Energy Security Board
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Tesla Submission to National Energy Guarantee (NEG) Consultation Paper

Tesla Motors Australia, Pty Ltd (Tesla) welcomes the opportunity to provide feedback to the Energy Security Board on the National Energy Guarantee (NEG) Consultation Paper (the Consultation Paper).

As a general rule, Tesla supports a strong, bi-partisan approach to emissions reduction that also encourages reliability and security in the national electricity market (NEM), and reduces customer costs.

While best known for its vehicles, Tesla also utilises the battery expertise and production capacity developed for its vehicles to make innovative, cost-effective energy storage systems for use in homes, commercial buildings, and on the bulk electric system. With over 7.5 gigawatt-hours (GWh) of total energy storage produced and deployed in vehicles and over 700 megawatt-hours (MWh) of stationary energy storage systems installed and operating, Tesla has extensive experience in both manufacturing and deploying commercial energy storage systems for use on the electric grid.

Australia is an important market for Tesla. In 2017 Neoen and Tesla commissioned the 100MW/129MWh Hornsdale Power Reserve (Hornsdale) project outside of Jamestown in South Australia. This is the largest lithium-ion battery project in the world and has been actively participating in both Australian energy markets and all frequency control ancillary services (FCAS) markets since being commissioned.

More recently Tesla, with the support of the South Australian Government, have initiated a project to deliver 50,000 home solar and battery systems across South Australia, to form the world's largest Virtual Power Plant[1].

The project will begin with a trial of 1100 Housing Trust properties, where a 5kW solar panel system and 13.5kWh Tesla Powerwall 2 battery will be installed at no charge to the household and financed through the sale of electricity. Following the trial the VPP will expand to at least 50,000 households over the next four years.

These projects demonstrate the growing role that battery energy storage will play as an important component of Australia's energy mix. In combination with the other electricity market reviews that are currently being undertaken by the Australian Energy Market Commission (AEMC) the NEG has the potential to create appropriate investment signals to recognise the full value of battery energy storage. However, in order to do so, it will be important that the settings for battery energy storage are well considered in the NEG architecture from the beginning.

[1] South Australian Government, "South Australia's Virtual Power Plant", http://ourenergyplan.sa.gov.au/virtual-power-plant

Our submission below provides an overview of the demonsted capability of battery energy storage to provide critical system security services, as well as the key considerations regarding battery energy storage that need to be considered in the detailed NEG design. This includes:

- Exemption from NEG liability for battery energy storage assets; and
- Appropriate consideration of emissions intensity for battery storage energy discharge.

Providing clear, appropriate and fair treatment of battery energy storage will be vital for the sector to continue to develop.

Achieving emissions reduction while maintaining reliability

Tesla's company mission is to accelerate the world's transition to sustainable energy. To achieve this requires both a supportive market structure and appropriate investment signals. The NEG can create appropriate investment signals, but only with an emissions reduction target that is scalable beyond the current 26% reduction by 2030. The contribution that Australia's electricity generation sector can make to achieving Australia's Paris Agreement emissions reduction target of 26-28% is significant. More importantly with the right mix of renewable energy and battery energy storage, emissions reduction can be achieved at scale, with speed and without impacting on energy security or reliability for end-use consumer.

Tesla believes that you can achieve low-emissions and reliable energy while reducing costs for consumers. The South Australian VPP is estimated to save consumers an average of 30% when compared with purchasing electricity from the grid.[2] This both demonstrates the opportunity for consumers to reduce their energy costs by taking control over their own energy generation – and highlights the important role that distributed energy resources will play within the NEG framework (see discussion below in this submission).

At a utility scale, a recent report from the Public Service Company of Colorado, summarising options to replace two closing coal generators, found that new build "dispatchable renewables" in the form of a combined solar PV and battery energy storage, was cheaper than the marginal cost of operating most existing coal generators in Colorado[3].

Similarly in Australia, the AGL closure plan for Liddell demonstrates that it is cheaper to invest in 1600MW of renewables and 250MW of battery energy storage in addition to new gas peaking generation and demand response, than it is to extend the operating life of the Liddell coal fired power station.[4]

Achieving the appropriate energy generation mix that maintains reliability and security, while reducing emissions is also dependent on appropriate market frameworks.

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[2] South Australian Government, "South Australia's Virtual Power Plant", http://ourenergyplan.sa.gov.au/virtual-power-plant

[3] Public Service Company of Colorado, "2016 Electric Resource Plan", https://www.documentcloud.org/documents/4340162-Xcel-Solicitation-Report.html and https://www.carbontracker.org/colorados-renewables-revolution/

[4] AGL, "NSW Generation Plan", https://www.agl.com.au/-/media/AGL/About-AGL/Documents/Media-Center/ASX-and-Media releases/2017/171209NSWGenerationPlanDecember2017.pdf?la=en&hash=529E1A89370A33DA8F378D761CEEF1D919C9C91D

Creating this optimal mix of generation in the market requires that all technologies enter on a level playing field and are appropriately rewarded for their performance and contribution to the energy market.

