MLF Framework Change Strawman List

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AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

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1 Purpose of document

Background

In 2024 AEMO conducted a consultation into its present Forward-Looking Transmission loss Factor (FLLF) Methodology whose scope was limited to AEMO's functions within the existing National Electricity Rules (NER or 'Rules'). That process is now complete and AEMO expects improvements in the accuracy of its annual Marginal Loss Factors (MLF) publication for the NEM, as well as the transparency of the calculation process.

During that consultation, and in other forums, concerns have been raised about the existing regime for determining and applying losses in the NEM that are laid out in the Rules. Whilst such concerns are not new, AEMO considered it appropriate to undertake some initial industry discussion to determine whether a detailed technical investigation of some alternative approaches should be a priority.

The WEM and NEM apply the same MLF approach, and although AEMO is unaware of these concerns being raised in relation to the WEM, it seems appropriate to consider reform in the context of both markets. In the NEM AEMO calculates MLFs, whilst in the WEM this is performed by Western Power. For simplicity this document refers only to AEMO in regard to the calculation.

Submissions to the FLLF methodology were invited to list alternatives that have been captured in a discussion points register[1]. A workshop was also held with NEM and WEM participants on 30 October 2024. Suggestions were made and discussed, but no clear majority industry interest in any specific alternative, nor indeed substantial change at all, has yet emerged.

At least one further workshop is planned. To provide structure, some 'strawman' reforms have been listed around which discussion can focus.

A further list of other suggested potential reforms is included for completeness, with explanations as to why these appear to be of lower priority.

Identifying strawmen

There is an infinite spectrum of possible reforms and combinations thereof. In listing these strawmen AEMO is not suggesting preferences for their development nor is it intending to exclude options. Rather the strawmen provide a structure to consolidate stakeholder input in a way that can be more clearly tested. Where that input shows interest, AEMO may choose to allocate resources to undertake further research.

The strawmen do not yet engage with how the reforms would be introduced, in terms of lead-time nor head of power. Some would clearly require Rules changes, whilst others might be implementable in other ways.

In selecting this group, AEMO considered:

- The fundamental objectives of loss pricing in striving towards investment and dispatch efficiency and settlement adequacy.
- The most cited challenges created by the current regime.

[1] At https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/market-operations/loss-factors-and-regional-boundaries/marginal-loss-factor-forums-2024.

- The likely acceptability of the reform strawman across industry, consumer representatives and AEMO, i.e. whether an option would trigger wide opposition.
- The implementation cost and challenge for AEMO and industry of the reform, in the context of AEMO's broader reform priorities and agenda.
- The commercial transitional impacts, i.e. whether the option creates difficulties for existing commercial relationships.
- The operability of the reform, i.e. whether the strawman has evident flaws.

The strawmen are not mutually exclusive.

Cited challenges of current regime

The strongest criticism in relation to the NEM's (but not the WEM's) MLF regime is the scale, volatility and uncertainty of year-on-year MLF change. This view was evident in stakeholder feedback to AEMO's 2024 methodology consultation[2], and the 30 October 2024 framework discussion workshop[3]. Whilst increased losses are an unavoidable and expected consequence of injecting additional energy into the grid at a point, AEMO understands that many investors did not anticipate, prior to investment, the scale and volatility of the MLF change. AEMO also understands that the resulting uncertainty is now causing investors to apply an additional revenue risk to their investment decisions.

The investment risk criticism arises in relation to intra-regional (transmission and distribution) rather than inter-regional loss factors.

[2] https://aemo.com.au/consultations/current-and-closed-consultations/consultation-on-forward-looking-transmission-loss-factor-methodology.

[3] Workshop materials are available at https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/market-operations/loss-factors-and-regional-boundaries/marginal-loss-factor-forums-2024.

