INSIGHTS FROM THE UK'S LARGEST CONSUMER ENERGY FLEXIBILITY TRIAL

THE DEMAND FLEXIBILITY SERVICE AND OCTOPUS ENERGY SAVING SESSIONS

MAY 2023

Centre for Net Zero
Powered by Octopus Energy

CENTRE FOR NET ZERO DELIVERS PIONEERING RESEARCH TO MAKE THE FUTURE ENERGY SYSTEM A REALITY

FOUNDED BY OCTOPUS ENERGY

We're **an impact-driven research unit**, founded by a global energy tech disruptor that services 25 million customers globally across 14 markets.

GROUNDED IN REAL-WORLD DATA

Our **access to tens of billions of customer data points** gives us an unparalleled insight into the real behaviours of people and businesses.

OPERATED AUTONOMOUSLY

We **set our own research agenda** and operate on a not-for-profit basis.

FLEXING DOMESTIC ENERGY DEMAND SUPPORTS A CHEAPER, CLEANER ENERGY SYSTEM

1. The energy system is changing

We are moving to cleaner, more affordable and homegrown energy to reduce our reliance on dirtier, more expensive and volatile fossil fuels. Renewable generation accounted for over 40% of all UK generation last year*.

2. We can intelligently match demand to cheap renewable supply

Electrification and a greater reliance on renewables - which vary with the wind and sun - mean that we need to keep supply and demand in balance.

3. Demand flexibility is critical to achieving this balance

Households and businesses can help shift demand from peak times by adjusting their consumption. We need to increase demand flexibility from about 6 GW today to 20 - 30 GW by 2030*, and potentially over 100 GW by 2050*.

4. It can empower consumers and save money on bills

Even those who aren't directly participating can benefit financially from a flexible energy system, because of the overall reduction in system cost.

*Sources: DESNZ, Ofgem & National Grid ESO

THE DEMAND FLEXIBILITY SERVICE
DEMONSTRATED THE SIGNIFICANT POTENTIAL OF CONSUMER FLEX

From November 2022 - March 2023, National Grid ESO rolled out its Demand Flexibility Service (DFS)

Energy suppliers were called upon to ask customers to use less electricity than usual on multiple separate occasions. These tended to be 1-2 hour windows specified by ESO, when the grid was under strain.

Households were paid a fixed incentive which varied between events (from £2/kWh to £4/kWh of electricity,[1] five to ten times the unit price of energy respectively.)

The trial was designed to test the appetite and reliability of households to support the grid during times of strain

It builds upon previous innovation trials run by Octopus Energy and National Grid ESO. You can find out more here.

THE DFS DELIVERED SYSTEM-LEVEL IMPACTS:

31
Approved DFS providers. 23 participated in at least one DFS event

2.92 GWh
The total amount of energy reduced from times of grid strain[2]

→ The equivalent electricity needed for every person in Great Britain to make a large cup of tea

~100%
The amount of the DFS requirement that was met by the industry[3]

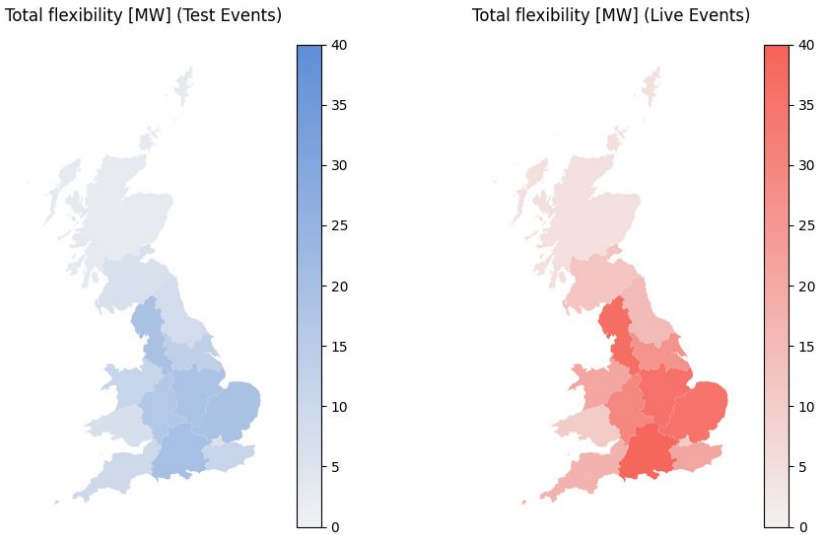
681 tCO2
Total amount of emissions associated with reduction in demand[4]

