

Mr John Pierce  
Commissioner  
Australian Energy Market Commission  
Sydney NSW 2000

## **ARENA/AEMO joint response to AEMC Directions Paper Section 5: Wholesale Demand Response**

Dear Mr Pierce,

The Australian Energy Market Operator (AEMO) and the Australian Renewable Energy Agency (ARENA) welcome the opportunity to comment on the AEMC's Reliability Frameworks Review Directions Paper.

Our joint submission reflects the importance that our organisations see in unlocking the significant potential for a range of demand side services in the National Electricity Market (NEM).

This submission is informed by initial learning from our joint ARENA / AEMO Demand Response trial, which is summarised below and which we hope will help inform and result in a sustainable role for demand side services within the NEM.

Unlocking the potential of distributed resources, and enhancing competition between supply and demand side resources within the wholesale market, will help deliver an efficient, lower-cost market outcome, that helps support the delivery of a reliable and secure energy future.

This submission also presents a framework for a series of joint ARENA / AEMO trials to be undertaken in close collaboration with stakeholders and the AEMC to rapidly advance this aim. This process will help inform future policy and regulatory frameworks.

Should you have any questions concerning this submission, please contact Violette Mouchaileh (Group Manager Market Enhancement, [violette.mouchaileh@aemo.com.au](mailto:violette.mouchaileh@aemo.com.au)) and Jon Sibley (Principal Policy Advisor, [jon.sibley@arena.gov.au](mailto:jon.sibley@arena.gov.au)).

Yours sincerely,

Audrey Zibelman  
AEMO, CEO

Ivor Frischknecht  
ARENA, CEO

## **Demand Response - two way system**

A number of recent reviews - the AEMC's Power of Choice Review, the AEMC's Strategic Priorities paper, the Finkel review, and more recently the AEMC's current Directions paper - have acknowledged that the value of demand response may not be fully realised in the National Electricity Market (NEM). AEMO and ARENA share the AEMC's view that this re-evaluation of demand response is being driven by the need for flexible and dispatchable resources to complement the increasing penetration of variable renewable generation. This can leverage the technological advancements which increase the potential for demand side resources to dynamically respond to market signals.

AEMO and ARENA consider that demand response, and more generally distributed energy resources, need to be valued as a resource that can provide a range of energy, ancillary, and network services. This value can best be unlocked through competitive markets to ensure efficient demand-side investment and operation.

The Demand Response Mechanisms, Option 1 and 2, put forward by the AEMC in the Discussion paper can both play a role in encouraging more flexible price responsive loads to participate in the NEM. Option 1 (Baseline Demand Response Mechanism) will give customers and their agents a greater ability to access pool prices as generation does today. Option 2 (Multiple trading relationships or metered method) will allow flexible distributed energy resources such as storage to access the market as generation or load. It also provides customer choice to engage with multiple parties for various service offerings. AEMO and ARENA see merit in trialling these options in a market context. This is captured in the proposed AEMO/ARENA distributed energy program discussed further below.

In respect of Option 3, ARENA's existing funding programs are supporting a number of retailers to develop innovative ways of harnessing the demand side resources of their customers, including through the AEMO-ARENA demand response trial and other 'virtual power plant' type initiatives. ARENA is able to work with the AEMC and industry stakeholders to support further initiatives in this area. Ultimately however, Option 3 on its own does not offer the potential to lower transaction costs for market participation in the same way as the other options.

As greater renewable energy and storage is integrated into the grid, ARENA and AEMO expect demand response to become an important part of a larger distributed energy or demand side landscape. Consumers are engaging with their electricity services in new ways, and we are seeing a significant proportion of energy being generated at the customer premises – facilitating a move from a centralised to a decentralised system. We see a need for changes to the market framework that facilitate demand response to complement changes to better integrate distributed energy resources generally. Such a framework would incentivise customers' assets, whether through generation, energy-usage or storage, to contribute to the energy system in a way that minimizes costs to consumers. Comprehensive consideration of these issues will

lessen the likelihood of piecemeal changes to the Rules to accommodate every new technology or business model as it arises.

