Backup Boost Knowledge Sharing

Report #5

30 October 2022

enel x

Overview of the trial

We are proud to partner with the South Australian (SA) government to provide support to local businesses by changing the way they use energy.

Enel X and the SA government are investing $2 million each to unlock the potential for cheaper more reliable electricity, supporting backup generator upgrades and battery energy storage systems (BESS) across several SA businesses.

The works will be partially funded by the SA government's Demand Management Trials Program, with no requirement to repay, to accelerate sites' entry into the market. The remaining costs are recovered by earning revenue under our demand response programs.

This project will upgrade existing backup generators or install new BESS at eligible businesses in SA and test the ability to:

> create an aggregated portfolio of fast-responding, dispatchable generation

> improve liquidity in the contract market

> show that demand response can bring financial benefits to participating businesses and consumers more broadly.

This is the fifth of our knowledge sharing reports where we share findings on the effectiveness and challenges of using backup generation and BESS in the wholesale market and selling financial derivative products on the ASX. It includes and builds on the information and findings set out in previous reports.

Meeting the objectives of the trial

The purpose of the trial program is:

> to show how existing backup generators or BESS can provide dispatchable demand response capacity in the NEM, and deliver value to small-medium commercial and industrial businesses in SA

> to assess the viability of selling a cap product in relation to the aggregated generation capacity.

The first stage of the trial focused on recruiting customers. We spoke with a lot of SA businesses and found that many have a strong interest in using their backup generators more flexibly and benefitting from opportunities to participate in the spot market. Those without backup generators are keen to explore opportunities to install onsite BESS. Enabling demand flexibility to help support the uptake of renewables is a driver that resonates strongly with many SA businesses.

Enel X now has over 10 MW of dispatchable capacity contracted for participation in the trial program. This capacity is located at eight sites for businesses in the materials manufacturing, food manufacturing, cold storage and water sectors. An outline of the lessons learnt and trial outcomes to date is set out in this report.

The next stage of the project will focus on:

> enrolling more businesses for participation

> enabling signed sites for market participation, including through generator upgrade works and the installation and commissioning of onsite BESS

> offering that capacity into the market over the summer period

> continuing to sell a cap product in relation to enabled capacity.

Trial outcomes to date

Customer recruitment and enablement

Enel X now has over 10 MW of backup generator and BESS capacity contracted for participation in the trial program. Approximately 6 MW of this capacity comes from backup generators, and 4 MW from BESS. These assets are located at eight sites owned by a number of businesses in the materials manufacturing, food manufacturing, cold storage and water sectors.

The backup generators at participating sites have been upgraded by Enel X, and other metering and communications equipment has been installed to enable those sites to participate in Enel X's virtual power plant (VPP). Construction and installation works at the BESS sites are also now substantially complete, with testing and commissioning works to be carried out over the coming months. Once complete, the BESS sites will also be enrolled to participate in our VPP. Participation in the VPP enables the customers to receive a greater return from their assets whilst contributing to grid reliability in tight supply/demand conditions.

Enel X continues to engage with identified customers and prospect for new customers to join the program.

Dispatch events

Trial participants' generator capacity is offered into the market as soon as Enel X has completed all site enablement activities. Enel X now has over 5 MW of capacity enabled for market participation through this program, all of which is backup generator capacity.

Demand response dispatches tend to occur when spot prices are high because of tight supply/demand conditions across the grid. In general, high prices are driven by a combination of the following factors:

> Very hot or very cold weather. Temperature extremes tend to increase demand above forecast levels.

> Low wind and solar PV output. South Australia's generation mix is dominated by renewable sources. Spot prices often increase when renewable output is low. For example, price spikes are often seen on hot days in the late afternoon when rooftop solar PV output drops off.

> Large generator outages. Planned and unplanned outages of large generators reduce available supply and can lead led to low reserve conditions, particularly when demand is high.

> Transmission line outages. Constraints on the interconnector between SA and Victoria, and between NSW, reduce available supply to SA and can drive prices higher.

There were 28 dispatch events in the reporting period (1 May 2022 – 30 Oct 2022). This is significantly more dispatches than the same time last year, reflecting the greater incidence of high spot price events due to tight supply and demand conditions in the energy market this year. Generation supply was affected by coal plant outages, reduced coal fuel availability relating to high rainfall earlier in 2022, international gas supply shortages (due to sanctions on Russia) drawing Australian production offshore, and limitations in domestic gas transport due to pipeline congestion. These tight supply conditions coincided with Australia's peak in winter demand. As a result, June 2022 and other short periods after were dominated by consistently high energy prices ($300-$700/MWh).