→ The equivalent to taking over 450 cars off the road for a year

[1] Measured using a standardised methodology (referred to as the DFS P376 Methodology)
[2] Energy reduction in DFS is measured based only on households that reduced energy use (and were paid for doing so); it does not count those who *increased* energy use during events and so does not represent *net* change in energy consumption.
[3] Median average in the last 5 non-onboarding events
[4] Average system CO2 emissions in each region, using DFS P376 turndown. Both datasets released by ESO

ACROSS ALL SUPPLIERS OVER ONE MILLION HOUSEHOLDS TOOK PART, DELIVERING FLEXIBILITY WHEN THE GRID WAS UNDER STRAIN

A map of total flexibility by DNO region, split out by event type



Flexibility was sourced from all parts of the country

Households repeatedly demonstrated that they can be relied upon when the grid is under strain

The trial involved engaging consumers in both ‘test events’ and ‘live events’. ‘Live events’ occurred when the grid was under strain and required support.

Household provided more flexibility during ‘live events’

This is likely to be a result of the higher prices on offer, additional communications from energy retailers and an increase in consumer awareness driven by coverage of the DFS in the media.

Open-source data enabled visibility and tracking of progress over time

You can find out more here.

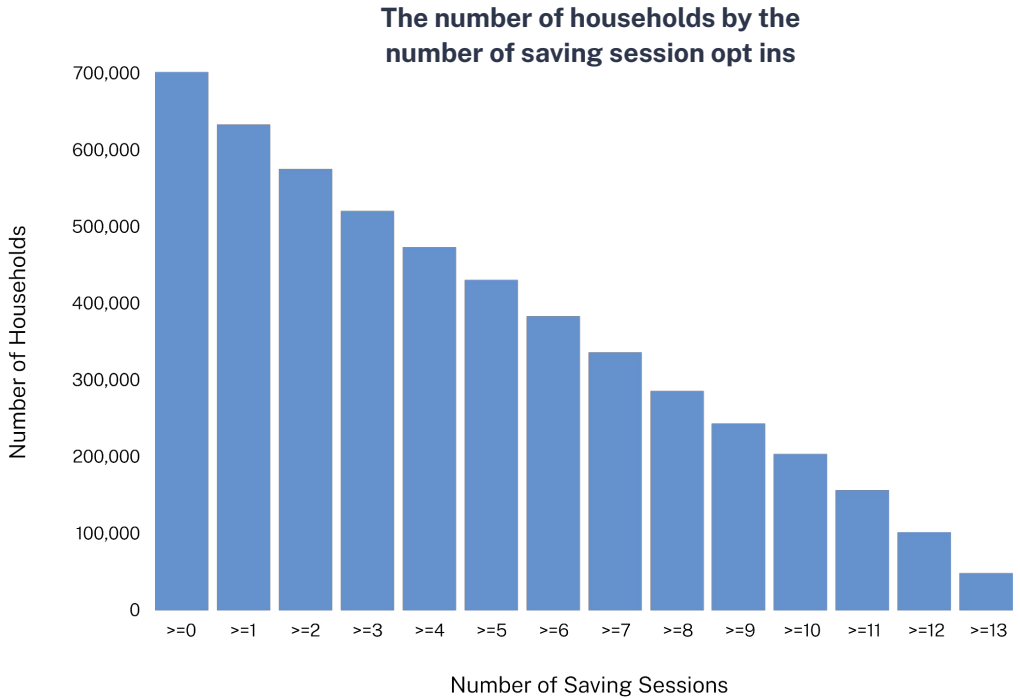
33% OF ELIGIBLE OCTOPUS ENERGY CUSTOMERS SIGNED UP TO SAVING SESSIONS

To sign up to the Saving Sessions, households needed a smart meter that was reliably sending readings.

