

4 June 2020

Mr John Pierce  
Chairman  
Australian Energy Market Commission  
PO Box A2449  
Sydney South NSW 1235

Dear Mr Pierce

**RE: Capacity Commitment and New 30-minute FCAS Raise and Lower NEM Rule Change Requests**

Delta is submitting two Rule Change requests (attached) that will address the need for new market mechanisms to deal with impact of variable renewable energy on NEM operations. These Rule Change Requests propose:

- the development of a new day ahead ex-ante market for capacity commitment to address operational reserve and system security concerns not currently addressed in any other market mechanism; and
- an extension to the current suite of FCAS Raise and Lower services to include sustained ramping.

Delta has been closely following the work being undertaken by AEMO and the Energy Security Board on the operational implications of increasing variable renewable energy in the National Electricity Market. In AEMO's Renewable Integration Study, it was concluded that "The NEM power system will continue its significant transformation to world-leading levels of renewable generation.." and "..the need for flexible market and regulatory frameworks that can adapt swiftly and effectively as the power system evolves". The Energy Security Board in its April 2020 consultation paper 'System Services and Ahead Markets' refers to 'missing markets' and that "there is a need for new market arrangements for the procurement of system services crucial to the secure and reliable operation of the system."

AEMO, has stated "Given the pace and complexity of change in the NEM, the RIS [Renewable Integration Study] highlights the need for flexible market and regulatory frameworks that can adapt swiftly and effectively as the power system evolves". Delta's NEM Rule Change Requests are readily implementable as solutions to existing system security and reliability problems in the NEM that will deliver clear net benefits for consumers and can be adapted to align with the longer-term requirements to be determined by the ESB post 2025 review.

Yours sincerely



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# NEM Rule Change Request New 30-minute FCAS Raise and Lower Services



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# New 30-minute Raise and Lower FCAS Services

## 1. SYNOPSIS

Delta has identified a current and developing issue that exists due to the proportion of Variable Renewable Energy (VRE) generation operating in the NEM. Delta proposes new 30-minute raise and lower FCAS services that address the need for dispatchable in-service generators to respond quickly to changes in the output of VRE. The proposed mechanism has the benefits of technology neutrality, price transparency, price discovery and competitive pressure to innovate both within the current generation fleet and for future new investment. The proposal represents a simple, relatively easy-to-implement solution using the existing framework of FCAS market design.

## 2. THE ISSUE

The issue identified in this proposal can be expressed as:

**As the volume of VRE generation in the NEM increases, in particular solar PV, high levels of sustained ramping from dispatchable generating units are required to ensure the balance of NEM scheduled generation is maintained. The total solar profile imposes high ramp rates extending for up to two hours while existing FCAS raise and lower services are designed with shorter time frames in mind (6 seconds, 60 seconds and 5 minutes) and the quantities available in the existing FCAS services may become exhausted before the ramping requirement is over.**

The generation mix in the NEM is changing rapidly. The market share of large-scale asynchronous generators (wind and solar) is increasing. Delta agrees with the Energy Security Board (ESB) that “the change in the generation mix is making some services that used to be abundant, now scarce at times. In a well-functioning electricity market, all services critical to the reliable and secure supply of electricity should be available whenever needed in real-time.”<sup>1</sup>

As expressed in the ESB paper there is a need for new market arrangements for the procurement of system services crucial to the secure and reliable operation of the system.

Delta proposes new 30-minute FCAS raise and lower services (**R30** and **L30**) which are broadly in line with the ESB’s identification of Essential System Services including:

*“...to ensure adequate flexible dispatchable reserves are available to manage variations in the supply and demand over a number of dispatch periods.”<sup>2</sup>*

Delta’s proposed rule change takes a pragmatic approach to dealing with this issue by leveraging off AEMO’s existing systems to manage FCAS. The proposal may be seen as

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<sup>1</sup> COAG ESB ‘System Services and Ahead Markets’ Paper, Section 3.1.

<sup>2</sup> COAG ESB ‘System Services and Ahead Markets’ Paper, Executive Summary.



a simple (for ease of implementation) measure to facilitate the transition to lower emission technology by ensuring the power system remains able to accommodate the amount of variable renewable energy generation as it increases as a proportion of NEM supply.

The mechanism is technology neutral. Any generating plant that has a 30 minute ramping capability can participate.

