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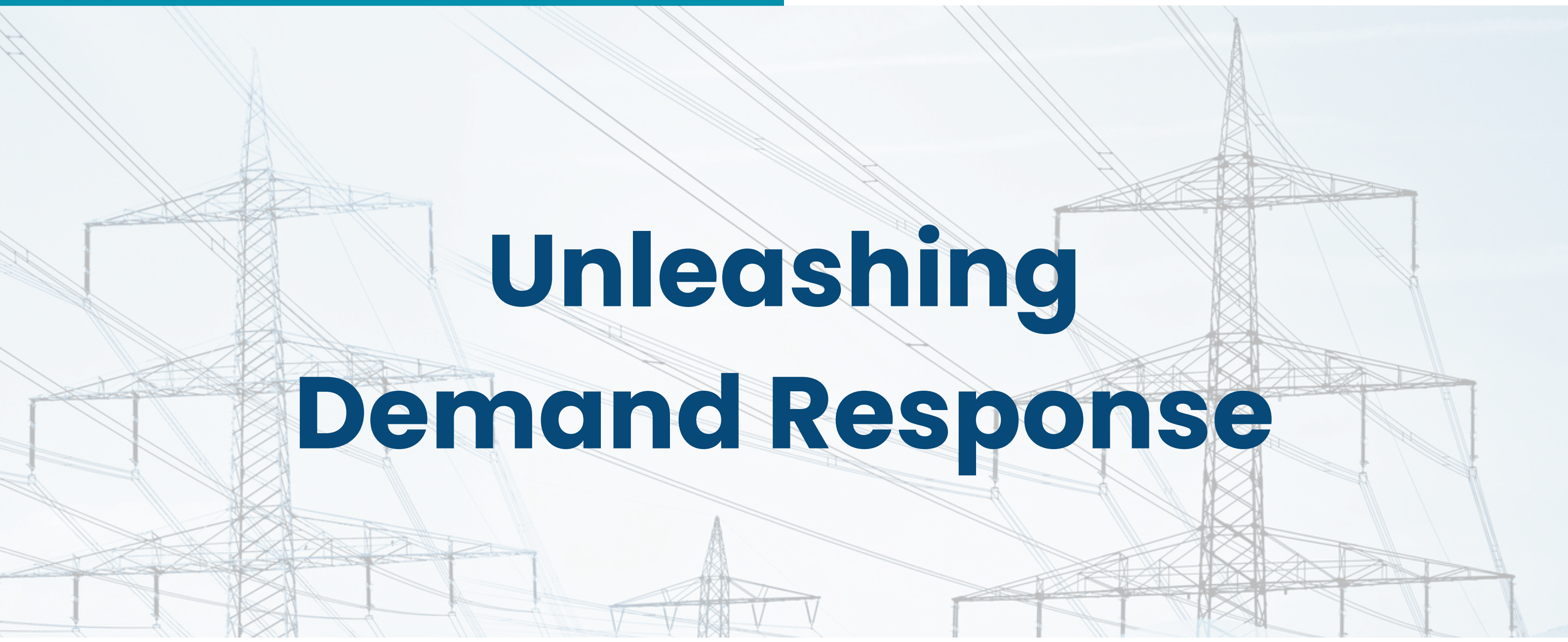


Unleashing Demand Response

Welcome to Energy Link's publication of a perspective newsletter!

Each publication, we provide insights into news or topics within the electricity industry from Energy Link's perspective.

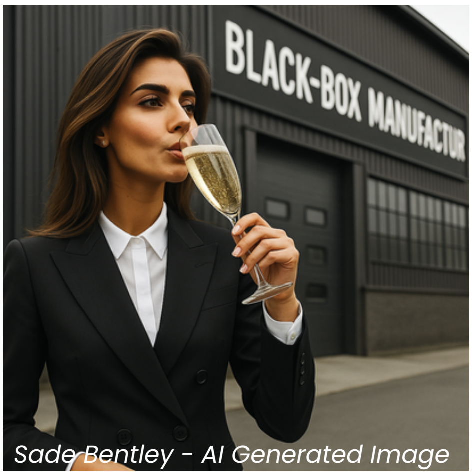
Discussion

Would more Dispatchable Demand be valuable in terms of keeping prices down and keeping the lights on?

If it is valuable, then how should it be set up to solve the issue of cost recovery?...

