Australian Government
Australian Renewable Energy Agency

ARENA

21 December 2018

Australian Energy Market Commission
PO Box A2449
Sydney South NSW 1235

Via https://www.aemc.gov.au/contact-us/lodge-submission

GPO Box 643
Canberra ACT 2601
Tel: +61 2 9243 7773
ABN: 35 931 927 899
www.arena.gov.au

Submission in response to the AEMC's Wholesale Demand Response Mechanisms Consultation Paper

About ARENA

The Australian Renewable Energy Agency (ARENA) was established to make renewable energy solutions more affordable and to increase the supply of renewable energy in Australia.

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.

Summary

This submission provides background information on projects funded by ARENA as relevant to the AEMC's Wholesale Demand Response Mechanisms Consultation Paper.

In summary:

- ARENA considers that demand response has an increasingly important role in wholesale energy markets as we transition to higher penetrations of low-cost variable renewable energy (VRE) generation. It is important that consideration of the resilience of potential market mechanisms, and the business case for alternative approaches, factor in benefits that might arise in the transition to renewables.
- The joint ARENA-AEMO RERT trial has demonstrated the potential for demand response to be a reliable source of capacity in wholesale markets under certain circumstances, and particularly in relation to customer loads that are consistent or otherwise predictable.
- Baselines are an area of significant complexity, especially where loads are subject to sources of inconsistent variability such as behind-the-meter generation or

inconsistent usage patterns. ARENA and AEMO have commissioned analysis that will inform the future development of baselines methods to enhance accuracy, and address variability in outcomes. This will be released early in 2019.

Further detail is provided in **Attachment A - AEMC feedback template** and **Attachment B Summary of RERT trial outcomes to date**.

ARENA is able to support the development of markets for wholesale demand response through further targeted trials and studies. We are happy to provide a briefing on the outcomes of the RERT Trial to date.

Please don't hesitate to contact ARENA (jon.sibley@arena.gov.au, 0400 031 596) if you would like to discuss any aspect of our submission.

Yours sincerely

Darren Miller

Chief Executive Officer

Attachment A - ARENA responses to selected items set out in the stakeholder feedback template

Questions		Feedback
Chapter 4 – Assessment framework		
Question 1: Assessment framework		
A)	Do stakeholders agree with the proposed assessment framework? Alternatively, are there additional principles that should be taken into account?	ARENA supports the proposed assessment framework. ARENA notes that the market value of wholesale demand response is largely a function of market volatility. In considering the resilience of, and business case for, current or potential future market frameworks, it is therefore important to consider a scenario where significantly higher penetrations of near-zero marginal cost variable renewable energy sources may create market opportunities for demand response beyond current levels, and how value for DR can best enable a lowest cost generation mix. Spillover benefits in terms of avoided network expenditure should also be considered.
Chapter 5 – Issues for consultation		
Question 2: Nature of the issue raised		
A)	Is it difficult for consumers to participate in wholesale demand response? If so, which consumers face the greatest amount of difficulty? What is the cause of this difficulty?	Spot pass-through products for residential and commercial consumers are in their infancy and as such it is not generally possible for these segments to achieve wholesale market value from demand response. The RERT scheme has identified the potential for these segments to respond to retailer incentives in the context of emergency reserve activation, although challenges exist with recruitment, measuring demand response and settlement. These issues are discussed further in Attachment B.
B)	What demand response providers and products are currently available in the market?	Refer to Attachment B which includes a summary of providers in the ARENA-AEMO RERT Trial.
Question 4: Approach for facilitating transparent, price responsive demand		
A)	Do stakeholders consider there are other regulatory solutions to: (a) providing the demand side with greater access to wholesale prices, and (b) increase the transparency of demand side response to these prices?	Any demand response mechanism will only support greater demand side visibility to the extent that resources are registered under that mechanism. ARENA's experience is the majority of value that can be obtained from BTM resources is associated with solar exports and self-consumption of solar at peak times, including that aided by load shifting (including batteries). Therefore complementary mechanisms may be required to provide adequate load forecasting as the rate of DER increases. ARENA notes that the Reliability Frameworks Review set out an option for customers or aggregators to unbundle and take responsibility for flexible resources, such as a solar-battery system, which may able to be managed in the market without having to be intermediated by their existing FRMP. ARENA considers this approach has some merit in terms of promoting customer choice and retail competition, and provide greater