2 'Strawman' proposals

2.1 An investment stability objective in the Rules

Background

Rule 3.6.2 lays out the process for AEMO to determine intra-regional loss factors. Clause 3.6.2(e) lays out principles for the methodology, with 3.6.2(e)(2) and (2A) demanding accuracy:

> (2) "….must, as closely as practical, describe the average of the marginal electricity losses…"
>
> (2A) "…must aim to minimise the impact on the dispatch of scheduled resources as compared to the dispatch of scheduled resources which would result from a fully optimised central dispatch process taking into account the effect of losses".

AEMO considers the existing rules limit AEMO's scope to consider matters outside of accuracy when determining MLFs and DLFs, even if in doing so generators are subject to large year on year changes.

Proposal

This strawman proposes weakening principles (2) and (2A), for example by removing the words "must" and "as closely as possible". An additional principle would be added requiring AEMO to have regard for *stability over time*.

Similarly, a stability principle could also be introduced into 3.6.2A(d) relating to the methodology for preparing forecast load and generation data.

There would be no change to 3.6.1 inter-regional losses and 3.6.3 distribution losses.

This proposal does not entail an immediate specific change. Instead, the proposal's shift in emphasis could inform how AEMO evolves loss factor methodologies evolve over time.

To illustrate how such a shift in emphasis might lead to specific change, suppose that Strawmen 3 (MLF glide paths) and 1 have been introduced. Strawman 1 would enable AEMO to apply its judgement in determining, applying and relaxing glide path limits.

Objective

The small inclusion of a stability principle in the loss rules would cause AEMO to, when developing its methodologies, consider ways to balance year on year stability against accuracy. The intent is to empower AEMO to lessen extreme annual movements, say caused by a recently observed shift in generation patterns that may not be permanent. Smoothing of short-term volatility may reduce perceived investment risk.

By retaining accuracy principles, AEMO would still have the right to make large changes in MLFs where the effect of not doing so on dispatch efficiency or settlement adequacy would be substantial.

Limitations

The impact of a subtle shift in principles is uncertain. It requires AEMO to develop its methodology within a two-dimensional space of accuracy and stability, and it would largely rely on AEMO's judgement, influenced by consultation, to determine where in the space to target. AEMO might, for example, prefer to maintain its historical emphasis on accuracy, which would still be Rule compliant, resulting in no actual change.

As the strawman introduces a new variable into the principles – AEMO's judgement – it may introduce a new investment risk that counteracts the intended benefit.

The objective regarding stability can only impact short-term year-on-year losses. Over the life of an investment a declining trend in a loss factor would remain.

2.2 Global re-opening power

Background

The present Rules specify that marginal loss factors are to apply for a whole financial year[4], except where AEMO determines that a modification to a connection point results in a material change in its capacity[5]. For example, suppose that a new generating asset at an existing connection point is registered within a financial year, but that asset did not have a committed status in the generation information publication[6] at the relevant time for the base study for that financial year. In such a case, AEMO must consider mid-term re-calculation of the MLF(s) at the individual connection point if the change in capacity is deemed material. In these cases, only the directly affected connection point may be corrected, despite there being flow on effects at other nearby points.

However, there are also cases where key assumptions about the network or dispatch patterns become out of date, with material widespread effects. For example, actual marginal losses in much of Queensland were materially lessened during the extended outages at Callide C power station beginning in 2021. Had AEMO been able to re-open MLFs upon awareness of the extended outages, it could have replaced these with more accurate, higher MLFs[7].

Proposal

The Rules would permit AEMO to recalculate all MLFs mid-period where it considered the basis for the original calculation had materially changed. The materiality triggers, notice period and MLF change threshold would need to be determined, perhaps in AEMO's methodology. Once determined, this could provide a basis to define the geographical extent of MLF revision.

[4] NER 3.6.2(e)(1)

[5] NER 3.6.2(i)(2)

[6] At https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-planning-data/generation-information.

[7] This is described further in the FY23-24 backcast MLF results available at https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/market-operations/loss-factors-and-regional-boundaries/marginal-loss-factor-forums-2024.

Objective

By enabling the exceptional re-opening of the global calculation, MLFs across a large area could be made more accurate following a major exogenous input change, such as the Callide C outages. MLFs could increase as they would have in that case, or potentially decrease, say if a large plant returned earlier than expected.

