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Iberdrola Australia submission to Primary Frequency Response Incentive Arrangements

Submitted to AEMC by website

1. Overview

We thank the AEMC for the opportunity to provide feedback on the draft determination and the design of the AEMC's proposed incentive scheme. The key points of our submission are as follows:

- We strongly support the introduction of an effective incentive mechanism for narrow deadband primary frequency control that will ensure services can be delivered throughout the transition to net-zero.
    - Our view is that a comprehensive market to replace the mandatory requirement would be more efficient and deliver lower costs to consumers.
- To inform our submission, we have undertaken detailed quantitative analysis of the proposed scheme at four second resolution to understand the potential impacts on participants and consumers (Section 3).
    - We find that, as proposed, the current scheme may actually weaken existing incentives for good frequency performance. For example, a participant with perfect frequency performance may now incur Regulation FCAS charges based on their share of load or generation.
- We have identified relatively minor changes to the AEMC's proposal that could help deliver more effective outcomes (Section 4). This includes:
    - More clearly defining key parameters such as the "Regulation Requirement" RR;
    - Recovering residual Regulation costs from a longer-term metric, rather than pro-rata with energy; and
    - Introducing a new lever that will increase certainty that the incentive mechanism can deliver the required response as the system transitions.
- We are concerned that the mandatory requirement will not be effective in delivering the necessary frequency control in the future. Furthermore, it imposes a cost on all participants that will ultimately be borne by consumers, rather than establishing a two-sided market where the most efficient providers

can be utilised to meet a standard. This is not consistent with the NEO. We do not support the removal of the sunset period, and provide further commentary in Section 2.

Finally, we note that the AEMC's advice from GHD was based on the AEMO 2020 Central ISP scenario, while projections of renewable generation to 2030 are already in excess of the AEMO 2020 Step-Change Scenario. We encourage the AEMC to reconsider the GHD advice in light of Australia's renewed commitment to net-zero by 2050 (and new legislated arrangements such as the NSW Energy Roadmap).

2. Enduring Mandatory Primary Frequency Response

AEMO[1] has argued that a narrow-band primary frequency response is essential for the effective functioning of the grid into the future. AEMO believes that the chosen pathway must enable robust effective aggregate frequency responsiveness in the long term that is:

1. Decentralised,
2. Distributed,
3. Simple,
4. Predictable, and
5. Flexible

Furthermore, AEMO's technical white paper identified that the need for PFR can be reasonably expected to grow over time due to factors from a transitioning energy system, and that an aggregate level of PFR delivery requires plant to be capable of frequency response, online and also to be carrying enough headroom or footroom to provide the response. AEMO identifies that the headroom/footroom could be provided from BESS, curtailed VRE generation or synchronous generation, and sourced through FCAS arrangements[2].

The appropriate standard should be defined *before* the market mechanisms

Iberdrola agrees that the mandatory primary frequency response obligations to date have managed to maintain a tight distribution of frequency around 50Hz. However, it is not clear how much response is needed to maintain this narrowband frequency distribution and what the cost has been in achieving this and what it could be in the future.

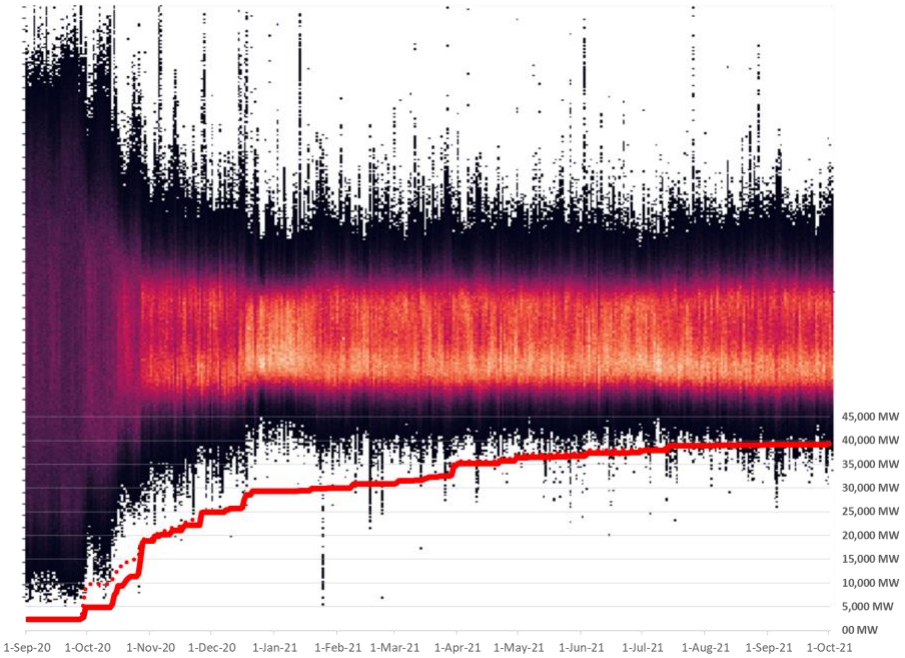
Error! Reference source not found. shows the change in the frequency distribution in the mainland NEM over the period of PFR implementation. The secondary axis (red line) shows the total capacity with a tight deadband implemented. It is clear from this figure that most of the narrowband frequency control was achieved with the units

[1] https://www.aemc.gov.au/sites/default/files/2021-09/AEMO_Enduring%20PFR%20requirements%20for%20the%20NEM%20technical%20white%20paper.pdf p. 5

[2] AEMO, p. 4

that had been implemented before January 2021. This suggests the service is currently oversupplied.

