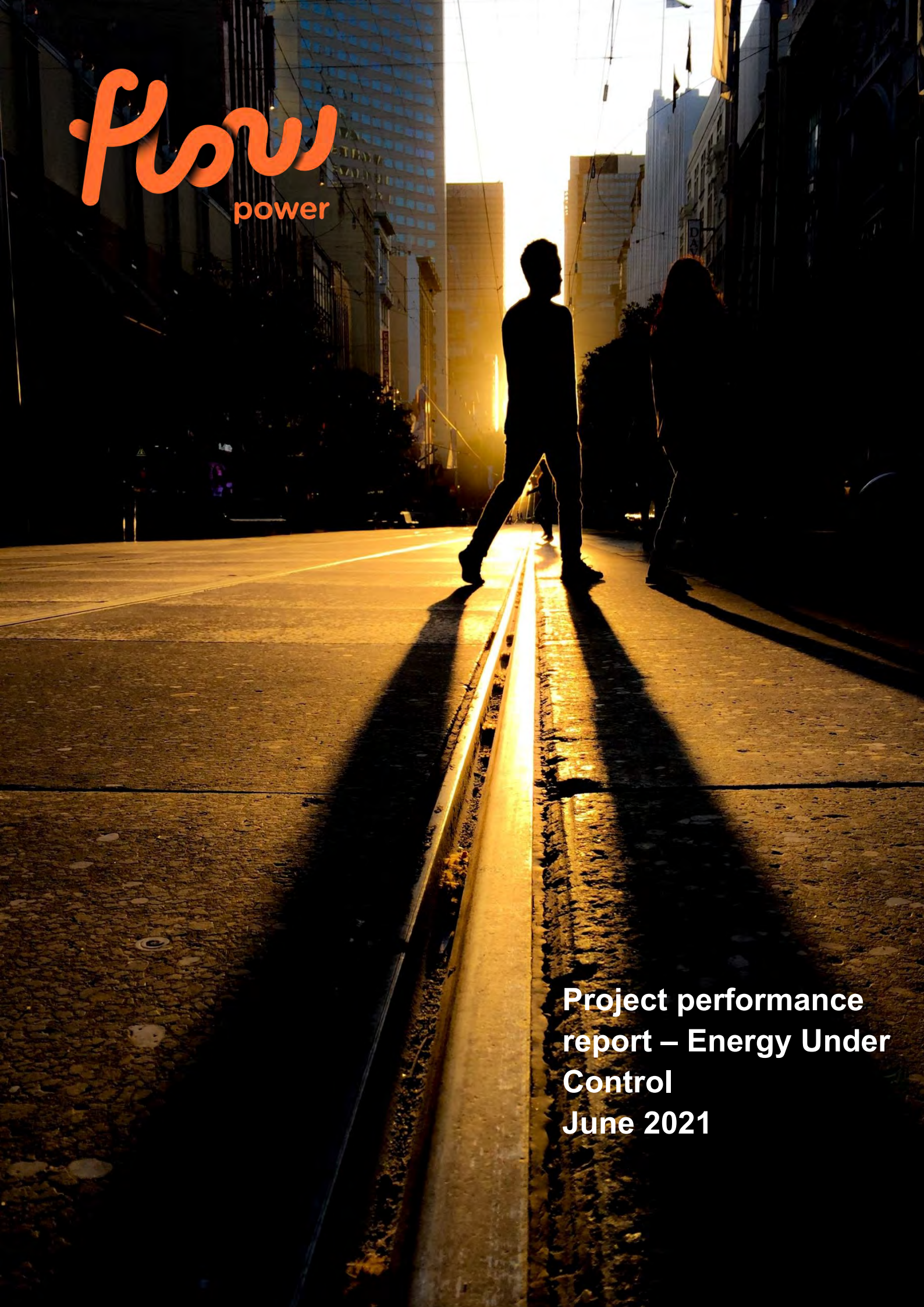

Project performance report – Energy Under Control
June 2021

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1. Executive Summary

This report summarises Flow Power's ARENA demand response trial program participation and experiences.

