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ARENA

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ARENA submission to the Integrating Energy Storage Into the NEM Rule Change process

This submission provides information and insight from projects funded by the Australian Renewable Energy Agency (ARENA) as relevant to the AEMC's Integrating Energy Storage Into the NEM Rule Change Consultation Paper.

In particular, ARENA's large-scale battery portfolio projects have experienced a number of issues raised by AEMO in their rule change proposal. ARENA has supported the development of 160 MW of large-scale battery projects to date with significant further capacity subject to future funding consideration. These projects have demonstrated a range of technology and commercial approaches that can support the transition to higher shares of renewable energy.

In summary -

- ARENA supports the development of a bidirectional trading category for batteries and hybrid systems that can reduce complexity for market participants and support the scale-up of flexible capacity in the NEM over the coming decades. We also support the AEMC's consideration of how this could be implemented as a step towards a more flexible two-sided market that is structured around the transaction of required services rather than current technology categories that may become outmoded in the future.
- Inconsistencies in DUOS and TUOS charging regimes can significantly distort battery investment decisions resulting in higher costs for project developers and ultimately, energy consumers. This appears to be principally an issue related to the economic regulation of networks, rather than the market registration categories that are the main focus of the current rule change. However, it is important that these issues are addressed in a timely manner.
- The Small Generation Aggregator Category could play a much more significant role in the future by allowing flexible resources, such EV smart chargers, to access wholesale market value. It is appropriate that a level playing field is provided for all generation and

load in terms of market and network cost recovery, scheduling and access to market revenue sources such as FCAS, which SGAs are currently excluded from.

Attachment A provides more information in the AEMC's stakeholder feedback template.

About ARENA

The Australian Renewable Energy Agency (ARENA) was established in 2012 by the Australian Government. ARENA's function and objectives are set out in the *Australian Renewable Energy Agency Act 2011.*

ARENA provides financial assistance to support innovation and the commercialisation of renewable energy and enabling technologies by helping to overcome technical and commercial barriers. A key part of ARENA's role is to collect, store and disseminate knowledge gained from the projects and activities it supports for use by the wider industry and Australia's energy market institutions.

Please contact Jon Sibley, Principal Policy Advisor (jon.sibley@arena.gov.au) if you would like to discuss any aspect of ARENA's submission.

Yours sincerely

Darren Miller

Chief Executive Officer, ARENA

Attachment A - Integrating storage – consultation paper: stakeholder feedback template

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Questions		Feedback
Chapter 1 – Introduction		
Question 1: Proposed assessment framework (p. 5)		
1	Do you agree with the proposed assessment framework or are there any additional assessment criteria the Commission should use when assessing identified issues and possible solutions?	The assessment framework should consider whether the changes promote technology and commercial flexibility and innovation in behind-the-meter arrangements over time. This is distinct from, but related to, the 'promoting competition' and 'minimising administrative and regulatory burden' considerations.
Chapter 2 – The threshold question: should storage be defined in the NER?		
Question 2: Current issues caused by the treatment of storage (and hybrids) under the NER (p. 14)		
1	Do you agree with AEMO that there are currently significant issues for storage units and hybrid facilities being caused by the rules not including a storage definition? Why, or why not?	ARENA's large-scale battery projects demonstrate a number of the issues highlighted in the paper. In particular, having to separately register as a Market Generator and a Market Load adds complexity to the project registration, bidding and settlement processes. ARENA notes that while the inconsistent application of DUOS and TUOS charges to storage and hybrid facilities is significant, it does not appear to be directly relevant to the issue of market registration categories. This is discussed further below.
Question 3: Implications for storage forecasts (p. 21)		
1	Do you agree that storage and hybrid facilities are likely to play a significant role in the future market? If so, do you agree that this indicates	The transition to variable renewable energy (VRE) sources such as solar and wind is associated with increased wholesale market volatility and greater incentives for load flexibility, especially at the commercial and industrial (C&I) scale. Overtime, this will drive

