

Access to Flexibility

A report for National Grid Distribution System Operator

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Executive Summary

This report explores the accessibility of domestic flexibility services within the region covered by National Grid. The Centre for Sustainable Energy (CSE) was commissioned by National Grid Distribution System Operator (DSO) to understand which households are participating in the DSO's flexibility markets, identify potential barriers to participation, and provide recommendations for increasing equity in access to these services. The overall objective of this research is to ensure that vulnerable and low-income consumers are not excluded from the benefits of flexibility services, which play a crucial role in supporting the transition to a low-carbon energy system.

Types of households providing flexibility to National Grid DSO

CSE analysed flexibility provision within National Grid DSO's constraint managed zones (CMZs) in their Low Voltage network. The research looked at the types of households that fall within CMZs in comparison to households not in CMZs and found very similar distributions for income and tenure type. However, when analysing the flexibility provided in response to tenders, significant differences were found. Income was strongly associated with procurement outcomes. The research looked at the top ten CMZs in terms of volume of flexibility delivered and found these areas had much higher proportions of high-income households and of owner occupiers. Similarly, when looking at CMZs where less than 1% of the tendered flexibility was procured, we found that private and social rented tenures were over-represented. We found that rural households were over-represented in CMZs where National Grid DSO received no response to their tenders. Most flexibility was provided by EV charge points with ASHPs also contributing significantly within high-income areas. Where lower income households did provide flexibility, this was typically through manual demand shifting.

DSOs can struggle to procure flexibility where they need it. This analysis highlights the need to widen participation in DSO flexibility markets to improve procurement outcomes. It also shows the need to demonstrate how flexibility delivered by high-income households create wider system benefits.

Options for National Grid DSO to widen participation

DSOs have very little influence over which households in their licence areas take up low carbon technologies or opt to provide flexibility. However, DSO markets do have some requirements that indirectly affect which households can take part. At a high level, consumers must have the right meter type, have some ability to adjust their electricity demand when required, and be located within a specific part of the network. CSE ran a deliberative workshop with the DSO using the CSE smart energy capabilities lens to identify the extent that National Grid DSO procurement rules may be indirectly affecting which of their customers can take part in DSO flexibility services. It

also discussed if there were options for mitigating these impacts. The workshop participants identified a number of options: adapting baselining approaches, including more types of electric heating as flexibility assets, undertaking more longer-term notice procurement, and supporting responsibility in the flexibility supply chain.

A broader literature review was carried out on other DSOs' activities relating to the accessibility of flexibility services. An analysis of technical procurement arrangements highlighted the variety of different flexibility platforms, products and baselining approaches currently used by different DSOs. No approach was found to be more inclusive than others, and the range of approaches in itself may make flexibility service providers' less able to engage with more diverse customers. The review also summarised relevant findings from recent DSO innovation projects focussed on flexibility and vulnerable consumers. Again, no stand-out solution was identified, although some more speculative ideas were identified that National Grid DSO could trial to improve outcomes for vulnerable consumers within their flexibility procurement. The review showed that more work is needed to support a wider range of households engage with flexibility.

Recommendations for National Grid DSO include further work to understand and track disparities in flexibility access and performance, and specific actions to address barriers for vulnerable consumers.

Recommendations:

1. Repeat work to assess uptake of flexibility services amongst households in vulnerable circumstances in future to track changes over time.
2. Share information about how system benefits are calculated and distributed by National Grid DSO publicly.
3. Leverage from learnings developed through existing National Grid projects, like Smart Energy Action Plans, to provide more targeted support for consumers in CMZs in low income or deprived areas to improve their smart energy capabilities and boost their provision of flexibility.
4. Present the case to ENA Open Networks and Market Facilitator to include non-heat pump electric heating as a specific flexible asset.
5. Review baselining approaches for domestic flexibility, with a view to increasing granularity and ensuring fair outcomes for low energy users.
6. Offer more longer-term domestic flexibility options – both in terms of procurement and notice period - incorporating relevant learnings from ongoing innovation trials about potential commercial models and community engagement best practice for including energy efficiency in flexibility procurement.
7. Consider the feasibility of more speculative options raised in innovation projects for improving flexibility accessibility, such as incentivising FSPs to capture more flexibility from vulnerable households.
8. Engage with and support the rollout of HOMEflex to build consumer trust across the domestic flexibility space through:
 - a. Incorporating HOMEflex principles into service agreements with FSPs.

