18/07/2019

Andrew Splatt
Australian Energy Market Commission (AEMC)
Level 6, 201 Elizabeth Street
NSW,2000

Via electronic lodgement

Dear Andrew,

Re – Transmission Loss Factors: ERC0251

Mondo appreciates the opportunity to comment on the AEMC's Transmission Loss Factor consultation paper in consideration of the rule change proposal from Adani Renewables (the proponent).

Mondo provides a variety of contracted transmission and distribution services, including grid connections for new generators, battery energy storage systems and aggregation of distributed energy resources.

In consideration of the merits of the proponent's rule change request, it is interesting to observe that the question of how best to represent transmission losses in the NEM has been raised on several occasions in the past. Ultimately, these previous discussions on the relative merits of different approaches has had to grapple with conflicting objectives of engineering accuracy, market efficiency and commercial practicalities. These same conflicting objectives all arise again when considering the current rule change proposals.

Mondo understands that there are two key elements to the rule change proposal, being:

1. Change to the allocation of the loss related intra-regional settlement residue (IRSR) to include generators in the region

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2. Change from the current marginal loss factors to an average loss factor[1].

Further to the proponent's rule change proposals, the AEMC are seeking stakeholder input on a number of matters related to the loss factor framework in the NEM including the frequency of calculating marginal loss factors (MLFs), notice period for participants, forward or backward looking methodology, whether collar and cap thresholds should be used and if grandfathering MLFs should apply.

In summary, Mondo is open to further consideration of alternative allocations of the IRSR, including consideration of allocating some of the IRSR to generators, but believes that this needs to be considered in the context of the COGATI access and charging review. This is discussed further in the body of this submission. Mondo does not support changing to a methodology based on average loss factors as this would deviate from the marginal pricing foundation of the NEM and therefore, less efficient, so not meeting the national electricity objective.

In consideration of the alternatives posed by the AEMC, Mondo is concerned that any such changes to the loss factor methodology may be premature given the current review into generator access and charging, which has the potential to fundamentally change generator pricing and incentives. In addition, the ESB 2025 market design review will take a holistic review of the complete market design, including how losses are allocated.

Mondo suggests that if there are to be efforts applied to improve loss factor arrangements, then they should focus on improving AEMO forecasting accuracy, and greater transparency of the calculations and methods. Such efforts should pay particular focus to those connection points which are subject to relatively large changes in MLFs from one year to another.

The remainder of this submission provides a more detailed response to the consultation paper.

Mondo hope that the comments contained in this submission are of assistance to the AEMC in its deliberations on this consultation. Please do not hesitate to contact me either by email or on 03 9695 6061 if you have any further inquiries.

Yours sincerely

Margarida Pimentel

Manager Policy and Insights

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[1] From reading the consultation paper and the proponents rule change request, Mondo was uncertain whether the proposal was for a change from marginal loss factors to average loss factors, or an alternative to the current volume weighted averaging approach. This was clarified at the AEMC forum on 4 July 2019 by the proponent's representative.

Inter-Regional Settlement Residue (IRSR) Allocations

The proponent has suggested that the IRSR be reallocated to generators and market customers evenly, noting the following three issues in support of this change:

1. the calculations of loss factors give rise to approximations rather than actuals
2. high IRSR reflects an "error" between actual and forecast transmission loss factors and consequently efficient dispatch is undermined and investment signals are impacted
3. the allocation of residues on a postage stamp basis exacerbates the impact of inaccurate MLFs

Before assessing the merits of the proposal to reallocate IRSR's, it is important to consider each of the above issues raised by the proponent.

1. Approximations rather than actuals

The current loss factor methodology produces a yearly static MLF for each connection point based on numerous forecasts quantities for the upcoming 12 month period. It is therefore inevitable that the current MLF methodology produces approximations rather than actual MLFs. It would only be possible to determine an *actual* loss factor at the very moment of dispatch (dynamic calculations of loss factors). The proponent has not proposed dynamic loss factor calculations, although the AEMC in its consultation paper, has raised this option for consideration.

In consideration of how the current yearly static (approximate) MLFs impact on the IRSR, it is important to first of all note that some amount of IRSR is an inevitable consequence of a marginal (as opposed to average) loss factor methodology. Settlement residues arise under a marginal loss factor approach since marginal losses are effectively twice the amount of average losses (see further discussion later in this submission). So even if the MLFs were dynamically calculated and therefore perfectly accurate, some amount of IRSR would still arise.