	that the issues AEMO has identified in its rule change request, arising from the current treatment of storage under the NER, are likely to become worse over time? Why, or why not?	customers to more active demand side management. Various studies also point to behind-the-meter (BTM) C&I solar as being one of the largest sources of new solar generation investment.[1] A single connection point could have: ▪ A grid-scale battery, ▪ A VRE generator, ▪ A flexible load, ▪ A variable load, or ▪ Any combination of the above. Any given connection point could therefore have both 'variable' and 'dispatchable' load and generation characteristics. It is important that market frameworks cater for various BTM configurations as they evolve over time whilst also enabling networks and AEMO to anticipate conditions and maintain the security of the system.
Question 4: AEMO's rationale for defining storage and hybrids in the NER (p. 25)		
2	Bearing in mind that the two-sided market reforms (as discussed in section 2.2.4) propose to move towards service-based requirements (rather than technology-based requirements), are there differences in the nature of the services provided by or to storage facilities that require these services to be distinguished from generation and load?	No. Different BTM technology configurations (as described above) will have different characteristics and strengths and limitations with regard to providing various essential system services. In all cases however, these differences need to be understood in the context of rapid innovation occurring in storage, industrial load and inverter controls. Even in the case of emerging services such as FFR and inertia, ARENA does not consider there to be any fundamental technological barriers to provision by, say, a hybrid solar plant and flexible industrial load. These facilities may also be able to transition linearly between production to consumption (for example by ramping down solar while maintaining a fixed load). It is beneficial for market frameworks to include participation in the services markets in a technological neutral way. This will support increased competition as different approaches achieve technology and commercial readiness.
Question 6: Alternative to AEMO's proposed solution to integration issues for storage (p. 29)		

[1] BNEF, Australia Behind-the-Meter PV & Storage Forecast, May 2018

1	In light of the alignment issues between AEMO's rule change request and the direction the ESB's two-sided market reforms are taking, which of the following approaches do you support and why? a. Waiting for the implementation of the two-sided market reforms to address the integration issues facing storage and hybrid facilities b. Introducing AEMO's rule change proposal as an interim step prior to the implementation of the two-sided market reforms c. Implementing certain aspects of the two-sided market reforms through this rule change project, such as combining the different types of market participants and imposing obligations based on services rather than assets d. Taking an alternative approach - please specify.	ARENA sees an opportunity for Option C, noting that storage is likely to be a first use-case of any new bidirectional registration category and that specific requirements relevant to storage could be set out in performance standards set in relation to the services being provided (energy, inertia, FCAS etc.).
Chapter 3 – Registration issues for storage units and hybrid facilities		
Question 7: Understanding the interest in registering hybrid facilities and the challenges that exist (p. 35)		

1	Why would you consider aggregating different technologies together in a hybrid facility? Which technologies do new participants propose to combine in hybrid facilities?	Solar and storage is likely to become more integral in BTM energy management as costs come down and they become more capable in a greater range of applications. This will be shaped by medium term market dynamics as they evolve over time. Some novel use cases may include: • Large-scale H_2 electrolysis (load) with integrated VRE and reverse electrolysis/H_2 gas turbine (generation), • Large-scale solar with integrated flexible (price responsive) industrial load,[2] or • Aggregated GW-scale BTM EV charging/V2G capacity.[3] Each of these configurations could provide services in energy and system services markets bidirectionally across generation and load.
3	Would you prefer to balance output and consumption across multiple connection points or combine technologies behind an individual connection point?	This ARENA-supported Gannawarra hybrid solar and storage project has illustrated the benefits and constraints on proponents being able to flexibility configure and and co-optimise BTM resources. For example, on 1 March 2019 around 10 MW of battery capacity could have been dispatched at the Maximum Pricing Cap, but battery output was inadvertently restricted due to inaccurate forecasting of the solar farm. This came at an opportunity cost of ~$150,000 of lost revenues on this particular day. These issues can be reduced with the introduction of more sophisticated self-forecasting[4] as well as being able to be able to co-optimise various BTM resources flexibly within a grid or connection constraint.
Question 8: Registration process issues (p. 36)		
3	Do you consider that the NER should set out how participants with storage units and hybrid facilities should register and participate in the market, rather than AEMO guides? Or have AEMO's guides and fact sheets now solved the identified registration issues for storage and hybrid facilities?	As described above, there could be significant advantages in market registration categories being technology-neutral with performance requirements being established in relation to the market service being provided (e.g. energy, FCAS, operating reserves).

