

Evaluation of ARENA and NSW's 2017-2020 Demand Response Portfolio

Final Report

June 2021



Executive Summary

Background

With a higher proportion of renewable energy coming into Australia's energy network, novel ways to manage the delivery of secure and reliable electricity are required. The role of demand response (DR) is becoming increasingly important as a potential clean and low-cost resource to manage grid security and reliability and, more generally, the ability to provide demand-side flexibility to balance variable renewable energy supply, therefore reducing the overall cost of supply.

In 2017, the Australian Renewable Energy Agency (ARENA) embarked on a three-year partnership with the Australian Energy Market Operator (AEMO) to run a DR trial to demonstrate the ability of DR to assist in managing the reliable supply of renewable energy at peak times. AEMO's Short Notice Reliability and Emergency Reserve Trader (SN RERT) panel was the mechanism with which to test participants' ability to reliably provide DR. ARENA's DR trial consisted of ten projects of which the NSW Government supported four projects located in New South Wales.

With most trials now completed or nearing the end of their contract, ARENA and NSW Government have engaged CutlerMerz to undertake an evaluation of the portfolio of projects in terms of the value provided to ARENA's stakeholders, NSW Government, the energy industry as well as the wider public to identify lessons learned which may be applied to future programs. This report focuses on the outcomes of the four NSW specific projects, however, also touches on the outcomes of the ARENA trial to the extent that the NSW projects were influenced by the portfolio of projects as a whole.

Evaluation Summary

Overall, CutlerMerz considers that the NSW Government's funding within ARENA's portfolio of DR projects was appropriate, effective, and efficient.

The trial accelerated the commercial readiness of the DR technologies, helping to establish a functioning and competitive market for DR services, predominantly for commercial and industrial (C&I) DR services in NSW and in Australia more broadly. The trial also provided critical lessons to the industry in the applicability of residential programs for DR.

ARENA's portfolio of projects as a whole was effective in delivering the trial's objective of 200MW of tested DR capacity for the RERT. In particular, the portfolio of projects in NSW was effective in delivering and exceeding the trial's objectives¹ of 80MW DR capacity within NSW. A learning curve for trial participants was evident as their ability to provide DR improved throughout the trial.

This broad success was driven by a combination of two external factors. Firstly, the trial was initiated at a time in 2017 when peak demand was a critical issue within the National Electricity Market (NEM) and thus the need for alternate solutions to manage peak demand existed. This meant that both AEMO and the industry more generally were incentivised to establish a trial at a scale sufficient to meaningfully contribute to managing extreme peak demand. Secondly, over the course of the trial the importance of DR in enabling a high-penetration renewable energy system became increasingly apparent. This culminated in the Australian Energy Market Commission (AEMC) receiving a rule change request in August 2018, midway through the trial, from the Public Interest Advocacy Centre (PIAC) to introduce

¹ The demand response trial had three core objectives, being to:

1. Demonstrate DR as an effective source of reserve capacity for maintaining reliability of the electricity grid during contingency events and that DR resources can be rapidly developed for deployment from summer 2017/2018.
2. Provide an evidence base to inform the merits and design of a new market or other mechanisms for DR to assist with grid reliability and security, allowing for greater uptake of renewable energy.
3. Improve the commercial and technical readiness of DR providers and technologies to help demonstrate and commercialise the use of DR for grid security and reliability.

a mechanism for wholesale DR in the NEM. This provided an actionable mechanism with which to apply learnings from the DR trial.

ARENA's DR trial accelerated scope definition of DR projects for funding recipients and provided the capital and internal commitment required for organisations to effectively test DR technologies and commercial models.

The trial directly gave rise to a competitive market for DR market in the C&I sector. The market is now close to saturation in NSW such that retailers and aggregators now compete to procure DR services from fit for purpose C&I facilities.

Learnings within the trial also informed AEMC's wholesale demand response mechanism rule change which will result in an expanded market for C&I DR market implemented in October 2021. This report suggests that AEMC's rule change validates the effectiveness of the DR trial in accelerating the market for DR.