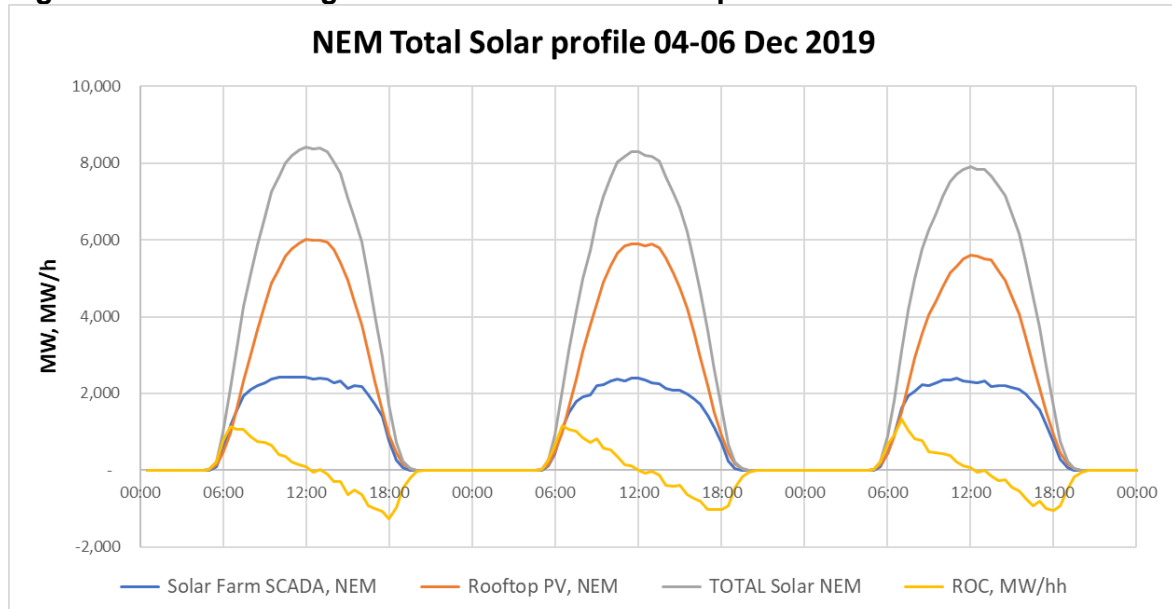
### 3. CONTEXT FOR THIS RULE CHANGE REQUEST

Delta believes that not enough attention has been placed on considering the consequences of the total solar profile, that is the aggregate of the output from large-scale solar farms that are registered with AEMO as well as the many small-scale rooftop solar PV systems that are embedded in the regional demand profile and the Rate Of Change (ROC) of this profile as it ramps up and down each day. Overlaying a forecast change in wind generation output could further exacerbate the requirement for a ramping service.

The aggregate solar ROC can currently exceed 1300MW per half-hour and sustains high levels >800MW per half-hour for 4 consecutive half-hour periods. These solar ROCs impose a requirement from the NEM's dispatchable generation to accommodate the solar profile.

Figure 1 below shows the NEM solar profile for a recent 3-day period and the ROC, in MW/hour on a moving half-hourly average rate over the day (data source: Neomobile)