Sign up rates to Saving Sessions were similar across all types of households, compared to all eligible households.

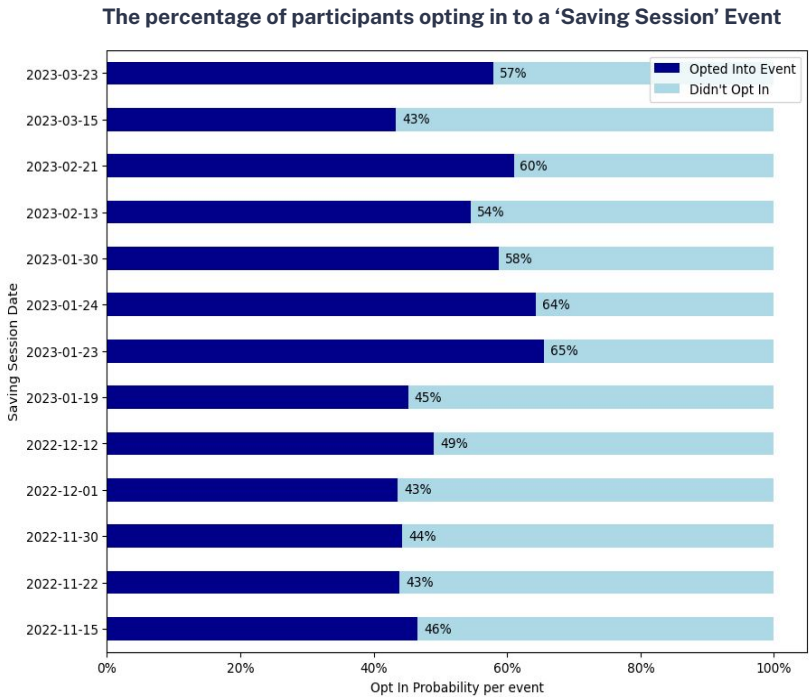
Opt-in rates for a single session was high: 91% of Octopus Energy households who signed up to Saving Sessions opted in to reduce demand in at least one event.

But, only 55% and 7% opted in for at least six sessions and all sessions respectively.



ON AVERAGE, EVERY SESSION HAD AROUND 50% OPT-IN RATES FOR THOSE WHO SIGNED UP TO THE SAVING SESSIONS OVERALL

Octopus participants opted in at a rate between 43% and 65%



There was some evidence of sustained engagement*

The 88% of households who signed up before the first event opted in to 6-7 events on average.

Among this group, those who showed sustained engagement were more likely to be:

- Households with a degree of energy automation (e.g. EVs, heat pumps, solar, batteries)
- Higher income (as measured by income deprivation group)
- Older Households. The 25-34 age group are less likely to show sustained engagement

The amount that customers earned affected levels of sustained engagement. Around 75% of those earning more than 50p per hour showed sustained engagement, compared to 49% earning less than 50p per hour. Earning £2 per hour, compared to £1, seemed to make little difference.

* 'sustained engagement' is defined as early joiners who opt-in to more than 50% of events.

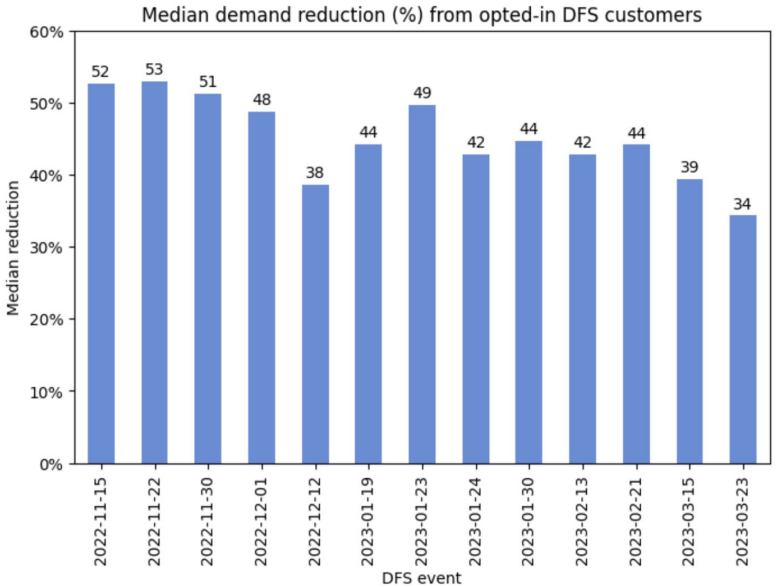
MEDIAN REDUCTION IN ENERGY DEMAND PER HOUSEHOLD WAS 45% FOR THOSE WHO OPTED IN TO AN EVENT