Figure 1 Frequency distribution heat map with megawatts implemented PFR



Source: Iberdrola Australia's analysis of AEMO causer pays dataset, and PFR implementation Report[3]

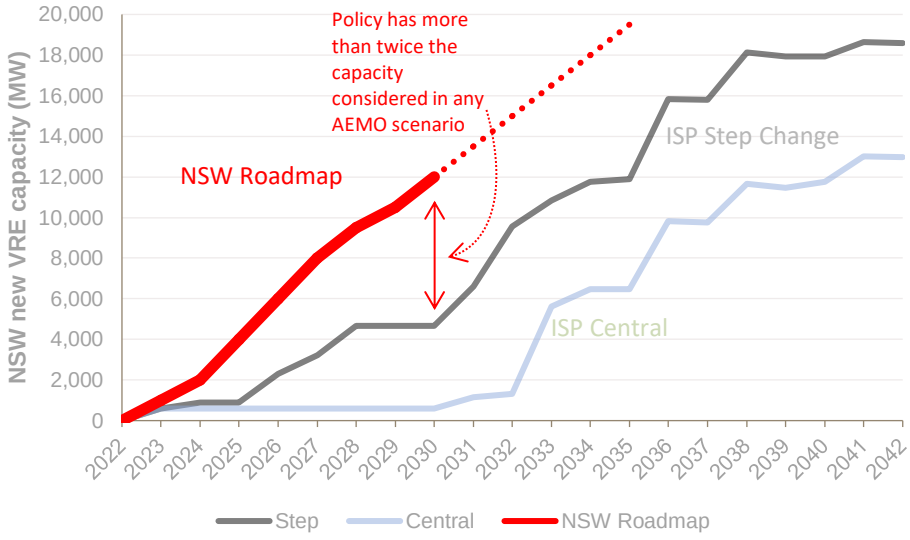
The likely pace of change has been underestimated

GHD's advice[4] to the AEMC highlighted we could have a shortage of headroom to deliver narrowband frequency response by the end of the decade – noting this work was based on AEMO 2020 central scenario in which we are already far outpacing the rate of change, shown in Figure 2 below.

[3] https://aemo.com.au/-/media/files/initiatives/primary-frequency-response/2021/pfr-implementation-report-v19-1-oct-21.pdf?la=en

[4] https://www.aemc.gov.au/sites/default/files/2021-09/GHD_Enduring%20Primary%20Frequency%20Response%20Final%20Report%20Final.pdf p. iii

Figure 2 Capacity built in NSW in AEMO ISP 2020 compared to NSW Roadmap legislated capacity



Source: Iberdrola Australia's analysis of AEMO Integrated System Plan 2020, and NSW Roadmap

Our view is that we will have a shortage of headroom well before GHDs analysis indicates and need sufficiently strong market mechanisms in place to procure headroom before we face shortfalls.

Need to assess costs and benefits to consumers of the mandatory requirement

We recommend the Reliability Panel should be engaged for their advice before the sunset period is removed.

As per our submission to the Mandatory Primary Frequency Response rule change, requiring all (capable) resources to provide tight deadband PFR will mean that the *necessary* service is not being provided by those that are best able to or at least cost. Instead, it risks over-consumption and, eventually, under-supply (i.e. the usual market characteristics of a mis-priced good). This will result in higher costs to participants which will result in higher costs to consumers, which is not consistent with the NEO.

If the true value of narrowband frequency response is not revealed, it does not provide forward looking investment signals to guarantee future provision of the service. This signal is pertinent to the delivery of the service particularly when the provision of headroom or footroom is needed to support PFR.

The Reliability Panel should work with AEMO to define a standard against which the success of the scheme can be compared, before a design is settled and before the sunset period is removed.

Iberdrola does not support the removal of the sunset clause at this time.

We support a two-sided market for valuing and delivering PFR

Relying on a mandatory obligation of PFR does not guarantee that sufficient headroom will be available. We support appropriate incentive relationships which incorporate both the value of the service and the cost of provision.

Critically, the scheme must provide appropriate "levers" to ensure sufficient PFR is available into the future. This includes valuing:

- The "mileage" (throughput or movement) a unit might be experiencing – droop response to frequency (this would be compensated through a performance payment linked to Frequency Deviation) or,
- The headroom required for the delivery of quality narrowband frequency response

We thank the AEMC for their work to date on proposing a possible scheme. In the sections below, we provide some analysis of the scheme and identify several areas where we consider changes are needed to deliver effective outcomes. In particular, we observe that the proposal may provide weak signals for incentivising PFR and may even mute the signal that currently exists with the causer pays framework.