This will require addressing some of the existing market barriers currently faced by battery energy storage in participating in energy markets. The process of registering Hornsdale highlighted that the current market rules and standards prevent fast responding technologies capturing the full value they deliver to the market. Tesla estimates that the Hornsdale Power Reserve battery has delivered 30-40% of its services to frequency markets without being paid due to existing AEMO technical specifications being written based on fossil fuel generation assets.

The AEMC is managing some of these issues through work streams to improve energy market settings for new participants, and to create new system security revenue streams for fast response services that are not currently monetised (such as markets for fast frequency response (FFR) and inertia). The Energy Security Board should focus on the additionality that the NEG can contribute in respect of reliability – beyond these bodies of work. This will be particularly important in aligning the emissions reduction and reliability aspects of the program.

As a summary of Tesla's position on the role that the NEG should play in supporting Australia's emissions reduction is as follows:

- The NEG needs to make a significant contribution to Australia's economy wide 26 – 28% emissions reduction target. The electricity sector can deliver more than 26% emissions reduction and should aim to do so.
- Domestic and international offsets should not be considered. For every tonne of carbon per MWh that is offset, a MWh of investment in new low emissions and reliable energy will be lost.
- Achieving an appropriate mix of generation assets is dependent on removing existing market barriers for battery energy storage as a technology type.
- The NEG needs to compliment the current market reform work-streams currently being undertaken by the AEMC, and consider the unique opportunities that may be presented by linking reliability with emissions reduction.

Market benefits provided by battery energy storage

The Consultation Paper notes the purpose of the NEG is to create investment signals for new generation, storage or demand response to ensure that:

- there is a minimum amount of dispatchable energy available to meet consumer and system needs (reliability requirement); and
- the average emissions level of the electricity they sell to consumers supports Australia's international emission reduction commitments, as set by the Commonwealth Government (emissions requirement).

Tesla agrees that energy storage will play a significant role in both delivering the reliability aspect of the NEG and in supporting the reduction in Australia's electricity generation sector emissions. We believe

that as the penetration of both utility scale renewable projects and distributed solar PV continues to grow, battery storage will play an increasing role in providing critical system security and reliability services

As an asset class, battery energy storage is unique in that it can provide almost any grid service required other than providing a primary source of electricity. In front of the meter, energy storage can act like generation, providing firm capacity and energy on demand. Battery energy storage can also provide any ancillary services in the form of fast, well-shaped and coordinated synthetic inertia to improve power system frequency stability. In Australia this includes providing both regulation and contingency FCAS services, as well as System Restart Ancillary Services (SRAS) more commonly known as black-start. Battery energy storage can be integrated with existing and planned renewable energy capacity to manage variability on both a daily and seasonal basis – all of which can be forecast and scheduled in an orderly manner.

To manage demand and generation, energy storage can shift energy production from off-peak times to on peak times. This reduces costs to the consumer and enhances returns to existing investors, by increasing the capacity utilisation of existing infrastructure, such as by reducing the need for new peaking generation capacity or curtailment of wind and solar sources when supply exceeds demand. Energy storage can also act as transmission and distribution infrastructure, providing voltage support, reducing line losses and offsetting new investment in network infrastructure. Through sophisticated control systems the same storage assets can dynamically and rapidly adjust the service they provide depending on market requirements.

The Consultation Paper also notes that "the ability of non-synchronous forms of generation such as wind, battery storage and solar photovoltaic powered generators to provide [frequency control, inertia and voltage parameters] easily is still developing". With due respect to the Energy Security Board, Tesla believes that Hornsdale in South Australia has already demonstrated how effectively battery energy storage can provide these critical system security services.

In South Australia, Hornsdale represents up to 30% of the South Australian registered market share (max cap MW) across the different contingency and regulation FCAS markets[5]. As a single asset, this is a significant portion. Operating as both a scheduled generator and a market load, Hornsdale has been an active participant in regulation raise and lower FCAS markets, as well as providing contingency raise services.

Figure 1 below provides a one minute summary of the Hornsdale performance in responding to contingency FCAS events. As demonstrated, Hornsdale was able to shift from charging to discharging in response to a grid frequency deviation within seconds. The fast responding and controllable nature of battery energy storage means that as an asset class they can quickly respond to frequency deviations and provide ongoing continuous response to signals from the Australian Energy Market Operator (AEMO) to provide regulation FCAS.

