Purpose of this document
AEMC staff have developed this paper to inform discussion at the technical working group. Please note that the thinking and views contained in this paper are indicative and have been developed by AEMC staff for consultation purposes only. The content is therefore subject to change. AEMC staff appreciate the assistance of the AER and ACCC, particularly Darryl Biggar, in the preparation of this paper. All misconceptions are our own.

Loss FTR Funding and Procurement

The paper discussed at the 5 June 2020 technical working group meeting focussed on funding and procurement arrangements for financial transmission rights (FTRs) which would hedge against price differences that arise due to congestion on the transmission network.

However, price differences across locations on the network also arise because of losses.

In the March 2020 technical specification paper, the Commission noted that FTRs that hedge against loss-related price differences are relatively unusual in market design, compared to FTRs that hedge against congestion risks.

The Commission noted that LMPs would reflect marginal losses that apply at each transmission connection point, consistent with the recent final determination on transmission loss factors. Losses could be reflected in LMPs either as: a static marginal loss factor, and applied over a year for each participant or dynamically, varying in each 5 minute settlement period according to the output for generators and load on the transmission network at any point in time.

The Commission also noted that there are a number of considerations as to how marginal losses should be reflected in LMPs:

- Some stakeholders consider that dynamic losses may increase risk for generators; other parties do not and consider that they would provide significant efficiency benefits.
- Dynamic losses would require significant system changes to NEMDE. Consideration of the options will occur further over 2020. There is an opportunity to coordinate changes being considered with other reforms that are being contemplated (such as those being considered by the ESB), which may minimise the cost of these changes.

The Commission noted that incorporating losses in FTRs would allow market participants to manage revenue risk and basis risk arising from volatility in LMPs due to marginal losses. This is analogous to the way in which congestion FTRs assist in managing price differences resulting from binding transmission constraints. At the same time, the Commission also noted that revenue adequacy for loss FTRs was under active consideration, and that other markets with LMP/FTR regimes do not commonly have products that hedge losses.

Accordingly, the March paper set out that there were several alternatives as to whether losses would be hedged through FTRs:

1. One alternative is for the development of a separate loss FTR that would allow market participants to hedge the risk of price differences arising from changes to marginal loss

factors. This would be backed by the loss rent that arises due to the application of marginal loss factors.

2. Another alternative would be to combine the congestion and loss FTRs.
3. A third alternative is to not have FTRs which hedge losses.

In relation to the choice between combined and separate loss FTRs, the Commission noted that separate products might provide participants with greater flexibility to adopt a risk management approach that best suits their requirements. The Commission also noted that while a combined product could be simpler for FTR purchasers, it might also make the auction process highly complex. This observation related to adjustments to the FTR auction that would be needed to ensure revenue adequacy for FTRs that hedge the effects of losses. Our thinking on these issues has moved on since March, which is reflected in this paper.

This paper considers issues related to the funding and procurement of FTRs that also hedge loss-related price differences ('loss FTRs'). It should be read in conjunction with the paper on congestion FTR funding and procurement circulated ahead of the 5 June TWG meeting. In this paper we discuss:

- Options for the funding and procurement of loss FTRs, first assuming that:
  - there is a combined loss and congestion FTR product (i.e. a single product that hedges both congestion- and loss-related price differences); and
  - the current static marginal loss factor (MLF) framework is replaced with dynamic marginal losses, that are calculated by the dispatch engine in every 5-minute dispatch interval.[1]
- We then consider specific considerations if we were to:
  - introduce separate loss and congestion FTRs; and/or
  - retain the current MLF framework.

We also recognise that another option is to not have FTRs which hedge losses; however, we think in order to answer that question, we have to consider what the FTRs would look like if we did have them. We also welcome comments on this issue.

We are seeking the technical working group's input on these issues. To maximise the time for discussion, we will take the contents of this paper largely as read. The paper sets out a number of questions for discussion during the technical working group meeting. While we are interested in your feedback on any aspect of this paper, please come prepared to discuss these questions.

1 Recap and summary

For reference, this section summarises the conclusions from this paper, and the paper discussed at the 5 June technical working group.

The conclusions from the 5 June paper were that:

[1] Please refer to section 4.5 of the March 2020 Technical Specifications Paper for a discussion of the options related to dynamic marginal losses.