3. Analysis and implications of the reforms to causer pays

We are concerned that the proposed frameworks may not deliver sufficient response in in the future. To further understand the potential outcomes, we have therefore completed comprehensive quantitative analysis of the proposed scheme, at four second data resolution, to understand:

1. The proposal of how costs of regulation are allocated
2. Whether the incentive for primary frequency response is enough for voluntary provision of the service

The modelling was performed on historical 4s causer pays data, between February 2021 and October 2021. This period was chosen as 8 months with between 30GW and 40GW of scheduled and semi-scheduled plants with PFR implemented.

Overview of the AEMC's proposal

The AEMC has proposed:

- Retaining the narrow-deadband (15 mHz) mandatory requirement on all generators when dispatched above 0 MW. (This does not include units enabled in the FCAS markets if *dispatched* to 0 MW, to avoid costly cycling of batteries, for example.)
- Retaining the existing Regulation FCAS market, but splitting cost recovery into two components:
    - Recovery of the component of the Regulation service actively "required" during a dispatch interval through a real-time causer pays performance factor for the DI, with an appropriate definition of "required" still to be determined; and

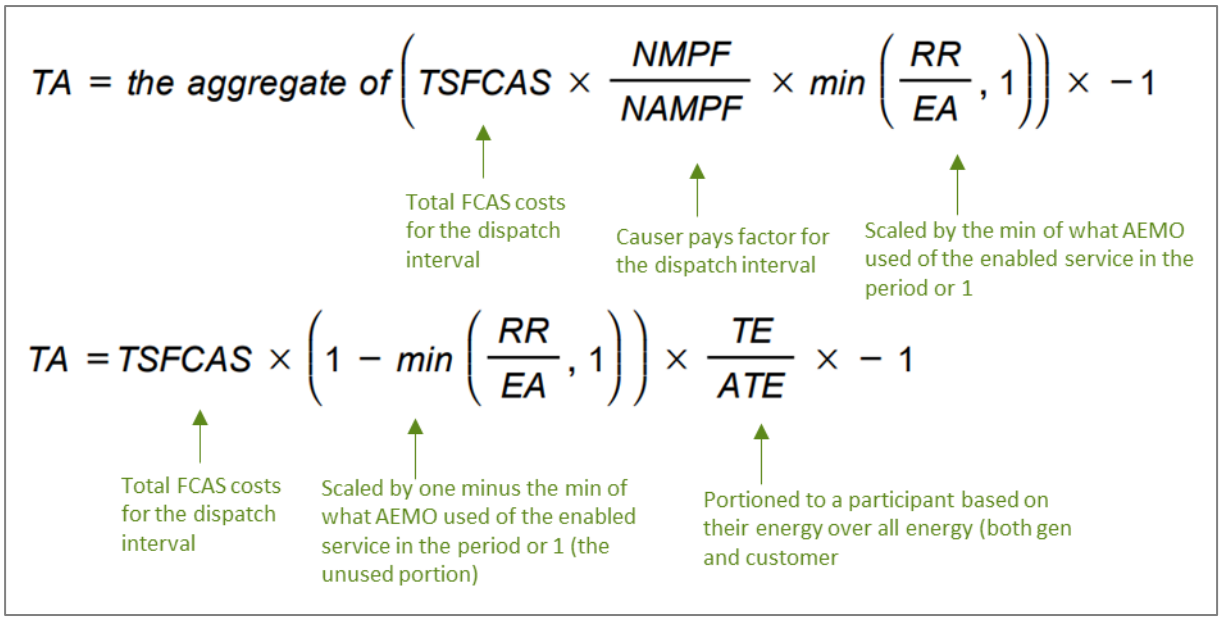
    - Recovery of the residual component of the Regulation cost for that DI through a slow factor, proposed to be the simple MWh consumption of the unit.
- Introduction of a positive performance payment to units that help the frequency during a period, which would be scaled symmetrically with the negative real-time causer pays factors above (i.e., a unit deviating 1 MW and helping the frequency would be paid the same as the charge to a unit deviating 1 MW in a harmful direction).

These elements are explored further below.

Role of Regulation Requirement

The first key area that needs more exploration in this rule change is the definition of *Regulation Requirement (RR)*. In the AEMC's proposal, this parameter is used to split the Regulation costs into a component recovered based on real-time performance and a residual recovery component.

Figure 3 Proposed cost recovery for regulation services (Clause 3.15.6A (i))



Source: Draft National Electricity Amendment (Primary frequency response incentive arrangements) Rule 2021

We agree that if a real-time causer pays factor is introduced, some mechanism is needed to scale the total costs allocated based on the aggregate system

performance. If all participants have good frequency performance in a period, all participants should see a reduction in their *real-time* cost-allocation[5].

In our modelling, we found the parameter RR in the proposed reforms was very influential in both:

1. The allocation of regulation costs
2. The strength of the incentive to provide primary frequency response

The AEMC does not explicitly propose a metric. However, in discussion with AEMO and other stakeholders, we consider that the Frequency Indicator (FI) is a useful metric. This is indicative of the amount of Regulation actually used in an interval, which in turn indicates the net MW deviation in the system from forecasted values.

