



Tesla Motors Australia Pty Ltd
650 Church St
Cremorne, Victoria, 3121

Dr Alex Wonhas
Australian Energy Market Operator
530 Collins St
Melbourne Victoria 3000

20 March 2019

Re: 2019 Planning and Forecasting Consultation

Dear Alex,

Tesla Motors Australia, Pty Ltd (Tesla) welcomes the opportunity to provide AEMO with feedback on its 2019 Planning and Forecasting Consultation Paper for the National Electricity Market (NEM).

Tesla commends AEMO's strategic approach to the ongoing evolution of the NEM and its commitment to whole of system, actionable planning over long-term outlook periods to support credible investment decision making, provide clarity to market participants and inform policy direction.

This submission focusses on proposed inputs, assumptions and scenarios that relate to the integration of battery energy storage in the NEM, noting its critical role in achieving an efficient, secure and low-emission future grid.

In particular, Tesla recommends:

- Expanding modelling to include a combined high DER, high utility-scale storage uptake, and strong emissions policy scenarios
- Adjusting cost and technical parameter assumptions to reflect latest characteristics and full value potential of energy storage (e.g. ancillary services)
- Including additional battery storage duration options (e.g. 4-hour system)
- Underpinning DER impacts with additional considerations – e.g. impacts of wholesale demand response mechanisms driving greater demand side participation
- Updating assumptions around MLF impacts and potential mitigation through storage solutions

Tesla looks forward to continued engagement on these items and actively participating in ongoing discussions to support AEMO in the development of its planning processes. For further information on any of the points raised please contact Dev Tayal (atayal@tesla.com) with any questions.

Kind regards

A handwritten signature in blue ink, appearing to read 'Mark Twidell'.

Mark Twidell
APAC Director – Energy Products

1. General Comments

As articulated by AEMO's inaugural 2018 Integrated System Plan, Australia's energy transformation must prioritise additional energy storage, electricity transmission infrastructure and demand-response mechanisms, supported by electricity-market reform that enables these technologies and fairly compensates for performance.

Future grid planning studies and associated work has often focused on facilitating higher renewable energy penetration levels (leveraging existing government subsidies for large-scale wind and solar); and/or on how to best manage the upcoming retirement of coal plants via replacement generation capacity and stronger transmission links.

Tesla commends AEMO's wider approach recognising that the integration of storage will need to be deployed in parallel to contribute to both reliability and system security outcomes in the short term, and drive affordability and efficiency outcomes over the longer term (e.g. providing an alternative to investment in network infrastructure, improving loss factors and reducing congestion, and enhancing market competition for energy and ancillary services). AEMO's 2019 Integrated System Plan will continue to advance industry and policy thinking in this area, and aligning with its overall purpose, provide actionable planning and assess credible pathways to support long-term investments.

2. Detailed Comments

The following sections outline Tesla's feedback on key areas of the Consultation particularly relevant to the uptake, integration and participation of battery storage systems:

- a) Scenarios modelled** – we understand AEMO's intention to deliberately impose an 'anti-correlation' between the growth in large-scale renewable generation and uptake for DER to maximise range of transmission network requirements across different scenarios. However, a correlated scenario should be included as an alternative fast-change scenario.
- There is still value in running a plausible scenario where both DER and large-scale renewable and storage uptake is maximised as this will illustrate corresponding requirements for other generation type and support policy design, especially considering the current environment of State and Federal policies incentivising both large and small-scale solar and storage as noted (e.g. LRET, VRET, QRET, and DER policies announced in South Australia, Victoria, NSW and Queensland).
 - A 'Fast Change' scenario could then be viewed (as it is most likely to be interpreted) as an outlook that sees high growth in demand-side settings (strong uptake of rooftop PV, demand-side participation, EV and aggregated behind the meter storage) as well as strong supply side cost reductions at the utility scale. As recognised by AEMO, and supported by Tesla's experience to date, more rapid uptake of behind-the-meter battery storage will help drive faster reductions in utility-scale battery costs and as such are highly correlated.
 - We also note the current assumptions proposed for the 'Fast Change' scenario use a neutral cost trajectory for batteries (both utility and behind the meter). It would be useful to model the impact of accelerated trajectories for this scenario, aligning with the approach taken for the 2018 ISP.
- b) Emissions Policy** - criticality of emissions reduction policy over the coming decade suggests at least one scenario should consider emissions reduction as a more active driver on the energy sector rather than simply as an output.
- It would be instructive for AEMO to explore modelling sensitivities that can transparently quantify the impact that a carbon price will have on the generation mix and future grid requirements. This will provide at least one pathway that can support the investment certainty required for low-

emission energy technologies. Suggest AEMO consider a 26-28% emissions reduction target from the electricity generation sector, or a 45% emissions reduction target.