- Including the FTR auction revenue to back FTR payouts in addition to the congestion rent (also known as "settlement residue") appears to make sure that FTRs have a very high probability of not being scaled back. This is because:
    - in a competitive FTR market, the FTR auction revenue would approximate the expected FTR payouts;
    - under the simultaneous feasibility test the *expected* congestion rent is equal to or greater than the *expected* FTR payouts;
    - consequently, in a competitive FTR market the inclusion of FTR auction revenue would approximately double the amount of money available to back the FTRs compared to using the congestion rent alone;
    - even in an FTR market with low competition, the auction revenue would be expected to considerably increase the amount of money available to back the FTRs, substantially lowering the chances they are scaled back.
- We have set out this detail in response to continuing stakeholder concerns that the FTRs will not be firm. We consider that the above supports the argument that the FTRs will be relatively firm. We are continuing to test this empirically through the NERA modelling; as well as looking at overseas experience of this issue.
- This also means that the precision of the simultaneous feasibility test (i.e. specifications of the simultaneous feasibility auction) is less crucial for ensuring the firmness of FTRs. Were "too many" FTRs to be sold such that the actual congestion rent is less than the actual FTR payouts, the auction revenue (which itself would be higher than would otherwise be the case because more FTRs have been sold) would be used to back the FTRs.
- We think that it is appropriate that FTR issuance should aim to fully utilise the expected congestion rent, as this leaves consumers in a "balanced position". If the actual congestion rent exactly equals the actual FTR payouts then the two exactly cancel out, meaning that the consumers receive a fixed offset to their TUOS – the auction revenue. If the two do not exactly equal, then consumers will be exposed to variability in the amount which is used to offset their TUOS (either higher or lower).
- The simultaneous feasibility test (which applies to fixed volume FTRs) does not target this objective precisely. Rather, it targets the congestion rent being at least enough (and therefore, on average more than enough) to back the FTRs issued.
- However, the simultaneous feasibility test (and fixed volume FTRs) is the only tested and practically implementable approach that we have identified for an auction-based procurement model. We are continuing to look at alternatives that could allow a more appropriate number of (potentially alternatively designed) FTRs to be released. However, based on our research, the simultaneous feasibility test is the only international example we could find that seeks to achieve this. We consider that this supports our conclusion that we can have confidence in how the simultaneous feasibility test operates.

At the 5 June discussion, technical working group members expressed a range of views on alternative options to make FTRs firmer. For example, suggestions included that rather than limit FTR funding to the congestion rent and auction revenue, FTRs could instead be made fully firm by exposing other parties to funding shortfalls that might occur.

Building on these points, the conclusions we reach in this paper are that:

- It is appropriate to use the loss rent arising from marginal losses to back FTRs that also hedge loss-related price differences, consistent with the design for FTRs relating to congestion.
- It would be appropriate to use the auction revenue to reduce the likelihood that payouts for these products would be subject to scaling – although not increase the overall volume sold. This would be consistent with the approach for congestion. This is a change from the position put forward in the March 2020 paper.
- To account for the fact that actual losses need to be paid for, the most practical method that we have identified for determining how many loss FTRs can be sold is to make a volume adjustment through the simultaneous feasibility auction. While this relies to an extent on forecasting system flows, the availability of the auction revenue to firm the products reduces the impact on FTR firmness of getting the forecast wrong. However, the impact on the risk position of consumers is also an important consideration. We are considering what empirical analysis could be undertaken to test the feasibility of this option.
- Based on the factors we have identified, we are inclined to think that a combined loss and congestion product is likely to be more straightforward to implement, and potentially simpler for participants to use. However, feedback from stakeholders is important for testing this position.
- We are continuing to assess the usefulness and feasibility of introducing a loss FTR product if the current static MLF framework is maintained and after stakeholder feedback on these issues.

2 Funding and procurement for loss FTRs

2.1 What are 'loss FTRs'?

If dynamic marginal losses are introduced, the LMPs calculated by the dispatch engine in every 5-minute dispatch interval will automatically reflect the impact of marginal losses. That is, the LMP at a connection point will reflect the change in total system losses from supplying an additional unit of energy at that location. We note that the introduction of dynamic losses would require changes to NEMDE and so interacts with other reforms underway, such as those being considered by the ESB in its 2025 market design work.

For market participants, the impact of marginal losses on the LMP at their connection point involves both:

- Price risk – i.e. the risk that the LMP generators receive / loads pay changes due to fluctuations in marginal losses; and
- Basis risk – i.e. the risk associated with buying and selling energy at different locations in the system, where the underlying wholesale price at those locations is different due to the effect of marginal losses.

As with FTRs that hedge congestion-related price differences, the purpose of a loss FTR is to allow participants to manage the price and basis risk arising from losses. A simplified example of how loss FTRs could assist participants to manage this risk is included in Appendix A.