		visibility to AEMO, while avoiding the issues associated with accurately baselining residential loads. Such an approach need not be viewed as being opposed to current retail models.
Question 5: Efficient consumption of electricity		
A)	Do stakeholders agree with our characterisation of how efficient wholesale demand response would improve outcomes in the wholesale market?	ARENA considers that the benefit of wholesale demand response includes greater demand side flexibility to enable higher penetrations of lowest-cost variable renewable energy resources (particularly wind and solar). ARENA expects that this value of demand response will increase over time and will be realised by market participants and end-customers through a lower cost generation mix.
Question 6: Competition for wholesale demand response services		
A)	Are consumers able to access competitive offers from retailers or third parties to assist consumers to undertake wholesale demand response? Is the level of competition greater for larger consumers?	ARENA is observing increasing innovation in electricity retail products, and complementary service providers, which utilise greater demand side participation to manage retailer wholesale market risk (for example Reposit Power, Amber Electric, Flow Power etc.). However consumer decisions involve complex trade-offs between factors such as perceived and actual price, simplicity and social/environmental values. Generally speaking, major retailers are not offering demand response products to small customers outside of the scope of limited trials. ARENA considers that the prevalence of demand response products may be influenced by relatively flat current wholesale market conditions, compared to what may arise in the future, which weaken the economic opportunity for demand response. As well as addressing current limitations in the opportunities for demand-side resources, ARENA trials are focussed on enabling demand response in a future state (high VRE) electricity grid where wholesale volatility may be higher and demand response may have a greater economic role.
Question 7: Demand response participating as a scheduled load		
E)	How should compliance with dispatch targets and the causer pays procedure apply to demand response providers?	Across the electricity sector there is a growing appreciation of the equivalences between demand side and supply side energy services and consideration of a more symmetrical system of incentives and obligations. Supporting this, demand response is playing an increasing role in frequency control and under the Reliability and Emergency Reserve Trader mechanism. Demand response is also increasingly being considered a tradable hedge commodity for electricity retailers and was specifically provided for as an eligible hedge product under the reliability obligation mechanism under the National Energy Guarantee. ARENA considers the long-term theoretical conclusion to a technology neutral, performance-based approach to market participation may be a simplified market designed around a single category of participant, that self-forecasts, bids and is scheduled variably in positive or negative amounts. This could be supported by performance-based, decentralised approaches to managing for system security such as the deviation pricing approach described in Appendix A to AEMC's Frequency Control Frameworks Review Final Report[1]. Such approaches could reduce the costs of