Key metrics from the 28 dispatch events are set out in the table below. Dispatches tended to occur during periods of low wind and solar output, when reserve generation was at about 50 per cent, and when South Australia was drawing significantly on the interconnectors to Victoria. The average price during events was $3,425/MWh.

Event number	Event date	Event start time	Event duration (hours)
1	9-May-22	4:35 PM	2.4
2	10-May-22	7:45 AM	0.6
3	10-May-22	5:05 PM	1.6
4	11-May-22	6:45 AM	2.1
5	12-May-22	7:30 AM	0.7
6	17-May-22	6:40 AM	1.8
7	26-May-22	5:40 PM	0.8
8	1-Jun-22	5:45 PM	1.1
9	2-Jun-22	4:50 PM	2.2
10	5-Jun-22	6:10 PM	0.5
11	13-Jun-22	6:00 PM	2.5
12	30-Jun-22	6:35 PM	0.4
13	7-Jul-22	7:55 AM	0.5
14	8-Jul-22	7:50 AM	1.7
15	12-Jul-22	5:05 PM	1.4
16	14-Jul-22	5:30 PM	1.5
17	27-Jul-22	6:20 AM	2.0
18	28-Jul-22	7:00 AM	1.8
19	10-Aug-22	11:50 AM	1.0
20	25-Aug-22	7:05 AM	1.9
21	26-Aug-22	6:10 AM	2.8
22	26-Aug-22	2:10 PM	1.3
23	26-Aug-22	5:00 PM	0.7
24	1-Sep-22	6:15 AM	2.8
25	7-Sep-22	4:50 PM	0.5
26	7-Sep-22	11:30 PM	1.2
27	8-Sep-22	6:55 AM	0.5
28	22-Sep-22	7:15 PM	0.5

The portfolio's dispatch performance across the events was not as strong as expected. Technical issues were experienced at some of the generators, which meant that they could not participate in all events or did not perform as to their full potential. These issues are in the process of being resolved to enable full market participation and higher performance in future dispatches.

In general, the customers in the portfolio did not fatigue over the period, despite being called to dispatch a significant number of times. This is most likely due to the fact that the portfolio is highly automated and customers are now quite experienced at dispatches.

Financial performance

Trial participants received energy payments in accordance with their contract with Enel X for the 28 dispatch events.

Enel X sold $300 caps for Q2 2022 and Q3 2022 against the participants' generator capacity. Cap products provide a firmer and more reliable source of revenue for customers because it means they don't have to rely on energy-only revenue if, and when, high price events occur.

Lessons learnt to date – backup generators

The opportunity is big, and interest is strong

Since the trial program started, Enel X has searched across SA's commercial and industrial sectors for sites that might be suited for participation. Several businesses have approached Enel X directly too. This has unearthed a great number of businesses that have backup generator capacity and are interested in an opportunity to maximise the value of that investment.

Conversations with customers have expanded to discussions about the future of the energy grid and the NEM, and the need for alternative supply sources including virtual power plants. This shows a genuine interest in the energy system and the objectives of the demand management trials program.

However, not all sites are suitable for participation

While we've had a significant amount of interest in this project, not all business sites are suitable for participation. Many have been deemed technically and/or commercially unviable for a range of reasons, including:

> The site doesn't already have a generator, and the cost of installing one would be prohibitive.

> The site has an old, under-sized or poorly maintained generator.

> The cost of connecting the generator to the network is prohibitive (explained further below).

> The site has a solar PV system and/or reduced operations, which means the generator would not have much load to support during an event.

> The site has a peaky or unpredictable load profile.

We have learnt a lot about the types of businesses that are likely to encounter the above issues. This has helped us to narrow down which types of sites are best suited to participation in the trial.

It's important to identify the decision makers early

Another lesson learnt is the need to progress as quickly and efficiently as possible to business decision makers. Sometimes the interest shown by staff at the site level is not matched by higher management, who may not see participation in the trial as a business priority.

If we are able connect with the right people within each business early on, we are likely to get a better understanding of the priority of program participation compared to other business objectives and see a faster turnaround for decision-making.

This was particularly challenging during the COVID-19 pandemic, which diverted management attention away from opportunities like this to focus on core business activities. However, with restrictions largely eased in SA, businesses are returning their attention to opportunities such as this.

It's important to really understand the site's load profile

A stable and predictable level of demand is important to be able to rely on the customer to provide the anticipated level of demand response when called on.