For the following discussion, we assume that a 'loss FTR' is a *combined* loss and congestion FTR; that is, it will manage the price and basis risk arising from both losses and congestion together (options related to separate FTR products are considered in section 2.4). As discussed at the 5 June technical working group, our proposed approach to selling FTRs – a simultaneous feasibility auction – means that the FTRs necessarily follow the standard FTR design. That is, they have a fixed MW volume and pay out on the full difference between two LMPs.[2] Therefore, if we have a combined product, the same FTR structure applies to loss FTRs. This structure has important implications for the funding of loss FTRs, discussed in the following sections.

2.2 Loss FTR funding

In the 5 June technical working group, we set out a proposed approach to funding FTRs that hedge congestion-related price risk. Specifically, we proposed to:

- aim to sell a volume of FTRs that is consistent with the congestion rent (i.e. target *congestion rent = FTR payout*); and
- use the FTR auction revenue to back FTR payouts, if necessary, in order to make the instruments very firm.

We consider that it makes sense to adopt the same approach in relation to losses. That is, loss FTRs could be funded through the loss rent that arises from dynamic marginal losses.[3] In addition – and different from the position expressed in the March 2020 technical paper – the FTR auction revenue could also be used to reduce the likelihood that payments to loss FTRs holders would be scaled back. We explain the thinking behind this proposal below.

Because LMPs are based on marginal losses, which exceed actual losses, this means that the amount that loads pay into settlement *exceed* the amounts paid out to generators, resulting in a 'loss rent'. This is similar to the congestion rent arising from binding transmission network constraints if locational marginal pricing is introduced.

Currently, the loss rent that arises from the application of intra-regional MLFs (i.e. within a NEM region) is returned to consumers directly via a rebate on their TUOS charges. The loss rent arising from inter-regional marginal losses (that result in differences between regional reference prices) is currently allocated to the holders of Settlement Residue Auction (SRA) units. The revenue used from the sale of SRA units is then used to offset TUOS charges for consumers.

In the March 2020 paper, we noted that the intra- and inter-regional loss rents could alternatively be used to support loss FTRs. This would be consistent with the approach we proposed for congestion at the previous technical working group which aims to result in a balanced risk position for consumers. However, if the loss rent is the basis for determining how many loss FTRs can be sold, some specific challenges arise.

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[2] That is, FTRs that pay out on the difference between to LMPs multiplied by a fixed quantity. As discussed with the technical working group, we are exploring alternative options that might allow alternatives to a fixed MW product. Our current understanding is that a fixed MW FTR structure can still accommodate time-of-use options (i.e. an FTR with a fixed MW volume, but that pays out only in certain specified time periods).

[3] For a combined product, the loss and congestion rent.

In order for a generator to exactly offset price differences from fluctuating marginal losses, it would require an FTR quantity equal to the flow between its transmission connection point and the regional reference node. However, given the relationship between marginal and actual losses[4], if the FTR quantity is equal to the actual flow between the two connection points, the loss rent will not be enough to fund the full FTR payment.[5] This reflects the physical characteristics of the system: physical losses are real, and must be paid for out of wholesale market settlement.

Therefore, restricting loss FTRs to match the available loss rent means that they would only cover *part* of the loss-related difference between two LMPs. In aggregate, this means that participants would be able to hedge the difference between actual and marginal losses. As we discuss in section 2.3 below, if we want the quantity of loss FTRs to be consistent with the loss rent, we cannot simply apply the simultaneous feasibility test used for congestion FTRs; at least not without some modification to either the FTR design or the auction.

Alternatively, we could find an additional source of funding to cover the cost of actual losses. We understand that this is effectively the approach taken in New Zealand (see Box 1).

Box 1: New Zealand FTR market

In New Zealand's FTR market, participants are able to purchase an FTR product that hedges the combined price difference arising from both losses and congestion. As far as we are aware, this is the only example of an FTR product that hedges loss-related differences in LMPs.

We understand that, in addition to the congestion and loss rent that arises from wholesale market settlement, FTRs in New Zealand are also funded by:

- The FTR auction revenue.
- A degree of conservatism in setting the available quantity of (combined loss and congestion) FTRs that can be purchased. This is implemented as an adjustment to the overall capacity of the network used in the simultaneous feasibility auction. The adjustment was estimated based on historical data.

The latter adjustment is needed to account for the fact that the auction revenue and congestion/loss rent might not always be sufficient to fully cover FTR payouts, due to uncertainty around the available loss rent.