[5] Based on AEMO current registration and exemption lists accessed 5 March 2018, at < https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Participant-information/Current-participants/Current-registration-and-exemption-lists>

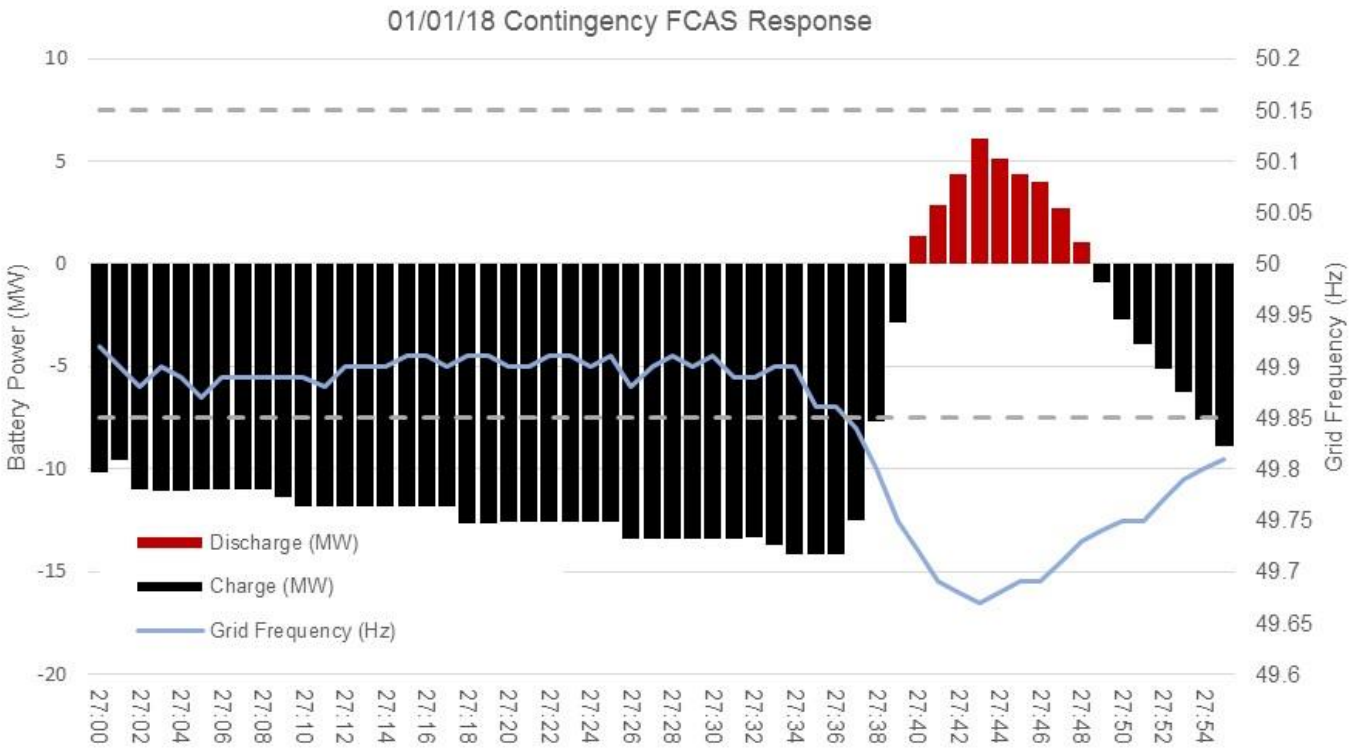

Figure 1: Hornsdale Power Reserve - response to contingency FCAS event

NEG framework considerations for battery energy storage

Battery energy storage assets are unique in that any asset over 5MW are currently required by AEMO to register as both a scheduled generator and a market customer (scheduled load)[6]. As a result, the policy settings on how battery energy storage is treated will require careful consideration and far more detail in the next release of NEG information.

Tesla would like to see the treatment of battery storage considered in appropriate detail from the beginning, rather than included at a later date. The NEG is in a unique position in that it will be adopted at a time when there are already battery assets registered in the energy market and a number of additional projects under development. As a result the NEG framework can take into account current market settings and issues surrounding battery storage as an asset class, rather than having to introduce sub-optimal settings at a later date.

The primary issues that we would like to see considered in far greater detail within NEG documentation are as follows:

- Exemptions for compliance liability for battery energy storage assets.
- Calculation of emissions intensity (tCO_2e/MWh) from battery energy storage discharge.
- Participation options and architecture for distributed energy resources.

[6] https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Participant-information/New-participants/Interim-arrangements-Utility-Scale-Battery-Technology

Battery energy storage should be exempt from NEG liability.

Under the proposed design of the NEG, liability falls on both retailers and registered market customers. According to the AEMO interim guidance[7] on battery energy storage all utility scale batteries over 5MW have to register with AEMO as a scheduled load. In effect the current arrangements would create a NEG compliance liability for all batteries over 5MW.