The trial also identified clear lessons for the residential DR segment. Notably, behavioural DR programs provided customer engagement benefits to retailers. Additionally, controlled load DR programs proved less effective gaining wider adoption due to the cost to implement and customers being resistant to relinquish control.

Based on our review and stakeholder interviews, we estimate that overall, the DR portfolio of projects brought forward the market for DR services in NSW and Australia more broadly by approximately three years. This was due in particular to the scale of the DR capacity required and milestone targets which required participants to continue to deploy technology at pace, despite challenges. Without milestone targets, participants stated that they would not have deployed at such scale and/or "failed fast" as challenges emerged. The NSW Government's funding contributed to scaling the program as the NSW Government's \$7M of funding introduced NSW specific projects into the portfolio, extending the program outside of South Australia and Victoria.

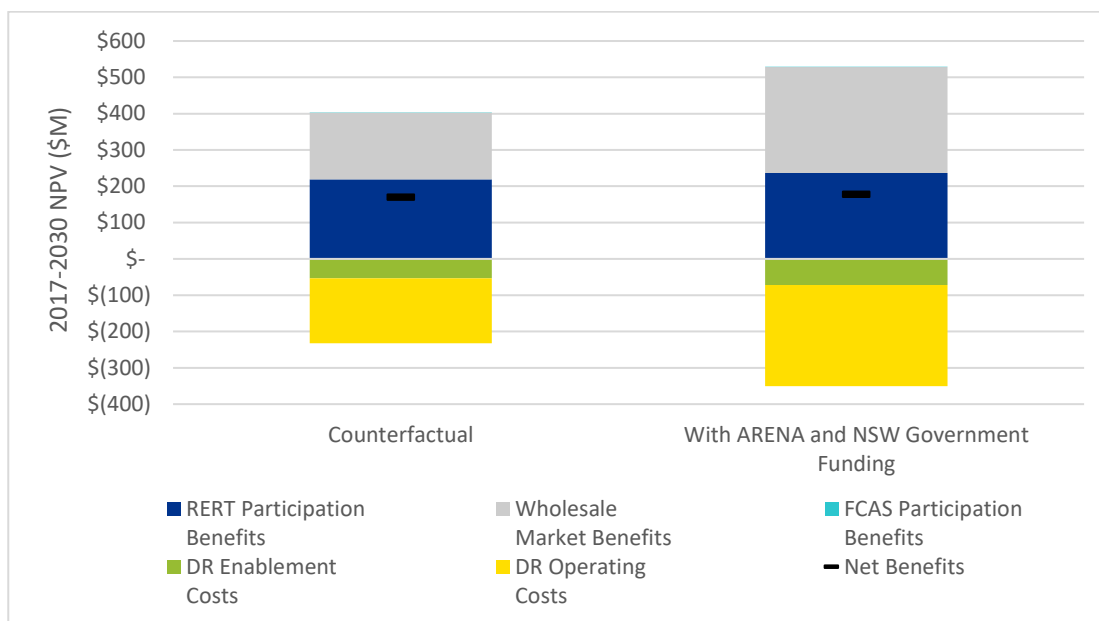
An identified limitation of the trial is that it concentrated on enabling and measuring the effectiveness of RERT DR. This meant that benefits of using DR for wholesale market arbitrage were not captured. This report suggests that wholesale market benefits provide the greatest financial incentive to enabling DR, but this was not able to be validated from trial specific data due to the lack of focus on this benefit.

Additionally, the trial could have improved the effectiveness of data collection. A more structured data collection plan that focused on commercial data such as customer acquisition costs, costs to enable DR for C&I customers and customers' willingness to participate would have proved valuable.

Our analysis of the costs and benefits of DR in NSW across two scenarios, the With NSW Government and ARENA Funding scenario and the Counterfactual scenario if no trial was funded, is shown in Figure 1. Compared to the Counterfactual scenario of no funding provided by NSW Government and ARENA, we estimate that the funding led to the acceleration of the DR market in NSW by three years. This results in an increase in net benefits by \$8M over the 2017 to 2030 period, where the incremental benefits compared to the incremental costs equates to a benefit cost ratio (BCR) of 1.07. Additionally, the acceleration of DR is estimated to lead to a reduction of 6.4 to 8.7 kilotonnes of greenhouse gas (GHG) emissions which would have otherwise been emitted over the period conventionally from gas peaking plants or diesel generators.