It is nevertheless true to observe that deviations between the static (approximate) and dynamic (actual) MLF could give rise to higher IRSR's. It is also true to observe that this deviation could in some cases give rise to a lower IRSR. In general the IRSR would be higher when the dynamic MLF was higher than the static MLF, and vice versa.

So the proponent has correctly observed that the static (approximate) MLF can impact on the quantum of the IRSR, but has not clearly established why this justifies reallocation to generators.

2. High IRSR represents an error undermining efficient dispatch and investment

The proponent's claim that a high IRSR represents an error that undermines efficient dispatch and investment is a serious claim that warrants close examination. First of all, the assertion that the IRSR is an error needs to be challenged. As noted in the preceding section, some amount of IRSR is an inevitable consequence of a MLF methodology, and it is therefore misleading to describe it as an error. Whilst it is true that forecasting inaccuracies can lead to higher (or lower) IRSR quantities, it is nevertheless incorrect to characterise the IRSR as an error.

Turning to the proponent's claim that a high IRSR undermines efficient dispatch, it is important to firstly recognise that the IRSR is a function of settlement, and is not explicitly known at the time of dispatch. Market participants are well aware of the fact that when the settlements calculations are done at the end of the settlement week, there will be an amount of IRSR calculated, and this will in turn be allocated to the TNSPs. It is difficult however, to envisage how this might impact on participants in their involvement in the dispatch process. The proponent has not clearly set out how this linkage might occur.

Finally, the assertion that a high IRSR would impact on investment signals needs to be considered. One of the aims of MLFs in the NEM is to provide a locational signal to inform potential investors of where they might choose to connect a new generator or load. As MLFs at a given connection point deviate further away from unity, this signals to potential investors at that connection point that their NEM revenue (for generators) or costs (for loads) will be negatively impacted, and that they need to consider this in their investment decisions.

When faced with a new investment decision, a generator proponent would not currently be concerned with the IRSR since that money is paid by market customers and ultimately allocated to all consumers in the region. The generator is largely indifferent. If some part of the IRSR was to be allocated to generators as suggested by the proponent, then it could be envisaged that this would to some extent provide an additional incentive to the generator to invest. The proposal does not seem to try and allocate the IRSR on the basis of locational signals however, so it would seem that the proposed reallocation to generators would simply be an additional amount of money to all generators in the region. This does not appear to be a very effective investment signal, as it will be difficult to calculate in advance, and will be smeared across all generators in the region.

3. Allocation of residues on postage stamp basis exacerbates impact of inaccurate MLFs

As noted in the consultation paper, the IRSR are returned to consumers on a postage stamp basis meaning that there is no link between the accrual of IRSR and the manner in which it is distributed to consumers. For this reason, it is difficult to understand the proponents claim that this postage stamp allocation somehow exacerbates the impact of inaccurate MLFs.

Concluding remarks on IRSR

In consideration of this rule change request and the matters raised in the consultation paper, it has become clear that there is insufficient transparency about the quantum of the IRSR within each region, their trends over time, and how the IRSR amounts vary with market events. For example, there has been some commentary that the IRSR in South Australia has recently been negative, but Mondo is not aware of any publically available data to confirm this. Mondo understands that negative IRSR amounts can occur when overall network losses as a proportion of regional demand become high. It is therefore assumed that the recent negative IRSR in South Australia was due to very high network flows, and subsequent high losses. It would be helpful to have this confirmed.

Mondo believes that it would be beneficial for market participants to have better insight into the characteristics of the IRSR, and would therefore propose that AEMO be required to publish relevant information and data. This information should be made available with sufficient granularity to enable stakeholders to understand drivers and correlations.

For the reasons set out above, Mondo does not believe that a strong case has been made in this rule change proposal for the reallocation of IRSRs to generators.

If such a proposal were to be considered by the AEMC, Mondo suggests that this should be progressed as part of the COGATI access and charging review, and specifically as a consideration under dynamic regional pricing. Noting that the settlement residues that arise under dynamic regional pricing are distinct from the IRSR due to loss factors, there may be an option to consider both of these residue amounts in the context of the COGATI access and charging review[2]. This would have the benefit of providing a targeted signal for new network investment when the residue amounts for a particular network location become large.

