Centre for Net Zero
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Centre for Net Zero response to the Ofgem Future of Distributed Flexibility Call for Input
May 2023

Centre for Net Zero (CNZ) welcomes the opportunity to respond to this Call for Input on the Future of Distributed Flexibility from Ofgem. CNZ is an impact-driven research unit founded by Octopus Energy. We deliver pioneering research to make the future energy system a reality. One of our core areas of focus is domestic flexibility and how can unlock more active participation of consumers in the energy system using technology and behavioural insights.

We strongly believe that one key barrier to the future of distributed flexibility is the issue of baselining (i.e forecasting electricity consumption at the household level) and the importance of achieving a standardised approach that accurately and fairly rewards households. CNZ has undertaken detailed analysis of different types of baselining methodologies and has shared some of the headline findings within this response, but would welcome the opportunity to engage further with Ofgem on the issue and discuss this work in greater detail. The issue of baselining must be addressed in the near-term in order to avoid issues of consumer trust hampering the potential of distributed flexibility at scale.

1. What do you think distributed flexibility could contribute to the energy system?

Centre for Net Zero strongly believes that distributed flexibility is critical for an energy system powered by renewables to function. We share Ofgem's view that this type of flexibility is not optional if we are to successfully decarbonise our energy systems and meet net zero targets.

Households and businesses are already helping shift demand from peak times by adjusting their consumption. As we adopt more distributed flexibility assets, there is opportunity to intelligently manage increases in controllable load from households, which will increasingly become a much larger share of demand - Future Energy System (FES) forecasts that EV charging and heating demand will require an additional 22GW of peak power by 2040. If we do not manage these consumer energy resources (CERs) intelligently, they will come at a huge cost to consumers and put the grid under increasing strain[1]. These assets are, therefore, both a massive opportunity and risk for the grid.

Fortunately, many CERs are proven to be highly flexible in their operation, especially through automation and responsiveness to market signals. Our research shows this is particularly the case for electric vehicles on smart tariffs, and thus represent the lowest hanging fruit.[2] However, while we expect the adoption of CERs to increase, a number of barriers restrict their ability to provide load shifting and efficiencies for the system, including limited consumer engagement, slow rollout of smart meters and a lack of shared digital infrastructure for energy.

[1] FES EC.02
[2] Centre for Net Zero, Lessons from Intelligent Octopus: Electric Vehicle Charging Behaviours & Automation, May 2022

This winter, many consumers - including those without any low carbon technologies - have demonstrated a willingness to adjust their consumption in response to price signals. National Grid ESO's Demand Flexibility Service (DFS) highlighted the significant potential of consumer flexibility in the UK and delivered system-level impacts. 2.92 GWh of energy was reduced during periods of grid strain, and 681 tCO2 of emissions were saved via the reduction in energy demand[3]. The UK has an opportunity to build on this to unlock domestic demand flexibility in a way that supports the grid and reduces overall costs.

Centre for Net Zero has released early analysis on the consumer behaviours of those who participated in the trial[4]. This analysis highlights the ability of households to provide flexibility closer to real-time and the ways that households reduced energy consumption (i.e. manually switching off high-load appliances versus scheduling appliances to come on before or after a flexibility event). We have attached a summary of this analysis with this submission, ahead of a more detailed academic paper that will be released later this year. The majority of the turn-down that occurred during the DFS was manual. We believe that automation is key to scaling up schemes such as the DFS in the future - but manual flex has a role to play, particularly in the nearer term while CERs are less widespread. Insights around manual behaviours are key to helping us understand the journey to automation and how we can intelligently deploy automation at a household level in a complex, real-world environment.

Automated CERs can unlock new opportunities to support the grid, particularly by providing closer-to-real-time services (e.g 30 minutes - 4 hours). It would most likely be entered by (groups of) automated households/assets. Automated actions, including controllable or dispatchable low carbon consumer flexibility, is more predictable and therefore should be grouped together. They can be relied upon to 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. One simple structure could be to price at similar to balancing mechanism (BM) costs (either 1:1 or a % multiplier of these bid prices) and this market would be specifically reserved for consumer flexibility. This has the advantage of avoiding the duplication of any work in the capacity market (4 hours from real-time) to which consumer flex could technically participate in, but provide additional capacity/availability closer to real-time without overhauling the BM to enable consumer asset participation. However, if we can unblock all barriers to existing markets quickly for CERs, then this would be preferred. This would be hugely valuable, given the availability of connected fleets of vehicles (and soon other devices) that could participate to the tune of ~GWs close to real time (see, for example, https://dashboard.krakenflex.com/).