FI is updated every four seconds, and so must be aggregated across a DI. In our analysis, we have used the average utilisation of the regulation services over a 5min period as the scaling factor RR of regulation costs and for the Frequency Performance Payment. This is the FI over total enabled MWs (EA) for the period. Alternative approaches are considered below, but all give similar qualitative (and semi-quantitative) outcomes.

Causer pays factors are calculated consistent with the current methodology, noting that more appropriate metrics might exist (discussed below).

Figure 4 shows that the average utilisation of regulation raise services is between 10%-40% and the average utilisation of regulation lower service is between 0-25%. Not shown on this chart, the introduction of PFR has reduced the Lower utilisation, but not impacted on Raise Regulation utilisation rate. This is consistent with our expectation that the Regulation service addresses the underlying mismatch between supply and demand, with PFR just helping to slow down frequency changes.

[5] For example, if the total Regulation cost was always recovered solely through real-time causer pays factors, the “size of the pie” wouldn’t change with the underlying frequency performance in that interval. Relative performance would be rewarded, but total costs would remain the same.

Figure 4 Average daily utilisation of Regulation services February 2021 - October 2021

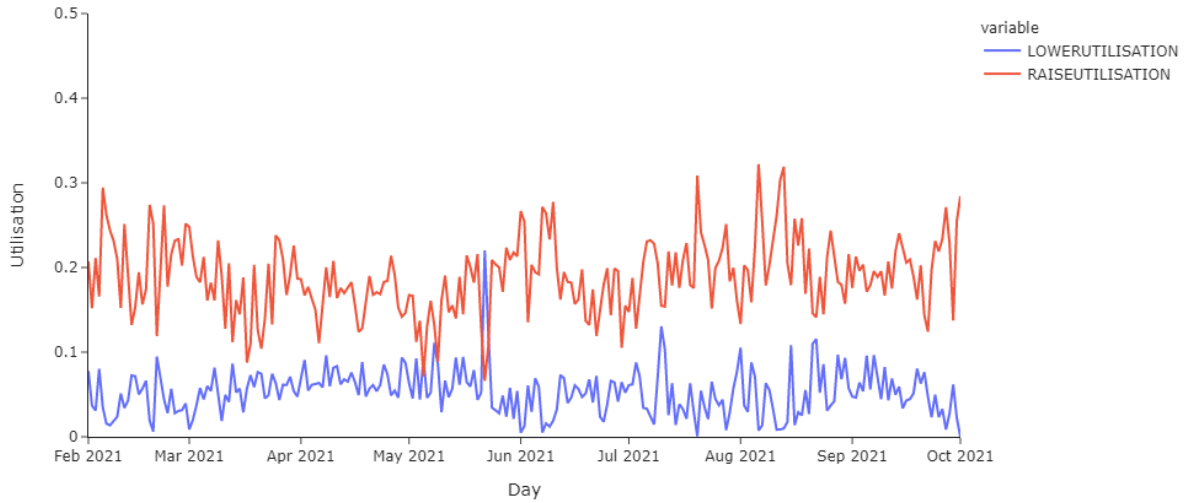
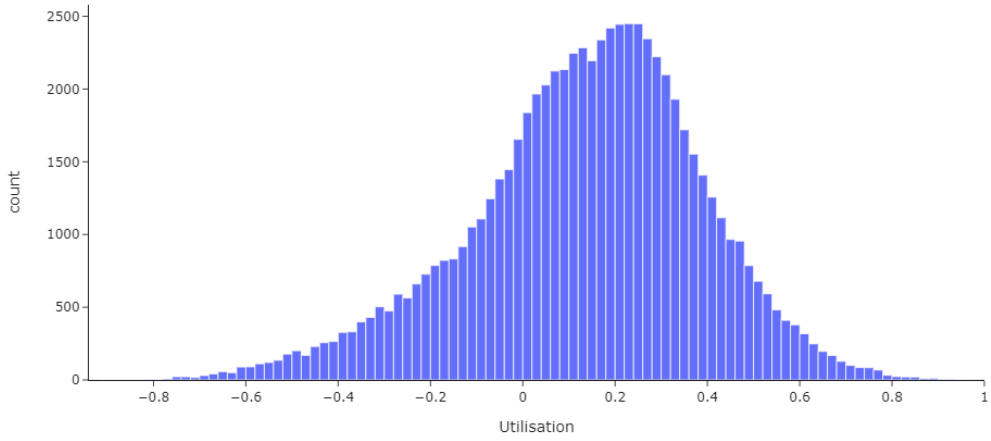


Figure 5 shows the distribution of RR under this definition, which means that the scaling factor for the proposed reforms will almost always be less than one[6].