Limitations

The strawman is targeted at improving accuracy, and in doing so it reduces stability, thereby conflicting with the major investor concern.

There are some implementation impacts as participants would need to occasionally manage MLF changes outside 1 July. MLF changes impact bidding and settlement systems.

The test to trigger a re-opening, and the re-opening itself, would consume AEMO resources.

2.3 Loss factor glide paths

Background

Whilst loss factors usually move progressively, occasionally after a significant new generator investment or change in network topology, there is a dramatic movement in one year. Occasions of large single year reductions in generator loss factors are often raised as concerns to AEMO. Since July 2016, 4.48% of annual MLFs published had a change from the previous year exceeding 0.05[8].

Proposal

In this approach an existing connection point's MLF would be constrained to changes, up or down, of no more than a fixed amount in any year, for example 0.05. Thus, the most severe year-on-year changes are capped, regardless of the resulting effect on accuracy.

There would be no constraint to the initial loss factor applicable to new connections, or to an existing connection point in a year where the activity materially changed, such as a plant expansion or installation of a large battery.

The threshold would be set by AEMO's methodology, allowing resetting over time. Uncapped figures would be published to give an understanding of long-term trends.

Objective

To reduce the financial risks associated with extreme year on year changes. As the limit is fixed and known upfront, investors can take note of it as a certain worst case.

Limitations

A cap, when binding, will have a detrimental impact on accuracy with resulting effects on dispatch efficiency and settlement adequacy which impacts consumers. An absolute limit to change is an inherently blunt and arbitrary

[8] Note this share includes connection points with commissioning plant, where large MLF changes are expected. If interest is expressed in this option, AEMO would undertake more detailed assessment of historical volatility.

mechanism. Unless combined with strawman #1 (section 2.1), the proposal provides no opportunity for AEMO to exercise its judgement in applying the cap depending on the significance of the inaccuracy.

Whilst limiting short-term movements, it would not lessen unfavourable loss factor movements over the long-term.

Where the entry of a generator caused a major decline in loss factors over a local area, the new entrant would receive a loss factor reflecting this whilst its neighbouring generators would initially be constrained by the glide path to higher numbers. This implies inaccuracy and the appearance of anomalous unfairness.

2.4 Quarterly diurnal forward looking loss factors

Background

The current methodology uses an adjusted historical dispatch pattern to obtain a year-long loss factor profile, then load weights this into a single annual intra-regional loss factor. In choosing a single loss factor for the entire year the design has placed operational simplicity ahead of accuracy.

The existing approach:

- implies a two-year delay from reference year dispatch data and the year to which it is applied; and
- provides a broadly accurate settlement over time but introduces dispatch inefficiency at different times of the day and year.

A more granular approach could achieve greater accuracy. There are infinite ways to slice time-weighted loss factors, such as seasonal and diurnal. However extremely short slices (*in extremis* a full half-hourly time series) would introduce a new inaccuracy due to noise in the historical data series.

An optimal slicing period could be informed by detailed analysis of historical loss variances. This analysis has not been performed. The purpose of this strawman is to gauge whether there is sufficient market interest to resource such analysis. The slicing chosen below is purely demonstrative to test participant interest for change.

Proposal

Each year’s loss factors are to be broken by quarter and day/night. Ahead of each quarter, each connection point would have two loss factors published; a unique day and night loss factor.

The diurnal boundary would adjust with length of daylight, e.g. 0800-1600 for Q2 & Q3, and 0600-1800 for Q4 & Q1.

By publishing ahead of every quarter, the loss factor would use as a reference quarter the previous years’ equivalent quarter, i.e. only a one-year lag and would be able to make use of fresher input information, such as the Callide C outage discussed in strawman #2 (section 2.2).

There is no fundamental change to the forward-looking methodology, the only change required is the periodicity of calculation and the periods of load-weighting.

