

# Consumer flexibility: ready to replace coal

Octopus Energy Saving Sessions Analysis · Simona Burchill, Kieron Stopforth · 8 June 2023<sup>1</sup>

National Grid ESO's Demand Flexibility Service (DFS) was a landmark moment in the UK's energy transition. For the first time, ESO dispatched demand flexibility from homes to keep the energy system balanced. Developed in just five months, the Service paid 1.6 million UK households and businesses to shift demand, reduced energy use by 3.3GWh over 22.5 hours and provided a key contingency resource during an extreme winter.<sup>2</sup> The Service and the customer response proved that consumer flexibility is ready to deliver a low-carbon, cost-effective resource to the grid at gigawatt scale.

Octopus Energy played a central role in the Service. Saving Sessions - Octopus's customer offer - delivered over 50% of the total demand shift through a creative engagement campaign and financial incentive, and delivered using the [Kraken](#) technology platform. Octopus shifted 1.86GWh of demand over 14.5 hours, hit a peak reduction of 188MW, and paid out over £5.4 million to customers. In one event, customers delivered a reduction of 111MW with less than six hours notice, showing that consumer flexibility can deliver significant volumes on similar timescales to other grid resources. The potential is clear: if all customers with a smart meter in Great Britain (GB) were invited to participate, DFS could deliver over 2.1GW today<sup>3</sup>, offering a cost-effective replacement for coal contingency.

National Grid ESO is developing a second iteration of DFS for this winter. We fully support ESO and industry's efforts to evolve the Service and broaden consumer flexibility's use in grid balancing. ESO and industry must take three measures to mobilise demand flexibility to its full potential:

- 1. ESO, with Ofgem's backing, must confirm as soon as possible that DFS will be renewed and work with industry to deliver at gigawatt scale this year, ensuring that coal contingency is permanently retired;**
- 2. ESO must make key changes to DFS design to maximise participation this winter, including closer to real-time procurement and allowing for demand turn up; and**
- 3. ESO must give clarity on the future path to demand flexibility being used in grid operations permanently.**

We welcome feedback on the proposals.

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<sup>2</sup> <https://www.nationalgrideso.com/news/demand-flexibility-service-delivers-electricity-power-10-million-households>

<sup>3</sup> Octopus averaged 177MW in Live events from a base of 1.4 million installed smart meters. Extrapolating to the 17.3 million households with smart meters in GB would mean over 2.1GW of flexibility.

## Demand Flexibility Service recap

National Grid ESO created the DFS to manage system stress during winter 2022/23, based on trials led by Octopus Energy. The Service ran from November 2022 to March 2023. It was open to all suppliers and aggregators in the UK. 31 providers signed up in total.

The DFS dispatch process was as follows:

1. ESO sent a warning notice at 10:00 on the day before an event;
2. By 14:30, ESO sent a notice confirming the event and requesting volume and price bids;
3. Providers bid into the event by 15:30, and ESO confirmed or rejected these at around 16:30;
4. If the bid was successful, providers notified their customers, who needed to opt-in to the event. Octopus enabled this through emails and push notifications on its mobile app; and
5. After the event, providers sent results to ESO and paid customers. Octopus awarded “OctoPoints,” points that convert to bill credit or charity donations at a fixed rate.

The events were 1-2 hours long, and were flagged as either “Test” or “Live.” Test events were dispatched at a Guaranteed Acceptance Price (GAP) of £3,000/MWh. Live events were dispatched in response to system stress conditions and were cleared through an auction. The MW response was calculated against a baseline set by a customer’s average consumption on 10 previous, non-event days with an adjustment for same-day usage.