Trials can play an important role in testing concepts to inform policy and regulatory change. The first year of the AEMO-ARENA demand response trial has provided insight into the role that demand side resources can play in the provision of emergency capacity, through the Reliability and Emergency Reserve Trader (RERT) arrangements. These insights, together with recent experiences in the ancillary services markets (following rule changes which introduced the concept of unbundled demand response providers), show that the demand side can play an active role in the provision of market services, and different business models may value these services differently. Allowing market access to different business models gives consumers greater choice, encourages greater competition and better service offerings to consumers.

The initial learning from the AEMO/ARENA demand response trial is summarised and discussed further in a Project Update provided below. Building on this, AEMO and ARENA are exploring a trial framework for moving the consideration of in-market demand side forward. We are exploring a distributed energy program that would take a holistic approach to the integration of demand side resources.

### **Distributed energy program - taking a holistic approach to demand side resources**

AEMO, and ARENA, in partnership with others, including some network companies, are exploring a distributed energy program that would actively support the better integration of distributed energy resources, including demand response. The program will<sup>1</sup> build on existing distributed energy resource trials funded by ARENA and other parties, providing a more structured way of identifying industry priorities and helping to improve the dissemination of results.

The program is expected to provide a framework to work with stakeholders to trial market design solutions related to the integration of distributed resources into market arrangements. The program will be comprised of a series of concurrent demonstrations to test the building blocks for the future market and identify regulatory changes, technical requirements and potential roles and interfaces between stakeholders.

Elements of the program being developed include:

1. **Direct wholesale market access for demand side resources:** Trialing demand response (both aggregated and individual C&I customers) participation in the wholesale market. This could test different approaches to settlement, scheduling and forward commitment.

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<sup>1</sup> The proposed program is subject to ARENA Board consideration and approval in early 2018/19  
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2. **Network hosting capacity:** This will leverage ARENA's DER hosting capacity funding program where we will work with networks to increase network or system level DER hosting capacity. AEMO will take an advisory role on projects relating to system-level hosting capacity, including guiding knowledge sharing outcomes.
3. **Distributed energy market framework:** Partnering with distribution network businesses and market participants to trial contractual or market-based approaches to utilising distributed resources that can vary their generation or load including orchestration across network support, energy and system services markets.

The intended outcomes from the program include:

- Simplifying demand side resources' access to wholesale electricity spot market pricing and other payments made by the market operator and networks, such as payments for system support services, encouraging greater participation and responsiveness to market conditions.
- Improving coordination between the range of energy, ancillary and network support services that can be provided by distributed energy resources, accounting for network congestion.

ARENA and AEMO will work collaboratively with other stakeholders to define the parameters for the program and trial elements taking the lead from options outlined in the Reliability Frameworks Review Directions Paper.

Where appropriate AEMO and ARENA would look to the AER to provide exemptions to participants to allow them to fulfil roles or undertake activity not currently anticipated in the Rules.

AEMO and ARENA plan to launch this program in early 2018/19 and will work with stakeholders to further shape and define the program of work.

# AEMO-ARENA Joint Demand Response Trial

Project update: May 2018

## Purpose

Knowledge sharing is a major focus of the ARENA-AEMO demand response trial. This paper outlines the key learning from the first year of the trial.

## Background

In May 2017, ARENA and AEMO partnered to trial demand response services using the Reliability and Emergency Reserve Trader (RERT)<sup>2</sup> arrangements. The objectives of the trial are to:

- Evaluate the performance of various demand response resources in electricity supply contingency events;
- Providing a benchmark for the cost of procuring demand response in the National Electricity Market (NEM) ;
- Improve the commercial and technical readiness of innovative approaches such as engagement with mass market customers, or behavioural demand response; and
- Provide an evidence base to inform the design of a new market, or other mechanisms, for provision of demand response to assist with grid reliability and security.