**Figure 1. Rate of Change of NEM Solar Generation profile**



Source: Neomobile, unitary MLFs assumed

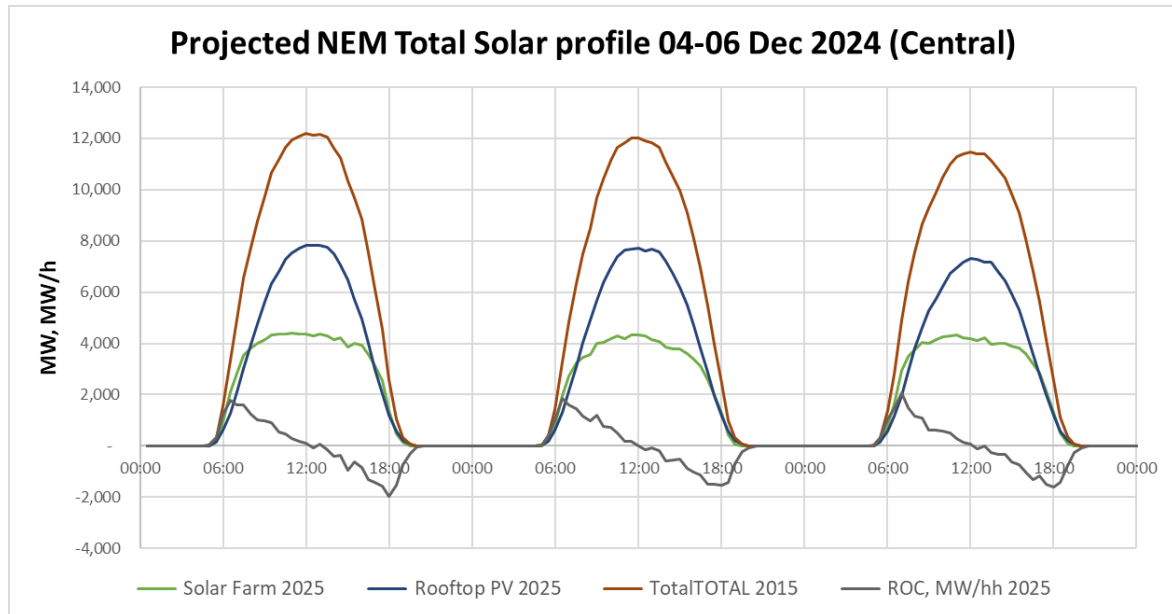
Using AEMO's 2019 SOO information for 'Central' scenario growth in both rooftop PV and solar farm capacity these traces are scaled up to illustrate the aggregate solar generation profile for similar weather conditions in 5 years' time (figure 2).

There continues to be substantial growth in the installation of both large-scale solar farms and in rooftop PV systems. Figures 2 and 3 illustrate the scenarios for the same days in



2024-25 under similar weather conditions and including the committed capacity of new solar farms and the projected installed capacity of rooftop PV under the “Central” and “Fast Change” scenarios respectively from the 2019 SOO.

**Figure 2: est. Rate of Change of NEM Solar Generation profile 2024/25, ESOO Rooftop Solar Central case**



**Figure 3: est. Rate of Change of NEM Solar Generation profile 2024/25, ESOO Rooftop Solar Fast change case**

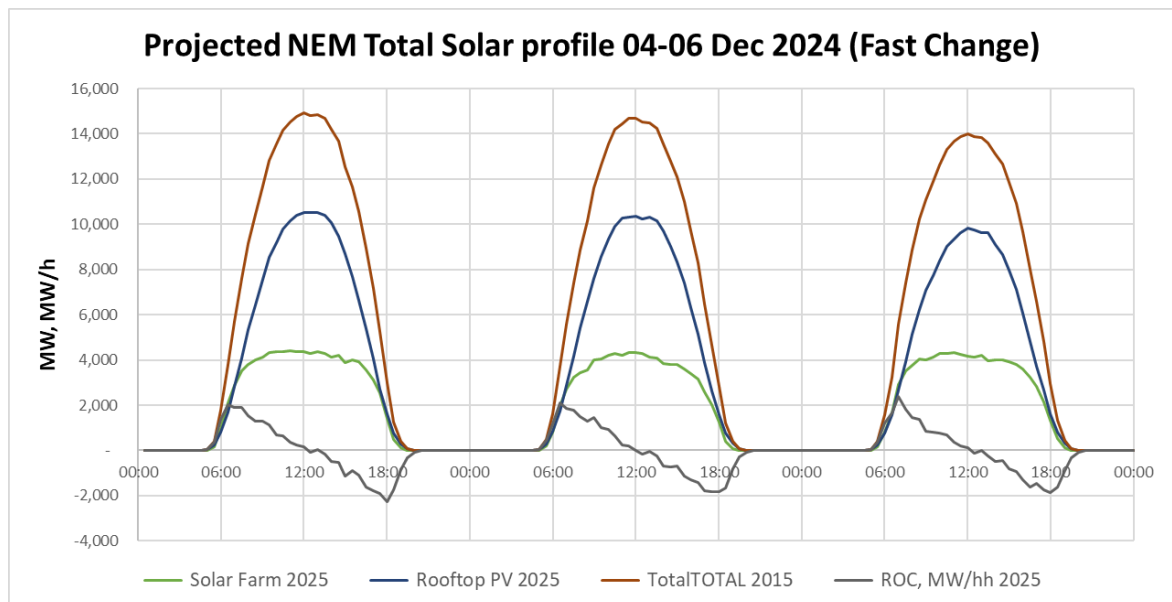


Table 1 below summarises the maximum rate of change and the total amount of ramping of the solar profiles in Figures 1, 2 and 3 above.