- Whilst de-carbonisation is seen as an outcome of coal plant retirements and renewable generation investment, both of these will be directly affected by any credible emissions reduction policy. This could complement the inclusion of a risk-premium to financing costs to reflect this carbon price risk for fossil-fuel plant, as is evident in the financial markets currently.
- This approach also lends itself to the overarching objective of AEMO developing an actionable integrated system plan that can inform both market participants and key policy makers, noting that the existing 26% by 2030 reduction pathway will need to be significantly more ambitious to achieve economy wide emissions reductions required.

c) Updated cost and parameter assumptions – support AEMO’s approach through the CSIRO GenCost 2018 process to iterate new entrant cost curve assumptions to reflect latest available market data.

- Recommend AEMO expand its commentary on how the modelling’s decision criteria considers total value contributions of battery storage across not just energy generation, but also to consider additional capabilities and flexibilities provided, such as ancillary service and system security benefits (see section (f) below). This will support market understanding of the role of storage relative to other generation plant, without jumping to conclusions by simply comparing capital cost metrics based on energy related costs (\$/kW or \$/kWh) - which should be used with caution for informing investment decisions. This traditional analysis is arbitrary for battery storage systems since the amount of energy stored and discharged can vary depending on the application.
- Strongly support the intention to explore additional range of storage capacity to energy ratios. This should be expanded further to recognise the increasing value provided by longer duration battery storage in the NEM. Recommend AEMO incorporate a 4-hour energy storage battery option as part of modelling (see additional comments on duration in section (d) below).
- There is potential to uplift battery storage properties relating to charge efficiency, currently listed at 81%. Deployments to date are already achieving greater than 90% efficiencies – as such we support AEMO in updating parameters for battery charge and discharge efficiency to at least 90%.
- Regarding technical life, we understand modelling will include a 10-year lifetime for battery storage. However, it is important to note that this is often based on a guaranteed energy provision warranty from manufacturers, where the market is already seeing the shift to 15 year warranties being offered as standard. Moreover, beyond this 10-15 years storage assets are not worthless and will still be able to provide value to the market, albeit with declining levels of energy. This should be equivalent to assumptions made around ageing coal and gas plants that are likely to see increasing levels of full/partial outage rates and expanding de-rate factors prior to retirement.

d) Duration assumptions – support increasing recognition of the role storage can play in supporting high-penetration renewable grids. Noting AEMO’s current approach to model 2-hour (short duration) battery storage complimented by long duration pumped hydro (6, 12, 24 and 48 hours), we recommend this be expanded to also include 4-hour battery storage systems, aligning with the range of pumped-hydro systems - modelled across 4 different durations.

- For storage, market participation is fundamentally an opportunity cost assessment – using dispatch models and forecasting software to optimise when, in what markets, and how much to bid the limited energy capacity that is available in order to maximise returns. This is where longer duration battery storage of 4 hours will allow for greater flexibility in market bidding strategies (to capture peak price events) and the additional energy capacity can also be used to provide additional ancillary services to deliver higher project revenues (‘revenue stacking’). Whilst strategic bidding and commercial drivers may not be explicitly captured in AEMO’s modelling, the additional storage

capacity option will at least provide an indication of the flexibility of the role battery storage can provide in the fully co-optimised NEM.

- Further, it is important to note a doubling of the energy capacity of a battery does not result in a doubling of the cost, as this is not a simple linear relationship. Whilst some deployment costs will vary (depending on project specifications, size, location and other unique installation costs), many of the costs of deploying a battery storage system are largely fixed (e.g. inverters, transformers, control systems, balance of plant, market registration, grid studies and connection).
- Network constraints and physical site limitations will also be key to understanding optimal system sizing. In general, an expanded range of options for storage should be considered and depending on the required role, different technologies or combinations will be most cost-effective.

e) Accelerating DER impacts – support AEMO exploring impacts /speed of uptake of DER, including Electric Vehicles, Energy Storage Systems, and Virtual Power Plants (VPP).

