1 May 2023

Mr Daniel Westerman
CEO, Australian Energy Market Operator
Lodged by email to: forecasting.planning@aemo.com.au

Dear Mr Westerman,

Response to *Update to the ISP Methodology Consultation Paper*

Windlab welcomes the opportunity to provide feedback on the Australian Energy Market Operators (AEMO)'s *Update to the ISP Methodology* (Consultation paper) published on 31 March 2023.

Windlab is a member of the Clean Energy Investor Group (CEIG) and fully supports the CEIG's submission.

In addition to what is contained in the CEIG submission, Windlab would like to make comments on questions 6, 7, 8-9 & 14-17:

- Question 6: The impact of network losses is worth quantifying. If introducing sub-regional loss equations, then it is important to ensure that losses are not double counted through these new equations and again from existing Marginal Loss Factors (MLFs). For example, if a new sub-region of North QLD is defined and loss equations built, then MLFs for generators in this new region should now be calculated relative to a new regional reference node in this sub-region. Using existing MLFs based on the QLD RRN will result in double counting.
- Question 7: The ISP should use average loss factors (ALF), not MLFs. Marginal losses are twice actual losses. Use of MLFs will mean that losses are not accurately represented, that supply will exceed demand plus network losses by almost 4% in 2050, and will result in the ISP will producing a sub-optimal generation mix.
- Question 8-9: Windlab agrees with the consistent use of land use data for screening potential VRE sites. However, Windlab notes that the currently assumed capacity factors for the SW-NSW REZ are much too low. Windlab is willing to provide measured wind speed & energy traces to AEMO to support this claim under a NDA. Windlab modelling suggests that using more accurate capacity factors in the SW-NSW REZ would see an additional 2.5 GW of wind in this REZ by 2030, most of which is moved from the Central Orana REZ.
- Questions 14-17. Windlab does not agree with the proposal to derate the MWh capacity of storage devices. If any derating is applied it should be to the MW power rating of the storage, though these deratings should be minimal.

Question 6: Do stakeholders agree that the impact of network losses for REZs and sub-regions is worth quantifying in the modelling? If not, why not?

Windlab believes it is important to accurately model the impact of network losses for REZs and subregions. The creation of sub-regions and associated sub-regional loss equations is a reasonable way to do this. However, it is important that this doesn't result in double counting of losses. To ensure that losses aren't double counted, then a new regional reference node (RRN) will need to be created in each new sub-region, and then loss factors between each generator in the sub-region & the new RRN determined. To avoid any doubt, if a new sub-region for Nth QLD is defined and associated sub-regional loss equations defined, then the existing MLFs for generators in Nth QLD should no longer be used. New loss factors between those generators an the Nth-QLD RRN will need to be calculated.

Moreover, as mentioned below, the use of MLFs result in an overestimate of transmission losses by 100%. If loss equations for flows between sub-regions also use marginal losses, then demand will have to be modified by the difference between actual losses and marginal losses so that supply = demand + actual transmission losses.

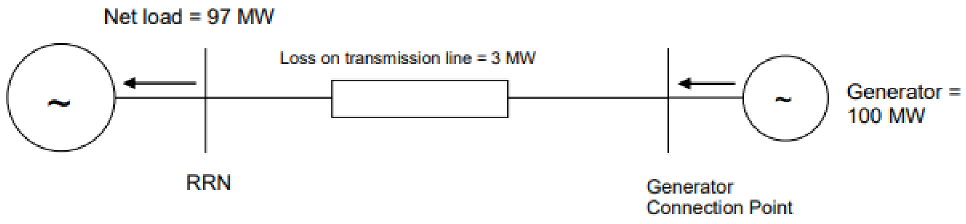
Question 7: What alternative methods could be considered for incorporating network loss impacts for REZs and sub-regions?

While Windlab supports the proposed methodology to include sub-regions to estimate network losses, we believe Average Loss Factors (ALF) should be used to use represent network losses rather than Marginal Loss Factors (MLF).

As noted by the consultation paper, the ISP needs "to make sure that enough supply is assumed to account for both meeting the needs of electrical loads and the energy that will be lost through transportation through the networks". However, the use of Marginal Loss Factors (MLFs) fails to do this as they overestimate losses by 100%.

This is demonstrated in AEMO's document "Treatment of Loss Factors in the National Electricity Market"[1]. Section 5.3 gives an example calculation of a generator supplying a load of 97 MW at the regional reference node (RRN) as indicated in the figure below. The generator must supply 100 MW to satisfy the load due to transmission losses of 3 MW. Three percent of generation is lost in transmission, resulting in an average loss factor (ALF) of 0.97. The calculation shows that the marginal loss factor (MLF) is 0.94. This is because the loss applicable to the very last MW of generation is 6%. Thus, we can see that the marginal loss (6%) is twice the actual or average loss (3%).

[1] https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Loss_Factors_and_Regional_Boundaries/2016/Treatment_of_Loss_Factors_in_the_NEM.pdf



The above example should demonstrate that using MLF to estimate transmission losses is not appropriate. Use of MLFs will result in the ISP over-estimating losses, and therefore over-estimating the required supply to meet a given demand. Indeed, the ISP has 78% of demand being met by wind & utility solar in 2050. If the average MLF of these wind & solar farms is 0.9, then that implies supply would exceed demand plus losses by almost 4% due to the use of MLFs over-estimating transmission losses.

If MLFs are used to represent transmission losses, then the demand trace will need to be modified to ensure that supply = demand + actual transmission losses. Thus, for example, if actual transmission losses are 4%, but the use of MLF makes it look like they are 8%, then demand will need to be reduced by 4% to maintain the supply-demand balance.

