Webinar: Market Products for System Stability	
Question	**Answer**
Thanks, excellent presentation! To clarify the balancing mechanism to meet the stability needs, is it equivalent to the 3 freq. response products or D-1 market?	Thanks for the kind feedback. The Balancing Mechanism is currently used for a variety of system and energy reasons, including for managing both frequency and stability. In terms of stability, this includes synchronising additional units to provide inertia or locational stability support. In terms of frequency, additional units in the BM can be instructed to provide Mandatory Frequency Response or deliver fast energy to regulate system frequency. The 3 response products were developed as faster, more specific ancillary services which are now procured daily on a cheaper basis; therefore, these products have mostly replaced response activation through the BM. The D-1 stability market is intended to follow the same direction - to provide a cheaper, more specific service that we can signal through an explicit market mechanism and displace more expensive activations in the BM.
Have you consider the possibility of having these services being built and operated by ESO (NESO) as a regulated asset? There is huge uncertainty for investors	The ESO and NESO are not permitted to own or operate assets as per our licence conditions.
Has any market/results analysis been done regarding the lack of successful GFM to date? Is it a price matter or technology maturity issue?	We saw 5 grid-forming batteries come through the second phase of our stability pathfinders which are due to go-live this year. These are the first of a kind on the GB system and we expect that stability markets will further incentivise the deployment of grid-forming assets on a larger scale. We recognise the immaturity of these technologies and the ESO's limited experience with procuring these services, hence we launched the Y-1 market as a priority to try and build that confidence.
Could you explain a little bit more about the payment? is it payed by grid operator to contractors? By how the cost is determined?	The payments in the MT (Y-1) market are split into two parts: availability and delivery. Both are submitted by the market participant during the tender process where they become final. If successful, the availability payment is guarenteed for each period in which the provider is available to deliver the contracted service. The delivery payment is then made in addition during each period where the asset is utilised/armed for inertia. The payments are made by the ESO with the costs passed through to GB consumers through our Balancing Services Use of System charging methodology.
Do you also have real-time market for these products? What happens if there are forced outages in realtime that requires these services?	There is currently no plans for a real-time stability market. The current approach would be to use the Balancing Mechanism as a final market in real-time to make any final adjustments.

In PF2 GFM BESS have shown high competitiveness for stability service provision. Why conditions have been changed in PF3 resulting in advantages for Sync comps?	The Stability Phase 3 tender was run on a technology agnostic basis similar to Stability Phase 2, ESO did not advantage or prefer sync comps over BESS. We were accepting bids from all technology types that met the technical specification and service requirements. The decision on what technology type to propose sits with the providers that take part, for Stability Phase 3 we saw that a majority of bidders offered synchronous compensators over GFM BESS assets. Our understanding is that market conditions at the time such as supply chain options and connections availability shaped their decision making process.
How dou you calculate the inertia requierement (amount of GVAs)?	The forward inertia requirement is calculated using models which can simulate future dispatch under different scenarios for weather, technology mix, and outages. This provides a baseline level of inertia for each settlement period which we can then use to calculate the defecit, both in terms of volume and duration. We use this to determine a target threshold to procure but reserve the right to procure more or less than this depending on the outcome of the economic optimisation.
Do you use a Demand Curve for procuring inertia in the stability market? If so, how is it defined?	The forward inertia requirement is calculated using models which can simulate future dispatch under different scenarios for weather, technology mix, and outages. This includes different assumptions / variations for GB demand across the year which allow us to calculate the level of inertia shortfall under different scenarios.
How did you create competition for stability services that historically were bundled into energy from spinning resources? Was there any pushback?	This was a challenging question during the innovation project - whether to pay universally for stability services, or whether to only pay for additional stability not delivered as a by-product of the energy market. Ultimately, the costs to GB consumers for paying universally were forecast to be very signficant and this outweighed the cons of drawing eligibility rules which only permitted synchronous machines who can provide services at 0MW export to participate. We decided to pay for a 'change in behaviour' which distinguishes between stability and energy being bundled together. However, we are mindful of the value these existing machines can provide and therefore have tried to establish a route to market for retrofitting capability to operate at 0MW export (e.g., a clutch on synchronous machine) if desirable.
Can you explain about 5 GFC (Grid Forming Converters) that you mentioned? What converters are those, e.g., HVDC?	The grid-forming units which were contracted during Stability Pathfinder Phase 2 were five Battery Energy Storage Systems with grid-forming convertors. Full results including tech types can be found here - https://www.nationalgrideso.com/document/248466/download
As inertia is not linked to a special voltage level, would synchronous machines connected at DSO level allow for Mid term service?	Currently, the mid-term (Y-1) market is limited to those providers directly connected to the transmission network or connected at 132kV and above. This is because we are yet to prove the effectiveness of inertia on the distribution networks and there are possible conflicts with RoCoF protection relays. However, we are planning to launch an innovation project soon to explore this further.

Any thoughts on how to get similar benefits to the system while minimizing costs without organized markets like were shown?	We have designed stability markets to create an explicit price signal to compete these services in an open, transparent, competitive marketplace, which we think is the most cost-effective way of meeting our needs in most circumstances. However, we will be continuing to explore the potential use of code modifications to consider whether mandatory provision of some services for some assets in some locations might be a more cost effective and sensible approach.
How the required inertia is calculated for pathfinders?	The inertia requirement was calculated for Pathfinders using models which simulate future dispatch under different scenarios for weather, technology mix, and outages. This provides a baseline level of inertia for each settlement period which we can then use to calculate the defecit, both in terms of volume and duration. We use this to determine a target threshold to procure but reserve the right to procure more or less than this depending on the outcome of the economic optimisation.
Assured provision of GFM requires power & energy reserves that are not for free for IBRs. Why mandatory GFM should be more cost-effective compared to market?	The current requirements for grid-forming in GB are non-mandatory and therefore we are using markets are the primary tool for accelerating the provision of these services. This is partially driven by the requirement for participants to invest in technology (e.g., storage) but also due to the operational trade-offs between supplying energy at maximum capacity and potentially holding headroom in reserve to provide stability through a market. Any exploration of mandatory grid-forming will consider these potential impacts and understand whether mandating certain services (e.g., SCL support) would have different consequences to others (e.g., inertia).
Thanks for the excellent presentation. Is there any instance where a balance is made of these markets, or are they all settled independently?	Thanks for the kind feedback. Currently the MT (Y-1) market is the only one which is in the delivery phase. The Y-4 market will be launched when system requirements dictate and we are working hard to establish a plan to deliver the ST (D-1) market in a timely way. Initially, we see all of these markets working in harmony to balance risk, flexibility, and cost; therefore, they should be co-ordinated but they will clear independently of one another in the first instance.
Is there also an upper threshold for inertia? Might a too high inertia also be challenging for system stability?	To our knowledge, there is no upper threshold for system inertia.