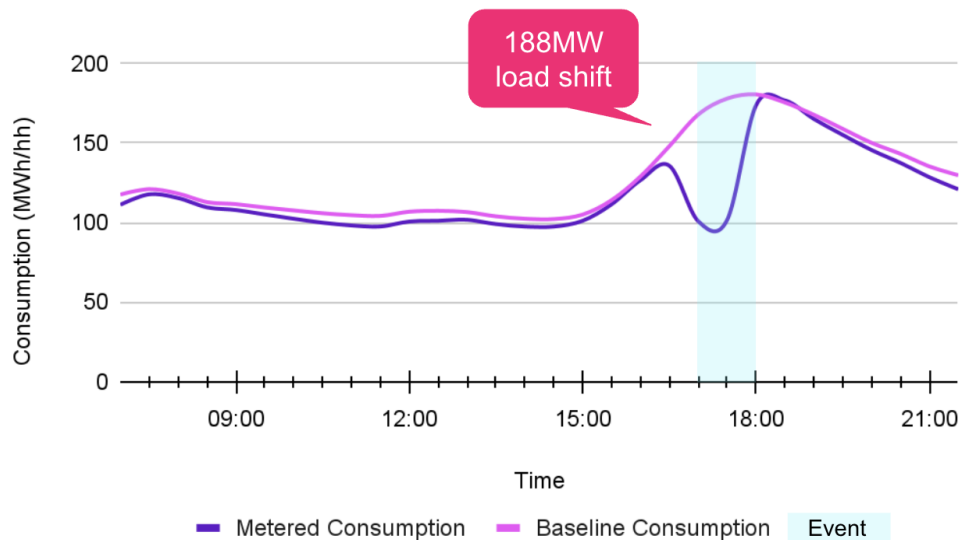
On 15 March 2023, Octopus tested customer participation and response at shorter notification periods. The process ran as above, except that customers were notified on the same day starting from six hours ahead of delivery up to the start of the delivery period.

## Saving Sessions results

Octopus delivered the single largest volume of any provider in the Service, 1.86GWh, and had the largest customer participation, with 700,000 households. In the past, domestic flexibility has had a reputation as an unreliable, variable resource, with limited customer interest in participation. However, Octopus’s results have proved decisively that domestic flexibility is ready for use as a grid resource today. In Saving Sessions, domestic flexibility: i) shifted demand at scale, without automation; ii) was sustained over the winter season at constant levels; iii) engaged a large set of customers; iv) provided demand shift at short notice; and v) delivered value to customers and the system operator.

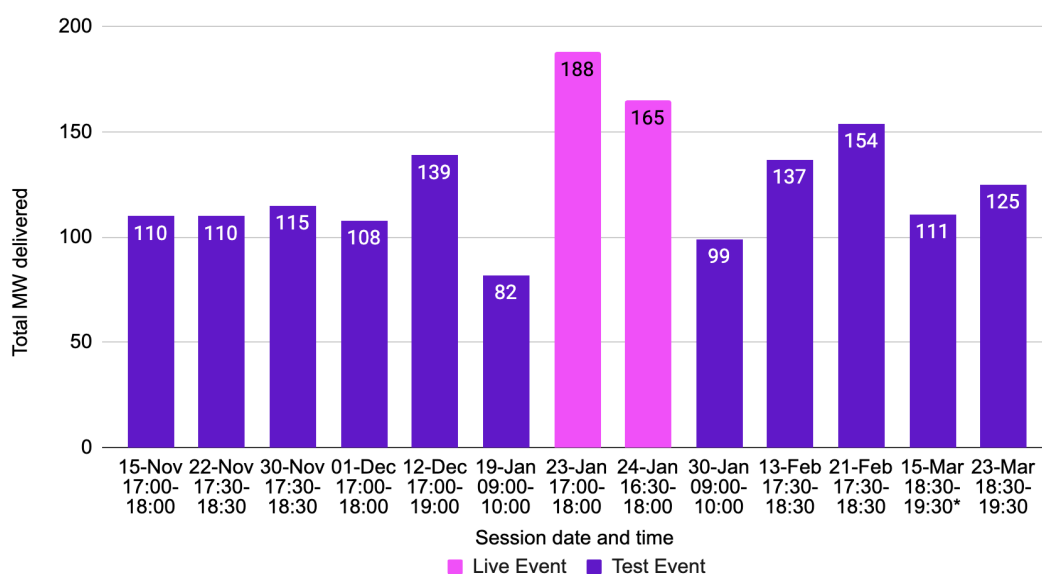
**i) Octopus customers delivered a peak power reduction of 188MW in response to real grid conditions, through manual dispatch alone (Figure 1).** On 23 and 24 January 2023, National Grid called two Live DFS events to support the system during cold temperatures and low wind conditions. Average demand reduction during the two events - on consecutive days - was 177MW. This was driven by a higher financial incentive, marketing efforts and general public awareness, through news coverage. The reductions were achieved through manual dispatch. Greater automation, wider use of smart meters and a higher penetration of smart devices, will further increase the MW response.