- b. Contributing financially to the creation of a domestic flexibility compliance scheme.
 - c. Providing advocacy for HOMEflex across the sector.
- 9. Advocate for a national communications campaign to provide trusted information and increase public awareness of flexibility and its benefits and challenges.

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1. Introduction

This report provides initial research into distributional impacts of domestic flexibility services. The Centre for Sustainable Energy (CSE) was commissioned by National Grid Distribution System Operator (DSO) to understand which types of consumers are currently participating in the DSO's flexibility services, establish any gaps and signpost options for the DSO to act on any unintended exclusions. The research was designed to:

- Analyse the households that fall within National Grid DSO's flexibility procurement zones, and their respective contributions towards flexibility provision.
- Assess the barriers consumers may face in accessing flexibility services in the National Grid region, and particularly which of these may be under the control of National Grid DSO.
- Summarise potential options for National Grid DSO in mitigating these barriers in future.

The research was developed in collaboration with National Grid DSO as part of the DSO's commitment to ensuring an inclusive low carbon transition for all consumers, including those that may be low income or in vulnerable circumstances.

1.1. Background

National Grid Electricity Distribution¹ is the largest electricity distribution company in the UK. As a distribution network operator (DNO), National Grid is responsible for the operation, maintenance, and development of the electricity distribution network in its licence areas, ensuring that electricity is delivered reliably and safely to homes and businesses. As the UK transitions to a lower carbon energy system, many renewable energy sources like wind and solar are integrated. These renewable sources are intermittent and variable, making it challenging to maintain a reliable and stable energy supply. The complexity of a decentralised energy system and the integration of renewable energy sources means that DNOs must transition to more flexible, responsive, and dynamic systems capable of accommodating supply and demand and managing grid congestion. National Grid Distribution System Operator (DSO) was established to address these evolving needs on the network.

Flexibility services can help the electricity system adapt to fluctuating supply and demand, ensuring the smooth operation of the grid while reducing reliance on fossil fuels. Flexibility is the ability to change electricity demand within a specific time frame. This can mean shifting energy use away from peak periods or in the case of demand turn-up events, using more energy for a specific time period. Flexibility is also used to manage localised constraints by DNOs within their network areas. Flexibility helps to avoid the over-build of electricity network and generation

¹ [National Grid Electricity Distribution | National Grid Group](#)

(renewable energy sources) and is therefore key to keeping down the cost of the low carbon transition for all consumers.

Consumers with some flexibility in their energy use are increasingly able to earn incentives or access cheaper tariffs while helping the transition to net zero. As flexibility services become more widely used across the industry to manage the electricity system, it is important to question whether all consumers are benefitting equally. The inequalities created by the electricity retail market are well researched, and DNOs are now taking steps to understand if and how flexibility markets may increase or decrease existing inequalities.

1.2. Flexibility and fairness

Research has shown that consumer access to domestic flexibility markets is uneven, and evidence is beginning to emerge that the distribution of benefits is inequitable^{2,3}. This may occur because some types of consumers, typically high electricity usage households with controllable, high consumption energy assets, are able to easily participate and receive financial rewards. Other households may put in considerable effort to participate, manually shifting their loads and adjusting their domestic routines, but will receive minimal financial reward, due to the smaller amount of energy they are shifting. In addition, there is still a significant proportion of households that do not participate, raising questions about the equitable distribution of system costs and benefits. However, DSOs have limited influence over which areas of their network will need to be managed through flexibility services, nor which consumers will participate in the services.

DSOs procure flexibility in areas where it is needed. One approach is to create Constraint Managed Zones (CMZs); geographic regions where some network requirements can be met through the use of flexibility services. This creates a local market open to some consumers in the licence area. One factor influencing constraints in the network is electrification of domestic heating and transport. Encouraged by policy, affluent consumers are taking this step themselves, by installing low carbon technologies such as electric vehicle (EV) chargers in their homes. In addition, social landlords and local authorities are also advancing the electrification of heat (through installing heat pumps) and transport (through EVs) which means there will be pressures on networks from domestic demand in lower income neighbourhoods. There are also other factors influencing constraints in networks that are not specific to the electrification of domestic demand. These factors mean there are geographic differences in the extent of the network's area eligible for earning rewards based on flexibility.