Under the ARENA-AEMO demand response trial, proponents have three years to fully build their capacity and were required to make that available at 2017 contracted prices.

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. Successful demand response service providers receive the ARENA capital-funding grant in the form of availability payments over three years and are required to sign onto the AEMO Short Notice RERT Panel and be available for SN RERT if requested. Providers will also receive usage payments of up to \$1000/MWh, if activated. If activated, the market would pay for the activation charges.

## Outcomes from the procurement process

Despite the short lead time, a number of providers participated (refer to [Attachment 1](#) for list of trial participants and their service offerings) and were selected to represent a broad range of technical and commercial solutions that together would contribute to the trial objectives.

The ARENA-AEMO demand response trial has contracted for 143 MW in year 1, 190 MW in year 2, and 203 MW in year 3, across NSW, Victoria and SA. This capacity complements 226 MW of non-market

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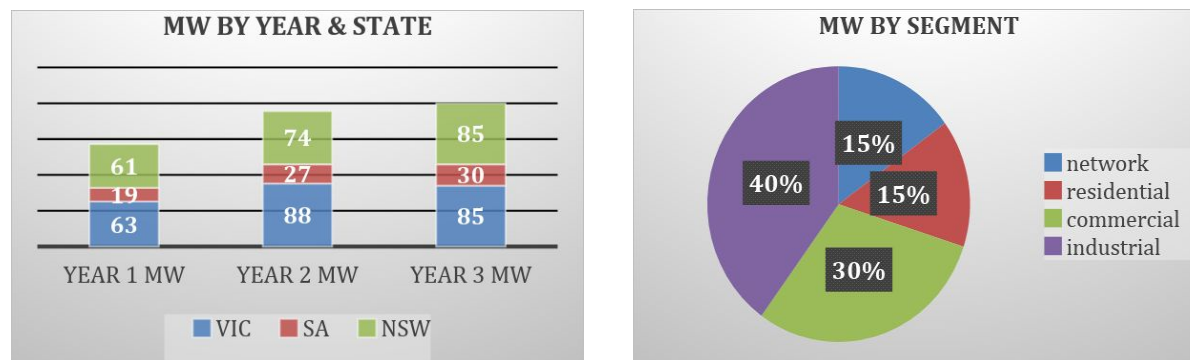
<sup>2</sup> The RERT is a function conferred on AEMO under the National Electricity Rules. Under the RERT, AEMO can enter into reserve contracts so it can call upon resources not available to the market if needed to ensure reliability of supply meets the reliability standard, and to maintain power system security.

generation and 741 MW of industrial demand response contracted by AEMO under the former Long Notice RERT arrangements for summer 2017/18.

Table 1: ARENA-AEMO trial participants by sector and state

Provider	Residential	Commercial	Industrial	State
AGL Energy Services	X	X	X	NSW
EnergyAustralia (NSW)	X		X	
EnerNOC Pty Ltd (NSW)		X	X	
Flow Power		X	X	
Powershop Australia Pty Ltd	X	X	X	VIC
United Energy Distribution	X	X	X	
EnerNOC Pty Ltd (VIC)		X	X	
Energy Australia (VIC + SA)	X	X	X	VIC/SA
Planet Innovation/Zen HQ	X	X		
Intercast & Forge			X	

Figure 1: ARENA/AEMO DR trial MW by state and MW by segment



### Funding arrangements and pricing

As noted above, \$28.55 million was provided by ARENA to support the demonstration of innovative demand response resources. A further \$7.18 million was provided by the NSW government to develop additional demand response capacity in that state.