*Figure 1: Octopus Saving Sessions aggregated consumption profile, 23 January 2023, 17:00-18:00*



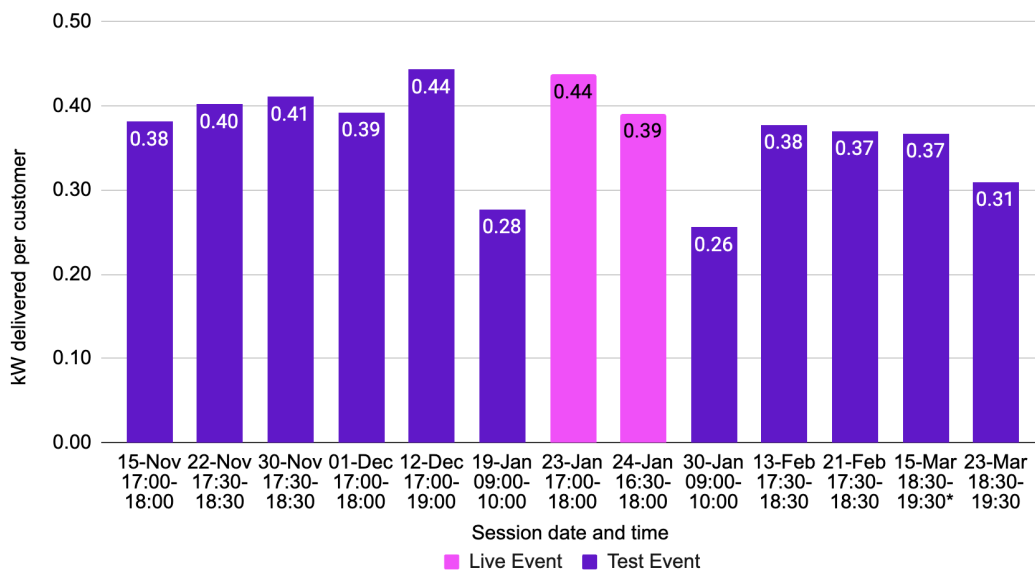
**ii) Octopus’s demand shift was sustained through winter at an average of 128MW (Figure 2)** This level remained constant over the five months, with no observed drop-off over time. During Live events, Octopus drove opt-ins by contacting customers directly and explaining the broader grid context. The group also showed higher response during evening events, 133MW average, compared to morning events, 91MW average, when customers use less energy and have a lower baseline. On a per customer basis, depth of response remained fairly consistent across the Service, with higher response shown during the afternoon events again - 0.27kW in the morning, 0.39kW in the afternoon (Figure 3). The average incentive levels were £2.25/kWh for Test and £3.69/kWh for Live events.

*Figure 2: Total MW delivered per opt-ins per Saving Session*



*Note: Test events were dispatched at a Guaranteed Acceptance Price (GAP) of £3,000/MWh. Live events were dispatched in response to system stress conditions and were cleared through an auction. \*15 March event was notified six hours or less ahead of the event.*