² Department for Business Energy and Industrial Strategy, Project InvolVe: How can innovation deliver a smart energy system that works for low income and vulnerable consumers? (2021): <https://assets.publishing.service.gov.uk/media/60cc5d47d3bf7f4bd6a9bd29/project-involve-smart-energy-system-low-income-vulnerable-consumers.pdf>

³ Smart and Fair Report (2024): <https://centreforsustainableenergy.ams3.digitaloceanspaces.com/wp-content/uploads/2024/02/25144104/smart-and-fair-working-with-the-smart-energy-capabilities-lens.pdf>

DSOs work with Flexibility Service Providers (FSPs) who offer their services to consumers. FSPs can be energy suppliers (such as Octopus Energy or OVO Energy), technology and app providers (like Equiwatt or Passiv), or independent aggregators (like Axle Energy or SMS).

Figure 1 shows the relationship between the consumer, FSP and flexibility procurer (DSOs). Note that some FSPs who hold a customer relationship, such as suppliers, will contract directly with the flexibility procurer. In other cases, generally with smaller tech or app companies, whilst the FSP holds the customer relationships, aggregators contract with the flexibility procurer on the FSP's behalf. Aggregators may also hold direct customer relationships themselves.

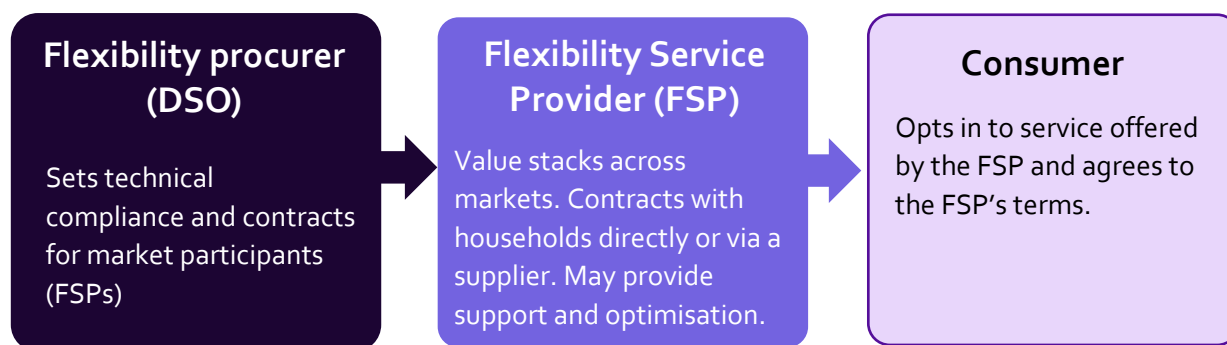


Figure 1: Schematic diagram of the DSO to consumer relationship

As organisations that procure flexibility, DSOs may be able to influence their supply chain to consider fair access and equitable outcomes as they develop and deliver domestic flexibility services. Requirements imposed by DSO procurement could help or hinder how flexibility markets develop. This creates an opportunity to look at how DSO markets are currently working and identify whether changing the market rules may affect adoption.

1.3. Project approach

The Centre for Sustainable Energy (CSE) has been leading the Smart and Fair programme⁴ which has been funded by National Grid and Scottish and Southern Electricity Networks (SSEN). This aims to put inclusion and fairness at the centre of the approach to the low carbon transition with a particular commitment to consumers in vulnerable circumstances. These consumers may face challenges in accessing or affording energy services due to factors such as financial hardship, health issues, age, disability, or other social or economic conditions. Through this programme, CSE has established the Smart Energy Capabilities Lens to understand the factors that affect a household's ability to access and benefit from the low carbon transition, including flexibility markets. The lens covers five areas that affect engagement: energy use, dwelling and local area, digital confidence, financial situation and personal or social values. CSE has used this lens to create two tools which have been used in this piece of work: the household level smart energy capabilities dataset and the Offer Profiling Tool. They are used to understand which types of

⁴ Smart and Fair Programme <https://www.cse.org.uk/smart-and-fair-energy-transition/about-the-smart-and-fair-programme/>

households can currently participate in flexibility services, and what market requirements may be preventing participation.