While manufacturing sites' operations can be quite variable within a day, their year-round load profiles are relatively predictable, including through summer. The cold storage sites provide storage and distribution services for refrigerated and frozen products to customers across SA. Cold storage facilities tend to have a stable baseload demand year-round, dipping slightly in the winter months due to lower ambient temperatures, and increasing between November and March when more cooling is required.

Our experiences so far have shown that we need to have a very accurate and detailed understanding of the site's load during expected dispatch timeframes (e.g. late afternoon to early evening) and the generator's likely output.

We conduct comprehensive tests before enrolling a customer. To do this, we request consumption data for the individual loads on site, as well as interval data at the gate/parent meter, including any customer SCADA data available for the past 12-36 months. This information helps to manage both our expectations and the customers' about what demand response capability will be available when an event occurs.

The costs of connecting a generator to the network is a significant barrier

We have found network connections are the most significant barrier to participation. A network connection is required if the customer wants to earn additional revenue from exporting energy, rather than just displacing their load.

The cost of connections, and therefore the financial viability of export, can vary greatly depending on the geographic location of the site within the network, and whether generator export is permitted.

If there are constraints on the network, the network service provider may either:

> not permit any additional generation to connect, or

> require the installation of additional protection and control solutions.

This appears to be particularly the case for sites in the Adelaide CBD.

Protection and control solutions increase the cost of site enablement substantially. So, even if connection is technically achievable, the costs of connection can deem many projects financially unviable.

Therefore, we have focused our attention on sites that would not require significant network connection works, and in general have not sought to achieve export capability. As a result, none of the participating backup generator sites have export capability.

Customers' retail contracts can also present a barrier to demand response participation

An issue Enel X has encountered not just in SA but NEM-wide is customers having clauses in their retail contracts that either prevent them from entering into a demand response arrangement with a third party without the retailer's consent, or that explicitly prohibit the use of a backup generator for any purpose other than for backup in an emergency (i.e. not for demand response).

On the first type of clause – retailers have little incentive to provide consent or to give it in a timely manner. If the process is too hard the customer may decide to abandon the idea entirely. Resolution of the second issue requires an amendment to the customer's retail contract, which again can take time and poses another barrier to demand response participation.

Dispatch performance will be lower on days when the site is using less electricity

While it will depend on the individual business, many commercial and industrial customers have Monday-Friday operations, using less electricity overnight and on weekends.

For sites with no export potential, backup generator capacity is used to support site load during a dispatch event. If there is not much load being used at the time, the amount of generator capacity dispatched to serve that load will be lower.

It is still preferable to dispatch a site during an evening or weekend event, even if it can't give its full nomination due to low demand at the time. We have planned to communicate better with customers ahead of time so that all parties have a clear understanding of the site's expected performance during the dispatch event.

Strong communication with customers before and during an event is vital

As noted in a previous knowledge sharing report, several customer sites experienced issues with their technical capability to respond to dispatch events in early 2021. This included a technical failure at one site and system configuration issues at another. As a result, the portfolio's performance during both events was not as strong as we expected.

These issues are now resolved; however, they highlight the inherent unpredictability of an individual load. It has also shown that we need to ensure we are aware of any issues on site before or during an event, and therefore have a clearer understanding of expected performance. Feedback from participants has also indicated that customers are keen to learn about their performance as soon as possible after an event, which we have taken onboard.

Finally, whilst the sites are now largely remotely operated by Enel X, customers still appreciate receiving notification of potential events, as there can be a few minutes of interruption when the generators are starting up and site operations switch from grid supply to backup generator supply. This also gives customers time to ensure adequate fuel levels and to make sure that all hardware is working.

These are important lessons that we will apply to all participants in the Backup Boost program.

Impact of dispatch during high solar PV output

Enel X dispatches the generators during periods of forecast high spot prices. High spot price events usually coincide with periods of high forecast demand (due to weather) and periods of low wind and/or low solar PV generation output. These periods tend to occur in the late afternoon to early-mid evening when there is lower solar PV output than during the middle of the day.

Many dispatch events occur in the late afternoon and evening when solar PV output across the grid drops off. This reflects an ongoing trend of low or even negative spot prices during the day when solar PV output is high, followed by prices increasing when solar output decreases. At times after solar PV output decreases, flexible demand, such as that enabled by the Backup Boost program, is most valuable to the market.

Individual customer experiences

Feedback from the customers we have signed has been generally positive.