*Figure 3: Average kW delivered per opt-in per Saving Session*

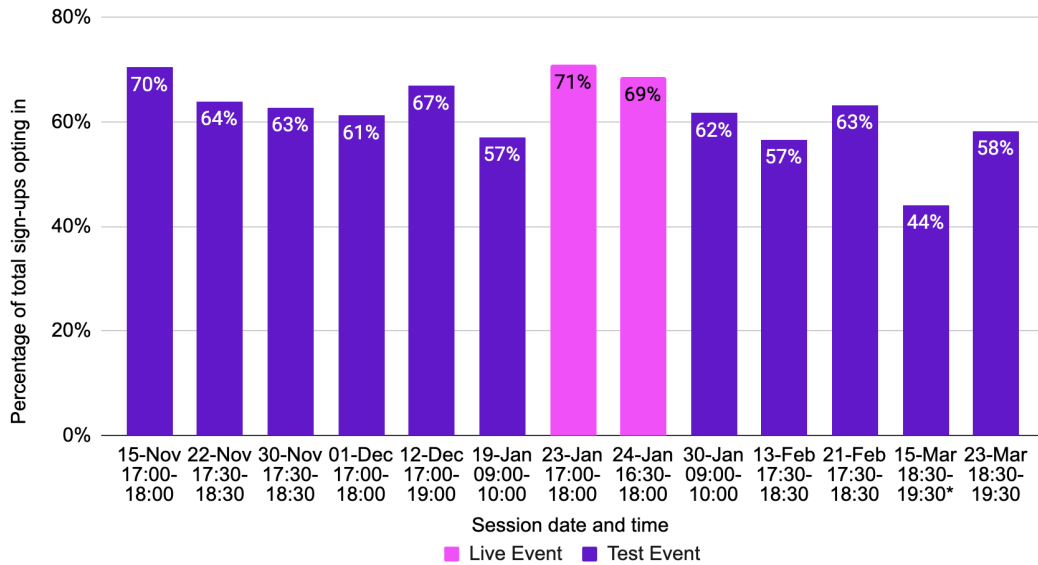


Note: Test events were dispatched at a Guaranteed Acceptance Price (GAP) of £3,000/MWh. Live events were dispatched in response to system stress conditions and were cleared through an auction. \*15 March event was notified six hours or less ahead of the event.

**iii) Octopus had strong customer sign-ups and participation - showing that customers are ready and willing to participate in demand flexibility offerings.** Octopus invited 1.4 million of its smart meter customers to participate and 700,000 signed up. 400,000 homes joined before the first event in November, 200,000 joined after a second invite in January, and the rest joined organically over the course of the winter. About 61% of customers participated in each Test event on average and 70% in Live events (Figure 4). More than 91% of people participated in at least one event, 56% participated in six or more events, and 23% participated in 11 or more of the 13 events.

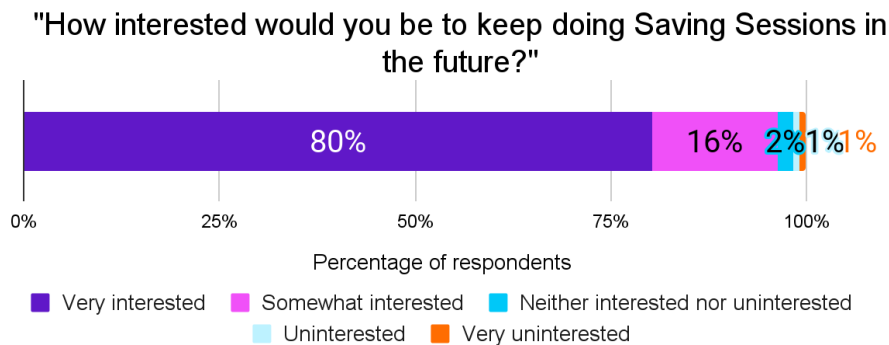
Participation was constant over the period between 57-71%, with the exception of the short-notice event at 44%. More participants opted in to events in the evening than the morning - likely because more people are typically home at this time. There was also widespread engagement on social media - customers tweeted about Saving Sessions over 33,000 times and swapped tips on online forums. 96% of survey respondents were interested to participate in Saving Sessions in the future (Figure 5).

