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Australia

David Reynolds
Australian Energy Market Commission
GPO Box 2603
Sydney NSW 2000

21/10/2021

RE: AEMC Capacity Commitment mechanism and Synchronous Services Markets (ERC0306)

Dear David,

Tesla Motors Australia, Pty Ltd (Tesla) welcomes the opportunity to provide a response to the AEMC's Capacity Commitment mechanism and Synchronous Services Markets Directions Paper.

Tesla's mission is to accelerate the transition to sustainable energy. Within this objective, Tesla is committed to working with all market bodies to improve power system security and reliability outcomes in the National Electricity Market (NEM) in a manner that is efficient for consumers, timely for system operations, and sustainable over the long-term. Accordingly, we recommend AEMC assess the costs and benefits of all reforms against not just costs to consumers, but also include an emissions reduction criterion. For new system service market considerations, we recommend AEMC seek to structure any new market or mechanism in a way that enhances the integration of new, low-emission, secure, low-cost energy technologies into the NEM (and avoid any unnecessary additional payments to high-emission, high cost, high risk ageing thermal plant).

We recognise the real and immediate need for action to improve the current system service frameworks in the NEM and agree with the AEMC and AEMO position that system security, frequency, and reliability have all been deteriorating over recent years, costly back-stop provisions have been overused, and transparency is lacking. At the same time, battery storage has proven particularly valuable in managing system security issues and providing premium stability, voltage and frequency services, as demonstrated in multiple power system security and islanding events. Going forward, storage at all scales – transmission, distribution and behind the meter – and in all forms – stand-alone, co-located, and aggregated – will be an increasingly critical component of Australia's energy mix. As such, it is essential that new reforms and requirements do not directly, or inadvertently disincentivise the uptake of future storage projects.

Tesla looks forward to working with the market bodies in addressing the priority objective to improve the efficiency and effectiveness of power system security and reliability in the NEM, ideally through a long-term, technology neutral approach that can ensure the National Electricity Objective remains central to the reform agenda and investor certainty is improved.

For system service provision in the operational timeframe, engineering methods must be updated to reflect the pace of innovation that is already occurring as our energy system transitions, and ensure new technologies that can provide equivalent services (e.g. grid-forming inverters providing virtual inertia and system strength) are not locked out of procurement based on out-dated system configurations reliant on historical experience. Tesla is keen to work closely with AEMO engineers to ensure the technical capabilities of battery storage is well understood and commends the recent Advanced Inverter white paper as a useful framework to build upon.

Sincerely,

Tesla Energy Policy Team
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Recommended Principles for System Service Market Design

Tesla can see both costs and benefits in either the market or non-market ancillary services approaches described in the Directions Paper. At a high-level, a market-based approach is typically the favoured design for flexible technologies such as battery storage using optimisation bidding strategies – as it would ensure granular, real-time transparency and will support dynamic value stacking of new capacity. However, we note the additional complexity involved in changing NEMDE and the uncertainty of new and un-tested spot market services and associated revenues.

Conversely, a 'non-market' pre-dispatch contracting approach would be less complex, with likely lower implementation costs, but would need to be carefully aligned with existing TNSP and REZ scheme contracts to avoid undermining availability payments and has a greater risk of not being technology neutral or transparent – potentially embedding the bias to synchronous plant and traditional secure system configurations that exclude inverter-based resources.

We note that more details on expected costs, timeframes and governance provisions will be useful to include as part of ongoing assessments between the different approaches.