[1] https://www.aemc.gov.au/sites/default/files/2018-07/Final%20report.pdf

		achieving system security in a future electricity grid characterised by high penetrations of low-cost variable renewable energy generation, energy storage and a more dynamic demand side. It would also mean a move away from a 'regulatory compliance' approach to an 'incentive' approach to encourage tracking to dispatch targets. This is more likely to elicit efficient behaviour from relatively flexible supply sources and demand side participants. We note the potential for the current joint ARENA-AEMO short term forecasting and RERT trials to continue developing knowledge and experience that would inform practical viability of this type of approach.
Question 12: Risk allocation for baselines		
A)	Do stakeholders have views on how risks and costs can be best allocated under a baseline used for demand response?	Attachment B to this submission sets out information regarding baseline accuracy, bias and variability based on the ARENA-AEMO RERT Trial.
Question 14: Embedded generation and storage		
A)	Do stakeholders have preliminary views about the ability for the proposed mechanisms to accommodate embedded generation, in the form of reduced consumption of electricity from the grid in high price periods?	Attachment B to this submission sets out preliminary analysis regarding the impact of transient loads (such as BTM solar) on baseline accuracy.
B)	Do stakeholders have preliminary views about the ability for the proposed mechanisms to accommodate, as demand response, increased consumption during low price periods (whether due to charging batteries, increasing production or any other action by the customer)?	ARENA notes that a lowest cost electricity supply system will seek to more fully utilise periods of high VRE exports by shifting loads to those times. ARENA will soon announce a series of trials and studies exploring how network hosting capacity can be optimised to facilitate increased availability of VRE at the distribution network level which will, in turn, facilitate optimal participation of DER in wholesale markets.
Appendix A – Wholesale demand response mechanism		
Question 17: Centrally determined baselines		
A)	How important is it to design against the possibility for bias and gaming?	ARENA consider the integrity of DR is critical and provides further information on baseline approaches under the RERT trial at Attachment B.
Question 18: Accuracy of baselines		
B)	What administrative mechanisms would improve baseline accuracy without imposing excessive burdens? For example, regular review of baseline methodologies by independent experts, or cross-checking against consumption data from customers that are similar to the demand response provider but are not engaging in demand response.	See Attachment B.
C)	Can a baseline accurately account for embedded generation and other dynamic	See Attachment B.

	resources that might exist behind the meter?	
D)	Should a wholesale demand response mechanism apply only to the types of customers for which baselines can be accurately set, and if so, what types of customers should be eligible?	See Attachment B.

Attachment B - Update on period 2 testing from the ARENA-AEMO demand response (RERT) trial

This section seeks to update the AEMC on recruitment and testing outcomes under the ARENA-AEMO demand response (RERT) trial. An analysis of the test results, including an international comparison of baselining approaches, is currently being prepared and ARENA intends to publish more details on the matters raised below in the coming months.

Background to the RERT Trial

In May 2017, ARENA and AEMO partnered to trial demand response services using the Short Notice Reliability and Emergency Reserve Trader (RERT) arrangements. A competitive process was conducted and successful demand response (DR) service providers received an ARENA capital-funding grant in the form of availability payments over three years. Providers then join AEMO's Short Notice RERT Panel and are available for SN RERT if requested. Providers will also receive usage payments of up to $1000/MWh, if activated.

ARENA has provided, over a period of three years, up to $22.5 million of funding for non-NSW projects and ARENA together with the NSW government (on 50-50 basis) have provided up to $15 million of funding for NSW projects.

The ARENA-AEMO demand response trial will provide 143 MW in year 1,189 MW in year 2, and 200 MW in year 3, across NSW, Victoria and SA. This capacity complemented 741 MW of industrial demand response contracted by AEMO under the former Long Notice RERT arrangements for summer 2017/18 and forms part of the intended total of 800 MW contracted for summer 2018/19.[2]

The RERT trial is generating learnings about DR customer recruitment and performance across residential, commercial and industrial loads, which are relevant to wholesale demand response. The information provided below provides an update to the outcomes of the procurement process and Period 1 test reporting set out in ARENA and AEMO's joint submission to the Reliability Frameworks Review.[3][4]

[2] https://www.aemo.com.au/[...]/AEMO-2018-19-Summer-Readiness-Plan.pdf
[3] https://www.aemc.gov.au/sites/default/files/2018-05/ARENA-AEMO%20joint%20submission.pdf
[4] Oakley Greenwood has been appointed as a Knowledge Sharing Partner for the RERT trial and is currently completing a more comprehensive assessment of test outcomes and baseline performance. Results have been drawn from draft material produced by Oakley Greenwood which will be finalised with a view to publication in early 2019.