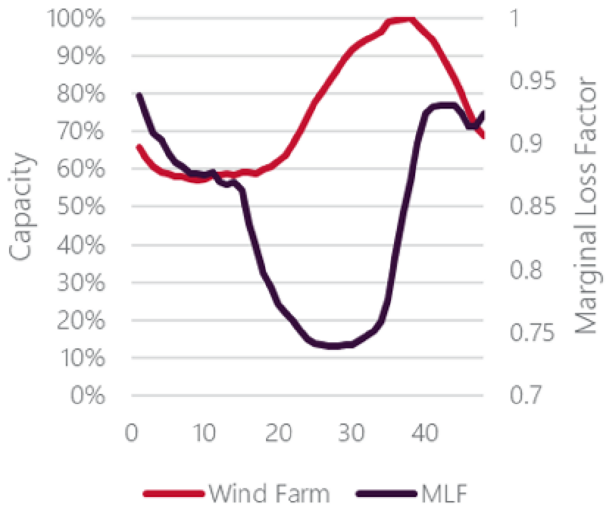
Objective

To obtain a more accurate loss factor recognising the power system's diurnal and seasonal changes in dispatch and to reduce the historical reference period lag. Quarters were chosen to broadly recognise seasonal shifts whilst diurnal captures the daily cycles in dispatch caused by solar generators. Non-solar generators located in areas of high renewable penetration would receive more favourable night loss factors. This would lead to more efficient dispatch and, at the margin, encourage greater utilisation of storage by these generators to shift exports from day to night. Solar generators would be less impacted as their MLFs are already load-weighted to daytime.

It may be assumed that in today's power system, seasonal and diurnal effects drive more dispatch variance than traditional classifications such as peak/off-peak and weekday/weekend. If this assumption is correct, quarterly diurnal loss factors would be a preferrable approach.

For example, Figure 1[9] shows normalised output (red) and the diurnal loss-factor characteristic (purple) of a non-solar generator located in a lossy network in proximity to solar farms. In this case a year was sliced into half-hourly averages (i.e. not by season). This shows MLFs materially improve overnight, and that time of day has a bigger impact on this generator's actual MLF than its own generation.

Figure 1 Diurnal losses of a wind farm



Limitations

Although a differently sliced FLLF calculation is straightforward, there would be large operational impacts of such a change:

- Bidding systems would be affected as bids are presently quoted at the connection point yet must be within the market price cap and floor at the regional reference node. Participants presently adjust bids around this restriction for only one annual change in loss factors. There is no existing way to adjust for a loss factor that changes intra-day. Most likely systems would need to redefine bid prices to be quoted at the regional reference node, a major system change with participant impact.
- Commercial contractual arrangements that adjust for loss factors would similarly be affected and may require participant settlement system adjustments.
- Depending on the way bids are quoted, intra-day loss factor changes could introduce a regular dispatch disturbance as similarly priced offers are re-ordered twice daily.
- There could be significant impacts on operational analysis tools that analyse historical generator bids.

[9] From *Marginal Loss Factors for the 2024-25 Financial Year (Figure 21)*, available at: https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/market-operations/loss-factors-and-regional-boundaries

- AEMO settlement systems changes to account for changing loss factors.
- The calculation process now must run four times a year implying greater ongoing resources.

This proposal purely targets additional accuracy, it does not improve investor stability in the short or long-term. The more granular loss factors should however not result in annualised financial volatility worse than status quo. As the loss factors are not published until the preceding quarter, there would be some loss of forward notice.

Quarterly MLF calculations would increase AEMO's workload, but not by a factor of four as much of the work would be repetitive.

2.5 Better risk allocation in government power purchasing agreements

Background

When an asset developer enters a long-term offtake agreement with a counterparty, it is sensible for risks to be left with the party with most ability to assess, influence and manage the risk. For loss factors risk is often allocated to the developer, presumably as they are typically better placed to understand the loss factor implications of different build locations. For example, a large consumer wishing to enter a long-term agreement for supply of bulk renewable energy from a developer would typically seek to purchase that energy at the regional reference node, i.e. loss factor risk would remain with the developer.