This report outlines findings from data analysis, workshops, and a desk-based review to analyse the household composition of flexibility procurement zones, assess the barriers consumers may face in accessing flexibility services in the National Grid region and whether more can be done to improve accessibility and equity in the industry.

This report has not been informed by engagement with FSPs because it focusses on DSO market set up. However, this report recognises the importance of future engagement with FSPs to enable the creation of inclusive flexibility.

2. National Grid DSO procurement zones analysis

This chapter explores the demographic, socioeconomic, and technological characteristics of households within National Grid DSO's Low Voltage (LV) Constraint Managed Zones (CMZs) to evaluate their contributions to flexibility procurement.

2.1. Background

Flexibility procurement at National Grid DSO is a response to the increasing challenges of a changing energy landscape. By identifying CMZs, areas where the network is or will be constrained, National Grid DSO targets specific regions where flexibility services can replace traditional network reinforcement approaches. This approach reduces costs and aligns with the broader need to accelerate the transition to a low-carbon energy system.

The range of procurement services in LV zones is diverse, and includes demand turn-up and demand reduction, which involves encouraging consumers to increase or decrease their electricity consumption during critical periods to help balance the grid. Local generators may be engaged to adjust their output by ramping up or curtailing their assets. Battery storage systems play a role in absorbing excess electricity and discharging it when the grid requires additional supply.

National Grid DSO procures these services through competitive tenders, inviting providers such as aggregators, businesses with onsite generation or storage, and large energy users to bid for delivering flexibility. The following analysis focusses on understanding how factors such as income, deprivation, and housing types within CMZs influence the outcomes of these tenders, and the extent to which these socio-demographic characteristics highlight the opportunity gap.

This chapter has three key objectives:

1. To reveal how socio-economic profiles of income, deprivation, and housing characteristics influence participation in flexibility schemes. This is achieved through assessing the distribution of different household types and characteristics within the CMZs, and how these compare to households outside of the CMZs.
2. To gain insight into the drivers of successful flexibility procurement, we assess the impact of household characteristics in the CMZs on the outcomes of the winter 2023/24 and winter 2024/25 procurement tenders in terms of the amount and success of flexibility procured.

3. Analysis of the types of assets used to procure flexibility to identify where current schemes are effectively supporting diverse technologies, or if procurement is dominated by a single type of asset (e.g. EV charge points) or a technology type is being underutilised, highlighting opportunity gaps.

2.2. Methodology

The analysis began by identifying household types within Low Voltage CMZs using CSE's household-level smart energy capabilities dataset (developed in the Smart and Fair programme). This dataset was spatially mapped to the boundaries of each CMZ to ensure accurate representation of household characteristics within each zone. Additionally, the dataset was enhanced with Lower Layer Super Output Area (LSOA) data from the Index of Multiple Deprivation (IMD). IMD measures deprivation across a number of domains including, income, employment, education, health, crime, barriers to housing and services and living environment. IMD ranks areas from most deprived (rank 1) to least deprived (10).

Household characteristics were quantified for each CMZ, including counts of households by income decile and tenure type. These counts were converted into proportions to facilitate comparisons between zones and across different demographic groups. The dataset was then joined with results from past flexibility procurement exercises, with non-domestic flexibility providers excluded from the analysis to focus solely on domestic contributions.

The study examined the household characteristics associated with different flexibility procurement outcomes. The caveat of note in this assessment approach, is that the correlation between household characteristics and procurement doesn't imply direct causation, and that other factors such as the tendered price for flexibility impact the procurement outcome (**Appendix 1**). Another factor may be the size of the CMZ. For example, rural CMZs contain, on average, half the number of households as CMZs in urban areas (157 households compared to 337), meaning fewer connected assets and perhaps less likelihood of receiving a response to a flexibility tender. This approach includes analysing CMZs where specific technology types, such as EV charge points and air source heat pumps (ASHPs), were successfully used to procure flexibility.

A clear presentation of the opportunity gap is lacking due to data constraints, whereby more granular data of exactly which households are participating in flexibility schemes is needed to explore the opportunity gap in detail. Our proxy for the opportunity gap throughout is therefore the difference in amount of flexibility tendered by National Grid DSO compared to the amount of flexibility that was successfully received. Further, the following is analysis of just one round of low-voltage procurement, and as such regular analysis should be conducted to ensure that the findings we present in the following sections hold true for subsequent procurement rounds, particularly as this is a relatively new sector that is changing at a fast pace.