Summary of demand response providers under the RERT Trial

The RERT trial includes 8 providers, through 10 projects, utilising a range of approaches across different customer segments:

Table 1: Summary of RERT trial demand response products, contracted in Year 1 and/or 2

Recipient	State	Portfolio	Approach	10/60 min
AGL	NSW	Residential Commercial Industrial	● Behavioural demand response driven through SMS alert campaigns ● Direct load control of air conditioners and EV home chargers ● DR software and hardware being implemented for monitoring and load automation.	60
Powershop	Victoria	Residential Commercial Industrial	● Behavioural demand response - primarily through the use of their smartphone app ● Supported by Reposit Power enabled batteries and firm capacity being provided through Monash University's cogeneration facility	60
Energy Australia	NSW Victoria South Australia	Residential Commercial Industrial	● Behavioural demand response driven through SMS alert campaigns ● Direct load control and battery storage group control ● Biofuel conversions and on-site generation	10
Flow Power	NSW	Commercial Industrial	● Locally installed kWatch Intelligent Controller device integrated to onsite equipment and allows user control to reduce demand	10
Zen Ecosystems	Victoria South Australia	Residential Commercial Industrial	● Direct load control through automated smart Zen Thermostats ● Behavioral demand response trialled in year 1	60
EnerNOC (now EnelX)	NSW Victoria	Commercial Industrial	● Automated and direct load control through smart metering technology allowing both users, and in some cases, EnerNOC, to curtail	10
United Energy	Victoria	Residential Commercial Industrial	● Voltage reduction through control devices installed at substations	10
Intercast & Forge	Victoria South Australia	Industrial	● Direct load curtailment on-site	10

Recruitment outcomes

Demand response providers participating in the RERT trial have recruited customers across residential, commercial and industrial customer segments to meet contracted targets which are expressed in MW capacity. Table 1 shows that overall recruitment levels in year 1 have exceeded targets taking account of all customer segments. This is consistent with conventional industry strategies to ensure targets are exceeded to provide a buffer against potential underperformance.

Table 1: DR capacity (MW) contracted and recruited in year 1 by customer segment

Market segment	Contracted (MW)	Recruited (MW)	%
Residential	18.4	14.4	78.3%
Commercial	33.6	43.8	130.3%
Industrial	91	105.4	115.9%
Total	143	163.7	114.5%

Recruitment levels in commercial and industrial segments are above target while residential levels are below target, impacted in part by short time frames provided for under the trial. Recruitment of residential customers varies between providers working in that segment, with two providers meeting or exceeding their targets. The novel nature of demand response products in the residential sector is considered a key challenge to recruitment as different providers trial alternative approaches to marketing their products. Recruitment numbers have grown strongly since year 1 with now over 23,000 residential customers enrolled in the program. This does not include the over 600,000 customers indirectly participating through the United Energy's project.

There have been no significant challenges in recruiting contracted levels of commercial and industrial (C&I) customers.

Performance from period 1 & 2 testing

Two testing periods have been completed to determine the extent that demand response providers can deliver contracted capacity. Results from both periods indicate that, overall, capacity delivered has exceeded contracted amounts on both test periods.

Table 2 shows that commercial and industrial customers overperformed while residential customers underperformed. Under performance among residential customers reflects a range of factors including some challenges in recruitment and with the performance of device controls and behavioural response. Performance in all segments is inherently influenced by potential baseline inaccuracy and bias. Analysis at this stage has not been able to unpick the relative contribution of these different factors. It is also important to note that test days have not always presented the same conditions as would be likely to occur during a RERT activation.