For those who opted in, the median household power reduction during an event was 0.21kW* - equivalent to a **45% change in energy demand.** There was some variation across sessions, as shown on the right.

Across all participants, the total power reduction during an event was, on average, 87MW - **equivalent to an 18% change in energy demand**.

Households who opted in earned an average of **90p per hour** of DFS participation

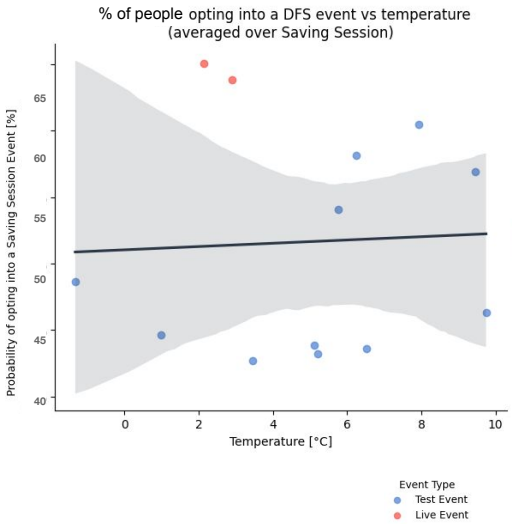
Median energy reduction for households opting into the Saving Session (%), based on DFS P376 methodology



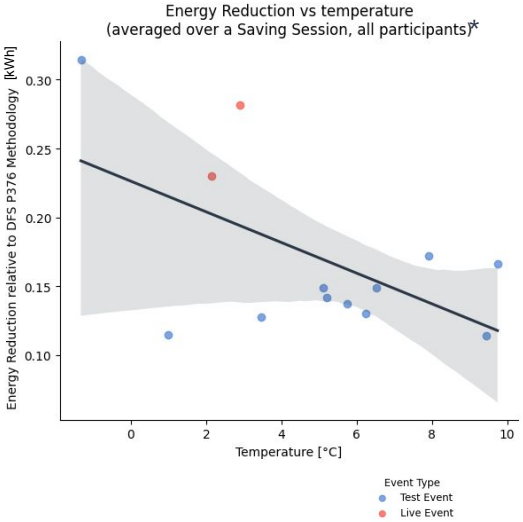
*Measured using the DFS P376 Methodology. Energy reduction is measured based only on households that reduced energy use; it does not count those who increased energy use during events and so does not represent *net* change in consumption.

WEATHER DIDN'T DETER HOUSEHOLDS FROM DEMAND REDUCTION & MORE ENERGY WAS REDUCED ON COLD DAYS

Based on Octopus participants, **opt-in rates on cold winter days were similar to mild and warm winter days***



Greater per-household electricity reduction occurred on the coldest days, on average*



Cold winter days saw a mean average turndown of 0.2kW of all Octopus participants who opted-in to the Saving Sessions.

If this was scaled to Great Britain (about 30m households) at the same rate of participation (1 in 3), **we estimate that there would be around 2GW of consumer flexibility on cold winter days - roughly equal to the entire capacity of GB's active coal power plants.**

*cold winter days are defined as <3°C, mild winter days as 3°C - 7°C, and warm winter days as >7°C

*Measured using the DFS P376 Methodology. Energy reduction is measured based only on households that reduced energy use; it does not count those who increased energy use during events and so does not represent net change in energy consumption.