Design Principles

Irrespective of the mechanism ultimately chosen, Tesla recommends the following principles guide the detailed design and are captured in the AEMC's draft determination:

1. **Strengthen investment signals for new capacity**
    - The NEM currently provides mixed signals for investors looking to develop storage projects, highlighting a significant gap in meeting AEMO's forecast levels of storage deployment by 2030 (i.e. up to 19GW by 2040 as projected in the 2020 ISP 'step change' scenario). These projects are crucial to contribute to both reliability and system security outcomes in the short term, and to drive affordability and efficiency outcomes for consumers over the longer term. However, storage still requires removal of existing barriers and recognition of its demonstrated capabilities to unlock the necessary levels of deployment in the NEM.
    - AEMC must consider both the individual and collective impact of the system service rule change proposals against a broader assessment of what potential market design features will be necessary to stimulate the requisite levels of private investment in a low-carbon future. It would be a hindrance to the energy transition (and ultimately add risk to the secure, reliable and low-cost supply outcomes) to introduce new markets or mechanisms that only cater to existing synchronous plant under the misguided objective to "ensure thermal plant will not prematurely exit". This would only serve as an expensive opportunity cost that would increase the barriers for new entrants (that can provide equivalent or better quality of service), and care must be taken to ensure any potential payments are sufficient (in aggregate with other sources) to drive investment in new capacity.
    - AEMO has a clear vision to achieve 100% instantaneous renewable energy by 2025. Successfully achieving this vision under a secure operating state will therefore be contingent on inverter-based provision of all system services, initially on an interval-by-interval basis, but ultimately to cover demand ongoing.
    - Whilst economic efficiency might naturally pre-dispose design decisions towards pure spot markets, it will be important to balance how investors perceive market price signals and whether volatility and unpredictability can be sufficiently managed to support adequate volumes of long-term investments (e.g. through financial CFD type products, state-based REZ schemes, TNSP network service contracts, or

other contracted revenue streams). Similarly, the investment signal from a limited quantity of possible direct contract arrangements with AEMO (with limited transparency) may be muted and/or discounted when being assessed by investors in potential new projects.

- Tesla notes the ability to stack system service payments in the 'operational timeframe', with contracted revenues from the 'planning timeframe' provides a clear benefit from a project finance-ability perspective, and links with state REZ schemes and/or system strength contracts with TNSPs should be encouraged under either approach. However, alignment with these schemes and contracts must ensure the risk of double-dipping is mitigated, including any potential bilateral contracting arrangements that jurisdictions may negotiate with ageing coal plants over the next 5 years. Regulatory checks and balances will play a critical role.

2. Technology Neutrality

- As the NEM transitions towards a high renewables and low-carbon future, synchronous services are increasingly being substituted by proven (and asynchronous) technologies that can contribute to fault current, actively support voltage waveforms, and dampen the rate of change of frequency, digitally mimicking the response of spinning machines - e.g. electrical inertia measured in MWs can be derived both from synchronous machines (kinetic energy) or asynchronous (chemical potential).
- Structuring markets or contracting mechanisms to value service provision (rather than enforcing mandates or relying on legacy engineering experience based on asset type, or size or classification etc.) becomes increasingly relevant for the evolving market designs that will need to integrate a suite of technologies providing comparable services across the grid. As a principle, all technologies should be able to access all revenue streams for which they can provide services – it is the MWs of inertia that is important – not how it is derived.
- System services (and market reform more generally) must use future proofed terminology rather than relying on prevailing and outdated assumptions that only synchronous generators can provide specific services, as inferred by the original rule change proposals. This should also include removing existing barriers contained in the NER – e.g. inertia being defined as 'synchronously coupled' which prevents equivalent service provision from (non-synchronously coupled) grid-forming inverter based resources. Participation should appropriately reflect the capacity of all resources to contribute to system services, noting this may include procuring new services from existing plant, or may incentivise innovation and bring forward power system contributions from future technologies. Innovation will flourish when design principles focus on achieving outcomes, rather than mandating specific short-term requirements.
- Synthetic, digital or 'virtual inertia' is a current prime example where technological advancement is demonstrating the ability of equivalent service provision through non-traditional assets. These developments should be encouraged – and ideally be rewarded through payment mechanisms that recognise premium service provision, capturing characteristics such as accuracy, speed etc. through suitable performance or enablement values.
- We commend AEMO's leadership in developing the Engineering Framework, including the Advanced Inverter White Paper that recommends pursuing immediate "*low-regret opportunities to incorporate grid-forming capabilities on new grid-scale batteries*"[1]. Continual evolution of engineering knowledge will be critical and Tesla supports additional work to ensure both AEMO and networks service providers are

[1] https://aemo.com.au/-/media/files/initiatives/engineering-framework/2021/application-of-advanced-grid-scale-inverters-in-the-nem.pdf

appropriately incentivised to explore and integrate new technologies and services – e.g. through clearly scoped demonstration trials that can progress immediately – see implementation section below.