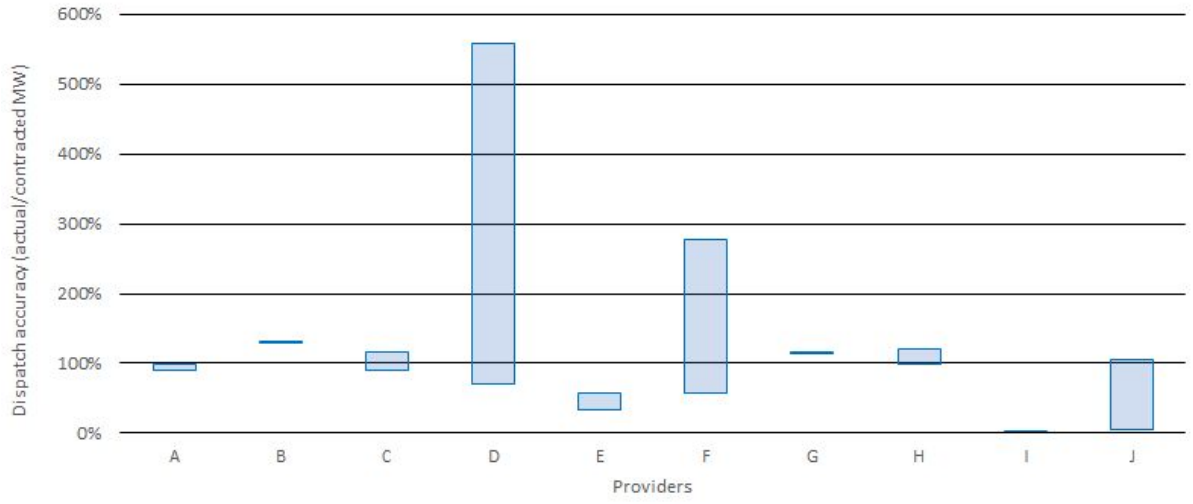
Table 2: Period 1 and 2 test results compared with contracted DR volumes

Customer segment	Contracted	Test results (MW)		% of contracted MW delivered	
		Period 1	Period 2	Period 1	Period 2
Residential	9.5	2.52	2.53	26.5%	26.6%
C&I	156.7	156.7	144.7	134.5%	124.2%
Total	126	159.2	147.2	126.4%	116.9%

Performance between individual demand response providers was highly varied in both test periods with some results either well below and well above contracted amounts (See Figure 1). For example, two tests resulted in demand response exceeding 200% of contracted capacity. Three providers were able to consistently deliver DR capacity within 25% of contracted amount.

To some extent these results reflect the early stage of the RERT trial and the innovative nature of some of the products being used. Performance is expected to be improved through future refinements, across recruitment, dispatch procedures and baseline determination. Results to date do however suggest that it may be harder for demand response to precisely meet dispatch targets compared to scheduled generators for each market segment.

Figure 1: Range of performances results for each provider (actual/contracted) between the two test periods



Baselines

Selected baseline methodology

The RERT trial uses a 10 in 10 approach (described below), which is similar to the method CAISO[5] used in 2013, as AEMO found that it provided the greatest accuracy and lowest bias of the various methods assessed in a study undertaken for them by DNV-KEMA.[6]

The key features of the AEMO 10 of 10 methodology are as follows:

- The method calculates a control baseline using up to 10 selected days selected from the baseline window. All 10 days are used, hence the term 10 of 10.

[5] The Californian Independent System Operator
[6] AEMO, DRM Detailed Design, 2013.

- Baseline window – The baseline window is the period of 45 days preceding the particular day on which demand response is activated.
- Qualifying days – Qualifying days include all days within the baseline window that are not weekends or public holidays, and that did not include a demand response event applicable to the facility / portfolio for which the baseline is being developed.
- Selected days – Selected days are the most recent qualifying days. A maximum of 10 and a minimum of 5 selected days are required for the calculation.
- Unadjusted baseline energy – This is the average energy consumption for each half hour of the demand response event during the selected days.
- Adjustment factor – Because energy consumption on the day on which demand response is activated can differ from the average day, an adjustment factor is applied. The adjustment factor is calculated as the the average of the difference in energy consumption between the demand response day and the selected days across the adjustment period. The adjustment factor can be positive or negative.
- Adjustment period - The period between four hours and one hour prior to the activation of the demand response.
- Adjusted baseline energy – The adjusted baseline energy is calculated by adding the adjustment factor to each trading interval of the unadjusted baseline.
- Delivered demand response – The delivered demand response is calculated as the difference in each trading interval between the adjusted baseline and the metered energy consumption of the facility/load providing the demand response.