There are a range of ways that actual losses could potentially be funded.[6] However, our current thinking is that, if loss FTRs are made available to the market, the funding arrangements should aim to place consumers in a balanced risk position (as explained at the last technical working group). That is, our target should be to sell combined loss and congestion FTRs such that:

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[4] That is, the marginal loss if an additional increment of energy is supplied will be higher than average actual losses (i.e. total actual system losses divided by total injections).

[5] See Appendix A for an illustrative example.

[6] For example, before deciding on its current approach, New Zealand also considered an option that involved the system operator buying contracts that would cover the losses associated with the power flows implied by bids in the FTR auction. In its submission to the October 2019 discussion paper (p. 5), the Australian Energy Council noted that another approach would be to apply a loss reserve price in the FTR auction and retain this from the auction proceeds in order to cover real losses.

congestion rent + loss rent = FTR payout

As noted above, this means that in aggregate, market participants would be able hedge the difference between marginal and actual losses.

In addition, the FTR auction revenue could be used to firm payments to loss FTR holders (i.e. reduce the likelihood that payments would be scaled back). In the March 2020 paper, we expressed the view that FTR auction revenue should not be used to fund loss FTRs. While not explained very clearly, our position was that the volume of loss FTRs made available to the market should be consistent with the loss rent. That is, the FTR auction revenue should not be used to *fund the cost of actual losses*. However, we did not explicitly consider the option that the auction revenue could be to *firm* loss FTRs, which is the current proposal.

Conclusion

Loss rent is an appropriate constraint for loss FTR issuance, for the same reasons as for congestion FTRs (i.e. to place consumers in a balanced risk position). In addition, FTR auction revenue should also be made available to make loss FTRs firmer.

Questions for the TWG:

1. Do you think that it is appropriate to take the same funding approach for congestion and loss FTRs? That is, all FTRs would be backed by the available congestion and loss rent, with the FTR auction revenue used to firm FTR payments (but not increase the overall volume of FTRs that can be sold).
2. Alternatively, would it be better to find a way to fund the cost of actual losses?

2.3 Loss FTR procurement

Due to the effect of actual losses, if combined loss and congestion FTRs (with a standard, fixed-volume FTR design) are sold through a simultaneous feasibility auction, this will not guarantee that the combined congestion and loss rent is enough to fund those FTRs.[7] Therefore, to meet the objective that *congestion + loss rent = FTR payout*, we need to either:

- **adjust the FTR quantity** (i.e. modify the quantity of FTRs sold, from what would be determined through a standard simultaneous feasibility auction); or
- **adjust the FTR design** (i.e. make changes from the standard FTR design described above).

From an implementation perspective, the most feasible option may fall into the first category: adjusting the FTR quantity. However, there is further work need to test this position. We are also after stakeholder views on this. The reasons for this are explained below.

2.3.1 Adjusting the FTR quantity

This option would effectively reduce the quantity of combined loss and congestion FTRs sold through the auction, to take into account the effect of actual losses.

[7] The standard FTR design means that: the FTRs are balanced (i.e. the source MW quantity is equal to the sink MW quantity); the FTRs pay out the full loss- and congestion-related difference between the two LMPs; and the FTRs have a fixed MW quantity.

A possible implementation approach is to apply a standard simultaneous feasibility auction to determine the overall quantity of FTRs that could be made available, but with an additional adjustment to the network capacity that underpins the auction. The size of the adjustment would be based on an estimate of how many FTRs could be supported by the available loss and congestion rent over their term. This is essentially similar to the approach adopted in New Zealand's FTR market.

The adjustment factor would need to be estimated empirically, because the loss rent depends on actual flows on the network, which change in each dispatch interval (i.e. there is no constant mathematical relationship we can rely to set the adjustment factor). In practice, the analysis to set the adjustment factor could be similar to the process AEMO already follows for setting static MLFs.[8] However, depending on the lead time and tenure of the FTRs, the forecast might need to be over a longer horizon. Therefore, the ability to accurately estimate the available loss rent – and the impact of this on FTR firmness – was a key concern described our previous papers, including the March 2020 discussion paper. Specifically, we were concerned that the difficulty with establishing an accurate forecast might mean that loss FTRs would be subject to frequent scaling (i.e. the instruments might not be very firm, or market participants might have limited confidence in the instruments).

As we are now proposing that the FTR auction revenue would be used to fund FTR payouts – for losses and congestion – this issue is likely to be of far less concern; at least from the perspective of firmness. Consequently, we are now more comfortable that the approach outlined above could be feasible. We are interested in whether stakeholders agree with this.