*'all participants' - defined as everyone who has signed up to Saving Sessions, not just everyone who opted in to each individual session

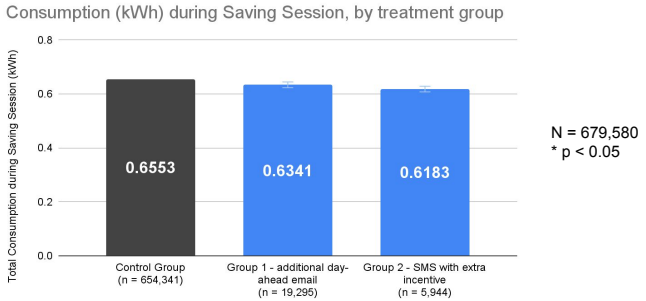
EVEN WITH SHORT NOTICE, HOUSEHOLDS ARE ABLE TO PROVIDE FLEXIBILITY

Centre for Net Zero ran a field experiment in March 2023 in collaboration with Octopus Energy, designed to assess whether we can rely on domestic flexibility closer to real-time if needed. 'Closer to real time' involves giving households six hours or less of advance notice.

The ability of households to react quickly to flexibility requests is an important tool in the future energy system. It can keep electricity supply and demand balanced during more volatile periods, increase competition for balancing services, and reduce overall costs of balancing the system for consumers.

In this field experiment, the **Control Group** was provided with six hour advance notice. **Treatment Group 1** was provided with an additional 24 hour advance notification email, and **Treatment Group 2** was provided with an additional SMS notifying them about the offer of extra Octopoints (about £1.25 worth) for turning down.

Customer opt-in rates were higher in both treatment groups: 45% in Group 1 and 50% in Group 2, versus 40% in the Control Group. **Consumption was correspondingly lower in both treatment groups**: 3.2% lower in Group 1 and 5.7% lower in Group 2, versus Control Group average consumption.



Only one iteration of this experiment was run. Further tests might reveal that customers get used to providing flexibility at short notice, increasing the amount of turn down available.

HOUSEHOLDS HAVE EXPRESSED STRONG INTEREST IN CONTINUING TO PROVIDE FLEXIBILITY

Centre for Net Zero ran a survey on Octopus Energy customers who participated in the Saving Session. Of those that completed the survey*, we found that:

Top three reasons for households participating in Saving Sessions

#1
REDUCE OUR DEPENDENCE ON FOSSIL FUELS

#2
BENEFIT FROM FINANCIAL REWARDS

#3
KEEP THE GRID STABLE

Households have expressed a strong interest in participating in future events:

- 92% of customers who filled out the survey said they were very interested in continuing to participate in future sessions year-round.
- 81% were interested in using more energy to avoid curtailment. Rather than turning down, this involves households using more energy during times of plentiful renewable generation.

Households changed their electricity consumption in a variety of ways:

- 3 in 4 participants reported demand shifting in at least one event, whereas 1 in 2 participants reported demand destruction in at least one event. To achieve this, participants most commonly shifted the times of high-load appliances (e.g heating/oven) by one hour.
- 75% of survey participants said they manually switched off appliances.
- 15% of participants scheduled appliances to come on before or after the event.

More notice is better, but households could be relied on at short notice if needed:

- 3 in 4 participants would like at least 4 hours notice before an event, but about 20% of participants said they could respond with 1-4 hours notice especially if notified by SMS/push notification as opposed to email.

* Results have been gathered from two separate surveys, one with 930 participants (out of 10,000 emailed) and the other with a separate 1,100 participants (out of 50,000 emailed)

PROGRESSING CONSUMER FLEXIBILITY
OUR AREAS OF ACTIVE RESEARCH

In order to unlock the potential of schemes such as the DFS and domestic energy flexibility more widely, Centre for Net Zero is currently exploring three key research areas:

1. Defining an accurate baseline

In order to accurately reward individual households, we need good forecasting techniques. The P376 methodology used in the DFS to baseline energy consumption performs better in aggregate, since household level inefficiencies “net off” against each other. However, better consumption forecasting models (‘baselining’) will ensure individual households are rewarded fairly in the future.