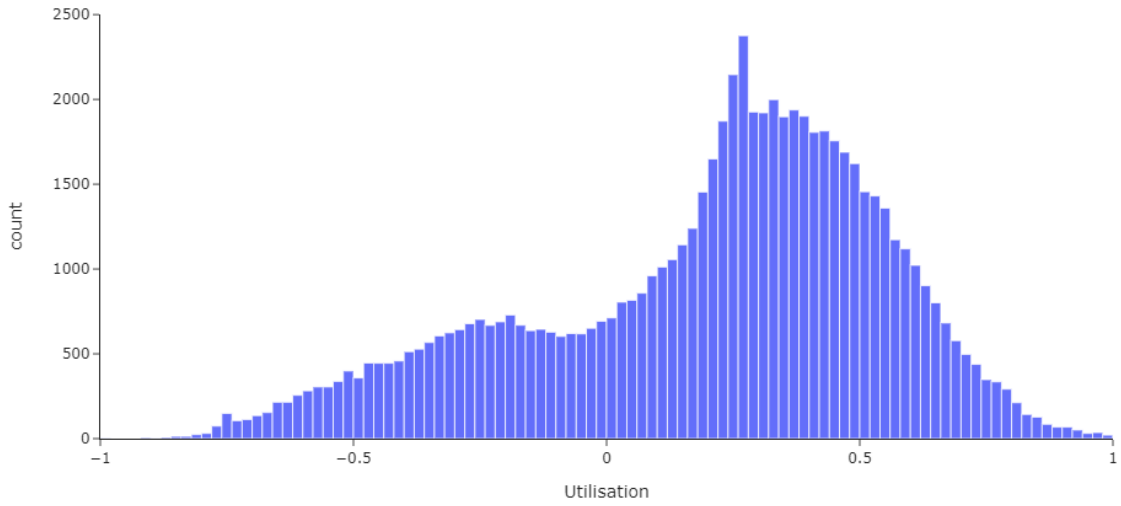
Figure 5 Distribution of average utilisation of regulation services in a dispatch interval



As shown above, as the RR/EA (utilisation) is less than one in all periods and in fact on average 18% for raise and 5% for lower. This means only 17% of Regulation costs, on average, would have been allocated through the real-time causer pays factors. This figure would be somewhat higher if the *maximum* FI over a 5 minute interval was used – approximately 27% (Figure 6).

[6] Historical FI data will not capture any period where more than the available regulation service would have be required (i.e., FI caps out at the enabled amount), but these periods will have been rare.

Figure 6 Distribution of maximum utilisation of regulation services in a dispatch interval



Note that the *shape* of these curves is independent of the amount of Regulation procured. Regulation usage will always be a roughly normal distribution, with long tails. Regulation is, by definition an insurance payment that is procured to cover "most" periods. Without a fundamental shift in the market approach procuring Regulation FCAS, we would expect Regulation utilisation to continue to be low. We further note that such a shift has not been contemplated, and based on the above distribution would require a significant reduction in Regulation MW to materially impact the scheme (and we further discuss the implications of this below).

Residual cost-recovery is likely to dominate

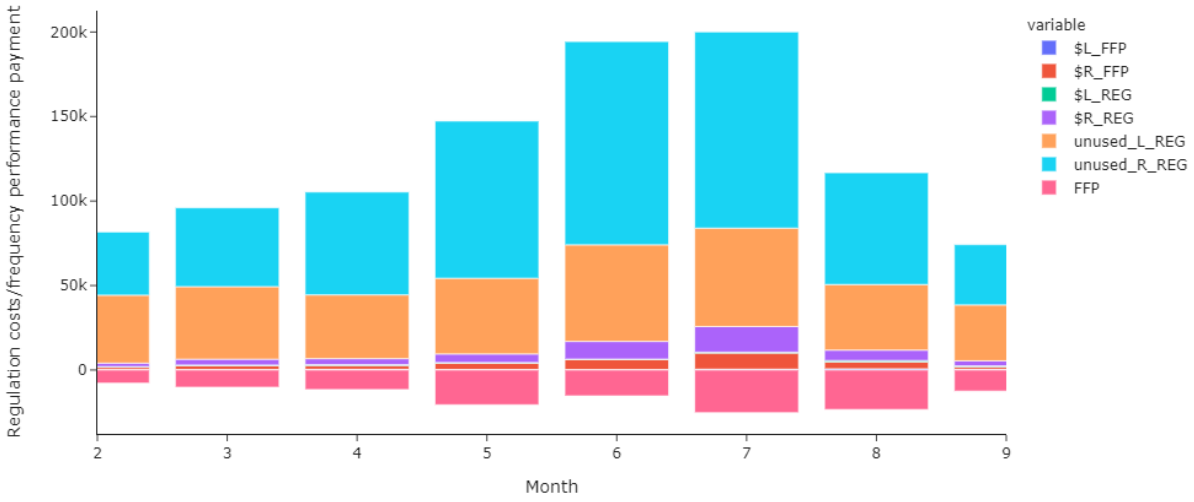
Given that the real-time utilisation of Regulation will typically be much less than the total amount procured, the majority of Regulation FCAS costs will be recovered from the residual allocation.

The AEMC's proposed allocation is to spread the remainder of costs over the energy generated or consumed by a participant. Under our modelled assumptions, this means around 83% of regulation costs over the eight-month period would have been allocated based on energy generated and consumed.

This approach could actually reduce the signal for participants to help frequency. Figure 7 shows the allocation of costs using the proposed reforms to causer pays for the historical analysis for a large market participant. Note that the regulation costs (purple and red) and frequency performance payments (pink) based on negative and positive contributions for this participant are dwarfed by the allocation of residual regulation costs being allocated based on the energy generated by this participant.