Unleashing Demand Response

Back in September-October 2024 we related the story of Sade[1] Bentley, and the frustration she faced while attempting to make demand response available to the electricity market. This was the second in a series of posts about demand response, starting with a description of the demand response arrangements in place under the new supply contracts for the Tiwai Pt aluminium smelter, signed in May 2024. Then came the story of Sade, and we finished the year with a post about the importance of demand response signalling its value to the market. This post is the final one in this series on demand response, and returns to Sade's story.



Sade Bentley - AI Generated Image

But first, let's briefly recap: Sade is the owner and Managing Director of the very successful Black Box Manufacturing (BBM) company based in Winton, Southland. The demand for black boxes took off in 2022 with the release of ChatGPT and the rapid rise in AI applications.

As a large electricity user, BBM could offer 10 MW of generation into the market based on having a reliable diesel genset on site, or it could bid 10 MW of demand into the market as dispatchable demand (DD). Sade discovered that offering the generation could be done while covering all costs, and perhaps even making a profit.

What Sade didn't realise, however, was that bidding DD would not recover costs, even though generation and negative demand (DD) are equivalent in terms of balancing supply and demand and ensuring a secure electricity supply.

There has only ever been one consumer using DD in New Zealand, and that was the paper manufacturer Norske Skog, which closed its NZ operations in June 2021. This incredibly low level of uptake confirms that DD is not working for consumers, or electricity retailers on consumers' behalf.

Coincidentally,[2] at the time we first wrote about Sade, the Major Electricity Users Group published a set of case studies of their members including Fonterra, NZAS and Oji Fibre Solutions and they all note that lower prices (through demand response) are not enough on their own to incentivise demand response. The basic problem, as Sade discovered, is that DD can only turn load off or on; it can never, and has never, provided a means by which the cost of setting up and bidding DD can be recovered.

The nub of Sade's problem was that offering 10 MW of DD achieved exactly the same end, in terms of balancing supply and demand, as offering generation, but generation could 'wash its face' whereas DD could not. **Where then, is the incentive to provide DD to the market?**

1. Pronounced Sha-day.

2. Truly – the author did not know about the MEUG case studies when writing about Sade.

This raises two questions: first, would more DD be valuable in terms of keeping prices down and keeping the lights on? Second, if is it valuable, then how should it be set up to solve the issue of cost recovery?

We only need to look at the events of 2024 in the electricity and gas markets to get the answer to the first question, in the form of the massive demand response provided by the Tiwai Pt aluminium smelter, which last year and this year, helped to keep lake storage levels from falling too far too fast.

But Tiwai is compensated for this demand response under new agreements it has with Meridian Energy and Contact Energy, not through any mechanism that is defined under the electricity Code (the rules of the market), in the way that DD is defined.

But the answer to the second question is also relatively obvious: treat DD, and its cousin "Dispatch Notification Load" (DNL), as generation.

Yes, you read that right – **treat demand as generation. More specifically, treat short-term demand response as generation.**

If DD was offered as generation, then a generation dispatch instruction for X MW would be read as 'reduce demand by X MW'. It's really quite simple, because reducing demand by X MW achieves the same outcome, in terms of balancing supply and demand, as increasing generation by X MW.

So, let's return to BBM and look at some of the details to see how this could work for Sade.

The Code currently contains three classes of generator: what we will call the default generator class, intermittent generators (wind, solar, run-of-river hydro for example), and type A or B co-generators.[3]

The default generators must follow dispatch instructions with an accuracy of 1 MW. But DD and DNL cannot always be dispatched this accurately. In Sade's case, BBM nominally has 10 MW of process demand which can be bid as DD, but in practice this demand varies across each day in proportion to the process throughput, and this can change rapidly. For example, 10 MW of DD might be bid into the market but only 5 MW might be available when dispatched.

As a result, DD is currently given an accuracy of between 5 MW and 10 MW, which raises the question: **is it appropriate for DD and DNL to be offered like generation if they cannot be dispatched accurately?**

3. Cogeneration is located at an industrial site and produces both heat for an industrial process and electricity.

But in today's highly renewable market, a large number of generators already have this amount of leeway, or more, in following dispatch instructions. Type A co-generators have a tolerance of 5 MW and intermittent generation a tolerance of 30 MW, so DD and DNL would fit somewhere between these two classes of generator.

If anything, the biggest barrier to turning DD and DNL into generation is likely to be a reaction along the lines of "that can't be, demand is not generation!"