[2] For example: https://reneweconomy.com.au/sun-metals-eyes-wind-battery-storage-in-shift-to-most-competitive-electricity-78337/
[3] We understand current arrangements allow SGAs to settle generation and load in the spot market without being scheduled. However AEMO does not allow SGAs to provide market ancillary services.
[4] https://arena.gov.au/assets/2020/09/gannawarra-battery-energy-storage-system-operational-report.pdf

Question 9: Issues with small storage units (p. 38)		
1	Do you agree that there is not sufficient clarity regarding whether SGAs and other market participants, can include small storage units in their portfolios?	To the extent that there is a lack of clarity in the Rules, it is preferable that this be addressed without prescribing the types of technology that may be included behind the meter, or require approval by AEMO to changes in technology configuration. In the case of EV charge points participating through an SGA, technologies may include EVs that are not fixed to a connection point (and that have their own performance characteristics) and the SGA participant may find it convenient to connect various small-scale generation or load over time. Such changes should not require central approval. To ensure a level playing field, it is appropriate that SGAs be subject to forecasting and scheduling requirements and thresholds equivalent to other market participants. In this case, the threshold should be set with regard to the full range of aggregated generation and load variability (max aggregate generation and max aggregate load). Ideally, maximum generation and load should reflect the risk of coincident operation rather than being set arbitrarily such as in relation to nameplate capacity.
Question 11: Registering pumped hydro facilities (p. 44)		
2	Is a storage unit's ability to ramp linearly from production to consumption the best way to determine whether it should classify as a bi-directional unit, or classify as a scheduled generating unit and scheduled load?	ARENA understands that constraints on a unit's ability to ramp (including between production and consumption) would be apparent in its bids. It is not clear in the proposal why this constraint also needs to be considered with regard to setting categories of registration. Where possible, it is preferable to avoid assumptions about future technology development such as improvements in ramping capability. As mentioned above, storage is not the only class of asset that can theoretically ramp in this way.
Question 13: AEMO's solution to clarify what small units SGAs can aggregate (p. 45)		
1	Do you agree with AEMO's proposal to clarify how an SGA can include storage units in its portfolio?	A bi-directional unit could be an appropriate technology unit classification assuming there is no prescription as to the internal configuration of a unit. For example, the operator of a unit should be free to add generation and load to the unit without being subject to approval by AEMO. In this case the market aggregator would assumedly be responsible for notifying AEMO of changes to its aggregate power transfer capacity.

2	Does AEMO's solution provide flexibility for an SGA to include DER, other than storage, that may have bi-directional energy flows?	The above flexibility should be provided for by the Rules to ensure it flows through to any subordinate requirements.
Question 14: Adding further registered participant categories (p. 47)		
1	Is there a strong case to add a participant category for storage or are there other alternative solutions that could help to reduce complexity?	The introduction of a more flexible a bi-directional aggregator category will provide more options to participate in the energy system and should enhance competition in service delivery. If wide-spread adoption were to occur, careful consideration needs to be paid to appropriate consumer protections. For example an aggregator could seek to progressively roll more flexible generation and load onto its metered circuit (e.g. solar, batteries, EVs, hot water and air conditioning). The only real differences between the aggregator and a conventional retail would stem from triggering Retail Law requirements. It is therefore also useful to think of retail vs non-retail aggregators and what issues and potential distortions flow from that classification scheme.
Chapter 4 – Technical and operational challenges relating to utility scale storage and hybrid facilities		
Question 19: Forecasting and energy availability (p. 60)		
2	Could this problem be addressed by requiring storage facilities to provide additional information on energy limits in their bids, as proposed by AEMO?	Yes. This information should also be made available by all market participants. This could occur via bids or via direct SCADA feed. The future grid will have much higher penetrations on VRE and energy storage. This will both diminish the accuracy of forecasts and increase the value in monitoring and responding to pre-dispatch information. ARENA projects[5] are demonstrating a range of innovations in forecasting generation and load ahead (e,g, 24 hours, 6 hours, 1 hour) and in real time including new sensing technologies and machine learning. New approaches will be more effective if they are able to make use of quality static and dynamic information regarding the power transfer capabilities of market participants including their energy limitations.