This actually moves away from "causer pays" – based on the sample data, costs would be recovered predominantly pro-rata with energy usage, rather than based on average deviations as under the current scheme. We suggest that it would be better to recover these costs through a longer-term causer pays factor, as outlined in Section 4.

Figure 7 Recovery of cost and Frequency Performance Payments for a large market participant (Feb-Oct 2021)



Incentive payments to positive responders

We also investigated whether payments under the proposed mechanism would be sufficient to incentivise a battery energy storage system (BESS) to provide narrowband frequency response voluntarily.

Batteries are exempt from being obligated to provide PFR when dispatched at 0MW (including when it is enabled for Contingency FCAS at a 0 MW setpoint). The reason for this exemption is that AEMC recognised that repeated charge and discharges of a battery consume the warranted cycles – a limited resource for batteries. Imposing the additional cost of delivering the service at all times would chill investment in new flexible resources that have reduced costs to consumers.

An appropriate incentive scheme is therefore critical to encourage batteries to participate in providing narrow-band PFR.

We simulated the Frequency Performance Payment mechanism over the eight-month historical period for a 1MW/1MWh battery that continuously provided PFR. This battery would clearly earn other sources of revenue, so we focus on the two key parameters:

- The payments received by the battery under the incentive mechanism
- The charge and discharge cycles required from the battery to deliver the service

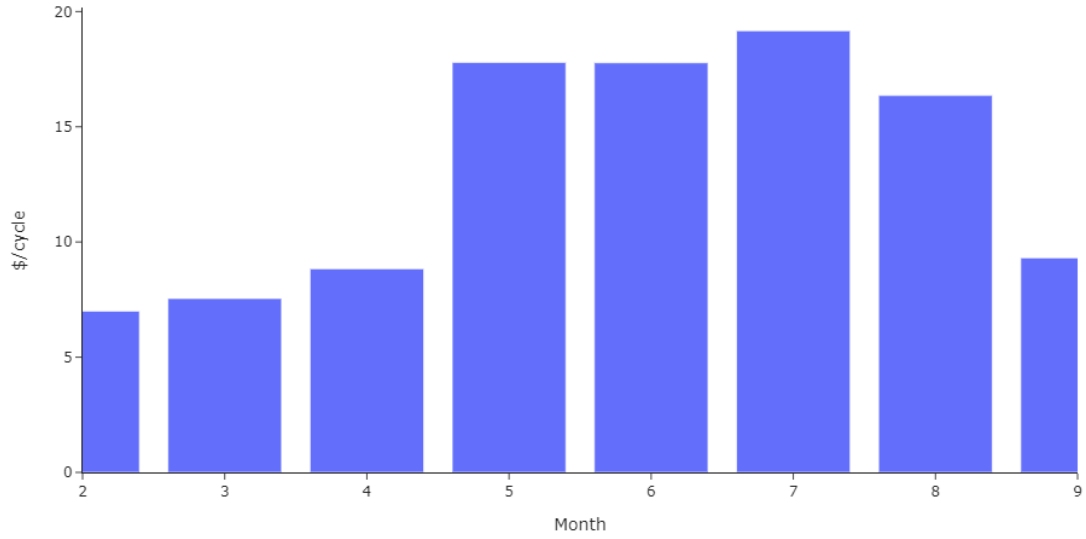
It is convenient to express the revenue (and subsequently costs) as $/cycle (analogous with $/MWh revenue for wind farm).

These payments are effectively proportional to the “Regulation Required” in an interval, and by the cost of the regulation service in that period. We agree that scaling payments by Regulation FCAS prices is *more* appropriate than alternatives such as scaling by energy price. That is, Regulation FCAS prices are more likely to reflect the

value (opportunity cost) of reserving headroom from the energy market than the energy price itself[7].

We find the hypothetical battery payments received were on average $12/cycle. Figure 8 shows the average payments by month over the analysis period: the total PFR incentive payments for that month divided by the total cycles required of the battery.

Figure 8 Incentive payment for a BESS voluntarily providing PFR per cycle



Given a one hour battery needs $100-200/cycle to recover the capital of the BESS (based upon current capital costs), the payments in this historical period would be unlikely be sufficient to incentivise the provision of PFR. That is, a battery would likely prefer to reserve its available cycles for other purposes, including bidding into the Regulation FCAS market. This would mean little voluntary response may be made available due to the incentive mechanism in the future. It is also not clear how AEMO would be able to increase the payments in the future.

We provide further commentary in Section 4 on what options (or otherwise) would be available to AEMO if a lack of narrow band PFR emerged in the future.

[7] For example, a unit with a $50/MWh SRMC has no opportunity cost for reserving headroom when prices are $50/MWh – it would be roughly indifferent to providing energy at $50/MWh or headroom at $50/MWh. Therefore, the Regulation FCAS price (potentially $0/MWh) is more likely to efficiently value headroom and hence the cost of voluntarily provided narrow deadband PFR than the energy price.