However, given the objective to sell loss FTRs that are consistent with the available loss and congestion rent, the degree of accuracy is still important from the perspective of achieving an appropriate risk balance. Therefore, we are considering what empirical analysis could be conducted to further test this option. At this stage, we consider that key areas to explore would be the relative magnitudes of the loss and congestion rent and the variability in the loss rent over different time horizons. For example, if the variability of the loss rent is low relative to the overall level of FTR funding we might expect (auction revenue plus loss and congestion rent), then this would support the view that scaling may occur relatively infrequently. We are interested in the technical working group's views on what other analysis might be helpful to test our thinking on this issue.

We have also considered alternative approaches, in which the FTR design is used to ensure that the overall payout of the FTRs issued would be consistent with the available loss and congestion rent. As we outline below, our current view is that these approaches may be either less desirable or less implementable than the option of adjusting the loss FTR quantity.

2.3.2 Adjusting the FTR design

Adjusting the FTR design would aim to ensure that, by definition, the loss FTRs issued could be backed by the loss rent. At this stage, we have identified two ways this could be achieved: **variable volume** loss FTRs and **unbalanced** FTRs.

Variable volume FTRs

As described above, a loss rent arises in wholesale market settlement due to loss-related price differences, and flows on the network. However, flows on the network change in each dispatch

[8] An alternative would be to establish an adjustment factor based on an assessment of historical data. We understand that this was the approach taken in the New Zealand FTR market.

interval. This implies that the FTR quantity would also need to change, if FTR settlement payments were to be perfectly balanced by the loss rent in each interval. This could be achieved by selling a variable volume FTR (for example, the payout of the FTR is one per cent of the loss rent, so that if 100 FTRs are sold, the rent always exactly matches the FTR payout).

However, allowing the FTR quantity to vary with network flows has implications for the wholesale market price signals faced by generators. This is because the loss rent is dependent on flows between connection points, and therefore also dependent on generator output. This would mean that at the margin, a generator that holds an FTR with a variable quantity would no longer be exposed to the locational marginal price at its connection point.

If FTR quantities are scaled to match flow, this could partly undermine the benefit of providing wholesale market price signals that accurately reflect the marginal value of supply at different locations in the network. Accordingly, our view is that in order to maintain the principle of marginal cost pricing, a fixed loss FTR quantity is preferable to a variable FTR quantity (although we are open to considering options for implementing variable quantity FTRs that would also maintain this principle and interested in stakeholder views on this point).

Unbalanced FTRs

Our research has identified an alternative approach to determining a quantity of fixed volume FTRs that would be consistent with the available loss and congestion rent. The typical FTR design – 'balanced FTRs' – involves the MW volume of the instrument being set at the same value at the 'injection and 'withdrawal' connection points. In an unbalanced FTR concept, the MW quantity at the withdrawal node is adjusted to reflect actual losses on the network. That is, effectively the FTR payout would be:

FTR payout = Withdrawal Node MW x Withdrawal Node LMP - Injection Node MW x Injection Node LMP

Instead of the following under a balanced FTR:

FTR payout = FTR MW x (Withdrawal Node LMP - Injection Node LMP)

However, we are not aware of this approach being applied in practice.

We understand that this approach may have been considered for other markets but abandoned due to complexities associated with the auction algorithm (although it was thought to be possible in principle), and also because stakeholders preferred a simpler balanced product.

In addition, as far as we are aware, the unbalanced FTR framework has been set out for FTRs that are *obligations* (i.e. that payout any price difference between two nodes, potentially resulting in the holder needing to make a payment). We are not aware of an equivalent framework having been described for FTR options. Therefore, as this stage we are concerned about the ability to implement an unbalanced FTR approach in practice. Therefore, we do not propose consider this further, but welcome any feedback from the TWG in this regard.

Conclusion

Determining the loss FTR quantity through a simultaneous feasibility auction, with a manual adjustment factor to account for the cost of actual losses, appears to be the most feasible procurement option from an implementation perspective (although further testing is required). We expect that using the FTR auction revenue to firm both loss and congestion FTRs should help to resolve revenue adequacy concerns associated with precision of the adjustment factor.

Questions:

3. Do you agree with our initial analysis of the options for determining what quantity of loss FTRs could be issued?
4. Are there other options that we should explore?
5. What empirical analysis could we consider in relation to the current preferred option (adjusting the FTR quantity)?

2.4 Should we have separate or combined products?

The conclusions that we have outlined above in relation to the funding and procurement of loss FTRs have implicitly assumed that the FTRs are combined products, that hedge both loss and congestion related price differences within a single instrument. There are some additional issues to consider in determining whether it would be preferable to offer a combined or separate product.