2.3. Results

In this section we present our findings relating to three aims and objectives of the flexibility assessment. First, we discuss the distribution of household types in the past CMZs (winter 2023/24 and winter 2024/25) and compare them to households outside of the CMZs. We then compare the outcomes of the past procurement rounds with the types of households found within CMZs of different flexibility-procurement outcome groups, and in CMZs where different asset types were used to provide flexibility.

Overview of households in Constraint Managed Zones (CMZs)

The following section looks at differences in various characteristics of the households that fall within the winter 2023/24 and winter 2024/25 constraint managed zone boundaries, and those that do not. This gives an overview of how well the CMZs represent different consumer types relative to National Grid licence area.

When comparing the numbers of households in each **income decile** between households within CMZs and those in the rest of the National Grid region, there is a negligible difference in the income distribution (**Figure 2a**), with the largest disparity showing that 8% and 9% of the households in CMZs are in the first and second income deciles (lowest income areas), respectively, compared to 10% for households in the rest of the National Grid licence area. The **index of multiple deprivation**, however, shows much larger disparities, with the least deprived areas (deciles 6 to 10) having a much higher representation in the CMZs compared to the rest of the licence area. (**Figure 2b**). Conversely, the most deprived areas (deciles 1 and 2) represent only 6% and 8% of households within CMZs, compared 9% for those not in CMZs.

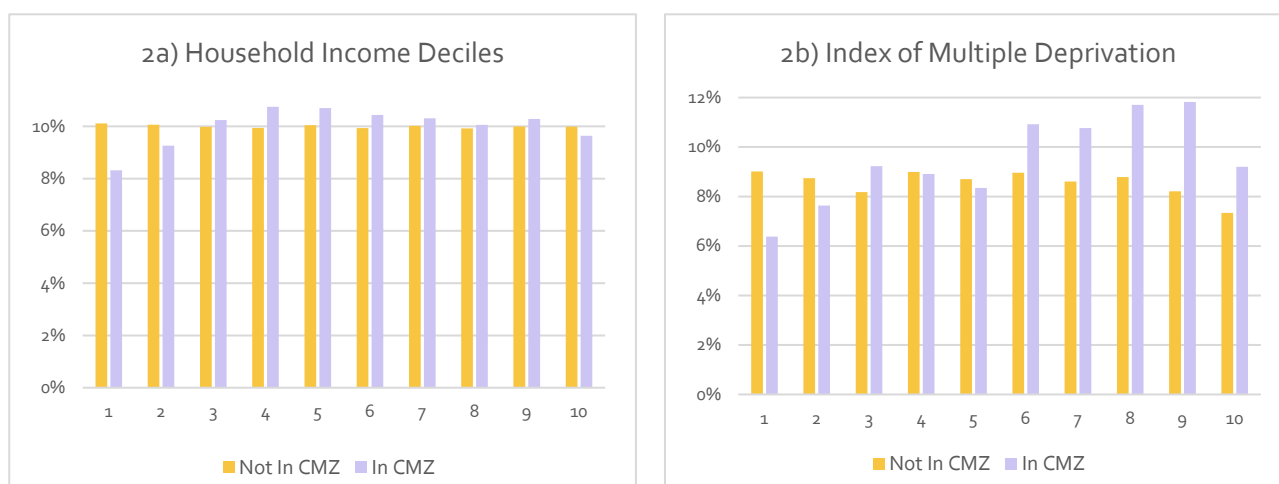


Figure 2: The proportion of households that fall within National Grid DSO's past CMZs and those that fall outside of CMZs for each (a) income decile and (b) index of multiple deprivation

The differences in **tenure** types between households within and outside of CMZs is also negligible, with private rented homes being 2% greater within CMZs, and socially rented housing 3% lower in CMZs (**Figure 3a**). There are larger differences when comparing **building types**, with

detached homes making a 6% greater proportion of households within CMZs compared to outside of CMZs, and flats being under-represented in CMZs by 4% (**Figure 3b**).