The ARENA demand response trial ran from 1 December 2017 until 30 November 2020. Over the course of the trial Flow Power built a portfolio of commercial and industrial (C & I) customers in New South Wales; these customers were enrolled in the Reliability and Emergency Reserve Trader (RERT) mechanism, an out-of-market emergency reserves mechanism in the National Electricity Market (NEM).

The start of the ARENA DR trial coincided with changes to the RERT mechanism which allowed distributed and aggregated demand response loads to participate for the first time. The ARENA trial was thus exploring entirely new territory for demand response in the NEM.

In addition to the ARENA DR trial portfolio in NSW Flow Power also tendered RERT portfolios in most states for each summer during the trial period (2017-18, 2018-19 & 2019-20), providing invaluable learning experiences for how commercial and industrial customers engage with demand response and specifically the RERT mechanism. Flow Power has also advised spot price-response customers of wholesale volatility dating back to 2009 and earlier.

This experience of demand response in the NEM, at a time when demand response in the NEM was experiencing a high degree of publicity and commercial interest, helped provide significant learnings in how commercial and industrial customers engage with both demand response and the broader spot market. The RERT mechanism was seen by many customers as both an easier to understand and less risky foray into providing demand response. The successful implementation of RERT demand response for several customers led to them shifting to a spot-price responsive pricing model and implementing wholesale demand response.

Although Flow Power's ARENA demand response portfolio in New South Wales was never activated in response to a contingency event, Flow Power's other RERT portfolios were utilised on several occasions to alleviate the stress on the grid. Notably on the 24 & 25 January 2019 in Victoria where incredibly hot weather coincided with forced outages at several coal-fired stations. Activation of the RERT was a significant contributor to minimising the need for, and duration of load shedding.

The ARENA demand response trial was also pivotal in furthering the design of Flow Power's *kWatch Intelligent Controller*, an internet-of-things type device which enables smart control of customer loads or generation assets in response to market signals. Flow Power considers this type of automated and semi-automated control as essential to the further development of demand response in the NEM. The limited warning and sudden onset of market volatility in the NEM lends itself to quick-responding demand response, which is often difficult to achieve through manual intervention.

2. Introduction

This is the Project Performance Report for Flow Power's Energy Under Control project. Part of ARENA's Demand Response Competitive Round, Flow Power works with commercial and industrial customers to provide strategic reserves in the National Electricity Market via the Reliability and Emergency Reserve Trader (RERT) mechanism.

3. Summary of Knowledge Sharing Activities

In the May 2020 to December 2020 period, Knowledge Sharing Activities were relatively muted with the impact of the pandemic on the ability to travel and the cancellation of events.

Flow Power's staff that manage the ARENA DR Trial are Melbourne-based and the significant extended lockdown and travel bans severely impacted the planned knowledge sharing activities for 2020. The inability to travel outside of Victoria after March prevented the planned 'DR roadtrip' to visit customer sites in New South Wales.

One initiative that Flow Power took during early in the lockdown was to produce a series of weekly webinars ('On the Spot') which allowed for a deeper dive into topics around the energy market. These included a deep look into some of the significant trends shaping the energy market (historically low demand and prices, and the accelerating duck curve) and the overhaul of energy policies which will shape demand response in the future. This webinar series was maintained over the course of the initial lockdown period while much of the country was working from home, and continued even as staff began to return to work.

ACTIVITY	KNOWLEDGE CONTENT	AUDIENCE	DOCUMENTATION
Webinars	'On the Spot', a weekly webinar series	Prospective participants and current participants	https://www.flowpower.com.au/on-the-spot-energy-policy/ https://www.flowpower.com.au/on-the-spot-summer-lookback/
Material creation / Partnership	Collaborated with the University of Technology Sydney Institute of Sustainable Futures to produce a report *More for Less: how businesses can flex their energy to get more from a Renewable PPA*	Customers looking to understand load flexibility and matching load flexibility with renewable PPAs	Public-facing version currently being finalised

4. Response Provided

Technology

Proprietary technology, the kWatch® Intelligent Controller, has been installed at each customer site to facilitate ten-minute response to AEMO activation signals.