In practical terms, we do not propose the abolition of DD and DNL, because some market participants already make use of these, for example operators of energy storage systems who need to be dispatched to increase storage at a price. (As an aside, it might be useful to roll the existing DD and DNL into a new class of energy storage systems, which would allow these systems to bid and offer in a single Code structure.)

Instead, the Code needs to have a new class of generator which could be called "balancing demand", for example, (BD). After all, generation balances supply and demand by adding supply, whereas DD and DNL balance supply and demand by subtracting demand.

Let's look at Sade's 10 MW of flexible demand as an example and, just for the sake of convenience, let's suppose this is the demand of a big electric motor which drives the process machinery through a series of gears. So BBM normally consumes 20 MW, which is made up of 10 MW at the motor and 10 MW of other demand.

Let's also assume the total cost of offering the motor as BD is $1,000 per MWh dispatched, which includes allowances for the cost of setting up the motor to respond to dispatch instructions, staffing costs, lost profit, and any other costs incurred when the process is dispatched down. If it were me, I'd add a margin for risk as well, because I would not know ahead of time how often the process would be dispatched down.

Then the 10 MW could be offered as BD at an offer price of $1,000/MWh, or $1,000 for short. (If you want to skip the math, scroll down several paragraphs now.)

Let's suppose a 10 MW BD dispatch instruction is received when the process is running at less than 20 MW, with motor demand of only 5 MW and the rest of the process demanding 8 MW, 13 MW in total. When this instruction is received, the motor would turn off, reducing demand by 5 MW. If this BD is on the margin, setting the price, then Sade will pay $1,000 for all 8 MW consumed during the period the motor is turned off, and receive $1,000 for the demand reduction of 5 MW.

First consider the financials when BBM is buying from the spot market, then the total electricity cost for Sade per hour of dispatch is 8 x $1,000 – 5 x $1,000 = $3,000 per hour, where the second term is the revenue received as a "BD generator": BBM is paid to reduce demand.

If instead the motor was bid as DD then we should assume the bid price is less than $1,000, because the $1,000 includes all the costs of being BD. Let's suppose the DD bid is $600, the value at which Sade wants to partially cap BBM's exposure to spot prices, and the DD bid is on the margin, then the total cost would be 8 x $600 = $4,800 per hour. In this example, offering the motor as BD is better than bidding it as DD.

In the case where the consumer only pays spot prices for electricity, then it turns out that DD can be better than BD in many instances. But in the example above, Sade could offer BD at any price up to $1,600 and be no worse off than bidding DD at $600. Without getting bogged down in the details, the incentive with BD would be to offer as much as possible at a moderate price, to maximise the amount of BD dispatched and hence to minimise the increase in the cost of purchasing the remaining demand, which would be at the BD offer price or higher.

But let's not get distracted by the issue of when DD might look better than BD, as **the whole point of offering BD would be to provide a cheaper alternative to having higher-priced resources dispatched.** Without BD, spot prices in our examples would be set even higher, or worse still, a shortage could result and then spot prices would be between $21,000 and $50,000: these prices are set when there is not enough generation to meet demand. With BD in the market, they would only be set this high when there is not enough physical generation plus BD to meet demand,

But, as we know, Sade is a smooth operator and wisely put hedges in place to reduce the volatility in the cost of BBM's spot purchases. Let's suppose BBM is 100% hedged at this lower level of demand of 13 MW, at a strike price of $120. With DD bid at $600, BBM is credited $1,440 per hour but with BD offered at $1,000 BBM is credited $8,440 per hour.

With the hedges in place, offering BD still sets a higher price than DD in this example, but the hedge now pays back more than is required to offset the higher spot price, and the BD provides revenue as well.

But what if BBM, like the vast majority of consumers, is actually on a fixed-price variable-volume (FPVV) contract? Under an FPVV contract, BBM buys electricity from its electricity retailer on a schedule of fixed prices. Let's suppose the fixed price is $120 under the scenarios above, when the spot price spikes to $1,000, a price set when BBM's BD is on the margin. Because BBM buys from a retailer, Sade must also negotiate an arrangement in which BBM submits its BD offer via its retailer, and the retailer pays Sade the revenue achieved when the BD is dispatched.

The three scenarios are:

BD not offered, motor not cut: cost = 8 x $120 + 5 x $120 = $1,560 per hour

BD not offered, motor cut: cost = 8 x $120 = $960 per hour

BD offered, motor is cut: cost = 8 x $120 – 5 x $1,000 = credit of $4,040 per hour

Under an FPW contract, with appropriate BD arrangements in place, Sade gets a large credit from BBM's retailer in this example to the tune of $4,040 per hour.