ARENA/NSW funding was associated primarily with the establishment of the capacity, such as the costs of customer procurement and upfront capital costs. Under the ARENA-AEMO demand response trial, these establishment costs had a weighted average of \$0.2m/MW. For comparison purposes, the average capital cost for a diesel engine is estimated at \$1.0m/MW.<sup>3</sup>

<sup>3</sup> Power Generation Technology Report, 2015, p.26  
[http://earthsci.org/mineral/energy/coal/LCOE\\_Report\\_final\\_web.pdf](http://earthsci.org/mineral/energy/coal/LCOE_Report_final_web.pdf) (p.26)

ARENA/NSW funding is provided on the completion of milestones, including live testing of the demand response capacity. Dispatch payments are made by AEMO on the basis of actual MWh delivered during RERT activation events.

Table 2 provides a summary of pricing under the ARENA-AEMO demand response trial. The \$/MWh ('LCOE equivalent') figures are provided as a range as the future utilisation (MWh delivered) from these resources is not known. 120 hours represents the maximum that providers have been contracted to deliver over the 3-year contract period. The differences in blended dispatch payments reflect different prices that were set for industrial, commercial and industrial sector demand response capacity.

This pricing data reflects the specific conditions of the demand response trial. These include the relatively truncated procurement process which transferred risk to providers as well as ARENA contractual requirements including knowledge sharing.

Prices should also be interpreted in the context of the expectation by providers of limited opportunities (hours) to provide services and receive dispatch payments. Longer running hours result in lower levelised costs. An approximate levelised cost of equivalent diesel generation capacity is provided for comparison purposes. The 'LCOE equivalent' price reduces with the volume of energy produced. The shape of this decline is influenced by the balance of establishment and dispatch payments which is somewhat arbitrary under the demand response trial.

Table 2: Pricing for ARENA-AEMO demand response trial participants over 3 years, alongside the cost of new emergency diesel generation (provided only to provide a sense of scale). These figures reflect the specific trial conditions rather expected or ongoing market pricing for demand response or diesel generation.

Provider	3-year average contracted MW	Dispatch payment \$/MWh	Total ARENA/ NSW funding (\$)	Capacity cost (\$/MW/yr)	'LCOE equivalent' price in 3-year trial period			
					\$/MWh (4 hour)	\$/MWh (12 hours)	\$/MWh (24 hours)	\$/MWh (120 hours)
Minimum	6	\$847	\$323,654	\$10,788	\$8,938	\$3,544	\$2,196	\$1,117
Maximum	30	\$1,000	\$6,929,000	\$92,071	\$70,053	\$24,018	\$12,509	\$3,302
MW weighted average	18	\$987	\$4,357,758	\$66,658	\$50,981	\$17,652	\$9,319	\$2,654
Diesel Generator*	1	\$160	\$1,324,463	\$441,488	\$331,276	\$110,532	\$55,346	\$11,197

\* Dispatch payments are substituted for estimated diesel fuel costs for comparison purposes. Operating costs for diesel not included. Funding costs are substituted for capital costs for diesel (\$1m/MW<sup>4</sup>). Cost of capital at 9% over 10 years for diesel, and taken to be included in total funding payments to DR providers. As with DR, the dispatch figure is added to the total establishment cost for each MWh produced for LCOE.

<sup>4</sup> ibid



## Product design and features

The program was designed with defined products that were developed taking into account ARENA consultation with industry, AEMO control room requirements, and international experiences.

Feature	Product 1	Product 2
Notification period	60 minutes	10 minutes
Activation duration	4 hours	4 hours
Activation triggers	LOR2, LOR3, System Security	LOR2, LOR3, System Security
Availability	10am to 10pm business days	10am to 10pm business days
Activation frequency	10 per year (ie. 40 hours)	10 per year (ie. 40 hours)

7 of 10 providers offered <10 minute response products while 3 opted to provide <60 minute response products. 60 minute products were typically associated with providers of residential and commercial demand response where there was a behaviour component or manual process required.

During this process, AEMO found it valuable to define standardised products which set out the service features required from an operational perspective. These were simpler to administer, minimised negotiation costs, and made it more manageable for AEMO control room to operate (compared to bespoke contracts). Standardised products also allow the operator to facilitate auction processes leading to more competitive price outcomes. We expect the trial program to help define standardised DR products for future market participation.