As noted above, it is the balance of the NEM generating portfolio, in particular the fleet of committed scheduled generators that are required to accommodate the total solar profile,



in effect scheduled fully dispatchable generators need to provide the inverse of the solar profile, as well as dealing with:

- wind generation variability;
- coincident changes in the pattern of underlying consumption of electricity; and
- any contingency events such as load shedding, generator trips or interconnector failure.

**Table 1: NEM Total Solar Profile Ramping Summary**

Scenario	Maximum ROC, MW/half-hour	Total Ramping, MW
2019/20 Actual	1328	8425
2024/25 - Central	2090	12212
2024/25 - Fast Change	2370	14908

Noting that the NER requires each thermal generating unit must provide a minimum 3MW/minute ramp rate, fully dispatchable plant typically is technically capable of substantially greater ramp rates, albeit at potentially greater operating costs.

For example (ignoring interconnectors between regions) if 50 generating units were in service in the NEM then AEMO has available to it  $50 \times 3\text{MW}/\text{min} = 150\text{ MW}$  per minute (4500MW/half-hour) of standard ramping capacity. However, the total quantity of MW capacity provided under the current FCAS services is in the order of 30 MW per unit, or 1500MW total in this 50 unit example. This is clearly well below the required level of total ramping indicated in Table 1.

At the present time, the inverse solar profile is being achieved by fully dispatchable generators, not through the FCAS services alone but also through the energy dispatch process with scheduled generators providing additional capacity in response to energy price signals.

Regional ramping capacity may be insufficient to cope with high and sustained (e.g. over an hour) rates of change due to volatility in regional VRE output or conversely, if there was a reduced number of fully dispatchable units in service in a region then the standard ramp rate may not be sufficient if the spot price for energy alone does not drive a faster generator response due to the generator’s bids.

This edge-effect of the predictable, daily, high rates of change of the total solar profile sets the scene for potential extreme price volatility as scheduled generators need to ramp through their bid bands. Extreme price volatility does provide a price signal for the provision of a service however it is Delta’s view that a more sustainable approach is to define a new service that addresses this need for high levels of sustained ramping capability. Accordingly, Delta proposes new raise and lower services.

AEMO’s pre-dispatch PASA may identify the need for additional ramp rate capability from committed scheduled generators. Under these circumstances AEMO could acquire additional ramping capacity (in excess of the mandated minimum and current offers by the generation fleet to the existing FCAS markets) as an additional ancillary service. Given the sustained nature of solar ramp-in and ramp-out new FCAS raise and lower 30 minutes products are proposed.

Eligible generators would be determined by AEMO on the basis of their ability to provide the new raise and lower services and market design and settlement would be similar to existing FCAS raise and lower services.



Currently there is no market through which AEMO may procure, or signal to market participants that their ramp rate capabilities in excess of mandatory levels may be needed at certain times.

#### 4. RELATIONSHIP TO THE PROPOSED CAPACITY COMMITMENT MECHANISM RULE CHANGE

This NEM Rule Change proposes to extend the current FCAS markets to include new raise and lower services over a 30-minute timeframe relates to Delta’s separate Capacity Commitment Mechanism rule change request in the following way:

- Some types of generation, in particular slow-start thermal generators need to be committed well ahead to ensure availability to provide their full range of system stability and reliability services, including the new 30-minute raise and lower services; and
- In this context it is worth noting that a gas peaking generator which has just started may not be able to commence its ramp up for 15 minutes whereas committed plant on minimum load may be able to ramp up on a sustained basis at 20MW/m, easily raising output by 300MW in the same 15 minutes interval.

#### 5. DETAILS OF THE NEW 30-MINUTE RAISE AND LOWER FCAS SERVICES

Delta proposes using similar dispatch and settlement processes to existing FCAS raise and lower services with the enhancement of providing the capability for generators to offer incremental rates of change at different prices. Delta considers that three ROC bid bands should be sufficient to reflect incremental costs such as increased wear and tear on the generating unit. This effectively provides the current nominal ROC at no to low additional cost, a 'high' ROC to reflect the costs of the highest technically available ROC and a band somewhere in the middle to provide much of the technical capability at a more modest cost. An example to illustrate a generator’s prices for increased ROC capability is shown below.