We can see that offering demand reductions as BD (instead of DD) potentially has significant benefits for consumers that are prepared to make these reductions to help balance supply with demand.

It is important to note that generators do not receive payments from the market if they don't generate, which is to say there is no availability payment for generators: if these were part of the Code, they would effectively be capacity payments, which don't fit with our energy-only market design. As a result of this, consumers offering BD would need to work out an offer price which covers their BD-provision costs based on an expectation of how many periods their BD would be dispatched.

The examples above gloss over an important point, that has to do with how the spot market is settled each month, i.e. who pays who for what. Once each month, the spot market Clearing Manager (CM) works out how much demand was actually taken from the main grid by electricity retailers and a handful of large electricity users (collectively known as 'spot market purchasers'), and how much was injected onto the grid by generators, The raw data comes from electricity meters, and it is combined with spot prices to work out how much spot market purchasers must pay to the CM and how much the CM must pay to generators. Needless to say, spot market purchasers must pay enough to cover all payments to generators, otherwise the market won't clear correctly.

But when BD is dispatched, it would not appear in metered demand, which means that total payments to the CM by spot market purchasers may not be sufficient to cover all payments to generators and to BD providers. As a result, introduction of BD would require changes to settlement and related processes.

For a start, there is a piece of software called RTD (real-time dispatch) which runs every five minutes to work out which generators should be dispatched to run, and how much each should generate. To ensure that the total of BD and generation matches total demand, the forecast demand that is used in RTD would need to count BD as if it will not be dispatched. This sounds odd, but if this does not occur, then the total dispatch of generation and BD will exceed forecast demand by the amount of BD dispatched, which would cause BD to be dispatched much less than it ideally should be.

Second, during the monthly settlement process, because metered demand would not include dispatched BD, there would need to be an additional payment made only to BD providers, equal to the amount of BD MW dispatched in each period times the relevant spot price in each period. This money would need to be collected separately from spot market purchasers: there are already a number of 'ancillary service' payments that are collected on this basis, so there is precedent for this approach.

Returning to our example above, with spot price of $1,000 and 5 MW of dispatched BD, suppose that total metered demand for NZ for the hour is 5,000 MW. To keep things simple, we'll ignore losses on the grid (which require extra generation to be dispatched over and above total demand) and also assume the spot price is the same at all points on the grid.

This gives us total dispatch of generation of 5,000 MW plus the 5 MW of BD, which is 5 MW greater than metered demand.

The total payments to the CM by spot market purchasers is 5,000 x $1,000 = $5 million per hour and the total payments to generators and BD providers is 5,005 x $1,000 = $5.005 million, which means there is a $5,000 'hole' in the settlements and implies the market does not clear.

So, the CM would need to collect the missing $5,000 from market participants as an ancillary service payment, and pay this to the BD providers.

Who would pay for BD? There are various ways this sum could be split between market participants, but since it primarily benefits consumers by helping to keep the lights on, it would make sense to divide it up between spot market purchasers in proportion to their respective purchase amounts.

An implicit assumption in this example is that it applies only to short-term demand response, so there is no suggestion BBM's 5 MW motor would be turned off for months at a time during dry periods with low water inflows into the hydro lakes. In practice, if the motor was dispatched off too often, Sade would 'call time' and simply withdraw BBM's BD offer from the market.

What about longer-term demand response that is required during dry periods, e.g. turning a potline off for several months at the Tiwai Pt aluminium smelter, as happened last year? That's a more complex scenario (if you didn't think BD was complicated enough!) and a story we'll pick up another day, as Sade will have her hands full working with her BBM ops team to get BD working, without having to think about dry years!

But returning to DD and BD, this seems to be an obvious change to make to the spot market that would allow consumers to recover the full costs of reducing demand at a price. There will be details to work out, no doubt, but it is clear that the current DD and DNL features of the market are not working for consumers (no one is using them!), so something needs to change, the sooner the better.

The introduction of BD, and its cousin "balancing notification demand" (BND), could lead to greater participation by consumers in the market as more and more consumers realise they can participate on an equal footing with generation. If there is sufficient BD and BND in the market, then it would go a long way to minimising shortages during periods of market stress.

Furthermore, as discussed in our post on signalling its value to the market, BD would put price signals into the market which would allow participants to assess the value of flexible assets which can help to balance the market, and provide better signals for when more generation is required.

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