This raises issues for two reasons. Firstly because battery storage is treated as both a load and a scheduled generator, liability is created on both the battery charge and discharge. This double counts the energy (and resulting emissions) used to charge and discharge the battery. Under the current model, battery owners and operators will be liable for the energy consumed from purchased from the spot market to charge the battery. Retailers and off-takers will then be liable for the energy purchased back from the battery energy storage unit.

Secondly, the current treatment of batteries is unsettled. The AEMO advice is interim only and this position is subject to change over time. We want to avoid a situation where first mover projects for battery energy storage projects are unfairly disadvantaged with a NEG liability, while future battery energy storage projects may not be. We also want to avoid a situation where investment in battery storage is delayed whilst this market structure is being sorted.

Taking these points into account, the likely costs of compliance associated with managing the reporting obligations, in addition to the potential liability incurred where the emissions intensity of the battery MWh output surpasses the required emissions intensity (see point below) will severely limit battery uptake. Noting the important role that battery storage can play in delivering dispatchable capacity to the market, we assume this isn't what the NEG intends.

Tesla proposes that an exemption for battery energy storage from liability will likely manage the risks associated with this current market uncertainty, and ensure that renewable energy project developers aren't subject to adverse investment signals, when considering options for improving the dispatchability of wind or solar farms.

Battery energy storage emissions intensity calculation

Tesla would also like to mitigate any risks associated with calculating the emissions intensity from battery energy storage MWh output. As noted above, battery energy storage can provide almost all energy services with the key exception of generating electrons. As such, the emissions intensity factor applied to battery storage output will be linked to the primary generation source.

The current AEMO registration requirements for battery energy storage assets to register as a separate asset (scheduled generator) even when co-located with an existing wind or solar farm, means that most assets will charge from the grid. Tesla would like to see more thought given to how the emissions factor for the subsequent discharge of the battery will be calculated. We are concerned

[7] https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Participant-information/New-participants/Interim-arrangements-Utility-Scale-Battery-Technology

that the emissions factor for the MWh used to charge the battery asset has the potential to be the punitive, unhedged factor that will apply to spot market energy purchases.

It's also unclear whether the MWh discharged from the battery and either sold to an off-taker or dispatched back into the spot market will have the same punitive emissions factor attached.

As with NEG liability for battery assets, Tesla is concerned that if the tCO2e/MWh output from the battery discharge is deemed as having the same emissions factor as unhedged spot market MWh – this is likely to dissuade investment in batteries as a technology.

As a starting point, we believe the following treatment should be considered by the Energy Security Board in calculating a representative emissions intensity factor for battery storage output:

- If battery paired with a renewable generator then deemed emissions intensity should be zero – even if battery does at time charge from the grid. This position takes into account the changing market definitions of batteries which will allow more utility scale batteries to be installed "behind the meter", while not disadvantaging first-mover projects registered under the interim guidance.
- If a battery is not paired with a renewable generator then deemed intensity should be lower that the unhedged spot market emissions intensity of the particular NEM region – the logic being the battery will charge when the wholesale spot market prices are low and this can be shown to be when wind generation is high and load low. Tesla would be happy to provide further evidence to support this position and assist the Energy Security Board in making an informed assessment on what an appropriate deemed factor should look like.

Participation options for distributed energy resources

As a final point, we believe it is vital that the NEG framework includes appropriate participation pathways for distributed energy resources to support the reliability component of the policy.

Tesla supports an approach that will open up new opportunities for aggregated distributed energy resource (DER) asset bases to participate in the wholesale energy, and FCAS markets, as well as providing demand response services.

Bloomberg New Energy Finance (BNEF) projects over 3GW of cumulative installed residential BESS capacity by 2030[8]. As with utility scale BESS assets, this represents an asset base of fully controllable generation and customer load that can provide critical reliability in a changing market.

As with utility scale battery energy storage, Tesla would like to see increased clarity on how this behind the meter capacity can participate under the NEG framework. The commercial arrangements and opportunities for virtual power plants differ from the contracting types that have been outlined in the Consultation Paper.

We support an approach that both allows retailers to offset their NEG liability through smarter use of behind the meter, distributed generation assets – as well as providing clear pathways for aggregators to participate under the NEG framework. This will provide improved investment clarity for behind the

[8] *Bloomberg New Energy Finance, "Energy Storage Forecast, 2017-30", November 2017*

meter generation as well as creating efficient, and cost-effective market outcomes for the replacement of closing coal infrastructure.

Tesla looks forward to further information that considers these elements in more detail. We are happy to provide any more information to the Energy Security Board on any of the points raised.

Should you have any questions on any of the content included in this submission, please contact Emma Fagan at efagan@tesla.com.

Kind regards

Mark Twidell

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