Baseline accuracy

Baseline accuracy is the extent to which a baselining method returns the correct result. The AEMO 10 of 10 methodology is best suited to loads that remain relatively stable from day to day. This reflects the nature of loads that have traditionally participated in demand response programs in Australia and the US.

Even after the adjustment factor is applied, there is still an assumption that the shape of the load on the event day is close to average. Inconsistent energy usage patterns, which may be weather dependent, or changes in behind the meter generation can therefore be a source of baseline inaccuracy. While, as would be expected, the accuracy of baselines for stable industrial loads was generally higher than for residential and other loads that are weather sensitive, there was still significant variation of loads with customer portfolios and between different NEM regions. Further work is required to explain this result.

Changes in residential load shape appear to be highly susceptible to weather. For example, data under the RERT indicates that the first very hot day in a series can correspond to very high peak afternoon loads associated with the start-up load for air-conditioning. Once running however, air-conditioning can have a flatter load profile over subsequent days.

Behind-the-meter solar is another important variable. Residential and commercial customers are typically net metered meaning that it is not possible to separate variations in load associated with demand response from uncontrolled fluctuations on net demand driven by cloud cover. The presence of rooftop solar PV introduces a transient load variable that does not need to have a high penetration within a customer group to have a material impact on the accuracy of baseline development.

Further analysis is required to determine the impact of weather variables at the portfolio level and to determine whether solar production should be netted out to firm up participating loads and how to best deal with periods of net export. Similar issues apply to other intermittent loads, where load shape is inconsistent from day to day or between metering intervals.

An overall observation from analysis to date is that the current baseline methods are structured in a way that makes them potentially more applicable to use in the wholesale energy market than in emergency response, in that they measure the change in average demand over a trading interval rather than measure the response against 5-minute dispatch targets. This is essentially a calculation of reduced energy consumption. Increased deployment of smart metering and the move to a 5-minute settlement interval will enable the development of DR measurement approaches better suited to the RERT than the current methodologies.

Baseline bias

Bias represents a measure of the degree to which the approach tends to either over or under-estimate the amount of DR actually provided. Analysis to date has not revealed a significant systemic bias.

Baseline variability/precision

Providers contracted under the RERT trial are contracted to provide DR capacity at the NEM region level. This typically involves aggregating DR from a number of customers. Variability or precision is how reliable the result is with repeated tests or how variable baseline accuracy is within a group of customers. Analysis to date has revealed a very high level of variability within a number of Provider customer portfolios and across each customer segment. The further refinement of baseline methods can be expected to improve accuracy at the customer level and reduce variability across a customer portfolio.

Next steps

A key objective of the RERT trial is to test and improve baseline measurement methods to improve accuracy, bias and variability outcomes. This is intended to improve RERT efficiency and effectiveness while also informing the design of any future wholesale demand response mechanism.

Individual proponents have proposed improvements to baseline methods which are being considered alongside alternative international practice. Alternatives that are being explored by the proponents include machine learning applied at the NMI level to accurately predict individual demand response. The use of anchoring points, immediately before or after a DR events may also allow for baseline adjustments to better reflect the baseline load shape on an event day.

Early indications are that improvements can be achieved by adopted methods developed by proponents and by hybridising approaches used internationally. There are also indications that baseline approaches may have inherent limitations with individual and aggregated loads that are inconsistently variable, especially in the residential sector.

The results to date confirm that demand response can be a reliable resource where loads are flatter and more predictable; a characteristic of certain industrial and commercial loads participating in the RERT trial. ARENA and AEMO continue to explore how accurate measurement of demand response can best be provided for all customer segments.