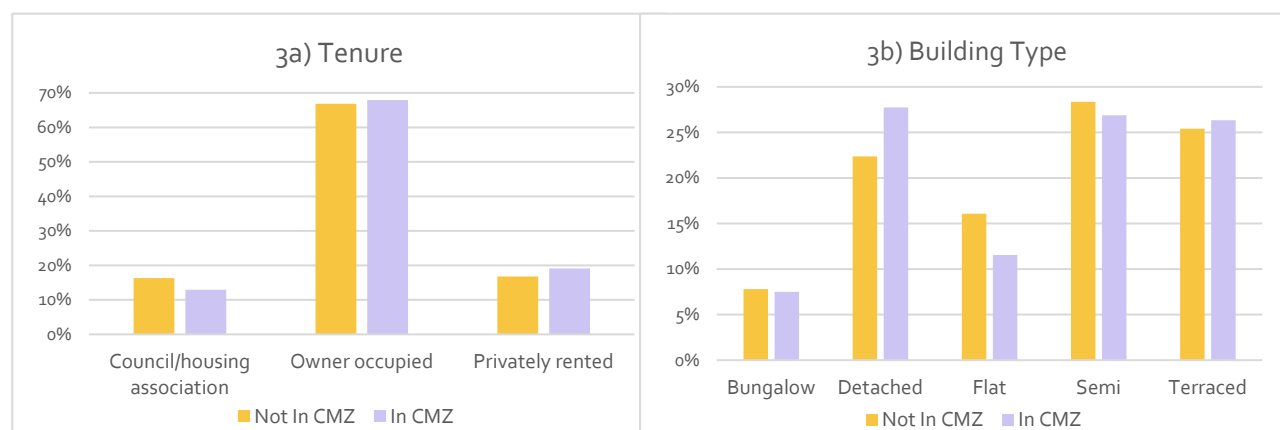


Figure 3: The proportion of households that fall within National Grid DSO's past Constraint Managed Zones and those that fall outside of CMZs for each (a) tenure and (b) building type.

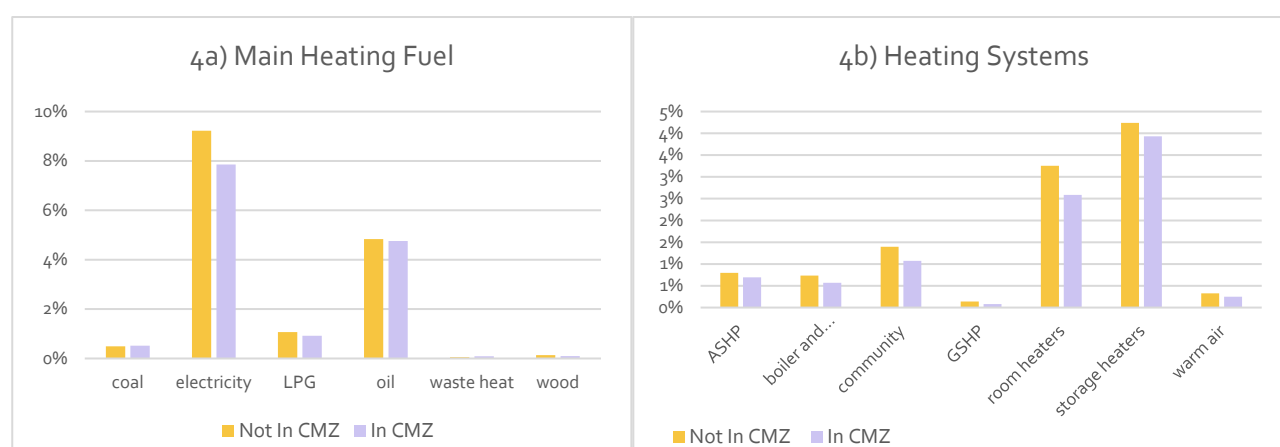


Figure 4: The proportion of households with each (a) heating fuel and (b) heating system that fall within National Grid DSO's past Constraint Managed Zones and those that fall outside of CMZs. The cut off 'boiler and..' category in (b) represents 'boiler and underfloor heating' system.