The average project cost for the projects participating in residential DR (AGL and EnergyAustralia) were more expensive than those that only subscribed C&I customers (Enel X and Flow Power). The results suggest that although the portfolio of projects helped demonstrate that residential DR is achievable, C&I is a more cost-effective means to provide DR.

Figure 1 – Comparison of 2017 to 2030 NPV of DR Costs and Benefits by Scenario



Evaluation against criteria

For the purposes of the evaluation, CutlerMerz identified a suite of evaluation criteria in terms of the appropriateness, effectiveness, and efficiency of the portfolio of projects, the outcomes of which are provided in Table 1 below.

NSW Government was effective in mapping the objectives of the DR trial to their strategic goals within the NSW Government's 'DR Program Evaluation Plan'. This included mapping of the goals to the *Energy and Utilities Administration Act 1987-No 103* and the NSW Climate Change Policy Framework. Thus, the objectives of the program were appropriate in aligning with NSW Government's strategic goals.

However, elements of the appropriateness evaluation did not fully meet the criteria. As the portfolio's primary focus was on the Short Notice Reliability and Emergency Reserve Trader (SN RERT), it is challenging to determine the extent to which the competitiveness and supply of renewable energy increased as a result of the investment. Additionally, increasing the share of funds leveraged from the private sector would increase the outcomes achieved through the NSW government's investment.

Similarly, elements of the portfolio design did not fully meet the effectiveness criteria. This includes improving the coverage of the portfolio across the DER Technology Integration Functional Framework² and maximising the effectiveness of knowledge sharing activities.

Funding recipients made note that NSW Government employed a 'hands off' approach in delivery of the projects, leveraging ARENA's skills in managing technology projects to deliver the NSW Government's objectives for the portfolio of projects. The outcome was that funding recipients were overwhelmingly positive towards delivery of the portfolio of projects over the course of the three-year trials. It suggests that the NSW Government was effective in drawing on ARENA's competencies to deliver the trial.

² ARENA (2021): <https://arena.gov.au/assets/2021/02/state-of-distributed-energy-resources-technology-integration-report.pdf>

Table 1 – Demand Response Portfolio – Evaluation Summary

Evaluation Criteria	Evaluation
Appropriateness	
Overall, the DR projects assessed are appropriate in terms of meeting ARENA's legislated objectives ³	Fully meets criteria
Overall, the DR projects assessed are appropriate in terms of contributing towards the expected results described in ARENA's Performance Framework ⁴	Partially meets criteria
Overall, the DR projects assessed are appropriate in terms of meeting the DR Competitive Round objectives	Fully meets criteria
Overall, the frequency of reporting required (milestones, finances and knowledge sharing) under the funding agreement was appropriate	Fully meets criteria
Effectiveness	
There are ancillary benefits outside of the trial	Fully meets criteria
A qualitative assessment suggests the Technology Readiness Level ⁵ (TRL) of the DR technology has progressed as a result of the ARENA funding	Fully meets criteria
A qualitative assessment suggests the Commercial readiness index ⁶ (CRI) of the project technology has progressed as a result of the ARENA funding	Fully meets criteria
The trial provides 'good' coverage of the Distributed Energy Resource (DER) Technology Integration Functional Framework functional areas which are applicable to demand response	Partially meets criteria
Overall, the knowledge sharing activities enhanced the competitiveness of renewable energy technologies	Fully meets criteria
Knowledge sharing activities better informed the public about renewable energy technologies and the role they can play in Australia's energy transition	Fully meets criteria
The knowledge shared as part of the NSW projects contributed towards improving the design of the DR market in NSW	Fully meets criteria
Overall, ARENA's responsiveness to communications with funding recipients was effective	Fully meets criteria
Overall, the timeliness of the milestones / report assessment process was effective	Partially meets criteria
Efficiency	
The total cost per MWh of DR appears to be efficient relative to benchmarks	Fully meets criteria
Trial participants (including funding recipients, ARENA, NSW Government and AEMO) believe that the trial was efficiently delivered by ARENA	Fully meets criteria