[5] For example, Solcast is trialing new approaches to anticipate the evolution of weather systems over SA to provide more accurate information for grid operation and enhanced management of generation, energy storage, and demand response. https://arena.gov.au/projects/gridded-renewables-nowcasting-demonstration-over-south-australia/

Question 20: Performance standards (p. 62)		
1	Are the current rules unclear on how performance standards should apply in facilities with a mix of asset types? Do the current rules create barriers for storage hybrid facilities? To maintain power system security, should AEMO have greater visibility of the assets behind a connection point?	It is essential that the framework for performance standards are scalable in relation to the energy transition underway. For example, it is possible that, in the longer term, a majority of connection points in the NEM will come to have bidirectional flows, with a mix of variable and flexible power transfer capabilities. For medium and large C&I loads this may include a combination of scheduled demand response, batteries and solar. At the residential scale, this may include electric vehicle charging capacity through an SGA participating in the market (potentially with scheduling obligations). It does not appear feasible to classify and maintain central oversight over the myriad of BTM configurations that might arise over hundreds of thousands of connection points. As much as possible, it appears preferable to address performance requirements through generic appliance and equipment standards (e.g. grid connected inverters or demand response controllers).
Chapter 5 – Issues with fees and charges		
Question 21: Issues with how fees and charges, and non-energy costs are recovered (p. 69)		
4	Are there any other issues that the Commission should consider with respect to fees and charges, and non-energy cost recovery?	Efficient outcomes will be enhanced where all generation and load are treated equitably for the purposes for cost recovery. This should include consideration of cost-reflective pricing that reflects the market benefits in loads being scheduled (e.g. large-scale battery charging) versus loads that can be unscheduled (e.g. retail or generator auxiliary loads).
Question 22: Solutions for issues with fees and charged and non-energy cost recovery (p. 71)		
1	Do stakeholders agree with AEMO's proposed solution that MSGA and the proposed bi-directional resource provider participant categories should pay non-energy cost recovery and NEM Participant fees and charges based on consumed and sent out energy separately (as is the current practice for a grid-scale battery registered as both a Market Generator and Market Customer)?	SGAs are principally in competition with electricity retailers (for customers) and consideration should also be given to the equity of cost recovery arrangements between these two categories.