Purpose built for allowing customers to respond to market signals and automate the curtailment of load, the Controller gives customers:

- Live data feed – weather, market data, other signals as desired
- Alerts
- Automation of connected equipment

If AEMO call an event, Flow Power sends alerts to customers. Customers typically need to accept the activation and opt in before the Controller will then reduce their load; however some customers have elected to operate on an 'opt out' basis.

Model

Customers receive two payments:

- Availability – based on the volume of capacity provided during tests or activations
- Activation – based on the volume of load shed during events

Customers pay an annual fee to cover the installation of and access to data from the Controller.

Portfolio

Flow Power's portfolio is comprised of customers from a diverse set of industries across NSW.

INDUSTRY	INDUSTRY TYPE	RESERVE	LOCATION
Agri-businesses	Orchards/Irrigators	1.47	NSW and VIC border
Warehouse/Storage	Refrigeration	1.16	Sydney
Councils	Water Management	1.3	Throughout NSW
Food Processing	Packaging/Manufacturing	1.7	Throughout NSW
Forestry	Timber Mill	0.5	North Eastern NSW
Manufacturing	Building Supplies	3.7	Western Sydney region
Manufacturing	Steel Production	20	Newcastle region

5. Analysis of performance

INITIAL TEST – 30/01/2018

TARGET RESERVES	5	MW
Recruited Capacity	7	MW in Maximum demand
Number of Customers	4	
Test Result	1.52	MW
Number of Activations	0	

RE-TEST – 27/03/2018

TARGET RESERVES	5	MW
Recruited Capacity	11.6	MW in Maximum demand
Number of Customers	7	
Test Result	3.51	MW
Number of Activations	0	

TEST TWO – 23/05/2018

TARGET RESERVES	5	MW
Recruited Capacity	39.3	MW in Maximum demand
Number of Customers	6	
Test Result	27.9	MW
Number of Activations	0	

TEST THREE– 24/10/2018

TARGET RESERVES	15	MW
Recruited Capacity	39.57	MW in Maximum demand
Number of Customers	7	
Test Result	21.8	MW
Number of Activations	0	

TEST FOUR– 24/05/2019

TARGET RESERVES	15	MW
Recruited Capacity	39.57	MW in Maximum demand
Number of Customers	7	
Test Result	23.1	MW
Number of Activations	0	

TEST FIVE– 3/12/2019

TARGET RESERVES	20	MW
Recruited Capacity	39.57	MW in Maximum demand
Number of Customers	7	
Test Result	19.16	MW
Number of Activations	0	

TEST SIX– 27/10/2020

TARGET RESERVES	20	MW
Recruited Capacity	39.57	MW in Maximum demand
Number of Customers	7	
Test Result	16.72	MW
Number of Activations	0	

6. Project Progress

Year 1 – Recruitment and Set up

- Many large customers (Maximum Demand > 1 MW) felt the financial reward was not significant enough to offset their risks of program participation. This forced Flow Power to shift the focus towards smaller businesses. In some cases the Controller was provided at no cost as an additional incentive to program participation.
- In comparison to Flow Power's experience operating and recruiting for RERT portfolios in Victoria and South Australia, NSW customers generally had less knowledge of demand response and the RERT mechanism.
- In some occasions, Flow Power found that within customer organisations there were varying drivers. For example, operation managers had different motivations to the main decision makers signing onto the program, namely operational targets being of greater importance than pure financial decisions. In some cases these different motivations may be encapsulated in operational or revenue-based KPI targets.
- Several customers, specifically those who are not existing Flow Power customers, expressed concerns about integrating new technologies with their existing control systems. This issue is often resolved through improving the customer's understanding of how the kWatch® Intelligent Controller operates and the process followed when sending customer signals.
- The initial recruitment of customers yielded significantly lower demand reductions than anticipated or estimated. For example, the initial contracted portfolio was expected to provide 6 MW, however the first test yielded only 1.5 MW. The second test yielded a 3.6 MW reduction in demand from an expected portfolio of 9 MW. The risk of portfolio underperformance due to weather conditions or altered production conditions can be mitigated by over-subscribing the portfolio.
- The kWatch® Intelligent Controller has had significant updates to its installed firmware. Major development effort was undertaken to improve the reliability and stability of the Controller under all conditions. Flow Power achieved the goal of keeping all the Controllers online most of the time. The Controllers have an in-built watchdog monitoring network failures and device recovery.
- The kWatch® Intelligent Controller has the ability for near-real time information collection from meters and delivery (via portal and app) to enable participants to make educated decisions about energy usage. Continued development also been undertaken to provide notifications of events via various communication channels.