More-over, the use of MLFs will result in the ISP applying a bias against generators located further from the RRN. This bias will result in the ISP producing a sub-optimal generation mix, as demonstrated by an example in the following table. Generator A can provide cheaper power than Generator B, even after accounting for actual (average) transmission losses. However, the use of marginal losses makes it look like Generator B is cheaper, and thus Generator B would be built in the ISP, leading to a higher cost of electricity. It would also lead to supply exceeding demand plus network losses.

Generator	raw LCOE	ALF	Post-ALF LCOE	MLF	Post-MLF LCOE
A	$50.00	0.940	$53.19	0.880	$56.82
B	$52.00	0.970	$53.61	0.940	$55.32

Windlab is aware that the NEM has adopted the marginal pricing approach for dispatch, which is why MLFs are used by the NEMDE optimiser. However, it is our belief that all the issues raised above demonstrate that the use of MLFs is not appropriate for the ISP.

Question 8: Do you agree with the consistent use of land use data for screening potential VRE sites to both REZ resource limit and wind resource traces in the REZ trace development process? If not, why not??

Question 9: Do you have a view on the proposed changes to the high wind and medium wind tranches, and the resulting capacity factors?

Windlab agrees with the proposed methodology for estimating capacity factors in potential VRE sites. However, Windlab is concerned that the capacity factor of wind in the SW-NSW REZ are severely under-predicted.

Windlab is a global renewable energy development company that has developed over 1 GW of operating wind farms around the world. Windlab's Australian projects include Coopers Gap, Collgar, Oaklands Hill, Kiata and Coonooer Bridge Wind Farms, and the Kennedy Energy Park. The Kiata and Coonooer Bridge wind farms regularly achieve the highest monthly and annual capacity factors of any operating wind farms in Australia. Moreover, Windlab has a long history and proven ability to accurately forecast the pre-curtailment capacity factor of a wind farm prior to construction, based on measurements of the wind speed.

Windlab has been monitoring in the SW NSW REZ for multiple years, and is confident that wind farms in this region will be able to achieve pre-curtailment capacity factors as high as 46%. Moreover, there is sufficient wind resource in the region to have multiple GW of wind farms in this region with capacity factors over 38%.

Windlab is therefore concerned that the wind traces used by the ISP in this REZ have annual capacity factors of approximately 30% for the high wind trace, and 29% for the medium wind trace.

Windlab believes that the low assumed capacity factors in this region as used by the ISP have underplayed the importance of this REZ. In addition, the SW NSW REZ is predominantly flat, easy to access and construct large infrastructure with low population densities compared to other NSW renewable energy zones. The capacity factors of the SW-NSW REZ are also helped by the higher air density associated with the lower elevations of the proposed locations, relative to other NSW REZs. All of these factors help explain why the SW-NSW EOI was swamped with 34 GW of potential generating facilities.

Windlab has used the ISP step-change model in PLEXOS and run a scenario with more accurate capacity factors in SW-NSW REZ (CF~40%). The simulation results are shown in the table below. Approximately 2.6 GW more wind being built in the SW-NSW REZ by 2030, compared to the ISP Step-Change scenario, with most of that wind being shifted from the Central-West Orana REZ. The impact is reduced by 2050, with the SW-NSW REZ having an additional 700MW of wind.

GW	N3 (CW-Orana)		N5 (SW-NSW)	
Year	Base	CF40	Base	CF40
2030	3.0	1.9	0.0	2.6
2050	8.3	7.7	3.6	4.3

It is worth noting that the ISP step-change scenario has 8.3 GW of wind in the Central-West Orana REZ by 2050, or almost 3x the wind build limit of the REZ. In contrast the SW-NSW REZ has 3.6 GW, or less than its wind build limit of 4.3 GW. Thus, the more accurate capacity factor for SW-NSW would see wind build in those two REZs closer to the current wind build limits.

It is clear that the ISP results are highly sensitive to the assumed capacity factor, so getting the capacity factors as accurate as possible is important. Windlab is willing to share its wind speed measurements and/or capacity factor timeseries data protected by a NDA if that would help persuade AEMO that the ISP capacity factors are much too low.

Questions 14-17: Dispatch behaviour of storage devices

Windlab understands AEMO's concern that the perfect foresight assumption can lead to exaggerated assumptions that storage devices can or will be dispatched at their full capacity rate at exactly the period when their output is most required by the power system.

However we strongly disagree that applying a derating factor of up to 50% of the storage capacity (MWh) is the most appropriate method.

A one-hour battery is much more likely to utilise its full capacity each day than a 4-hr battery. It may not discharge at the most optimal time, but it is more likely to discharge its full capacity each day than the longer duration battery.

Batteries in the ISP are primarily used to storage excess solar generation during the middle of the day, and discharge later in the afternoon or evening as the solar generation declines. While the solar generation profile is not perfectly predictable in advance, any developer is likely to be able to ensure that their battery is fully charged during the peak solar hours while the prices are low. And while they may not be able to predict the most optimal time to discharge during the evening peak, they could most likely ensure that the battery is fully discharged during the elevated prices in the afternoon and evening.

For this reason, it should be clear that there should not be a derating factor applied to the MWh capacity of the battery. The lack of perfect foresight should not affect the likelihood of the battery being fully charged or discharged.

However, a derating factor to the MW rating of the battery may be appropriate. This derating is better able to capture that the battery may not be discharging at full power at the time of most need. Windlab believes that any derating should be small in magnitude.

Windlab thanks AEMO for the opportunity to provide feedback on the *Draft 2023 Inputs, Update to the ISP Methodology*, and looks forward to continued engagement on these issues. For any further information about Windlab's submission, please contact David Osmond via the email david.osmond@windlab.com

Yours sincerely

David Osmond

Principal Wind Engineer

Windlab