With respect to government underwriting schemes such as the Commonwealth Investment Scheme (CIS) and NSW Long-term Energy Supply Agreements (LTESA), governments are explicitly considering network circumstances when selecting successful tenderers.

This changes the nature of the developer-offtaker relationship. The offtaker is becoming a sophisticated buyer conducting an ex-ante assessment of the deliverability of each new asset and buying across a broad portfolio, whilst the developers' role more naturally becomes focused within each asset. In this commercial environment, it is more appropriate for the offtaker to absorb market access risk, including loss factors. However, AEMO understands this is not yet reflected in any of the major government offtake agreements being entered.

Proposal

Government selection processes should (continue to) assess and forecast network risks for each tendered project, including by forecasting loss factors. Governments should also (continue to) pool risk by contracting at a diversity of locations. Having selected on this basis, on-going loss factor changes are appropriately absorbed by the offtaker.

This proposal would need to be implemented by the relevant governments and is outside the power of the Rules or AEMO to bring about. AEMO could however assist by explaining the rationale to governments.

Objective

The majority of large-scale battery and renewable energy projects likely to be developed in the next few years will be underwritten by a government agreement. A reallocation of loss factor risk in those agreements would clarify that it is the role of the offtaker to consider this risk ahead of execution and to pool loss factor risk across its large portfolio of contracts.

By shifting risk from developer, the developer is able to present a more competitive offering to government. As government has engaged with a broad set of assets, its ability to pool the ongoing risk would lower the total cost of this risk as opposed to the present situation of being absorbed by individual developers.

Limitations

There is no way for AEMO to impose a new structure in the commercial dealings of government and can only achieve this desired outcome through independent expert explanation. AEMO's role gives it particular influence, but noting they are monopsonistic buyers, it may still be difficult to convince governments to reallocate a risk towards themselves.

3 Concepts not shortlisted

In shortlisting the above strawmen, AEMO knowingly set aside other reforms that have been previously raised, an inherently controversial choice. The selection was subjectively informed by:

- The likelihood of the reform meeting the criteria listed under "identifying strawmen" in section 0;
- The perceived level of breadth of interest and/or likely support for the reform in participants and institutions;
- The complexity of the reform and whether its implementation is likely to be justifiable; and
- Limiting the scope of the reform to the problem of loss factor volatility risk.

The following were briefly considered but not short-listed at this time.

3.1 Forward market modelling of supply and demand profiles

This involves using a market model to estimate all future dispatch patterns rather than using minimal extrapolation from historical patterns[10]. This would be hoped to both remove historical noise (such as seasonal anomalies) whilst not being subject to trend lag, particularly with new technologies such as batteries having very little historical behaviour to draw upon.

Even though the current approach relies primarily on minimal extrapolation, a degree of modelling is likely to emerge to manage changing technologies, for example estimating large-scale battery behaviour. Even if minimal extrapolation remains at the core of the calculation, it is quite possible that modelling will progressively play a larger role.

At this time AEMO is doubtful as to prospects of a fully modelling solution. There does not appear available a model suitable for the dispatch granularity required for a holistic loss factor assessment. Having developed a novel model, it would need skilful hands-on operation and judgement to oversee that the dispatch forecast is reasonable.

Prima facie, the theoretical benefits of holistic forward market modelling over minimal extrapolation don't appear likely to justify the additional resources to develop and operate the tool and the necessary introduction of judgement.

In early discussions, the use of forward market modelling was of high interest to a small number of stakeholders but did not appear to be of widespread interest.

3.2 Real-time loss pricing

By operating dispatch on a full network model, markets such as New Zealand's do not require loss factors as their locational marginal prices directly and accurately incorporate the effect of marginal network losses at all nodes at

[10] 'Market modelling' and 'minimal extrapolation' are terms used in this document to describe two different approaches to projecting future dispatch of the system for the purposes of MLF calculations. Technically, the calculations under the minimal extrapolation umbrella are a form of market modelling, meaning the language used in this document is a simplification. Minimal extrapolation is defined in the slides from workshop 1, available at: https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/market-operations/loss-factors-and-regional-boundaries/marginal-loss-factor-forums-2024.

all times. Replacing the NEM and WEM's hub and spoke representation with a network model would be an extremely large and long-term project with many implications beyond loss reform.