Marginal loss factors versus average loss factors

The proponent has suggested a move from the current MLF methodology to an average loss factor methodology, asserting that this change "from MLFs (with IRSR reallocation to include generators) to an average loss factor methodology will be a further improvement as average loss factors can be calculated at the commencement of each year (rather than a wash up of IRSRs in arrears)"

The proponent's suggested justification for moving to average loss factors since they can be "calculated at the commencement of each year" is difficult to comprehend. Whether an average or marginal loss factor approach is used, unless dynamic loss factors are applied (which the proponent has not sought), either approach requires AEMO to calculate loss factors at the commencement of each year.

In any case, the proposal to move to an average loss factor approach needs to be considered in detail.

The first thing to note is that the NEM is based on marginal cost pricing which is used in many different markets around the world, and is recognised by economists as optimising social welfare. It is not apparent that the proponent is disputing this premise.

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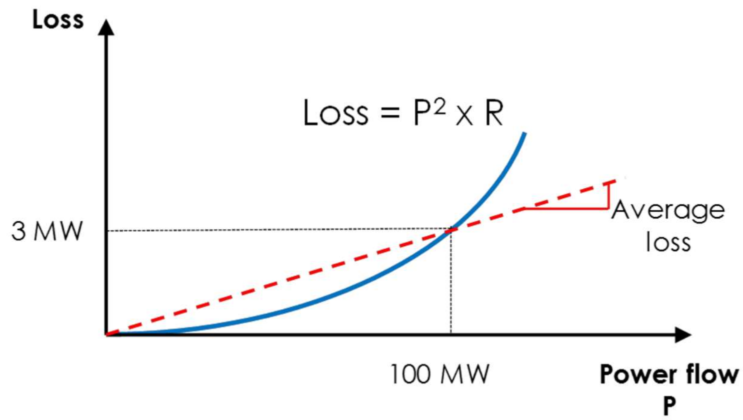
[2] At the AEMC forum on 8 July the representative from New Zealand commented that both the loss, and the constraint residues were used in their calculations for financial transmission rights. This was not examined in detail, but may be something that the AEMC could investigate in detail to ascertain if there are ideas that might apply to the NEM.

To understand how loss factors are applied in the NEM, it is helpful to consider how transmission losses increase as the power flow across a transmission line increases. This is often referred to as the loss curve, and is shown by the blue line in the following graph.[3]



The blue line is a curve, due to the power squared term in the loss equation. In this example, the transmission line is assumed to have a resistance (R) of 0.0003 Ohms, and the graph shows a current operating point with a power flow of 100 MW, resulting in a loss of 3 MW.

Since the NEM dispatch engine is a linear optimisation algorithm, it is unable to model the curved nature of the power curve (blue line) – we must therefore find a suitable linear (straight line) approximation.

The average loss is represented by the dashed red line in the above graph. Average loss is calculated for a given operating point, by dividing the losses at that operating point by the power flow at that point. In other words, average losses are equal to the slope of a line going from the operating point back to the origin.

The average loss equals the slope of red line. This is equal to Loss / Power at any given operating point. This can be expressed as $P^2 R / P$ which equals PR.

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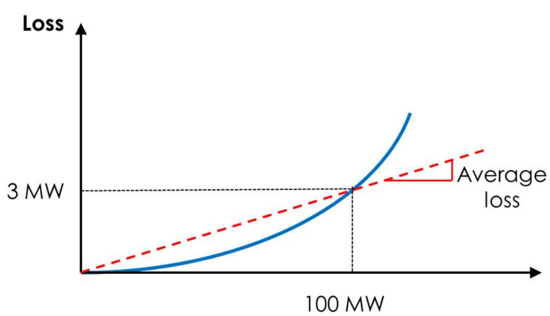
[3]At the AEMC conference on 4 July the proponent suggested that the “I squared R” formula for calculating losses was relevant to direct current and not to alternating current power systems such as the NEM. Although it is true to note that this formula, and the often used approximation of “P squared R”, are approximations in the AC context, it is not correct to suggest that these formula are not relevant to AC power systems. The relationship between losses and the square of the power flowing through a transmission line is sufficiently accurate, provided that voltage profiles across the transmission network are maintained at or near to their nominal operating levels. This formula forms the basis for how losses are modelled in the NEM, as well as most overseas power markets.