Year 2 – Build and Maintenance Phase

Year two of the project brought increased understanding and learnings across four broad categories: technology, data, customer-specific and the impact of externalities on DR. The discussion below will dive into these categories further, from a general and a customer-specific perspective.

General Perspectives

- Baselines continue to be a significant aspect of demand response, particularly the RERT program. Unlike spot-responsive DR customers, the RERT program relies on a baseline against which to assess performance and determine the value provided. The baseline used (the CAISO 10 of 10 asymmetric adjustment) has been the topic of much discussion throughout the ARENA DR trial and suffice to say that impact has been noticed on Flow Power's portfolio.
- The significance of the baseline to Flow Power's portfolio was observed when the time window for testing the portfolio varied significantly from the time that the portfolio would typically be called upon. One of the tests was conducted in the morning, where typically the requirement for RERT is late afternoon/early evening. The difference in available load, as determined by a baseline, is apparent – particularly in agriculture and cold store customers who have seasonal and/or temperature dependent loads.
- Data access is a continued impediment to the efficient management of demand response. Without real time data it is impossible to monitor the performance at some customer sites. While most industrial customers have their own SCADA systems are able to monitor their own energy consumption, aggregated real time data on the aggregator side would lead to more efficient DR management outcomes.
- As discussed previously, the delay in metering upgrades in NSW has made receiving data feeds more difficult than in states such as Victoria. The Controller is designed to receive customer energy usage and other site-based data via the Modbus standard (available on the EDMI mk10 device but not the mk6, for example). Modifications have been made to the Controller to allow pulsing inputs from older meters, however due to reliability and scalability concerns meter upgrades have been the preferred path forward.

Customer-Specific Perspectives

- As the program matures individual customer performances have been improving. This is a combination of improved understanding of demand response on the customer side, education and resources provided by Flow Power as well as improved operational systems and processes within Flow Power. While the improvement with program maturation is to be expected, it highlights the importance of familiarity and education to implementing successful demand response initiatives.
- Although public awareness of demand response and it's benefits to commercial customers has broadly increased, Flow Power has had challenges signing up new customers to the ARENA DR trial in order to diversify the portfolio. Multiple customers were initially very keen on the concept of implementing demand response, but later decided not to participate. In most of these cases this was a commercial decision – the impacts of demand response were determined to be too significant on their business operations.