We have identified the following reasons why a combined product might be preferred:

- If dynamic marginal losses are introduced, marginal losses will be reflected in LMPs automatically. Therefore, it may be simpler for market participants to purchase a product that hedges the full LMP price difference between two connection points.
- If the products are combined, there is no need to separate out the loss and congestion components. We understand that decomposing LMPs in this way is possible. Indeed, this is the case in some LMP/FTR markets in the US, where marginal losses are included in LMPs but FTRs hedge only congestion related price differences. However, the decomposition relies on the selection of a reference connection point (i.e. a connection point at which the marginal loss is 'absorbed'). While approaches to selecting an appropriate connection point exist, the choice is somewhat arbitrary.
- From an auction perspective, it is likely to be less complex to offer only one combined product, rather than separate products (particularly if participants wished to have the ability to place bids that are conditional on receiving both a loss and congestion FTR). The only existing example of loss FTRs – New Zealand – has taken the approach of offering a combined product.
- The overall pool of congestion and loss rent for a combined product will be larger than for two separate loss and congestion products (assuming that for separate products, the pool of funds would also be separated). This may make it more practical to manage the overall firmness of a combined product.

On the other hand, there are reasons why a separate product might be preferred:

- Some participants' may prefer to manage loss-related price risk through different means (e.g. through their contracting arrangements) or have difference preferences for loss versus congestion products. This has been raised by participants at previous technical working group meetings.

- In overseas markets, there is less experience with offering FTR products that hedge loss-related price risk. Therefore, it may be preferable to 'quarantine' loss FTRs as separate products, as experience with their operation is developed.

Overall, our current view is that if dynamic marginal losses are introduced, it would likely be preferable to offer a combined product. Slightly different considerations might arise if the current MLF framework is retained, as we discuss in the following section. An alternative is to just not have a product for hedging losses. We are interested in stakeholder views on this point.

Questions:

6. Are there other factors we should take into account when considering whether combined or separate or no products should be offered?
7. Do participants have an initial view on which would be preferable?

2.5 What if the current MLF framework remains in place?

In the options described above, we have assumed that dynamic marginal losses are introduced. However, this design choice is still being evaluated.

If the current static marginal loss factor (MLF) framework is retained, it would in principle still be possible to introduce a loss FTR product. This is because, the application of MLFs already, effectively, results in different LMPs for participants depending on their location on the network. As a result, there is already a loss rent that arises from the application of static MLFs, that could be used to back FTRs.

In the context of static MLFs, the purpose of a loss FTR would be hedging changes in the (currently annually determined) MLF, rather than changes in marginal losses as calculated by the dispatch engine in every 5-minute dispatch interval.

However, we have identified some additional considerations for introducing a loss FTR product if the current loss factor framework is retained:

- Static MLFs are set by AEMO over a year. Given that market participants already have MLFs that are fixed for a year, the tenure would need to be longer than this to provide a hedging benefit, relative to the status quo. However, it is not clear how well this requirement would combine with congestion FTR products that might be offered with both shorter and longer tenures. For example, if some congestion FTR products are offered one month ahead, it is not clear how this could be combined with a loss FTR product that is intended to hedge annual changes in the MLF.

- If loss FTRs cannot be readily combined with congestion FTRs in a single product sold through the same auction, we will need to think of an alternative approach for the procurement process (i.e., it may not easily be implemented as an adaptation of a simultaneous feasibility auction).

We are interested in stakeholder feedback on the above.

Questions:

8. Are there other factors we should take into account when considering loss FTRs under the current static MLF framework?

2.6 Summary

In summary, our current thinking in relation to loss FTRs is that:

- It is appropriate to use the loss rent arising from marginal losses to back FTRs that also hedge loss-related price differences, consistent with the approach for congestion.
- It would be appropriate to use the auction revenue to reduce the likelihood that payouts for these products would be subject to scaling – although not increase the overall volume sold. This would be consistent with the approach for congestion. This is a change from the position put forward in the March 2020 paper.
- To account for the fact that actual losses need to be paid for, the most practical method that we have identified for determining how many loss FTRs can be sold is to make a volume adjustment through the simultaneous feasibility auction. While this relies to an extent on forecasting system flows, the availability of the auction revenue to firm the products reduces the impact on FTR firmness of getting the forecast wrong. However, the impact on the risk position of consumers is also an important consideration. We are considering what empirical analysis could be undertaken to test the feasibility this option.
- Based on the factors we have identified, we are inclined to think that a combined loss and congestion product is likely to be more straightforward to implement, and potentially simpler for participants to use. However, feedback from stakeholders is important for testing this position.
- We are continuing to assess the usefulness and feasibility of introducing a loss FTR product if the current static MLF framework is maintained and welcome stakeholder feedback on this

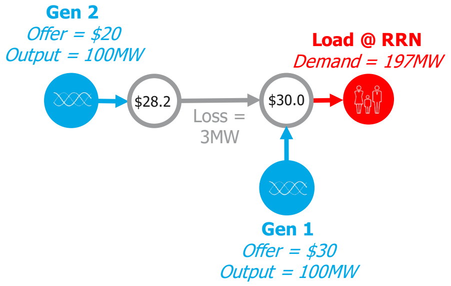
Appendix A.