Question 23: Alternative solutions for issues with fees and charges and non-energy costs recovery (p. 73)		
1	Do you consider it appropriate to recover non-energy costs from Market Customers and Market Generators in the same way AEMO recovers costs form grid-scale batteries? That is, should participant fees, charges and non-energy costs for Market Generators and Market Customers be calculated on energy consumed and energy sent out separately, not on netted energy as is the current practice?	Efficient charges raise revenue without encumbering trade. They can also be used to price in externalities and for cost recovery for specific service obtained from the system. As a general rule, encumbrances would appear to be reduced where costs associated with the general operation or fixed costs of the system are recovered from market customers (as customers will face these charges anyway). In principle, charges to generators would be limited to specific service fees for service (e.g. connection) or on a causer pays basis so as to not distort investment or inhibit value-creating trade.
Question 24: Issues with TUOS and DUOS charging arrangements (p. 76)		
1	Do you agree that there is ambiguity and uncertainty around how transmission and distribution network businesses calculate and charge TUOS and DUOS for battery systems?	Perhaps not ambiguity, but there are indications that current arrangements for the application of DUoS does shape battery investment decisions. For example, The ARENA-supported Gannawarra project has constructed a private network that allows the 25MW battery and 50MW solar farm to connect at a single connection point. Physically the private network is seen by the grid as a single entity with bidirectional flows and DUoS is charged on a net basis. However, it is unable to trade on a net basis. The battery must participate in the market as either a generation or a load, and the battery and the solar farm must be settled separately. This creates complexity for optimising the performance of each asset when considering they are all bound by a common 50MW constraint as point of connection.[6]
Question 25: Solutions for clarifying the application of TUOS and DUOS charging (p. 79)		
1	Do you agree with AEMO's proposal to exempt all energy storage systems from TUOS charges? If you agree with an exemption, should the exemption of TUOS charges also apply to energy used on site (auxiliary load) i.e. energy that is not stored and sent out into the network?	Separate to the scope of the current rule change, ARENA has observed issues with the network cost recovery regime which create a material and inefficient barriers to mid-scale battery deployment. For example we have observed a number of instances where batteries choose to connect to the transmission network, at a materially higher cost and with lesser potential for value creation, rather than face DUOS charges that would be crippling to their business case. This is despite the willingness of the proponents to operate within a defined operating envelope to ensure their operation is not detrimental

[6] https://arena.gov.au/assets/2020/09/gannawarra-battery-energy-storage-system-operational-report.pdf

		to, or impose costs for, the distribution network. This appears to be the result of inconsistencies in the cost recovery approach between distribution and transmission and weak incentives for distribution networks to encourage third party storage projects on their network. Overall, there appears to be a prima facie case for greater consistency in charging regimes across network boundaries.
2	If battery systems are exempt from TUOS charges does this: a. create a subsidy for battery technology and therefore an advantage over other generation technologies? b. remove the ability to provide an efficient location and/or price signal to potential battery system proponents, and therefore impact on the efficient entry and location of new battery system participants?	Inconsistent application of costs across different levels of the network inherently distorts investment as is observed currently.
3	If battery systems are not exempt from TUOS charging does this: a. create double charging of TUOS /DUOS for end use customers? b. distort investment signals and not align with the need for significantly more storage investment across the NEM?	Our understanding is that, to the extent that there is 'double charging', that would apply equally whether the battery was connected at the transmission or distribution level. Observations from ARENA's battery projects and forward pipeline suggested that efficient investment decisions will be supported when DUOS and TUOS are based on cost-reflective pricing principles, regardless of the level of the system at which an asset connects.
4	How should TUOS and DUOS charges apply to hybrid facilities? Should TUOS and DUOS charges be based on metered data at the network connection point, or another option? Are there technical or implementation issues with this?	Efficient investment and operational decisions will be supported by allowing BTM assets to be operated in a way that enhances the utilisation of their connection to the grid. This requires either net metering or, virtual net metering where assets are located closeby on a network. This would allow, for example, a community battery to charge from nearby solar customers.
5	Do you agree that battery systems should pay DUOS charges for consumed energy? Please explain why or why not.	As suggested above, network cost recovery should be cost reflective. This may result in batteries paying substantially less where they are bound by dynamic operating envelopes that reflect local network constraints.

Chapter 6 – Storage and hybrid integration drafting and other issues		
Question 34: RRO – storage contribution to reliability issues (p. 101)		
1	What are your views on the issues which relate to whether or not storage contributes to reliability issues?	Energy storage can either contribute to reliability or reliability shortfalls depending on its operational incentives. For example, BTM storage operating on a simple self-consumption or retail price arbitrage algorithm will generally mitigate evening peak demand events thereby improving reliability outcomes. However, this mode of operation will be insensitive to sudden LOR conditions that may be associated with a weather change or loss of generation elsewhere in the system. For example, it has been reported that non-VPP batteries contributed net load during the LOR3 (load shedding) event of 25 January 2019.[7] It is almost certain that the value of the lost load was greater than the value obtained from charging those batteries.

[7] Page 144, https://arena.gov.au/assets/2019/04/virtual-power-plant-knowledge-sharing-workshop-summary.pdf