As noted above, interest from potential trial participants is strong and many are eager to participate provided their site is technically and commercially viable. Enel X's ability to recruit trial participants has been supported by positive experiences

of working with Enel X in other jurisdictions or demand response programs. One of the manufacturing customers cited positive experiences from being enrolled in a previous demand response program with EnerNOC (now Enel X) in 2010-11. The same customer also cited positive experiences with Enel X at one of their sister sites enrolled in a demand response program in Western Australia.

Sites that respond automatically to an Enel X dispatch instruction generally deliver stronger dispatch performance. Sites that retain manual control can take up to 10 minutes to turn on their generators, whilst automated sites can respond within 1-2 minutes of a price spike. Automated sites therefore deliver greater certainty and speed of dispatch, which means we can negotiate more favourable pricing for this capacity.

Customers have appreciated our regular and timely communication about market conditions and the likelihood of dispatch events. And in general, customers in the portfolio have not fatigued, despite having now been called to dispatch a significant number of times. This is most likely due to the fact that the portfolio is highly automated and the customers are now quite experienced and comfortable with dispatches.

On a broader level, customers see participation in Enel X's VPP as a win-win. It enables them to access a new revenue stream and contribute to the reliability of the grid on days of high demand and / or supply shortfalls.

Patterns in customer experience

As we still have relatively few participants in the trial program, we cannot identify any strong patterns in customer experience across industry sectors, generator size or geographic location. We hope to do so in the later stages as more businesses are enrolled and enabled for market participation.

However, our experiences to date indicate that:

> sites that have a stable and consistent load during high demand periods, in both summer and winter, are likely to be better performers in this program

> sites located in the Adelaide CBD are likely to experience greater barriers to participation if export capability is sought, given network constraints in the area

> most customers appreciate being able to earn a predictable and steady revenue stream via availability payments, and recover their costs when required to run their generators during dispatch events

> participating businesses were happy to be dispatched as much as they were in the reporting period, which is not always the case for businesses offering demand response.

Many commercial and industrial businesses have standard retail contracts, which do not include exposure to the wholesale spot price. While the backup generators on site certainly provide protection against power outages and brownouts/blackouts and allow business continuity, they don't provide an explicit hedge against price volatility if the customer is on a standard retail contract.

In future we may recruit customers who have some degree of exposure to wholesale spot prices. If so, we will provide an update on whether their backup generators are effective at being used as a hedge against wholesale price volatility.

Businesses prefer firm availability payments

Enel X's standard pricing structure is to provide businesses with a steady and ongoing stream of "availability payments" for their capacity, and then "energy payments" to cover the costs of running the generators, such as fuel. An alternative is

to offer no availability payments but higher energy payments during dispatch events, typically when spot prices are forecast to be high.

We have found that most prospective participants prefer firm availability payments over energy-only payments for energy delivered during events. Like most businesses, they prefer ongoing and predictable revenue streams year-around as opposed to uncertain but potentially very lucrative energy payments.

Sale of cap products, and impact on contract market liquidity

Enel X sold $300 caps for Q2 2022 and Q3 2022 against the participants' generator capacity. Cap products provide a firmer and more reliable source of revenue for customers than energy-only payments, which are only paid if, and when, the generator is dispatched.

Traditionally, volatility above $300/MWh has been confined to a small number of hours in the quarter. As the energy crisis unfolded through May and June, the number of hours in which prices exceeded $300/MWh increased significantly, at times up to all 24 hours of the day. Market prices in those quarters significantly exceeded cap premiums where we had sold in advance, resulting in lower-than-expected revenue. This loss can be offset by dispatching the generation portfolio during high price events. However, as there are limits on how long customers can / are willing to run their generators for, this is not an effective strategy during sustained periods of high prices.

Because of chance of these conditions recurring, we are looking at other hedging products that better match the physical characteristics of the generation portfolio. We are also re-evaluating the level of hedging needed, as there is now a smaller chance of an extended run of low prices. Fundamentally, the risk-reward calculation for $300 cap sales has shifted.

Impact of five-minute settlement

Five-minute settlement began in the NEM on 1 October 2021. This changed the way the market is settled from an average of the price from six five-minute dispatch periods to the price in each five-minute dispatch period.

Under 30-minute settlement there were occasions when price spikes were caused by generator rebidding rather than fundamental mismatches in real-time supply and demand. The move to five-minute settlement has meant that generators can no longer rebid and spike prices to gain value. The frequency of this type of occurrence has decreased after moving to five-minute settlement. While not potentially being directly related to the settlement change, it does appear that it could be due to prices more closely reflecting supply and demand conditions.