[3] Centre for Net Zero, Insights from the UK's largest consumer energy flexibility trial, May 2023
[4] Centre for Net Zero, Insights from the UK's largest consumer energy flexibility trial, May 2023

Whilst much of the debate about the role of distributed flexibility in the changing energy system focuses on its ability to support the grid when demand is high and supply is limited, the intelligent automated operation of CERs can also help support the grid during times of excess renewable generation. In 2022, a year characterised by significant hikes in energy prices for consumers, the UK spent £215m on turning wind farms off, and then another £717m turning on gas power plants to replace the lost wind power. In the process, we emitted an extra 1.5 million tonnes of CO2.[5] Distributed flexibility presents an opportunity to move consumers loads to periods of excess wind energy, which could provide numerous values to the system. Recent analysis that determine the optimal number of subscribers to yield sufficient reduction in excess wind energy while ensuring reasonable cost savings for the subscribers shows that subscribers could provide a 67% reduction in constraint and a 74% reduction in curtailment; consumers can save up to £220 per year, depending on their priority in the dispatch process; and system operators could save up to 78% on constraint payments.[6] Crowdflex, an innovation trial Centre for Net Zero is involved in, looks at integrating CERs into a range of services that solve different grid needs, with an initial focus on constraint management between regions.

2. Will a focus on CER flexibility also help enable other forms of flexibility, especially distributed flexibility?

Focusing on consumer-enabled flexibility is a strong testbed for the grid working with other sources of flexibility, including aggregators. This is something we are currently exploring through our work on the Crowdflex project. If we can reimagine the way the grid currently operates and successfully sources flexibility from consumers, we can use similar mechanisms to source other types of flexibility. By understanding ways to successfully harness flexibility from assets with smaller controllable loads, the grid can then transition to working with larger-sized assets, using key learnings to lower risk. However, there are key differences involved - for example, much more rigorous customer protection rules are likely needed for CERs than DERs.

4. What is your vision for how to accelerate the delivery of accessible, coordinated and trusted markets for distributed flexibility?

There are multiple strategic challenges that are collectively preventing distributed flexibility at scale. One particular area of focus for Centre for Net Zero is the issue of baselining, which defines the value of flexibility provided. The consequences of continuing to use an inaccurate baselining technique, as more distributed assets feed into the capacity market, are significant.

The P376 methodology, like others currently used across industry to baseline energy consumption, performs better in aggregate than at the household or asset level, since forecasting

[5] Archy de Berker, The UK is wasting a lot wind power, January 2023
[6] Agbonaye et al, Value of demand flexibility for managing wind energy constraint and curtailment, Science Direct, May 2022

inaccuracies can balance each other out. However, algorithms that perform well at the household level are necessary to ensure individual households are rewarded fairly in the future. This is critical to enabling a trusted and successful market for distributed flexibility.

Centre for Net Zero has undertaken detailed research into different baselining techniques and their relative performance, measuring how accurately they perform on households with smart meter data. At a high level, we recommend splitting households into those that can provide automated versus manual flexibility.

For manual flexibility:

- Any in-day adjustment period at the household level should be removed if customers are notified day-ahead, thereby removing the potential exploitation of the adjustment period to inflate the baseline. The in-day adjustment could still be included if the service is moved closer to real time, but we propose an alternative formulation where the in-day adjustment period is applied at the portfolio level rather than the household level. Instead of applying the in-day adjustment correction factor at the household level for settlement, we should determine the correction factor from the sum-total portfolio level (or unit-level) and apply that factor to each individual household for settlement. This makes it more robust to individual level household setups (e.g heating/EV behaviour) and better captures the correction factor for external events (e.g weather).

For automated flexibility, especially pertaining to those managed by aggregators:

- An intraday notice period should be used to notify participating flexibility units or their aggregators.
- The use of an adjustment period may be more appropriate for some types of flexibility units than others. For example, energy demand from EV charging would not change depending on weather conditions so may not be required but baselines for heat pump energy consumption may benefit from an in-day adjustment period.
- Where an adjustment period is used, it may be applied at the household or asset level. Crucially the adjustment period should be defined as the settlement periods prior to notice being given so as to reduce potential exploitation of the adjustment period.
- Additionally, aggregators may become aware of upcoming flexibility requirements even before being notified, for example if other day-ahead flexibility has been requested so exploitation of the adjustment period is still possible. Longer adjustment periods could be used to mitigate against such exploitation.

General baselining recommendations include:

- *Upweighting recent data against older data*
  Household electricity consumption has strong time-of-day and day-of-week effects.