- This behaviour has been observed in Flow Power's spot-responsive demand response customers, and typically takes a combination of a strong sales cycle with an in-house champion. Without the in-house champion driving the idea of implementing DR the proposition always falls over. The sale or job of convincing companies that DR is worthwhile is a complex one, and typically requires a long and technical sales cycle. Flow Power is still working on improving the DR pitch and has developed some sales material to help businesses understand the benefits and potential ease of implementing DR.
- This inability to recruit new customers has led to a lack of diversity within the portfolio, which is a significant risk factor in the portfolio
- The lack of spot price volatility and reliability concerns in the New South Wales region haven't helped with the demand response sales cycle. Memories are short and the reliability concerns of February 2017 in NSW seem long gone. This isn't helped by a strong media focus on the reliability and price volatility in Victoria and South Australia. In this regard selling DR to businesses is much easier in these regions – if customers see a potential situation where they could choose to reduce load and be rewarded or be forcibly disconnected from the grid during a load shedding event than the choice is an obvious one. This dichotomy doesn't currently seem to exist in New South Wales.
- There are several technology barriers and concerns still being observed with customers – the first of these are the integration of the kWatch Intelligent Controller with customer sites. Integration of the controller requires three fundamental things – a compatible electricity meter, access to the site for installation (and sometimes temporary interruption to operations) and integration with the on-site control systems. There has been a surprising amount of resistance by customers to site access in order to installation equipment. This is further exacerbated when the integration of on-site control systems is factored in.
- One surprising barrier experienced in upgrading meters has been the cooperation of the Metering Data Providers. From a customer perspective the retailer, and in the case of the ARENA DR trial the aggregator, owns the relationship and manages all aspects of the electricity connection. However, the NMI meter is the exclusive domain of the MDP, and all changes including upgrades or maintenance to this meter must be done by the MDP. This is further exacerbated by the fact that different customers typically have different MDPs, which means new relationships and new negotiations.
- One customer in the portfolio has a high voltage connection with the NMI meter located in the HV switch yard of the distributor away from the customer site location. Access to this HV switchyard has been all but impossible due to the nature of the work required to access a HV site.
- One of the challenges developing an in-house technology solution with a small team has been developing a platform that is flexible enough to handle a range of different customer control systems. The general approach has been to provide a single point of relay control, which a customer's electrical contractors can then integrate with their specific control systems. However, in some cases Flow Power has worked more closely with customers to integrate and specifically program parameters on the Flow Power platform side.

- Seasonality of customer loads continues to be significant – the agricultural loads are primarily based on irrigation requirements, which are significantly reduced or in some cases non-existent during winter. Cold store loads while constant throughout the year are highly dependent on ambient temperatures. This is an issue for the ARENA DR portfolio which has a static size between the winter and summer periods as well as payments based on a constant rate of MW availability and delivery.

Year 3 – Transition Phase

Summer 2020

Early 2020 brought a number of challenges to the power system with extremely high temperatures and bushfires affecting both Victoria and New South Wales. This was seen in an extreme fashion when a bushfire saw the emergency shutdown of the Upper Tumut substation, which disconnected the interconnector from Victoria and preventing and power exports This prevented Victoria from much needed power into New South Wales, which subsequently saw a severe shortage of availability and 'Lack of Reserve' conditions.

Despite these very trying conditions on the grid Flow Power's ARENA portfolio wasn't activated during this period, despite being available and being a short response-time portfolio.

In fact Flow Power's ARENA portfolio wasn't activated on the afternoons of January 23 and January 31 when very hot conditions saw the activation of other RERT portfolios, including Flow Power's non-ARENA portfolio. This was quite a surprise given that the ARENA portfolio is essentially already paid for via the availability payments made over the course of the period and the activation rate during the event is very low.

Given that this summer was the first time ever the RERT was activated in New South Wales it felt like somewhat of a missed opportunity to fully test the ARENA portfolio, outside of the twice-annually scheduled tests.

The portfolio test was also marked by confusion over scheduling – originally planned for late November the test was accidentally scheduled in late December by AEMO operations. This led to the test actually being conducted in early December, within the 6-month period rather than prior to its commencement.

Regulatory Changes

As the ARENA DR Trial has been progressing there has been several very significant movements in the DR regulatory space:

- The Wholesale Demand Response Mechanism
- Integration of Distributed Energy Resources into the grid
- Five Minute Settlement

In the last 6 months more details around how these will be implemented, and the impact on the market have been realised.

These regulatory changes will have a significant impact on the operation of the electricity grid and the way customers, especially large commercial and industrial customers, interact with the grid. A few themes are readily apparent:

- The DR trial has encouraged interest in spot price exposure, which more accurately aligns DR to market signals and the design of the electricity market. Flow Power has seen a number of customers begin down a path of participating in emergency demand response programs and later migrate to a retail spot price exposure contract. This is significant because it shows that a) customers typically have a significantly more load flexibility in their operations than initially thought and b) a willingness to utilise DR in order to improve commercial outcomes. The flipside of a migration of commercial DR load from emergency DR programs to spot price

exposure is that it should help mitigate some of the underlying reliability concerns without the requirement to call the RERT trigger.