³ ARENA has two core legislative objectives, which are to improve the competitiveness of renewable energy technologies and to increase the supply of renewable energy in Australia

⁴ ARENA's performance framework is captured in ARENA's 2019/2020 Corporate Plan: <https://arena.gov.au/assets/2019/08/arena-corporate-plan-2019-20.pdf>

⁵ The Technology Readiness Level (TRL) tracks progress from blue sky research to technical maturity. It applies to research, development and demonstration projects.

⁶ The Commercial Readiness Index (CRI) measures progress towards commercial viability. It applies to a range of projects including studies, pre-commercial deployment projects and knowledge sharing

Recommendations

It is recommended that the following approaches be implemented to further improve the appropriateness, effectiveness, and efficiency of future portfolios of projects.

Appropriateness

- As NSW Government financially supports developing technologies (such as DR) it must balance investment in less commercially mature projects that require a higher percentage of public funding with funding more commercially mature projects that attract a higher percentage of private sector investment. When electing which projects to invest, it is recommended that NSW Government balance investment and commercial maturity to help attract an appropriate level of investment from private sector. Developing a risk / cost KPI may be an appropriate metric to help NSW Government strike the balance between investment and commercial maturity of a technology.
- The trial validated C&I as the most cost-effective means to enable DR. Future funding could test two pathways to increase adoption of DR;
 - The trial validated funding recipients' ability to provide DR to access RERT benefits. The cost to funding recipients to provide DR to access wholesale market benefits was not tested. Future trials could focus on better understanding the cost and benefits of using DR to access wholesale market benefits for C&I customers. Doing so could identify the technical and commercial gaps for wider adoption of DR in the C&I market.
 - The cost of technology and technical challenges to enable controlled DR for residential programs inhibited scaled deployment of the technology, thus retailers are less incentivised to implement the technology. It was reported that this was in part due to the lack of standards that mandate compatibility of DR enabling devices with air conditioning units (and other high load devices). It is suggested that the adoption of pragmatic standards will help lower the cost and therefore increase uptake of controlled load DR.

Effectiveness

- Scale is important in obtaining critical mass to establish new markets and accelerate uptake of technologies. Identifying future technologies that have the potential to be scaled will be of value for NSW Government and ARENA. Though there are applications in which a 'fail fast' strategy may be applicable, the DR trial highlighted benefits of scale. The funding provided by NSW Governments assisted in extending the scope and scale of the trial. Identifying similar partnership models in which industry bodies objectives align will prove to be effective for increasing the impact of future programs.
- Maximise the effectiveness of knowledge sharing through focusing on mechanisms that provide the most value:
 - Funding recipients found that the face-to-face workshops were the most impactful for sharing industry learnings. Running more workshops and establishing expert working groups is expected to accelerate industry learning and the enablement of technologies.
 - Providing feedback and guidance to funding recipients on the quality and content of knowledge sharing reports such that reports contribute to the portfolio objectives.
- Further data collection to better quantify the potential of DR and its impact on the competitiveness and supply of renewable energy. Programs that gather data on the following would be of value:
 - Success of the customer acquisition process for both residential and C&I customers and once acquired, the customer retention rates.

- The cost of C&I customers to participate in DR markets as a result of managing their energy demand.
- Customers' willingness to participate in the wholesale market including frequency and duration of DR events.

Efficiency

- NSW Government should continue to pursue funding partnerships with other industry bodies and agencies when portfolio objectives align. In the case of the DR trials, the fact that ARENA was the single point of contact proved an efficient model. It is worth noting however that a balance must be struck between deploying a 'hands off' approach to maximise the efficiency of program delivery and actively steering the project to maximise the effectiveness in meeting program objectives specific to NSW Government. Applying more active engagement in the DR trials by NSW Government may have assisted in driving the program to further improve the trial outcomes.