*Figure 4: Percentage of total Saving Sessions sign-ups opting in to particular events*



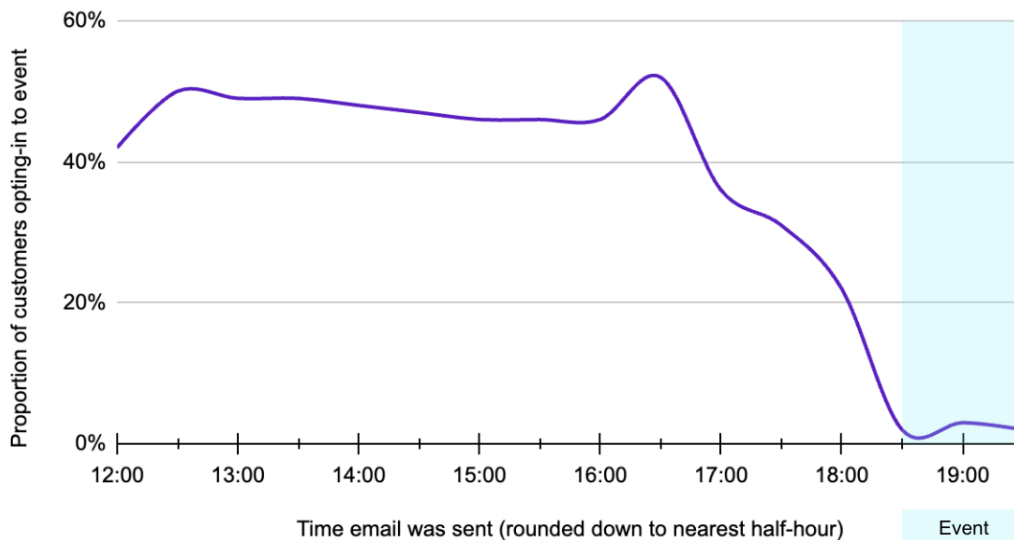
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Figure 5: Responses from a survey with Saving Sessions sign-ups, 5,000 respondents



**iv) Customers participated in an event with less than six hours notice - showing that demand flexibility can respond on similar timescales to other grid resources.** Most of the events were notified one day ahead of time. For one event, on 15 March, Octopus notified customers on the same day, starting six hours ahead of delivery through to the event start time. 44% of Saving Session customers opted in to the shorter-notice event compared to 63% on events notified day ahead. Customers delivered 111MW in the shorter-notice event - just 11% less than the average response shown during other afternoon Test events. The opt-in rates remained flat from the beginning of the notice period and two hours before delivery, showing that a two to six hour notice period is sufficient for customers to provide a turn down response (Figure 6). Average response per customer was relatively unchanged despite the short notice, at 0.37kW compared to 0.39kW evening event average.

Figure 6: Proportion of customers opting in to a short-notice event depending on time email was sent, 15 March 2022, 18:30-19:30



**v) The Demand Flexibility Service provided value for customers and National Grid ESO.** It paid out millions of pounds to customers during a winter of extreme energy costs. Saving Sessions alone passed on over £5.4 million to those who participated. The average opt-in earned £8 over the course of the Service and the top 5% earned over £40.

This flexibility was also valuable for National Grid and less expensive than conventional alternatives. ESO paid a reported £340-395 million for 2.42GW of coal contingency this year - a cost that is ultimately passed onto consumers through BSUoS charges.<sup>4</sup> At Octopus's £44/kW blended DFS price, this would have been significantly lower at £106 million across the 13 events, even though it was dispatched more frequently than the coal contingency. DFS also compares favourably to recent pricing in the Capacity Market, whose T-1 auction has cleared between £60-75/kW in the last two years (noting prices are expected to stabilise in the £45/kW/yr ballpark).<sup>5</sup>

There is also potential for a subset of customers to participate more frequently at lower system prices as the market settles, e.g. 20-30 events per year at £1/kWh could match or exceed Saving Sessions payments this winter, at £15-30 depending on usage.

## Recommendations

National Grid ESO and all industry participants delivered impressive progress on demand flexibility in a short period. It is crucial that momentum is maintained and demand flexibility is set on a path to full scale and use in grid operations. ESO and industry should take the following steps.

- 1. ESO, with Ofgem's backing, must confirm as soon as possible that DFS will be renewed and work with industry to deliver at gigawatt scale this year, ensuring that coal contingency is permanently retired.**

ESO and Ofgem should first set clear direction for the continuation of the Service to give providers enough certainty to build necessary offers.