In parallel to this process, AEMO commenced a process to enhance the RERT reflecting on the learning from this trial and other processes. Some of the feedback AEMO received from participants, and which is reflected in AEMO's Enhanced RERT (strategic reserve) proposal submitted to the AEMC, is the need for seasonal products lowering the administrative burden on participants participating in reserve in future, and the need for a 24 hour product for larger loads (which were not part of the trial given the 30MW restriction).

## Demand response test outcomes

Each of the participants in the ARENA-AEMO demand response trial undertook testing of their response capacity. While overall, the results were positive there was a wide variation of test performance between participants.

In total, participants were able to recruit 165 MW of capacity compared to 143 MW contracted (115%). Test performance was positive, with overall 167 MW delivered (116% of contracted capacity). This result was influenced by one participant achieving 227% of its contract capacity. If this participant is excluded, the weighted average tested capacity was 87%. 4 of the 10 participants achieved test results within 10% of their contracted capacity.



These test performance results need to be interpreted in the context of the restricted timeframes for customer recruitment and the development of business systems and technology infrastructure as well as the ‘first of a kind’ nature of some of the demand response solutions. Another potential contributor is baseline inaccuracy which is being refined through the trial. In particular, novel mass-market solutions, which relied on customer behaviour change, faced the greatest challenges in achieving contracted capacity during the test phase and validating deviations from baseline energy usage. As such, results are expected to improve in future tests as new providers learn about the technical characteristics of their products and have more time to establish appropriate systems.

### **Activations over summer**

During May, AEMO intends to release the following reports which will provide detailed information regarding RERT activation events for the past summer:

- Summer 2017-18 Operations Review report, which will provide a summary of all off-market generation and demand response resources engaged as part of RERT activities for the summer 2017-18. This will include information on RERT providers and costs.
- Quarterly Energy Dynamics providing information on electricity and gas market dynamics, trends and outcomes during Q1 2018.
- NEM Event Report for the 19 January 2018 RERT activation event.

### **Lead times and other procurement learning**

The strong participant response to the AEMO and ARENA process together with the AEMO RERT tender indicates there is significant latent price responsive demand in the NEM.

In terms of lead time, feedback during the procurement process and in a recent session held with trial participants to reflect on learning from the trial noted the importance of longer lead times to procure reserves. Short procurement timeframes create risks for proponents, particularly with regard to residential and commercial customer recruitment, and impacts service costs and performance. Parties noted that it takes time and effort to recruit customers into their portfolio, to implement systems and, in some cases, to train participants.

Centralised procurement, with funding of upfront establishment costs (capacity payments), encourages more parties to make demand responsive, particularly where third party demand response aggregators may have difficulty accessing other value streams. In addition, education and ongoing engagement was an important aspect – noting that the three year feature of the trial meant there was an incentive to actively engage DR resources on an ongoing basis. A degree of revenue certainty is therefore essential to ensuring efficient participation by DR under a future demand response mechanism.

A number of demand response provider business models act independently of the customer’s Financially Responsible Market Participant (contracting directly with ARENA and AEMO). The trial showed how multi-party relationships do exist with customers, where retailers are different to the customers’ demand response providers. This creates potential windfalls for the electricity retailers

where they benefit from greater demand elasticity (reduced spot exposure) while not contributing to the cost of the demand response service.

### **Baselining analysis**

The measurement of demand response requires the development of an electricity consumption baseline (counterfactual) against which demand reductions can be measured. This provides the basis for contract performance verification and revenue earnings calculations. As part of the trial we used one baseline method that was developed as part of AEMO's demand response mechanism designed in 2014.

Feedback from trial participants was the baseline method was not suitable for non-variable loads or those with solar PV. AEMO and ARENA are working together to review and develop additional baselines to reflect different load profiles and features. The intent is to develop some additional baselines to be captured in time for the second year of the trial. This assessment of baseline options will be reported in mid-2018.