Enel X implemented no major changes to its dispatch strategy following the introduction of this change. However, it is now much harder to capture the value of very short events as prices are no longer averaged over the 30-minute interval. Nevertheless, we have not observed a significant change in market prices due to the switch to five-minute settlement, nor has it significantly changed the value capture we can achieve for our customers.

Lessons learnt to date – battery energy storage systems (BESS)

In October 2021 Enel X and the SA government negotiated an amendment to the Backup Boost program to allow for the installation and use of BESS at participating customer sites. We asked for this amendment because businesses without backup generator capacity are increasingly interested in BESS as a way to manage supply reliability, reduce costs and support the renewables transition. The amendment has provided an excellent way to help businesses achieve these objectives, and also achieve the objective of the trial program.

Some the lessons we've learned about BESS to date are set out below.

In general, there are a lot of processes that need to be navigated to deliver a BESS project. This includes fulfilling planning requirements (native title, environmental), preparing connection applications, determining site electrical infrastructure and physical location, carrying out data collection, undertaking geotechnical reports and selecting OEMs. The key lesson we have learned so far is to start engaging on these processes as early as possible.

Building the value proposition

Where a business does not already have a backup generator, it is generally much more interested to explore onsite BESS than a backup generator as a solution to their energy requirements. The narrative around supporting the grid by enabling greater renewable penetration appears to resonate strongly. So, there is significant interest.

However, maximising value from BESS is more complex than that for a backup generator. As a new entrant to the BESS market, we have needed to innovate our commercial model by taking on more risk while market experience grows.

Network connection requirements and processes

Our experience to date is that SAPN does not consider time of export in its assessment of a BESS application – that is, a connection application will be assessed having regard to its potential to export, not the times at which that export is likely to occur. Given the high levels of solar PV penetration in SA, the operation of most BESS would be optimised such that they do not export during periods of high solar PV output. Making a time-based assessment of export access would likely reduce connection barriers and encourage the further uptake of BESS in SA.

We've also found SAPN's ramp rate requirements for BESS are quite restrictive and could undercut the use case for distribution-connected BESS, particularly in a five-minute market. These requirements (which derive from AS4777 and were designed for PV inverters) are stricter than grid-connected backup generators, despite reciprocating engines having the potential to create more fault current issues.

SAPN requires all inverters to meet AS4777.2 2020, regardless of size or voltage connection, which differs from other DNSPs' practices interstate. We've found that some suppliers are reluctant to invest in certification under this emerging market, which can lead to supply constraints and cost increases for BESS projects in SA.

In terms of process, SAPN (as with most DNSPs) will only start the clock on assessing an application once all information is received and will require new applications to be submitted where the project characteristics change. This is reasonable but can be challenging for market participants navigating the process for the first time.

We've also found that the connection approval conditions can vary for different sites within the same network.

The uptake of distributed battery systems will be held back if connection conditions are not more consistent between projects and proportionate to the risk that the battery presents to the network.

Procurement and contracting with suppliers and delivery partners

The BESS market is relatively mature for residential and utility-scale applications. However, there is only a small field of suppliers serving commercial and industrial customers, particularly where local certification is a pre-condition (as above). This means that equipment costs are relatively higher than larger applications, and it is critical to focus on standardised sizing rather than custom configurations to control costs. Engineering, procurement and construction (EPC) costs are relatively high as a percentage of total costs, relative to other markets. There appears to be a large risk premium built in (relative to other energy projects such as solar) due to the nascency of the markets. However, we have seen an opportunity to work with EPCs to bring these costs down with greater risk sharing.

The labour market is still tight as a result of COVID-19 and the significant number of infrastructure projects underway across the country. This makes selection of contractors challenging but very important to manage costs and timeframes for delivery. We have learned to engage with potential contractors earlier and allow them more time to quote.

We are also seeing the contractor market start to evolve to become more comfortable with battery projects. In the early stages of the BESS projects, very few contractors had the requisite experience or were willing to carry out the work. This has since changed as contractors build their experience, which has meant the contractor market is becoming more competitive.

In general, the battery market is substantially constrained. Global supply chain constraints and a surge in demand have resulted in significant cost increases and lengthy delivery timeframes for components. The economies of scale that exist for large battery systems do not yet exist for smaller LV-connected systems. In an ideal world, major equipment procurement would be held off until all planning and grid connection approvals are obtained. However, in the current environment there are a major equipment price risks – the price of some components has increased more than 50 per cent while waiting for approvals. As a result, battery proponents must be willing to accept a much higher level of cost risk than other distributed energy projects.

To find out whether your business can be a part of this program, get in touch with our team at info.enelxanz@enel.com.