<sup>4</sup> <https://www.nationalgrideso.com/document/268126/download>

<sup>5</sup> Aurora Energy Research, GB Flexible Energy Market Forecast April 2023

Demand flexibility can replace the need for coal. To reach Net Zero, Great Britain must retire its final coal power station and end coal contingency contracts. Both EDF and Drax have ruled out extending the life of coal units used in last year's contracts<sup>6</sup> - consumer flexibility at scale is critical to ensure low-carbon security of supply this winter.

The potential of domestic flexibility today is 2.1GW, based on observed results during real system stress events - roughly equal to the 2GW capacity of Ratcliffe-on-Soar, the only operational coal-fired power station in Britain.<sup>7</sup> Octopus averaged 177MW in Live events from a base of 1.4 million installed smart meters. Extrapolating response and participation to the 17.3 million households with a smart meter in GB today would mean upwards of 2.1GW of flexibility,<sup>8</sup> a similar scale to the 2.42GW of capacity in ESO's coal contingency contracts.<sup>9</sup>

Consumer flexibility is a lower cost alternative to coal contingency and capacity market, as shown above in (v). By ensuring all smart meter households in GB are invited to participate in DFS this winter, ESO can access the volumes required to replace coal with consumer flexibility. Octopus was the only supplier to invite all households with a working smart meter (subject to marketing preferences). ESO can ensure greater uptake by:

- Requiring or incentivising providers to reach out to a broader set of customers - for example, requiring maximum invites to be sent out or placing providers who have invited a larger percentage of their customer base at the top of the merit order;
- Giving providers more confidence in the Service by confirming its implementation by early June with certainty from ESO and Ofgem, signposting to an enduring, in-market service in the future - providers will not invest in a one-off product;
- Providing value to customers, e.g. maintaining prices at £3/kWh for Test events; and
- Laying down the challenge publicly to suppliers who are not inviting customers.

## **2. ESO must make key changes to DFS design to maximise participation this winter, including closer to real-time procurement and allowing for demand turn up.**

### **a. DFS should remain as a winter contingency measure with a guaranteed acceptance price (GAP) for this winter.**

DFS should remain as an enhanced measure this winter to act as a buffer for tight margins given ongoing supply chain issues and a retiring coal fleet. A contingency measure this winter with a GAP should “bridge the gap” to an in-market service for winter 24/25 or participation in existing services.

Providers need a minimum level of value to maximise flexible volumes - to incentivise customer participation and to cover investment in the Service -

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<sup>6</sup> <https://utilityweek.co.uk/edf-and-drax-rule-out-using-back-up-coal-plants-again/>

<sup>7</sup> <https://www.uniper.energy/united-kingdom/power-plants-in-the-united-kingdom/ratcliffe-soar>

<sup>8</sup> To be clear, this is not 17.3 million smart meters participating, but opt-ins and participation at the same rate as in the Live events, i.e. approximately 44% of the invited group participating.

<sup>9</sup> <https://www.nationalgrideso.com/document/268126/download>

a GAP can be an effective way of ensuring this. This could also be achieved via a more capacity-based payment - for example, a one-off payment per provider through an auction that gives providers flexibility to allocate reward to their customers, or an availability payment alongside a smaller utilisation payment could work to ensure value for suppliers.

In the long run, we see DFS moving towards an in-market, enduring service that is priced against existing services and we are keen to engage with ESO on its design (see item 3). We also see scope to split demand flexibility into different types based on period of response e.g. that which can respond at short-notice (i.e. less than 30 minutes) and that which can respond on 4-6 hour ahead timescales - and participate more broadly in existing services. It is important to note that any separation should be made on technical characteristics of response and not on whether the response is automated or manual (an arbitrary distinction).

**b. ESO should utilise DFS more frequently - consumer flexibility is a reliable resource.**

ESO must leverage the full potential of demand flexibility this coming winter by calling the Service more frequently, during times of actual grid stress. Customers have shown they can provide significant value to the grid over multiple months and events, particularly when the system is under strain. ESO should give more information around event triggers and used more objective measures so that industry has more clarity on when the Service is used. ESO should also engage with Ofgem on the best way to trigger DFS more frequently without distorting the market - more clarity on this point would help see the Service used more without risking perception of distortion.