**Table 2: Sample Generator ROC Costs**

ROC Band	ROC offered MW/min	Offer price, \$/hr
1	3-5	\$0
2	10	\$x,000
3	20	\$y,000

These offers would be reflected as three different FCAS trapezoids offered by each unit for the new R30 and L30 services, where the three trapezoids sum to equal the total technical ramping capability of the unit.

In predispach AEMO would determine the half hour by half hour ramping requirement as VRE generation shifts with changes in weather and insolation conditions.





AEMO would receive the bids from participants and stack them from lowest price to highest price. The marginal bid for the service requirement will set the price as is done in the FCAS markets. Services would be enabled in pre-dispatch and generators providing the service capability would be dispatched in the same way as the 5 minute service but with 5 minute targets set as one sixth of the 30 minute target. The trapezoid parameters will allow the dispatch engine to set targets within the capability limits.

### Scheduled Generator Eligibility

Generators need to be in-service to provide their ramping capability and/or be able to provide the service immediately upon enablement.

This proposal is designed to provide a market-based solution to secure the availability of sustained and higher rates of ramping capability from committed scheduled generators at least-cost and irrespective of technology type.

Eligible generators under this proposed rule change are those committed scheduled generators that can provide the required R30 and L30 services.

## A. Participant Registration

Operators of generators may classify one or more of their eligible generating units to provide new R30 and L30 services.<sup>3</sup> An eligible generating unit must have relevant capabilities. For example, must be able to be ramped up or down at a controlled rate for the defined period. At registration the market generator must declare, and AEMO must assess, the eligible generating units technical characteristics and capabilities. The relevant technical characteristics and capabilities may include:

- maximum generation capability;
- minimum stable operating level (MSOL)<sup>4</sup>; and
- ramp rate capabilities (MW/min).

Registering a generating unit to provide the new R30 and L30 services would leave the existing registrations of the generating unit unaffected. For example, a generator providing new R30 and L30 services may also be an ancillary service generating unit for the purpose of providing other frequency control ancillary services (FCAS).

If AEMO is satisfied of their relevant technical capabilities, scheduled generators would be eligible to participate in the new R30 and L30 markets

## B. Interactions with the Spot Market

Current spot market operations would be largely unaffected. All generators participate in the spot markets for energy and other FCAS markets in the usual way. Energy markets may settle at slightly lower levels due to the R30 and L30 services being disaggregated

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<sup>3</sup> Scheduled generators may be market or non-market generators. Currently, there are no non-market scheduled generators registered in the NEM. Small generation aggregators would also be eligible to register their aggregate scheduled generating units.

<sup>4</sup> A MSOL is the lowest output a generating unit can sustain without becoming unstable or requiring auxiliary fuel. This level of output would be established for each eligible generator based on technical characteristics and plant safety rather than commercial considerations.



from the energy dispatch process. As with FCAS services, a co-optimisation process would need to occur.

## C. Interactions with Frequency Control Ancillary Markets

Market participants providing R30 and L30 would not be prevented from bidding into the other frequency control ancillary market as long as they can comply with their obligations in the R30 and L30 markets. For example, scheduled generators with a MSOL would not be able to provide frequency lower ancillary services while operating at MSOL. It is expected that market participants would manage their ancillary service bids in line with their capabilities and system requirements.

As indicated in Section 4 above, the proposed new ‘Raise and Lower 30-minute’ FCAS services for sustained ramping capability would be dispatched as a separate market. If that service is to be sourced from slow-start thermal generators (considered a System Stability and Reliability Service in Delta’s separate Capacity Commitment Mechanism rule change request), it would only be available from those that are in service and are dispatched to at least at their MSOL. Accordingly, if not already committed, such generators would need to be committed well in advance, for example under the proposed day-ahead Capacity Commitment Mechanism.

## 6. HOW THE PROPOSED RULE WOULD ADDRESS THE ISSUE(S)

The issue that this proposed rule change is intended to address is that there is an imminent and growing problem in the sustained ramping requirements imposed on the NEM’s fleet of scheduled generators to accommodate the total solar daily generation profile.