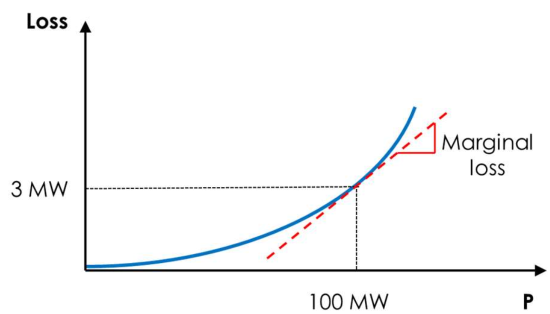
Close examination of this red straight line reveals that it is a poor approximation of the blue loss curve, as they are close in value only at the current operating point. The average loss red line is informative only of how (on average) we have arrived at the current operating point. It is not an accurate representation of what will happen if the operating point were to increase or decrease by a small amount (e.g. 1 MW).

The fundamental objective of marginal cost pricing is to identify the optimal way to meet a 1 MW increase (decrease) in demand from a given operating point. Marginal cost pricing has no interest at all in how we have arrived at a given operating point, but is only interested in small perturbations from that operating point.

If the objective was to describe the consequence of operating at the current operating point, including the actual losses that are being incurred at that point, then average losses would be a good approach. However, this would not reveal good information about the effect of deviating from that point, which is what marginal cost pricing seeks to do.

The marginal cost pricing approach therefore relies not on the average loss at an operating point, but the marginal loss, which is represented by a line tangential to the loss curve at the current operating point, as shown in the right hand graph below.





Average loss = P R

Marginal loss = 2 P R

By comparing the marginal loss with the average loss, it can be seen that the marginal loss has a steeper slope than the average loss. In fact, it can be shown that the marginal loss slope is 2PR, which is twice the average loss slope of PR. This is what gives rise to the losses being twice as large under a marginal approach versus an average approach. This is not an error as suggested by the proponent - it is the true reflection of the marginal increase in losses from a given operating point.

The marginal loss line is a much better representation of the actual losses for small changes above or below the current operating point than the average loss line. This can be seen by examination of the red straight lines representing marginal and average losses, and comparing them to the blue actual loss curve.

Average loses need to be recognised as being a less accurate representation of losses for the purposes of the marginal cost pricing, and therefore the NEM. It is recognised in many different markets that the marginal cost of supplying one additional unit is greater than the average cost at any given operating point. This marginal value of trade principle is fundamental to ensuring that businesses operating in the market which are paid the clearing price, are able to also recover their fixed costs in the longer term. If this principle is undone, it could undermine the business model for existing businesses, and weaken the investment signal for new entrants.

One further point to note is that the likelihood of IRSRs being negative is exacerbated using average loss factors, as there is a smaller difference between the generator and the load loss factors.

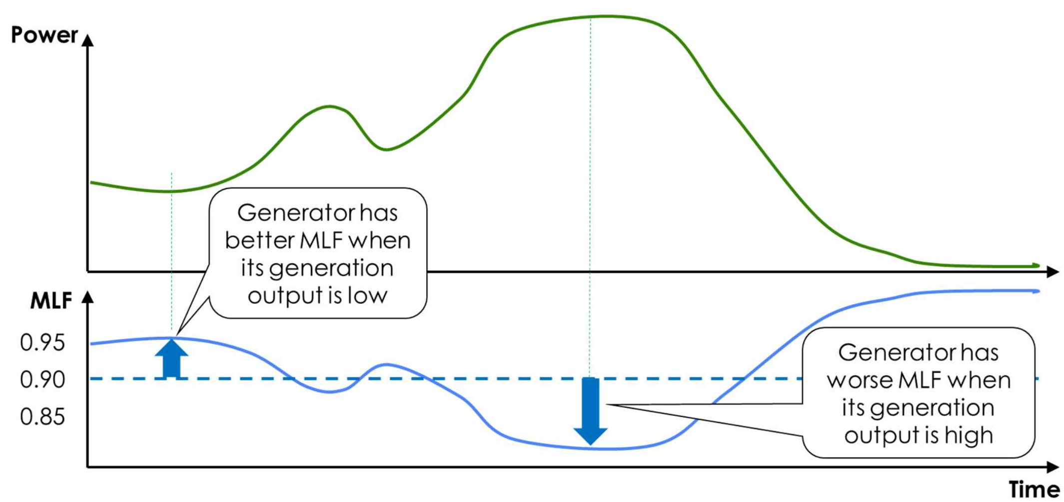
For the reasons set out above, Mondo does not support changing to an average loss factor methodology as this would lead to less efficient outcomes in the NEM and therefore fails to meet the requirements of the national electricity objective.