Centre for Net Zero’s research includes ongoing development of more accurate forecasting models. We plan to release more on this later this year.

2. Exploring counterfactuals

Establishing a true and robust counterfactual is a key principle in our research. A cleaner way to measure the flexibility that households can provide in aggregate would be to use a control group that compares average actual electricity consumption. This would enable a cleaner estimate for the amount of flexibility provided.

We will release a working paper in which we explore such a counterfactual in due course.

3. Understanding price responsiveness of UK households

As we gather more granular data, we will know more about how households respond to price signals during flexibility events, which can inform the design of flexibility services including the DFS.

Centre for Net Zero is exploring this through Crowdflex, a multi-year project led by ESO that is designed to realise the potential that domestic flexibility can play in addressing decarbonisation.

WHAT DOES THIS MEAN FOR THE ENERGY TRANSITION?

KEY TAKEAWAYS

Demand flexibility can have a significant impact on the grid at all times, but especially at periods of strain on the grid.

Households are receptive to changing their energy consumption and can make savings on bills.

Automation is likely to have a big impact in future but manual flex has a role to play, particularly in the nearer term while flexible assets are less widespread.

Demand flexibility is ready to scale and can play a vital role in emergency response, decarbonising our energy system and hitting net zero.

RECOMMENDATIONS FOR POLICYMAKERS

1. Obligate supplier participation in the future DFS, with default opt-in for all eligible domestic customers.

Energy suppliers would be obliged or incentivised to take part, but opting out would remain a choice for their customers.

Under the current DFS model, there is only upside for the customer. However, only a third of eligible customers signed up. The vast majority of those who opted-in to at least one event went on to do more, while households showed a strong interest in continued participation.

To ensure more customers are eligible, smart meter rollout is essential. The DFS itself could also encourage consumer adoption.

2. Engage the public on the benefits of flexibility and encourage suppliers to provide clear, household-specific communications.

Raising awareness of domestic flexibility and the opportunities it affords. Encourage suppliers to demonstrate unambiguously the household-level savings or benefits customers have received due to a reduction in energy consumption within the DFS windows. This could encourage households which are not actively participating but which generate passive savings to engage more actively, until intelligent automation becomes more prevalent.

3. Require DFS suppliers to compensate households for unlocking flexibility at a minimum rate.

In the short-term, DFS suppliers should be required to compensate customers for their demand reduction at a minimum of five times the prevailing unit rate. Further data will establish the actual value of the market over time, but a larger initial commitment will help to encourage sustained engagement.

Suppliers need to be sufficiently supported to compensate customers accordingly, which means the DFS Guaranteed Acceptance Price (GAP) should be maintained at £3 per kWh (£3,000/MWh) in the near-term. The GAP represents the absolute lowest price ESO will accept during the DFS and is designed to deliver certainty to providers.

RECOMMENDATIONS FOR POLICYMAKERS

4. Facilitate rollout of smart consumer energy resources (CERs), such as EVs, heat pumps, solar and batteries, to unlock greater flexibility.

Address key barriers to the adoption of low carbon technologies (LCTs), including stronger regulation to signal future direction of travel. Reform flagship government schemes designed to drive LCT adoption, urgently addressing low take-up.

Provide additional financial support for vulnerable customers to enable them to benefit from flexibility.

5. Establish a funded research programme to explore alternative baseline methodologies and alternative ways to incentivise demand reduction.

Higher accuracy baselines will support integration of household flexibility into grid systems operations.

6. Develop an overarching Government consumer flexibility strategy, collating the work of Ofgem, ESO and industry.

This should include fully defining the role of the Future System Operator in consumer flexibility.

Strategy should include a roadmap for meeting GW capacity targets delivered by consumer flexibility in 2035 and 2050 respectively.

Please get in touch if you want to discuss the findings of this analysis in further detail info@centrefornetzero.org.

You can find out more about our range of ongoing research on our website.

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