- The DR trial has shown a desire to integrate controls equipment more significantly with a customer site and improve automation. Automated DR is the gold standard, both from the perspective of the DR portfolio manager (guarantees a higher level of performance and control over the aggregated assets) and from the customer perspective where less resources are required to manage the ongoing DR activities. Many customers are initially hesitant to significantly integrate third party controls into their operations but will do so when the commercial benefits are clear.
- The DR trial and the broad media coverage have provided an ability to utilise and leverage this DR positively to enter new customer verticals. Traditional DR loads (pumping, cooling) have been low hanging fruit targets of many international DR programs, but as the general understanding of demand response increases more opportunities in industries traditionally hesitant to explore DR become possible. This includes highly risk adverse businesses and those with tighter production and delivery timeframes.

Additionally, the work of Energy Security Board has begun to much more broadly consider the role that demand-side resources will play in the future of the grid. While much discussion to date has focussed on *Distributed Energy Resources*, particularly behind-the-meter photovoltaic systems and batteries, demand response still remains a critical part of the energy ecosystem moving forward.

The ARENA DR trial has help demonstrate the depth of the market, both for traditional commercial and industrial loads and in the residential space. It should be seen as no coincidence that early 2020 saw the rise of a retailer focussed on providing wholesale market signals to residential customers, as well as demand response as a physical hedge to this price exposure.

The final stage of the ARENA DR trial portfolio is focussed on transitioning customers out of the trial and into the broader DR ecosystem. For many customers this will mean transitioning into Flow Power's non-ARENA RERT portfolios for summer 2020-21, however the intention is to encourage customers consider spot-price exposure demand response or consider how they could prepare themselves for participation in the Wholesale Demand Response Mechanism in October 2021.

7. Project Summary

The ARENA demand response trial had several objectives to explore the role demand response could play in the National Electricity Market. The outcomes of the project against the objectives are detailed below.

Program Objectives

"Demonstrate that demand response is an effective source of reserve capacity for maintaining reliability of the electricity grid during contingency events and that demand response can be rapidly developed for deployment from 1 December 2017."

The purpose of the RERT mechanism is to provide reserve capacity when the reliability of the electricity grid is threatened. Low periods of reliability typically occur in conjunction with contingency events – the loss of large power stations or significant network elements. These reserves are intended to come from outside the market – assets that are otherwise not spot responsive or cannot be guaranteed to respond to price signals alone.

Prior to December 2017 the RERT had never been activated. However with the closure of the large Victorian coal-fired Hazelwood power station in March 2017 reliability during summer was significantly impacted in the southern regions, putting a significant emphasis on the importance of the RERT mechanism.

On 18 January 2018 extremely hot weather in Victoria and South Australia, combined with the loss of a large coal-fired power station in Victoria, saw the first large scale test of demand response as reserve capacity to maintain the reliability of the grid. Demand response provided through the RERT, in both Victoria and South Australia ensured that although tight, the reliability of the grid was maintained with no loss of customer load (load shedding).

Although Flow Power's ARENA demand response portfolio was not utilised in this regard, Flow Power had other RERT portfolios in Victoria and South Australia which provided critical reserves on this day. Importantly both of these portfolios were built from scratch just prior to December 2017, demonstrating that demand response portfolios can be scaled rapidly to provide important emergency reserves.

The system reliability in the southern regions was tested more severely in January 2019 when extremely hot weather combined with three coal-fired Victorian power stations offline through plant failures on the 24 and 25 January. Although Victorian homes and businesses experienced some load shedding, the duration and number of affected customers was significantly reduced thanks to emergency reserves provided by demand response.