**c. ESO should procure consumer demand flexibility closer to real-time and in both directions - customers can deliver significant volumes at short notice periods and this will be a valuable resource for intraday balancing.**

Close to real-time procurement is important for reducing overall system balancing costs, which totaled £4 billion last year.<sup>10</sup> Although day-ahead dispatch will provide a greater volume of response, it is important that the second iteration of DFS includes an option for procuring closer to real-time, allowing some customers to provide a more valuable intraday balancing tool. In this case, we support the continued use of an in-day adjustment to correct for weather changes as long as the adjustment takes place before the customer is notified of the event - this will stop customers easily gaming the baseline. For day-ahead dispatch, the P376 baseline should be used without an in-day adjustment to prevent any gaming. This will also work better from a behaviour perspective: when notified day-ahead, domestic customers may drastically reduce their demand on the day of the event by leaving their property - here, the in-day adjustment would reduce their baseline to zero, leading to disappointment and reduced

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<sup>10</sup> <https://www.niauk.org/cost-of-balancing-britains-power-grid-shatters-record/>



engagement. With greater automation of flexible domestic assets, the volumes provided at short notice will become even more significant.

Similarly, procuring turn up will help to reduce balancing costs, especially during the summer when excess renewables are curtailed. Octopus customers have already proven turn up potential in areas of high renewables, averaging 0.7kW turn up during afternoon events in the SPEN Windy Day Fund trial. ESO should run events in the spring and summer to procure turn up and this should be part of the initial service design - we are happy to share learnings on this point.

**d. ESO should automate operational processes and allow stacking with other services - this will avoid overburdening providers and maximise volumes.**

The operational processes behind DFS were largely manual. This was a huge administrative burden for providers last winter and - ultimately - limited volumes.

Developing an API for all data transfers and notices will significantly reduce supplier and ESO administrative costs, rather than relying on CSV SharePoint submissions. Similarly, the weekly MPAN de-duplication check took disproportionate time and effort, and became an extreme barrier to new customer recruitment because providers had to pay new sign-ups at risk if there was an event. Instead, ESO should specify a fixed minimum period for customers to sign up and develop an API which providers can check registered MPANs against. The 100MW cap on units and bids also created unnecessary complexity.

This winter, allowing stacking with the Capacity Market (CM) and any DNO flexibility services will also unlock more DFS volume. The main arguments for not allowing stacking in the first iteration of the Service were a) to ensure DFS unlocked additional volumes; and b) to avoid paying twice for the same flexibility if CM events and DFS events coincided. These reasons are no longer relevant: allowing stacking with the CM for both residential and commercial & industrial participants will increase available volumes, who can no longer participate in TRIADs. The CM has never been called “in anger”, whereas DFS was called twice in its first winter - coinciding events will not be a problem. The CM was always intended to be stackable with everything, so allowing stacking of DFS and the CM will increase available volumes at no disadvantage to ESO. In future, ESO should give clarity for the status of DFS as a standalone service or routes for demand flexibility to participate in other services.

**3. ESO must give clarity on the future path to demand flexibility being used in grid operations permanently.**

As disruption to global energy supply chains calm, residential demand shifting should have wider inclusion in existing services. We believe that the majority of domestic flexibility can participate with 4-6 hours notice - i.e. similar timescales to coal warming or Capacity Market notices. New technology is also starting to enable a faster response at 30 minutes or less. This could start to be incorporated in existing services - e.g. the Capacity Market and others dispatched closer to

real-time - ESO should review barriers and give a roadmap for further inclusion. The distinction should be made on operational characteristics (i.e. time to respond) and not on arbitrary measures such as automated vs. manual, which are hard to define precisely. The Service should also move towards locational targeting, ideally by spring of 2024 - this is an area where domestic flexibility can easily be deployed, and would be particularly useful for turn up in areas of high renewables.

DFS has mobilised consumers, providers and wider industry - it has been a breakthrough service that has proven the potential of consumer flexibility to replace coal contingency. We must take advantage of this momentum to improve DFS by iterating in the real-world, to create a more valuable service that maximises volumes and - ultimately - gives consumer flexibility its well-deserved place in ESO's set of balancing tools.