Half-hour predictions should be made using the same half-hour on similar types of day (weekend vs weekend), favouring the same day of the week to other days of the week and more recent data to older data. Industry should not average over more than ~1 month of data.

- *Considering explainability of baselines to consumers*
  As we rely more regularly on households for flexibility, consumers will want to better understand the method for remuneration. It is therefore important that baselining techniques are easily explainable to consumers and avoid being overly complex.
- *Considering alternative baselining techniques for households with LCTs*
  The same baseline will perform differently on different types of customer archetypes. It is harder to predict EV charging in particular compared to other LCTs, since the model averages charging events and non-charging events which leads to a high average error. It may be more beneficial to use a ML algorithm to predict EV charging or heat pump usage and combine with a standard baseline to create a more accurate forecast - so differential baselining techniques should be considered for specific types of flexibility units. In addition, it is likely that using asset-level data for baselining will be more accurate than smart meter data.

Centre for Net Zero's research includes ongoing development of more accurate forecasting models, and we plan to release more on this later this year.

Another strategic challenge to address is better asset visibility. Centre for Net Zero is calling for providers to be mandated to group CERs by low carbon technology (LCT) type. This will become more important when households own multiple LCTs and want to opt in some CERs to flexibility services, such as electric vehicles, but not others, such as heating systems. By grouping by LCT type, the source of flexibility is more explicit, which is beneficial to the grid - but suppliers may not want to share this openly. This could be resolved by using pseudonymised grouping units and sharing metadata about each unit privately with the grid separately.

Households should be able to compete and provide multiple different types of flexibility services, from scenario-based flexibility requests such as the DFS to participation in the Balancing Mechanism. The consumer proposition should be simple and straightforward to navigate, with easy ways to opt CERs in and out of flexibility services, supported by clear communications that explain the value of these services to the grid and a breakdown of financial reward received in exchange.

Finally, as we continue to unlock household flexibility, flexibility aggregators should be required to compensate households at a minimum rate, particularly when they are supported by mechanisms such as the Guaranteed Acceptance Price (GAP). In the short-term, we recommend

that DFS suppliers are 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 in flexibility and consumer trust in a distributed flexibility market.

5. Will certainty of an end vision help accelerate enabling work and make it cohesive?

Centre for Net Zero is calling for the development of an overarching Government consumer flexibility strategy, collating the work of Ofgem, ESO and industry. This work should include fully defining the role of the Future System Operator in unlocking distributed flexibility.

The strategy should define an end vision and map out a roadmap for meeting GW capacity targets delivered by consumer flexibility in 2035 and 2050 respectively. Current estimates set out by Ofgem and National Grid ESO of the need to increase demand flexibility from about 6 GW today to 20 - 30 GW by 2030[7], and potentially over 100 GW by 2050[8], do not currently quantify the amount of flexibility that should be sourced from households within overall demand-side flexibility requirements.

8. What is your view on the desirability and feasibility of the archetypes or your own alternative proposition?

Whilst we see the greatest potential in Archetypes 3 and 4, Centre for Net Zero believes that Archetype 3 is the most realistic option out of the choices outlined. Archetypes 1 and 2 will fail to deliver a connected, intelligent system powered by CERs, given the limited strategic intervention that is proposed. We believe an established coordination mechanism between markets is key to the success of distributed flexibility markets. A digital, singular 'exchange' platform, where multiple markets are visible and coordinated under a known governance is preferable - yet markets should have the ability to retain their own designs, platforms and systems. We are supportive of 'Archetype 4', but the time and financial investment required for it to be built from scratch would fail to meet the requirement to address the challenges facing distributed flexibility in the near-term. We would, however, support this Archetype if it was built out from existing infrastructure. We share Ofgem's view that the industry has hit an inflection point where we need to focus on ensuring we rapidly join up markets to reach a coordinated end-state, avoiding any potential negative impacts of the increased adoption of CERs on the energy system and instead setting in place a policy approach for distributed flexibility that benefits both consumers and the overall system.

Archetype 3 provides important asset visibility and importantly protects consumers. In rolling out

[7] Ofgem, Call for Input: The Future of Distributed Flexibility, March 2023
[8] National Grid ESO, Flexibility

this archetype, Ofgem should consider how the ‘double counting’ of flexibility service providers (FSPs) can be avoided. Regulatory frameworks that help FSPs identify asset ownership is key to this archetype’s successful implementation. Finally, Ofgem should consider how it plans to incentivise FSPs to join this market and how they will be accredited.