4. Possible changes to the framework

Definition of key parameters

Our experience in the AEMC's Technical Working Group is there is a lack of consensus as to the possible definitions of several key parameters. These are:

- RR – the regulation "required", which is used to apportion Regulation costs into real-time and residual cost recovery buckets, and also to scale positive contribution payments;
- The metric for the residual "unused" cost recovery; and
- The Causer Pays factors, used to allocate costs by units and measure positive performance; and

While not every detail needs to be, or should be, defined in the Rules, many of these are critical to the *policy intent* of the rule change. That is, different approaches will incentivise (or otherwise) different behaviours and have significant commercial implications for participants and consumers. Our view is that these key design decisions should be agreed now as part of the rule change, rather than being left to a subsequent consultation.

Definition of RR

There is no consensus agreement on the definition of Regulation Requirement (RR) or how this parameter might change in the future. This key parameter, RR, is critical for policy intent of the service, including how strong the signal will be for delivering quality PFR.

Part of the confusion may be due to the phrase Regulation "Requirement". Regulation needs are set in advance in anticipation of covering "most" potential deviations. It is not a real time concept, but instead an insurance based on a long-term measure. If the Regulation service is not used in a period, that doesn't mean it wasn't the "right" amount to buy for that period, as actual deviations cannot generally be predicted. "Regulation Used" may be a more appropriate description.

A good metric of "regulation used" will be a robust system. For example, just summing the negative deviations of all units would usually overstate the Regulation (as some units will naturally be high when others are low), and would change depending on if or how units were grouped.

In our view, the Frequency Indicator, or a similar metric of the net deviations in the system, is likely to be most appropriate measure of Regulation Used in an period, and consistent with AEMO's current methodologies. We recommend that the AEMC consult further on this option and make it clear in the final determination.

Further details should be developed around the treatment of regional requirements, different Raise and Lower utilisations, and treatment of portfolios.

Reviewing the calculation for real time Causer Pays Factor

Causer Pays factors are currently based on the deviation of the unit multiplied by the frequency indicator (the deviation of the entire system, based on AEMO's central processing). Conversely, the Mandatory PFR obligation is for to respond to an instantaneous, locally sensed frequency.

Given the proposed move to a real time causer pays factor, it would be logical to shift from a lagging FI variable[8] to a real-time frequency proportional variable. Basing performance payments on respond to local frequency provides a clear, transparent signal to participants and avoids participants needing to track FI (or some other integrated, lagging signal) in real-time. Simplicity is key to participants knowing how to respond appropriately with the best interest for the system.

We understand that AEMO has been considering similar approaches, including using only the *sign* (positive or negative) of the frequency deviation. Effectively, participants would receive a positive (negative) signal when helping (hurting) the system frequency, scaled only by their MW of deviation rather than by how badly the frequency deviates. This might avoid some of the other challenges with a real-time signal, such as data quality, timing, etc. We see this idea as having merit[9].

Current providers of Regulation FCAS would presumably need to be included in these calculation. Assuming the performance obligation is to respond to instantaneous, local frequency as described above, we consider the only viable option for a Regulation FCAS unit's "target" to be their AGC signal from AEMO (i.e., dispatch target trajectory plus Regulation MW signal)[10]. This would then provide a performance incentive on Regulation FCAS providers to move to their AGC signal.

Recovery mechanism for the "unused" component

Recovering the cost of regulation services that are *"unused"* through a pro-rata with energy charge is a large change from the current causer pays procedures. As described in Section 3 we agree with the philosophy of splitting the payments, however the unintended consequences of this change could distort the intent of the policy.

For example, a participant that always delivers perfect frequency control (e.g., a solar farm with a battery used for smoothing) would currently not pay for Regulation. Under the AEMC's proposal, this unit would become liable for Regulation costs through its

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[8] FI is (roughly) a 35 second average deviation metric. Currently, periods where the frequency and the FI point in opposite directions are excluded from the causer pays calculation.

[9] It is worth noting that using "frequency deviation x unit deviation" would make causer pays factors that are, effectively, quadratic in deviations: when the FI is large proportional deviations will also typically be large, creating a larger incentive to respond as the frequency deviations from 50 Hz. Conversely, using just the sign of the frequency would provide a constant incentive to respond in whichever direction (up or down) is required, regardless of how big the deviation is – a constant $/MW-deviation payment. More complex scaling functions (e.g., cubic) could also be developed.

[10] Measuring deviations against only their dispatch target trajectory (without including Regulation AGC signals) would mean that Regulation FCAS providers would receive very large positive or negative factors if the frequency abruptly moved against them.

energy consumption[11]. Alternatively, a unit that *usually* performs well might (and so usually avoids a real-time causer pays allocation) still contribute to regulation need because of rare deviations, and this may not be in proportion to its energy consumption/generation.

We suggest that rather than pro-rata with energy, a longer-term causer pays factor could be used to recover the residual costs of regulation services. This long-term factor could provide a smoother transition from current scheme: anything not recovered through the real-time factor would be recovered similar to existing frameworks.

Alternatively, another factor could be developed that captures the contribution of each unit to AEMO's regulation need. This could involve measuring the 99th percentile deviations of each unit or portfolio, similar to AEMO's approach to forecasting long-term regulation requirements[12].

We note it is not appropriate to simply allocate these "unused" costs to the residual (unmetered) loads. The need for the total MW of Regulation procured will be due to both metered and unmetered participants, regardless of how much was actually used in that interval. Indeed, even if all participants were metered, there would still be "unused" MW of Regulation that would rightly be procured by AEMO, and whose costs would need to be recovered.