Improving the loss factor framework

In addition to the rule change proposals put forward by the proponent, the AEMC consultation paper identifies three key pieces of work related to MLFs and its framework currently being carried out by AEMO and the AEMC. The consultation paper also identifies potential options which are suggested as being potentially either alternative or complementary to the proponents suggested changes. These additional options are discussed below.

Should multiple loss factors be used?

There is no doubt that the current approach of calculating one static loss factor per connection point which is then applied for a full year is an approximation of what the actual loss factors would be at the time of dispatch. In considering how this might impact on a generator for example, the following diagram shows a generators power output as it varies over the course of a year (green line), and its static loss factor as calculated by AEMO as 0.9 (dashed blue line). If we were to look at the actual MLFs calculated for each dispatch output, then the MLFs would vary roughly as the inverse of the generator output, as shown by the solid blue line.



The first point highlighted on the left hand side of the above diagram shows that when the generator power output is relatively low, the dynamic MLF is likely to be higher (better) than the static value.

Generators would generally prefer high MLFs, but it is less important to the generator when its power output is low.

Alternatively, looking at the second point on the right of the diagram, when the generator power output is relatively high, its dynamic MLF is likely to be lower (worse) than the static value. This is likely to impact strongly on the generator since it is more keenly impacted by its MLF during periods of high power output.

A similar example could be shown to demonstrate that as customer load at a connection point varies, its dynamic MLF will also vary in a manner that may not be to the customer’s advantage.

So although it is true that dynamic MLFs are more accurate, it is not entirely clear that greater accuracy will be beneficial to the connected party.

A further complication with dynamic MLFs is that it creates an additional volatile unknown that market participants would need to manage. Currently market participants manage their risk exposure to the volatile NEM spot price by entering into longer term financial hedge contracts. At present, these contracts do not need to contemplate the effects of a volatile MLF, since this is fixed for each year. If dynamic MLFs were to be introduced, market participants would then need to manage not only the volatile NEM spot price risk, but also the additional risk introduced by a volatile MLF.

It seems inevitable that to manage a volatile MLF, market participants would need to come to some agreement in advance of the likely average MLF over the period, and then agree on a calculation to deal with the ‘unders’ and ‘overs’ introduced by the dynamic MLF. If this observation is correct, then it raises the question of what is the value of the dynamic MLF, if it then needs to be effectively ‘averaged away’ by market participants.

For the reasons outlined above, Mondo does not support moving to a dynamic MLF framework.

How often should MLFs be calculated?

Currently AEMO determines the intra-regional loss factors once a year as directed by the NEM Rules. As outlined in the consultation paper, increasing the frequency of this calculation is likely to increase the administrative costs for AEMO and the complexity for stakeholders, but may also result in MLFs that better reflect the actual flows in the transmission network.

There seems to be a suggestion that the main beneficiaries of more frequent MLF calculations are likely to be those market participants which are subject to a predictable variation in generation / load across each year. This needs to be considered carefully for the reasons outlined in the preceding section relating to dynamic MLFs.

For example, suppose that MLFs were calculated on a seasonal basis, with a distinct MLF calculated for winter, summer, autumn and spring. Suppose that a particular generator typically has a higher output in the summer months. When AEMO calculate the MLF to apply to this generator for the coming summer, they will note that the generators output was high during the previous summer, and use that to calculate its MLF. The likely result will be that the generator will receive a lower (worse) MLF for the upcoming summer period, which is unlikely to be what that generator would prefer.

It seems that the averaging across the entire year might work in the favour of such generators, although the volume weighting of the current averaging method might diminish this advantage.

The key point to note is that moving to more frequent calculations of MLFs may give results that some participants might not have expected, or might not prefer. To better assess this, it is suggested that AEMO perform some example calculations of what all connection point MLFs would be for say, a seasonal calculation. Stakeholders would then be better placed to understand the implications of such a change.

Notice period for participants

Under the current arrangements AEMO is required to publish the MLF values each 1 April to apply for 12 months from 1 July. This provides market participants three months' notice of any changes to the intra-regional loss factor values and the inter-regional loss factor equations.