### **Third party access to data**

A key issue raised by third parties, and even retailers who acquired customers that were not their retail customers, was the ability to access meter data from distributors or retailers even though they had customer consent. AEMO does not have the ability to provide this data to third parties. This restricted the ability of some providers to tailor their offering to the customer or manage the load profile (i.e. how would they know if they responded). The Commonwealth government is currently reviewing third party access to data. We understand that the Commonwealth intends to progress its proposal to the COAG Energy Council in August 2018.

### **Next Steps**

Knowledge sharing is a major focus of the ARENA-AEMO demand response trial and a number of specific evaluation reports will be released over the course of the program.

Building on the experience with RERT to date, ARENA and AEMO are exploring the potential for new trials to demonstrate how distributed resources may contribute to reliability and affordability in electricity wholesale markets. This process will benefit from input from the Australian Energy Regulator, Australian Energy Market Commission and other industry stakeholders to inform the development of a demand resource mechanisms and frameworks.

## Attachment 1: Summary of providers

This table lists participants in the three-year AEMO/ARENA demand response trial.

Name	State	Year 1 (MW)	Year 2 (MW)	Year 3 (MW)	Summary of project
Progressive Green trading as Flow Power	NSW	5.0	15.0	20.0	Flow Power will create a program called Energy Under Control which involves rollout of their own kWatch Intelligent Controller (designed and manufactured in Victoria) to 100 commercial and industrial energy customers across New South Wales, targeting manufacturing, agricultural businesses, and cool storage.
AGL	NSW	18.0	19.0	20.0	AGL will provide 17 MW of capacity from large commercial and industry customers, and 3 MW from 10,000 New South Wales residential households with smart meters, using a combination of behavioural demand response and controllable load/storage.
EnergyAustralia	NSW Vic/SA	18.0 20.0	20.0 30.0	20.0 30.0	Energy Australia will sign up commercial and industrial businesses and residential customers, using WattWatchers' remote monitoring and load curtailment devices and GreenSync's VPP technology for aggregation, along with Redback Technology's smart battery storage systems.
EnerNOC	NSW Vic	20.0 30.0	20.0 30.0	20.0 30.0	EnerNOC will install its own hardware to automatically and remotely control and curtail energy use in 20 large commercial and industrial businesses (approximately 1 MW available per site). Demand response will be 100% generated by curtailment of loads. EnerNOC will also provide frequency control ancillary services (FCAS), demonstrating how customers can receive multiple revenue streams from their reserves.
United Energy Distribution	Vic	12.0	30.0	30.0	United Energy intends to use voltage control devices installed at substations across its Melbourne and Mornington Peninsula distribution network. During a peak event, it will slightly lower the voltage across its whole network of 600,000 households and businesses, using smart meters to ensure the voltage remains at a safe allowable limit.
Planet Innovation	Vic/SA	5.0	10.0	15.0	Zen Ecosystems will deploy its smart, connected, and controllable network of Zen

(Zen Ecosystems)					thermostats. The demand response capacity will be delivered by controlling air conditioning, heating, and ventilation. Zen Ecosystems will roll this out at business customers, and through a combination of voluntary and load control programs aimed at residential customers, run in partnership with the RACV.
Intercast & Forge	SA	10.0	10.0	10.0	Intercast & Forge is a South Australian metal foundry which manufactures metal castings. This local business has installed sophisticated energy systems that allow it to provide dispatchable demand response by powering down furnaces during peak events.
Powershop	Vic	5.0	5.0	5.0	Powershop will run a behavioural program called Curb Your Power using a mobile notification system for its Victorian retail customers. It will invite customers to reduce energy consumption for 1-4 hours and receive the equivalent of a weekend of free electricity. Powershop will also be able to draw on 1 MW of Reposit enabled batteries installed in its customers' homes, and on a 1 MW co-generation facility at Monash University.