3. **Clear transparency for procurement**

    - As demonstrated in day-to-day operations as well as during non-credible power system events, battery storage technologies are well aligned with the AEMC objective of efficient provision of services to meet multiple system needs, including security, reliability, and resilience. Storage assets have the ability to optimise across multiple services and multiple markets – to provide what is needed when it is needed the most – driving increased flexibility, improved competition and enhanced stability to the local grid and the NEM more broadly. Multiple services can also be provided by a single asset simultaneously – ensuring the cost-of-service provision maximises efficiency, and can be co-optimised across energy and system services. However, current biases to 'known' system configurations precludes many of these efficiencies from being realised.
    - The status quo process for procuring non-market services is neither transparent nor efficient. The underlying decision-making process remains unclear – with unilateral operational control requirements enabling AEMO to direct/intervene as needed, overlapping with pre-dispatch scheduling and commitment requirements and even longer-term planning time horizons – all creating unnecessary uncertainty for market participants. This is underpinned by an understandable approach to risk aversion from system and network operators, where familiar processes and technologies are naturally favoured given the asymmetric cost to benefit outcomes if something goes wrong. However, the energy transition is inevitable and accelerating, and therefore new technologies, methodologies and processes are a necessary condition of achieving a 100% renewable future securely.
    - New procurement methods must provide industry with clear governance, accountability, and transparency on detailed design, contract / dispatch decision criteria, constraints, and price volume calculations used in procurement. If system operators are provided with greater flexibility, it should be coupled with higher scrutiny and transparency requirements to ensure principles of efficiency, neutrality etc are upheld.

4. **Scale agnostic procurement**

    - Tesla notes that the future NEM, under any credible future scenario, will see a significant contribution from distributed energy resources (DER), demand-side response, and aggregated fleets operating as VPPs that should be enabled to participate in all energy and system service markets given their ability to provide many of these services much more efficiently and at a localised level. Many of these capabilities are already being demonstrated as part of AEMO's Virtual Power Plant trials.

Implementation

Whilst there are many inter-related rule change proposals at various stages of progress (e.g. FFR, system strength) per the ESB and AEMC 'essential system service' roadmap, we support the AEMC in progressing immediate steps that can ultimately support the unbundling and valuing of these system services. For example, a potential pathway for the NEM could involve:

1. AEMC (together with AEMO and TNSPs) clearly define additional services to be procured in (pre)dispatch – e.g. inertia and system strength. These definitions must not lock out non-synchronous provision (e.g. virtual inertia) by restricting participation to 'synchronous service' (this is short term, inefficient, and would not be technology

neutral). Instead seek to define service requirements (for example response time and active power level required). Definition refinement could leverage ElectraNet (ESCRI) and HPR findings locally; AEMO's advanced inverter white paper, as well as Eir-grid studies going back to 2016.

2. In parallel to 2023 FFR implementation, establish system service procurement guidelines (using demonstration trials to ensure system and network operator confidence in technology capabilities) and undertake initial competitive contracting process. For inertia services, this could include reviewing FFR and inertial substitution.
3. Revise AEMO's Renewable Integration Study and Engineering Framework findings/limitations to reduce non-synchronous vs inertia safety nets as confidence in a high renewable penetration system grows.
4. Ongoing - improve measurement and compliance, with finer time resolution measurement and detection protocols, to further incentivise grid-forming inverter-based assets and explore co-optimisation into real-time dispatch (i.e. market ancillary service approach).