Additional levers are required to ensure sufficient frequency control

As the system transitions, headroom and battery cycles will likely become more valuable, and we do not consider that the mandatory requirement will be sufficient to incentivise sufficient response. Furthermore, the incentive payment only indirectly considers the *cost* of providing headroom, mileage, etc. (through the Regulation FCAS price).

This risks a similar situation to recent shortfalls in inertia and system strength – a lack of an unpriced service.

It is therefore relevant to ask: if insufficient narrow deadband primary frequency control is available in the future, what options are available to AEMO to incentivise further response? This could include batteries reserving cycles for PFR or wind or solar farms curtailing to provide headroom.

The Frequency Performance Payment is calculated as show in the figure below. The incentive to deliver PFR is derived from the total regulation costs, multiplied by the unit's positive contribution factor multiplied by the regulation utilisation. If this

[11] That is, in the equations of Figure 3, while a participant might have a causer pays factor (NMPF) of zero, it would be liable for its share of the unused component through its share of energy (TE).

[12] See, for example, Chapter 6 of the 2016 NTNDP Methodology paper (https://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/NTNDP/2016/Database/2016-NTNDP-Methodology-and-Input-Assumptions.pdf) or Section 9 of ROAM Consulting's report to the IMO on LFAS requirements (https://www.erawa.com.au/cproot/14768/2/ROAM%202014%20Ancillary%20Service%20Standards%20and%20Requirements%20Study%20Draft%20Report.pdf).

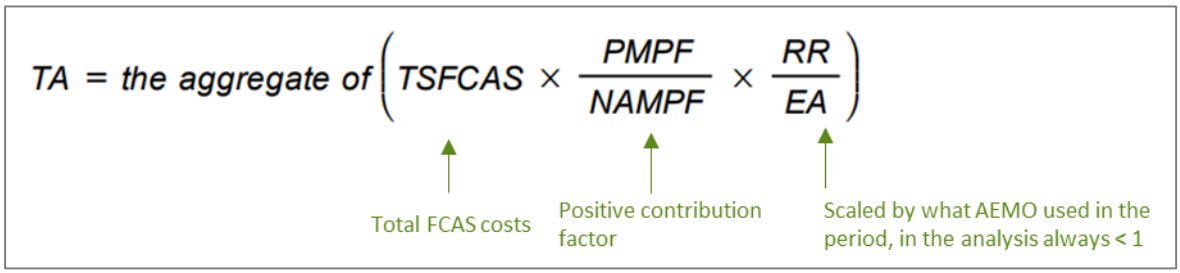
payment is insufficient, there is only one “lever” available: the quantity of regulation procured (EA).

Therefore, to improve narrowband frequency under this arrangement, AEMO can either:

- Increase regulation enablement (EA increases). This will increase TSFCAS, but (assuming RR remains constant) the regulation utilisation (RR/EA) decreases, and payments will be the same. More MW of narrow deadband response may now be available, due to more MW of Regulation procured plus the mandatory requirement, but the incentive payment will not be sufficient.
- Decrease the regulation requirement, which will similarly not increase payments, and seems inappropriate during times of poor performance.

In fact, if TSFCAS ∝ EA (i.e., a flat $/MWh regulation bid stack), payments will remain unchanged. Therefore, it isn’t obvious how to tune the incentive if more PFR was needed.

Figure 9 Frequency Performance Payment or PFR incentive (Clause 3.15.6A (i1))



Source: Draft National Electricity Amendment (Primary frequency response incentive arrangements) Rule 2021

Possible alternatives are to develop a second “lever” to ensure we have sufficient primary and secondary reserves. Examples of levers in other designs is:

- The quantity procured in a PFR FCAS market; and
- the pricing function used in Double Sided Causer Pays

In the current proposed mechanism a scaling factor could be introduced to the equation in Figure 9, which can then control the strength of the incentives to PFR providers.

$$TA = TSFCAS \times PFR\ Scaler \times \frac{PMPF}{NAMPF} \times \frac{RR}{EA}$$

AEMO could adjust this scaler over time to deliver a new frequency standard. This would further support the mandatory requirement being removed. If the mandatory requirement is retained, a floor (nominally of 1) should be put on the Scaler to provide at least some compensation for the costs incurred in mandatory provision.

5. Conclusions

We are keen to support the AEMC in delivering an effective incentive mechanism that will ensure effective frequency control under a rapidly evolving system. However,

we consider further work is required before the final rule is considered, including additional quantitative analysis. At the moment, we consider there is some ambiguity as to whether the scheme is designed to efficiently value PFR to incentivise future investment, or simply to compensate existing generators for the mandatory provision of PFR.

We recommend that the Final Determination date be extended, allowing further time for AEMC to engage with stakeholders and consider the important issues raised in the Draft Determination.

We look forward to the opportunity to continue to engage with the AEMC. If you would like to discuss this submission, please contact me on joel.gilmore@iberdrola.com.au or 0411 267 044.

Yours sincerely

Dr Joel Gilmore

GM Energy Policy & Planning