The hub and spoke model is able to operate with interconnector loss functions that adjust real time according to actual flows, however these are applied to only a small number of network elements. It is unlikely that a hub and spoke model could operate with similar functions to hundreds of intra-regional connection points.

AEMO has not heard any stakeholder interest in replacing loss factors with real-time loss pricing and considers it to be a solution beyond the scale of the concerns raised around loss factors.

3.3 Average loss factors

Electricity markets' use of marginal pricing tends to create a settlement surplus as, in a perfect representation, metered losses should equate to a lower, average, loss characteristic. The loss pricing surplus is used to offset customer network charges.

A 2019 rule change[11] proposal put forward using the square root of the calculated marginal loss factor in dispatch and settlements as a proxy for average losses, which would roughly halve the financial impacts of loss factors. Settlement surpluses would no longer accrue, and, due to inherent errors in average losses, some deficits would be expected that would be recovered from transmission providers and then consumers. For example, even with marginal pricing South Australia regularly accrues a negative intra-regional surplus.

The proposal would be straightforward to implement.

The AEMC rejected the 2019 proposal as it would represent a major departure from the marginal pricing philosophy of the NEM, introducing dispatch inefficiency and muting new-investment locational signalling. It would also represent a significant wealth transfer away from customers and between existing competing generators.

Despite the rejection, there remains strong interest in the proposal from some stakeholders, although not widespread. AEMO understands that the NEM has evolved since 2019, but also understands the AEMC's reasons for not progressing the reform at that time and considers they remain relevant today.

3.4 Longer-term loss factors

This proposal involves setting rolling annual loss factors (say) 3 years ahead, implying a longer-term extrapolation process than is done presently. Clearly this would increase short-term predictability in losses but at a major loss of accuracy as it would require many assumptions around entry and exits that will be committed on a shorter timeframe than the outlook.

Whilst it would give loss factor certainty for the short-term period, it would not change long-term investment risk.

AEMO's initial view is that the expected forecasting challenges and loss of accuracy makes this proposal a low priority for investigation. AEMO considers that the potential benefits of this sort of approach from a stability perspective could be delivered through other options (for example, to varying degrees, the strawmen described in sections 2.1, 2.2 and 2.4).

[11] https://www.aemc.gov.au/rule-changes/transmission-loss-factors

3.5 Rolling historical generation reference years

This proposal calculates MLFs using several recent complete years rather than one. It is intended that by smoothing natural dispatch volatility across say two reference years, it would be expected that annual loss factor volatility would reduce at the loss of some accuracy due to the use of older data. This may be useful for investor confidence.

Note that whilst the current methodology defaults to one reference year, AEMO presently adjusts that data where it considers an exceptional generation pattern has occurred that is not expected to repeat, such as a drought. Once outliers are removed, other sources of MLF volatility include forward-looking changes in generation and network topology, and natural generation variance driven by the underlying weather resource. Of these, natural generation variance is a relatively small cause of volatility.

There is some participant interest in this approach, but AEMO has not shortlisted it for more analysis as it considers it unlikely to deliver a materially more stable output whilst also delaying the capture of developing trends, reducing accuracy. Below are two simple examples of a generation patterns over six historical years, with renewable generators showing natural variances for which smoothing over time may be appropriate, but the thermal showing progressive trends which smoothing would delay.