EirGrid experience

As a reference point, the electricity market reforms that have been pursued in Ireland provide an instructive case study, given similar ambitions to realise a high penetration of renewable generation by 2030 (targeting over 70%). Ireland has recently launched a system services market under EirGrid's Delivering a Secure Sustainable Electricity System (DS3) program[2]. There are currently 14 available system service value streams market participants can access through DS3, including primary and secondary operating reserve products, as well as new fast acting services to help support grid stability. Access is defined by service capability, not technology, and the program is likely to evolve with additional services over time.

At a high level, DS3 procurement strikes a balance between transparent TSO contracting (where there is insufficient competition) and enduring market arrangements (where there is sufficient competition in service provision). Importantly, the program leveraged demonstration trials early and effectively, within initial regulations providing:

> *"an opportunity to establish the mechanisms by which the characteristics of new technologies can become "Proven" and "Measurable" for the widest range of non-energy system service providers possible."*

We support a similar approach being progressed in the NEM, where TNSPs and AEMO can facilitate confidence in new plant capabilities and system configurations and ensure they are treated equivalently to synchronous generators under a single 'proven technologies list', including smaller-scale assets such as active DER and VPPs.

[2] https://www.eirgridgroup.com/site-files/library/EirGrid/DS3-Programme-Brochure.pdf

Background: Battery storage benefits

Appropriate planning and integration of energy storage is vital for the long-term reliability, security and emissions reduction ambitions of the Australian energy market. This is now widely recognised by all market bodies: AEMC's recent Integrating Energy Storage draft determination is testament to the importance of storage; with AEMO's 2020 Integrated System Plan anticipating that up to 50GW of new large-scale renewable energy generation will be supported by almost 20GW of new storage capacity (per the step change scenario) to provide resource adequacy. This capacity will be made up of pumped hydro, large-scale battery energy storage systems, and distributed batteries, including virtual power plants (VPPs).

In addition to wholesale market services (energy and frequency control ancillary services), there are three further applications where battery storage can competitively provide services:

	Traditional Approach	Battery storage role
Capacity Constraints	Expand substation; network upgrade; curtail renewables	Defer/complement network investment, reduce risk of load shedding / congestion with 'virtual transmission'
System Services	Syncons; Statcoms	Provide all inertia, system strength, voltage and network services via grid-forming battery inverters
Grid Protection & Resiliency	Network upgrade; synchronous plant back-up (diesel/gas generators)	Contingency and re-start protection; resiliency services (SIPS, SRAS) – e.g. Victoria Big Battery

Battery storage systems have proven their ability to provide all essential energy, system and network services (e.g. fast frequency response, inertia, voltage stability, system strength) – with premium speed and accuracy. AEMO's latest white paper on advanced inverter technologies[3] highlights the importance of inverter-based technologies, grid-forming battery storage in particular, in supporting the transition to high penetration renewable systems, and the need for new assets to provide inertia, system strength, and voltage stability in place of a retiring synchronous thermal fleet. Tesla is actively working on two leading project trials to demonstrate its grid-forming capabilities through its Virtual Machine Mode (VMM): (1) Hornsdale Power Reserve (HPR) in South Australia; and (2) TransGrid's Wallgrove Battery.

Unlocking provision of all services (stacking wholesale market revenues with essential system and network services) is a necessary precursor to deploy storage at the scale required and will accelerate uptake and support development of new commercial models. This is being increasingly recognised by state-led energy policies, including NSW Government's 2GW storage target, and the Victorian REZ Development Plan to integrate 2.4GW of storage across the state. Whilst some market reforms are progressing to support this future (e.g. TransGrid's System Strength rule change), achieving these targets will require regulatory reforms and rule changes that ensure our network planning framework keeps pace with speed and scale of the transition already underway.

[3] See AEMO White Paper – Application of Advanced Grid-scale Inverters in the NEM