This appendix provides some simple examples of how a loss FTR product could work in principle, and the issues that arise in funding loss FTRs. These examples are taken from the March 2020 Technical Specification Paper. For ease of reference, these assume that the current static MLF framework remains in place for intra-regional losses.

FTRs that hedge loss-related price differences would operate in a similar way to the standard FTR design for congestion. That is, they would allow the holder to receive the loss-related difference between two LMPs, multiplied by the FTR quantity. If the FTRs were a combined loss and congestion product, the payout would be based on the full LMP price difference. A simplified example of how market participants could use a loss FTR product to manage the risk of changing marginal losses is provided in Box 2 below.

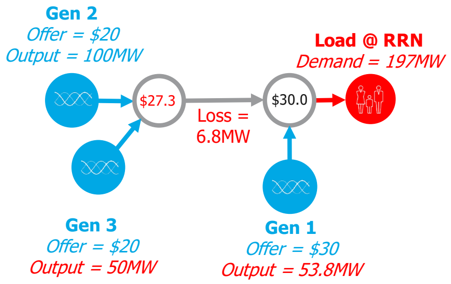
Box 2: Loss FTRs and risk management

The simple two-node diagram below shows two generators - Gen 1 and Gen 2 - supplying a single load located at the regional reference node. Gen 1 is also located at the regional reference node. The load is non-scheduled and both generators are scheduled. Gen 1 and the load have, by definition, a marginal loss factor (MLF) equal to 1, because they are located at the regional reference node. Gen 2's MLF is 0.94. Gen 1 and Gen 2 offer their output at $30/MWh and $20/MWh respectively. Gen 1 is the marginal generator and therefore sets the LMP at both connection points. There is no congestion in this example, so the difference between the LMPs for the two generators and the RRP for the load is due only to the effect of marginal losses. Dispatch and settlement outcomes are shown below.



	Energy	RRP	MLF	"Local price"	Settlement
Gen 1	100MW	$30.0	1.00	$30.0	$3,000
Gen 2	100MW	$30.0	0.94	$28.2	$2,821
Load	197MW	$30.0	1.00	$30.0	$5,910
Loss settlement residue					**$89**

Now assume that another generator (Gen 3) builds next to Gen 2, at the same transmission connection point. When AEMO recalculates the MLF to take the changing patterns of generation into account, the MLF at Gen 2/Gen 3's connection point falls from 0.94 to 0.91. Accordingly, the LMP falls from $28.2 to $27.3.

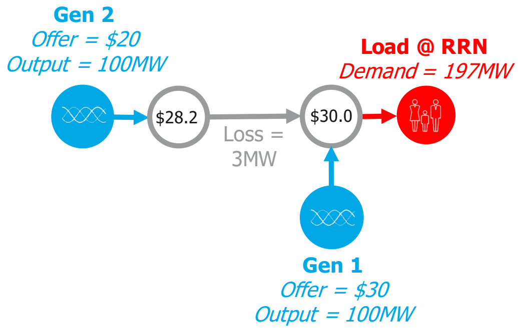


	Energy	RRP	MLF	"Local price"	Settlement
Gen 1	53.8MW	$30.0	1.00	$30.0	$1,613
Gen 2	100MW	$30.0	0.91	$27.3	$2,731
Gen 3	50MW	$30.0	0.91	$27.3	$1,365
Load	197MW	$30.0	1.00	$30.0	$5,910
Loss settlement residue					**$201**

As illustrated in the figure above, although Gen 2's output is unchanged at 100MW, its wholesale settlement revenues have fallen by around 3%, due to the adverse change in its MLF resulting from the entry of Gen 3.

What if Gen 2 held an FTR with a quantity of 100MW (equal to its output)? Assume the FTR pays out on the full loss-related difference between Gen 2's locational marginal price and the regional reference price. Settlement outcomes pre- and post-entry of G3 are shown below, including the FTR payout.[9] For simplicity, this example assumes there is no transmission congestion. Therefore, the price differences shown relate only to the application of MLFs.