These first two summers in the post-Hazelwood NEM demonstrated the significance and importance of emergency demand response in the NEM. Not only was the RERT activated for the first time in

the history of the NEM, but multiple participants built and scaled demand response portfolios from scratch to provide this emergency capacity.

"Provide an evidence base to inform the merits and design or a new market, or other mechanism, for demand response to assist with grid reliability and security, allowing for greater uptake of renewable energy."

The three years that the ARENA demand response trial ran was pivotal in both the development of demand response in the NEM and the start of the shift away from coal-fired power generation as the primary supply of power; each year since 2017 has seen successively lower amounts of coal-fired generation meet the total grid demand, with the difference being supplied by renewable generation.

The evolution of the wholesale demand response mechanism (WDRM) rule change ran in parallel to the ARENA trial. Throughout the design of his mechanism the experience of demand response based RERT portfolios was crucial. Almost all participants in the ARENA demand response trial provided input to the design of the WDRM. This was evident in the final design of the WDRM mimicking certain elements of the RERT mechanism parameters such as the use of the CAISO 10 of 10 baseline and minimum scheduled unit sizes of 10 MW. The participation of demand response in the RERT mechanism thus fed directly into the design of the WDRM, a mechanism which much better suits the energy-only design of the NEM.

The other significant market development over the course of the ARENA demand response trial was the formation of the Energy Security Board and their post-2025 market design work. The demand side participation stream benefitted particularly from the experiences of ARENA demand response providers and customer experiences, particularly on the residential scale. The ARENA demand response trial marked the first utilisation of residential customers in demand response in the NEM, an important milestone on the path to a truly two-sided market.

"Improve the commercial and technical readiness of demand response providers and technologies, in particular to help demonstrate and commercialise the use of demand response for grid security and reliability."

Over the course of the ARENA demand response trial Flow Power was able to develop and refine the *kWatch Intelligent Controller*, an internet-of-things style device which enables control of customer assets for use in demand response. As part of the ARENA DR trial all customers had kWatch controllers installed.

The ARENA demand response trial provided significant learnings opportunities around the installation, integration and interaction of controllers with customer assets. Installing and integrating

control technology on customer sites provided more challenging than initially anticipated, which was instructive in considering how to roll out controllers at scale. However, despite these challenges the controllers were still successfully deployed and customer assets were controlled in order to participate in grid security events, showing that there is significant value in fully integrating control.

Additional Objectives

"Demonstrate that load management has benefits throughout the year."

Many of the customers participating in Flow Power's ARENA demand response trial were new to the concepts of demand response and demand management. By having a funded framework to explore how demand response could work at their site they were able to explore load flexibility concepts more broadly.

Notably two customers implemented significant load management regimes active throughout the year:

- A cold storage customer implemented a fixed daily load shifting regime, switching off power to the freezers between 6:00 and 8:00; and 16:00 and 18:00. Although not a perfect reflection of market peaks, this fixed regime of load shifting typically captures the most expensive periods of the day, minimise the customer's exposure to high wholesale prices.
- A steel smelter implemented an automated demand response system which switched off power to the smelter when wholesale prices exceed $300/MWh and provided a warning to operators when the price exceed $100/MWh.

These two examples customers with flexible load implementing year-round load management contributed significantly to reducing their electricity costs and extending the idea of demand response purely as reserve capacity.

"Build the business case customers to participate in demand response."

The ARENA demand response trial provided a significant initial carrot to interest commercial and industrial customers to implement demand response. The success of the program was seen in the willingness of customers to continue to provide demand response of part of Flow Power's other offerings – customers from the ARENA demand response trial transitioned into Flow Power's non-ARENA RERT portfolio at the conclusion of the trial. Additionally several customers took up a spot price responsive demand response.

In another successful demonstration of the business case of demand response, a customer with three sites in the ARENA demand response trial signed up half a dozen other sites in other states to Flow Power's other RERT portfolios.

"Understand the triggers for customers responding to energy signals."