Figure 2 Historical output of example wind generator

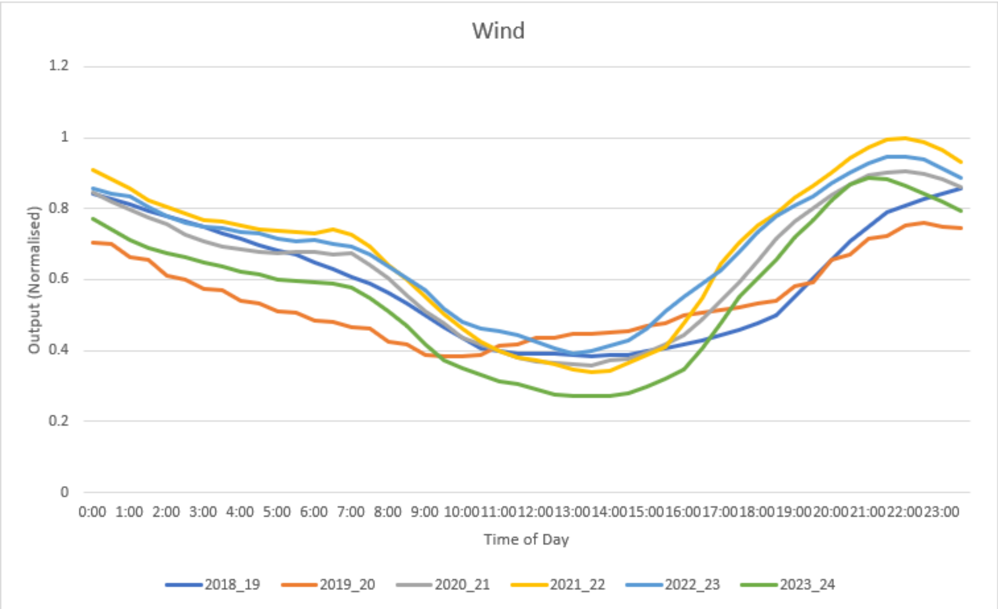
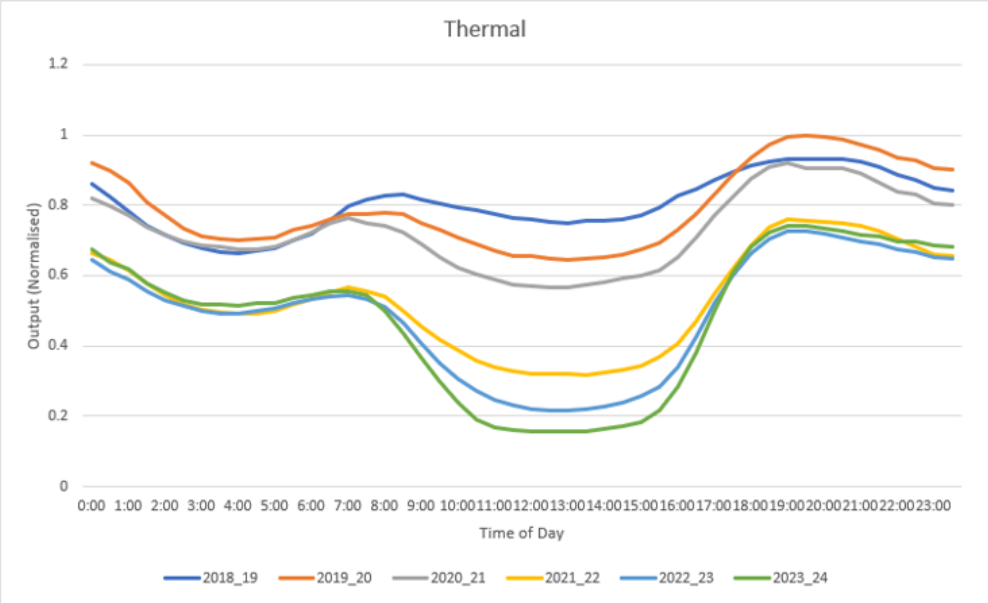


Figure 3 Historical output of example thermal generator



Regardless of the potential benefits of rolling historical reference years, AEMO considers that the glide paths strawman (section 2.4) would more effectively and transparently deliver MLF stability and therefore does not consider that rolling reference years should be further investigated.