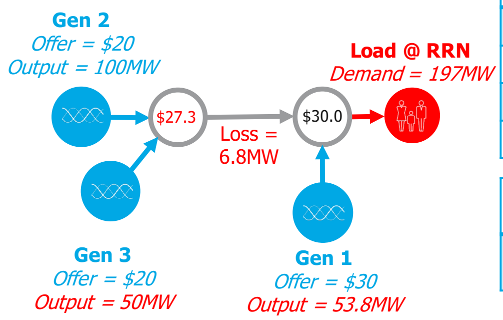
[9] Remember, in this example we are assuming that the static MLF is equal to the actual MLF in the dispatch interval depicted.



	Energy	LMP/ RRP	Wholesale settlement
Gen 1	100MW	$30.0	$3,000
Gen 2	100MW	$28.2	$2,821
Load	197MW	$30.0	$5,910

	Loss FTR	Price difference	FTR settlement
Gen 2	100MW	= $30.0 - $28.2 = $1.8	$179

Gen 2 total settlement
$3,000



	Energy	Local price	Wholesale settlement
Gen 1	53.8MW	$30.0	$1,613
Gen 2	100MW	$27.3	$2,731
Gen 3	50MW	$27.3	$1,365
Load	197MW	$30.0	$5,910

	Loss FTR	Price difference	FTR settlement
Gen 2	100MW	= $30.0 - $27.3 = $2.7	$269

Gen 2 total settlement
$3,000

As noted previously, while Gen 2's output is unchanged at 100MW after the entry of Gen 3, its wholesale settlement revenues have fallen by around 3%, due to the adverse change in its MLF resulting from the entry of the new generator. However, because the loss-related price difference hedged by the FTR has also increased, the FTR payout has increased proportionately, allowing Gen 2 to maintain the same total revenue. Effectively, the FTR provides Gen 2 with an MLF equal to 1.

Of course, Gen 2 would have paid some amount to acquire the FTR. A 'fair value' price for the instrument would be the actual payout over the 2 periods in question (in this case $179 + $269), plus an adjustment for the time value of money – assuming that the generator is risk neutral and does not place any additional value on managing the loss related risk. In turn, had Gen 2 paid 'fair value', the same amount of money that would otherwise have offset TUOS directly would instead offset TUOS via the sale of the FTRs.

If Gen 2 had paid the fair value, its net position would be the same as not purchasing the FTR. However, acquiring the FTR allows Gen 2 to 'lock in' a cost for offsetting the impact of future changes in MLFs on its locational marginal price upfront, ensuring that it will receive the regional reference price on the FTR quantity (assuming this is matched by Gen 2's output). Gen 2's fixed costs would be higher, but these would be known upfront and could therefore be factored into its investment, operating and contracting decisions.

As described in section 1.2, due to the presence of actual transmission losses, the flow between two connection points will result in a loss rent that is *less than* the payout on an FTR with a quantity equal to the flow. Box 3 below provides a simplified illustration of this, for a radial network example.

Box 3: Loss rent

Referring back to the wholesale settlement table in Box 4 (pre new entrant), while the payout on Gen 2's 100MW loss FTR is $179, available loss rent are only $89. In this simple radial network example, if loss FTRs were funded by the loss rent alone, Gen 2 would only be able to purchase an FTR equal to approximately half the flow between its connection point and the regional reference node (noting that this relationship may not hold for a non-radial case). In this case, Gen 2 would effectively be hedged against only half the revenue impact resulting from a deterioration in its MLF. This is shown in the table below.

Gen 2 revenue	Wholesale settlement	FTR settlement (FTR 50MW)	Total settlement
Gen 2 – (pre-new entrant)	$2,821	$90	$2,910
Gen 2 – (post-new entrant)	$2,731	$135	$2,865
Change post-new entrant	-$90	+$45	-$45

With the entry of Gen 3, flow between the two connection points would increase to 150MW.[10] Therefore, the total loss rent also increases to $201. In practice, Gen 2 could improve its position by purchasing enough loss FTRs to capture all the available loss rent (effectively, a loss FTR of 75MW, given the parameters of this example).[11] However, in this example, this is also not enough to fully mitigate the revenue impact of changes in Gen 2's MLF. Further, this would mean that no loss FTRs would be available for Gen 3 to purchase.

[10] That is, the combined Gen 2 and 3 output of 150MW. Recall that under the current loss factor framework, flow is defined at the connection point that is remote from the RRN.

[11] Whether Gen 2 could in practice purchase this quantity of loss FTRs would depend on how the available quantity is determined through the FTR auction.