pays basis, incentivising accurate IG offers to minimise costs. To avoid the split-incentive of under-forecasting and over-delivering IG’s actual output could be limited to within a defined percentage of their forecast offer. Compliance repercussions could also be in place.
<b>16</b>	If the Authority was to implement a centralised forecasting arrangement: a) do you have any suggestions for what type of incentives could be applied? b) should penalties for not meeting the standard(s) be prescribed? c) should penalties be higher for over generating than under generating (or vice versa)?	Vendors of these services will have existing contracts which can for a start point for negotiation. Having negotiated a load forecasting contract which includes accuracy provisions Transpower has relevant experience which may be helpful in this process
<b>17</b>	Do you have a view on who should have responsibility for submitting forecasts and who should pay for forecasting?	Generators submit offers, not forecasts. Offer submission should remain the responsibility of the generator. If a centralised forecast is pursued, then that forecast would be made available to IG owners to update their own offers reflecting plant unavailability and their offer prices. If a centralised forecast is progressed it should be paid for by IG owners, however materiality and practicality would be a consideration
<b>18</b>	Do you have a view on what types of information should be published and what platform it should be published on?	Access to confidence intervals or the range of IG forecast outputs is becoming increasingly important to the situational awareness required by the SO to operate the power system. It is also useful information for industry. This information may be easier to make available under a centralised forecast arrangement. Under a decentralised arrangement the IG owner would have to provide this information separately to their offers.

	<b>Questions</b>	<b>Transpower (as system operator) response</b>
		It makes sense to publish this information to WITS as the market portal.