Providing a longer notice period would give participants more time to adjust and prepare for the new loss factor values but would mean that the loss factors are less likely to reflect recent changes to network flow patterns. Providing a shorter notice period will have the opposite effect, meaning that loss factors will be more up to date with recent changes, but provides les time for participants to prepare.

On balance, Mondo cannot see strong arguments in favour of change in either direction.

Forward or backward looking methodology

As noted in the consultation paper, the forward looking methodology which was introduced in 2003 is superior to the previous backward looking method, as it allows changes in generation and network topology to be incorporated into the forecasts in a timely manner. Mondo is not aware of any convincing arguments that support reverting to a backward looking approach.

Whether collar and cap thresholds should be used

Mondo understands this option would impose an upper and lower limit that would be applied to MLFs, for example in the range of 0.8 to 1.1. Another alternative would be to impose a restriction on the amount by which an MLF can vary from one year to the next.

Any artificial limitation of the type described above would introduce an anomaly into the allocation of losses in the NEM, creating some winners and some losers. Applying arbitrary limits of this kind does not meet the objectives of market efficiency and therefore should not be supported.

Whether grandfathering MLFs should apply

This option would mean that a connection point would have a fixed MLF for the period of grandfathering. Similar comments to those for the preceding section apply here. This would impose artificial constraints into the methodology which must be accounted for by adjustments elsewhere. Again, the inevitable creation of winners and losers is another example of inefficiencies that would be introduced in the NEM, which should therefore not be supported.

Alternative approach

In Mondo’s view, it is difficult for any stakeholder (perhaps with the exception of AEMO) to genuinely understand the potential implications of any of the above proposals on individual participants or the NEM as a whole. This is because there is insufficient detailed data available for participants to properly analyse and deduce how alternative methodologies might play out. For this reason, it is our view that participants would be taking something of a gamble in fully supporting any of these rule change proposals, as it quite difficult to predict the ultimate outcome.

In weighing up the various options outlined in the consultation paper, there appears to be a common theme that emerges which is lack of transparency about the existing loss factor methodology including the input data, assumptions, load flow methods, regression techniques and averaging. This lack of transparency is understandable to a certain extent, given the inherent complexity of the calculations, the high volume of data and the fact that the impact of MLFs within the NEM has up until recently been less significant to market and investment outcomes.

As an example of the desire for better access to detailed data, the presentation by AEMO at the AEMC loss factor workshop on 4 July included a scatter-plot of the MLF calculations for a particular connection point. The point was made at the workshop by a stakeholder that publication of this type of data for all connection points would help better inform all stakeholders. Mondo supports this view.

Rather than propose any particular change to the methodology as a result of this rule change proposal, Mondo suggests that requirements be placed on AEMO to greatly improve the level of data and information available to participants. The type of data and information that would be helpful includes:

- input data used in the loss factor calculations,
- assumptions made as part of the methodology,
- descriptions of the load flow method used including any simplifying assumptions (e.g. voltage profiles, load distribution, generator and transmission reliability assumptions, etc.),
- list of MLFs calculated for every half hour of the upcoming year for each connection point,
- detailed descriptions of all statistical analysis carried out on the results, including any regression and averaging techniques,
- resultant ex-ante static MLFs for each connection point.

Once the ex-ante static yearly MLF has been applied, it would then be useful if AEMO were to dynamically calculate and publish in real time (but not use) the dynamic MLF for each connection point. This would assist participants in understanding how a dynamic MLF would vary from their static yearly ex-ante MLF. It would also be interesting to compare the actual dynamic MLF’s with the published half hourly forecast MLFs to ascertain the degree to which they differ.

In addition to publishing the dynamic MLF, AEMO should also be required to publish the IRSR for each region, ideally for each half hour period (if possible), or at the very least, for each settlement week.

As a final step, it would also be useful if at the conclusion of the year, AEMO use the dynamically calculated and published half hourly MLFs to determine ex-post, what a static MLF would have been for each connection point using actual data, rather than the forecast data used for the ex-ante calculation. This would provide insight into the extent of the forecasting error, and how this might vary from one connection point to another.

The above suggestions for what data and information are provided as examples of what is thought to be useful to better inform stakeholders, and ultimately lead to better decisions on how we should proceed in improving treatment of losses in the NEM. If such an approach were to be pursued by the AEMC, Mondo would suggest that further consultation be conducted to finalise exactly what data should be made available.