The ARENA demand response trial provided evidence of how different customers were incentivised by differing energy signals. The capacity-style payment of the ARENA trial was enough to incentivise many customers, but Flow Power also encountered a number of prospects who advised that the amounts being paid were not enough of an incentive to implement demand response. This was typically true of customers who felt that they had no load flexibility whatsoever and were unwilling to explore the opportunity further.

Outside of the ARENA demand response trial Flow Power's experience with RERT and spot price responsive demand response has provided valuable insight into the industries best suited to demand response and the price points at which demand response becomes appealing.

"Increase the awareness and participation of demand response in Australia."

The ARENA demand response trial coincided with a flurry of demand response related activity in Australia – the development of the wholesale demand response mechanism, the Energy Security Board's demand side participation workstream and the activation of the RERT mechanism over three consecutive summers.

All of this activity helped bolster the awareness and perception of the role that demand response could play in the NEM. Flow Power took advantage of this broader market awareness by encouraging customers to participate in spot responsive demand response and Flow Power's non-ARENA RERT portfolios.

Flow Power also built on the momentum of demand response in the broader market by producing regular webinars highlighting the advantages of demand response for commercial and industrial customers and participating in industry forums to promote demand response. These public-facing materials helped raise both profile of demand response in Australia and Flow Power as a leading provider of demand response in the market.

Flow Power has also worked with the University of Technology Sydney and RMIT providing case studies and anonymised customer data to further their research into the uptake of demand response in the NEM.

"Finalise development and testing of the kWatch Intelligent Controller."

At the beginning of the ARENA demand response trial the kWatch Intelligent Controller was a new device, experiencing issues with installation, configuration and ongoing reliability problems.

The experience of the ARENA trial was invaluable in working through these challenges to produce a robust working controller that can be deployed to any commercial and industrial customer.

Knowledge gained during the ARENA trial has also informed the development of the next generation of the controller, including helping to reduce the cost to manufacture and streamline the critical elements of the controller that are valued by customers.

8. Project Key Lessons

After three years participating in the ARENA demand response trial, as well as an equivalent amount of time providing demand response based RERT portfolios outside of the ARENA trial and over a decade of spot price responsive demand response experience, there are some demand response learnings that stand out:

- A balanced demand response portfolio – the ARENA demand response trial highlighted the risks associated with having an uneven spread of customer load sizes. Ultimately the Flow Power portfolio was over-reliant on a single large customer. Demand response portfolios should strive to consist of a spread of evenly sized customers and across different industry verticals. The reliance on one single customer or single type of industry presents significant risks to achieving a desirable outcome during activations.
- The combination of spot price responsiveness and RERT – some customers in Flow Power's portfolio responded to both wholesale price signals and reserve signals. In most instances tight reserve conditions coincide with extremely high prices, however some limited cases see a separation in triggers (a key example of this was the administered pricing experienced on 25 January in Victoria). The other challenge with dual trigger customers was erosion of the baseline. The CAISO baseline used in the RERT program has a scalar adjustment that is particularly sensitive to changes in load prior to the start of a demand response event. Customers responding to high prices which preceded RERT events by more than two hours experienced significant reductions in their baseline usage which subsequently reduced their payments from the RERT program.
- The static nature of RERT nominations – the size of RERT portfolios are nominated by submitting a static number, based on a single test. Although the ARENA trial included winter and summer testing, the target size of the portfolio was still the same. This does not leave the ability to reflect loads which vary significantly between winter and summer (agricultural loads in particular). Indeed time of day was another factor observed to affect the measure size of the portfolio. RERT nominations could be improved significantly by making allowances for the size of the portfolio based on the time of year or time of day activations are expected.
- Hardware challenges – installing, integrating rolling out hardware to commercial and industrial customers is a challenge that should be underestimated. The range of different electrical configurations seen at commercial and industrial customers relative to residential customers, and the requirement to coordinate full or partial site shutdowns between electrical contractors and customer production schedule complicate the integration of hardware at commercial and industrial sites. These problems are not insurmountable, but they increase the cost and require careful planning and management to execute efficiently.

9. Key contacts

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