- The significant potential impact of DER highlights the importance of incorporating accurate and transparent battery storage costs and uptake forecasts across modelled scenarios.
- Tesla looks forward to the independent analysis being provided by consultants on these topics and would be happy to support this process as it progresses.
- VPPs are gaining increasing recognition in their ability to contribute to market and system benefits across the NEM, and following 2019 trials by AEMO and ARENA and incentives from multiple jurisdictions, are likely to have significant impacts on the future energy system. We support AEMO's intention to include 700MW of VPPs by 2022 across all scenarios. We also encourage AEMO to specify scenarios for how DER assets operating in aggregate may be scheduled – including the minimum size requirements for scheduling.
- Tesla's experience in EVs to date suggests AEMO is significantly underestimating the total amount of electricity charging required from 2019 and onwards. This appears to also not be aligned with the specific charging profiles we are observing. We would be happy to further engage on supporting data that can inform AEMO's modelling for EVs.

f) Ancillary service benefits: recommend AEMO include the full-range of potential ancillary service benefits of storage. Tesla supports the proposed external consultant insight paper to quantify these benefits and looks forward to engaging with AEMO on this process.

- As acknowledged by both AEMO¹ and AURECON² independent assessments, battery storage can support stable grid frequency through the provision of a 'premium' regulation frequency control ancillary service (FCAS) – offering flexible, more accurate and faster performance in following control signals to continually counteract frequency deviations during normal operating conditions.
- In addition, Hornsdale Power Reserve's fast frequency response to the major system security event that occurred on 25 August 2018 highlights the ability for battery storage to provide precise output as required to stabilise the grid³. The Hornsdale battery provided significant frequency support to all connected NEM regions during the initial low frequency event, and then to the SA region during its islanded, high frequency event.
- For future developments, it is expected that the value of these services will only increase as more thermal generators retire and market changes are made to incentivise and reward all fast acting and flexible frequency, voltage and inertial responses that battery storage can offer. Overtime,

¹ https://www.aemo.com.au/-/media/Files/Media_Centre/2018/Initial-operation-of-the-Hornsdale-Power-Reserve.pdf

² AURECON, 2018: www.aurecongroup.com/markets/energy/hornsdale-power-reserve-impact-study

³ https://www.aemo.com.au/-/media/Files/Electricity/NEM/Market_Notices_and_Events/Power_System_Incident_Reports/2018/QLD--SA-Separation-25-August-2018-Incident-Report.pdf

these non-energy services should increase their proportion of the value stack, particularly as non-traditional network support services and grid infrastructure deferrals are able to be monetised, and as regulatory reforms unlock more appropriate markets to value the services being provided.

- It is also unclear whether inertia contributions are being captured, if at all. Ancillary services should include the ability for battery storage to provide 'virtual inertia' – as currently being demonstrated to AEMO via off-market firm-ware trials as part of wider primary frequency control reforms. Even technical commentary from AEMO on the potential for innovative solutions to manage system security constraints will be valuable to clarify expectations for industry, particular in light of recent decisions being made to procure large synchronous condensers and an increased focus on inertia requirements going forward.

g) MLF benefits from storage: AEMO is in a position to clarify potential avenues for improving MLFs for new generation, and assumptions on the benefits of co-located storage should be included in REZ assessments (i.e. correlated charging during times of high generation and low-load).

- This is particularly useful for grid planners and market participants to assess impacts over the long-term, particularly in light of recently released draft MLF values for 2019-20 which highlight the increasing attention and impact these values will have on current and future generation investments.

3. Conclusion

Tesla welcomes all the ongoing work undertaken by AEMO to enable a streamlined and coordinated electricity system transformation, notwithstanding the significant market, policy and economic uncertainties that complement any long-term planning studies.

With substantial levels of investment still to come to drive the integration of new generation, transmission and energy storage (as cogently identified in AEMO's inaugural 2018 Integrated System Plan), Tesla appreciates the opportunity to assist AEMO increase the accuracy, robustness and reasonableness of its conclusions and insights from its planning publications.

Tesla will continue to engage with AEMO as this planning work progresses, in particular to provide support where relevant to battery storage, and ensure the development of a robust and credible planning framework to achieve the longer term vision can be effectively translated into actionable investments and policy design in the years to come.