The proposed rule change addresses the two components ESB identified to ensure the system will have the right mix of resources in real-time, and at lowest overall costs to consumers<sup>5</sup>:

- “Establishing new frameworks to value all essential system services so that they will be available to the power system when needed; and
- Incorporating a mechanism in the NEM’s pre-dispatch and dispatch process that provides visibility and enables efficient co-optimisation of the diverse set of resources ahead of time to ensure all necessary system services will be available, without costly and distortionary interventions. “

The proposed rule change is presented as a solution that directly addresses the issue and which has the following merits:

- A. advances the ESB’s vision of valuing all essential system services;
- B. addresses market needs in a timely fashion;
- C. relatively easily implemented using existing FCAS IT and rules structures; and
- D. is market-based, providing a visible price signal of the value of the service to promote efficiency in both short-term dispatch and long-term innovation and investment

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<sup>5</sup> COAG ESB ‘System Services and Ahead Markets’ Paper, Introduction.



## 7. HOW THE PROPOSED RULE CHANGE WILL CONTRIBUTE TO THE NEO

The National Electricity Objective (NEO) is the efficient operation of, and investment in, the electricity industry for the long-term interests of end-users.

Delta Electricity considers that the proposed R30 and L30 markets contributes to the achievement of the NEO by separating out a new system service that, in the context of the evolution of the NEM towards a high-VRE system, becomes essential as traditional scheduled generation (coal, gas and hydro) contributes a smaller proportion of the overall electricity supply.

Defining and implementing the R30 and L30 services allows a visible market to develop that will provide an alternative to the status quo of generators ramping through their energy bid stacks and signalling value through additional volatility in the energy market.

Delta's position is that the R30 and L30 markets offer a potentially more sustainable and less volatile price discovery mechanism that will provide a more orderly glide path for the exit of synchronous generators that presently provide this service and at the same time provides a price signal for alternatives such as demand response and storage technologies such as hydro, battery and hydrogen that may in the long term form the bulk provision of this service.

## 8. COSTS AND BENEFITS OF THE PROPOSED RULE CHANGE

Delta considers that while the proposed rule change is not cost-free the costs are modest:

### Costs:

1. payments made to R30 and L30 suppliers: On face value, this represents a new cost, however this market proposes to price a service that was previously provided at a cost embedded in the current energy market. Accordingly, Delta expects that this cost will be negligible initially (when scheduled generation is in good supply) but would be expected to rise over time when existing scheduled generators withdraw from the market unless offset by new, equivalent capability;
2. aspects of these services such as increased rate of change may include additional costs that a generator will take into account in its offers; and
3. implementation costs should be modest by cloning existing FCAS systems and rules.

### Benefits:

1. the availability of R30 and L30 services will ultimately benefit consumers if it supports a more orderly transition to a high VRE NEM through more predictable and manageable prices, avoiding price shocks for customers;
2. the energy market should settle at slightly lower levels with less volatility from the disaggregation of the R30 and L30 service from energy dispatch;



3. the visibility of a transparent price signal for R30 and L30 markets. Once these markets become visible then the competition for these services should yield short-run dispatch efficiency; and
4. the visibility of a transparent price also gives over the longer term the prospect of a traded market and the price signal provides the opportunity for allocative efficiency in investment in technology to meet AEMO's eligibility criteria, including for new technologies or demand-side response where those services are able to meet the R30 and L30 needs.

#### Cost Allocation of AEMO's costs between NEM Participants

In terms of cost recovery, there are two possible scenarios:

- R30 and L30 market costs are allocated via a “causer pays” charge which would largely fall on VRE providers in accordance with the ramping requirement that VRE variability has caused on a day-to day basis.; or
- R30 and L30 market costs are borne by the entire market as a system security cost, similar to other ancillary services.

Delta is of the view that the fundamental driver for the emergence of very high rates of change on scheduled generators is the increasing levels of VRE generation in the middle of the day, in particular solar PV generation. Applying a causer-pays principle, it is this class of participants who should bear the costs of the proposed R30 and L30 markets. This allocation will incentivise this class of participants to invest in energy storage to mitigate their ROC or alternatively provide equivalent ramping capacity, or to curtail. For example, co-located battery energy storage or hydrogen production combined with hydrogen-fuelled generation capability using the stored hydrogen fuel addresses the issue directly.

Ultimately, customers also benefit from adequate system stability and the promise of lower costs of electricity from VRE, accordingly there is also a case for allocation of some of the costs to customer load.