Mains gas systems make up 86% and 84% of households in and out of CMZs respectively. This data was removed from **Figure 4a** for clearer visual comparisons of other **fuel types**. Similarly, boiler and radiators heating systems made up 91% and 89% of households in and out of CMZs, respectively, and this data was removed from **Figure 4b** for the same reason. Electric heating systems, notably room heaters and storage heaters, are underrepresented in households in the CMZs compared to out. The proportion of households using coal, oil and LPG are no different between in and out of CMZs.

The under representation of **storage heaters** is notable given that they can be used to deliver flexibility. Further, lower income households and households in deprived areas have a higher proportion of storage heaters relative to higher income and less deprived areas (**Figure 5**).

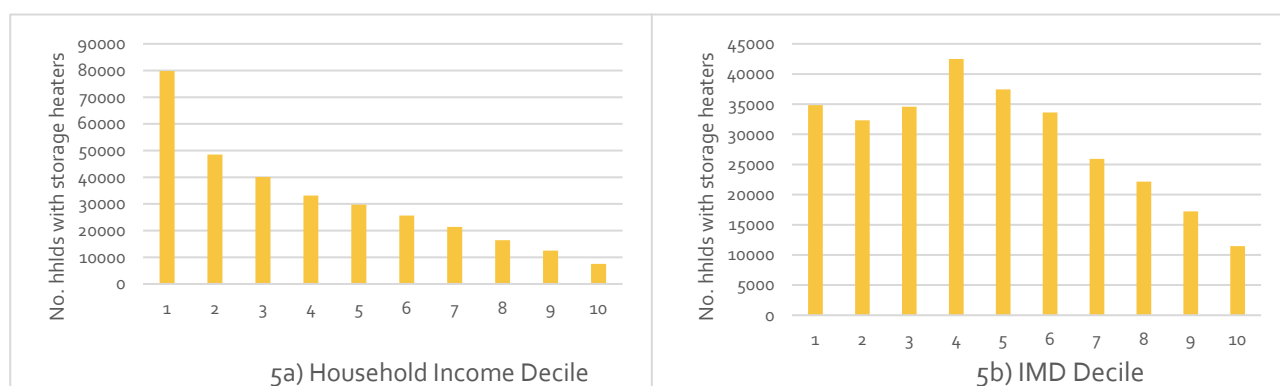


Figure 5: The number of households in the National Grid licence area with storage heaters in each (a) income decile and (b) IMD decile.

Procurement results

The following section explores patterns in the results of the past flexibility procurement processes and compares them with the characteristics of households that fall within the CMZs. The analysis explores aspects such as the tendered capacity, accepted flexibility capacity, number of assets and capacity of assets, broken down by supplier, technology type, and trade outcomes. **Table 1** gives an overview of the procurement by **technology type**. Household demand relates to manually shifting household energy demand without specific energy assets which may mean adjusting domestic routines.

Table 1. Overview of results from flexibility procurement tenders during the winter 2023/24 and winter 2024/25 rounds, broken down by different asset technology types utilised for providing flexibility in LV CMZs.

	EV charging point	Household demand	Air source heat pump	Battery	Hybrid heat pump	Total
Total Asset Capacity (kW)	6458	58	94	235	54	6899
Total No. Assets	2102	290	33	52	18	2495
Total Accepted Flexibility (kWh)	3234	130	163	255	58	3840
	Accepted	No response received				Total
No. trade outcomes	1075	3011				4086

EV charge points were the predominant technology type for procuring flexibility in the LV zones in terms of total asset capacity, number of assets, and the total accepted flexibility. This was followed by batteries, air-source heat pumps, household demand, and hybrid heat pumps.

Procurement outcome bandings

The following section looks at the household characteristics of different groups of CMZs. The groupings are based on metrics of the flexibility procured:

- The Top 10 CMZs that provided the highest amount of flexibility.
- CMZs where < 1% of the tendered procurement was successfully procured.
- CMZs where more than the tendered procurement was successfully procured.
- CMZs where there was no response to the tender.

The **income deciles** of households within CMZs have strong associations with the resulting procurement process. The distribution of income deciles was heavily and linearly skewed towards higher incomes in the households present in the ten CMZs that provided the ten highest amounts of flexibility. A similar pattern was also observed in CMZs that provided more flexibility than was tendered for. In contrast, households in CMZs where less than 1% of the tendered flexibility was procured were skewed towards lower incomes (**Figure 6**). Further, CMZs where there was no response to a tender contained more households in the middle-income deciles.

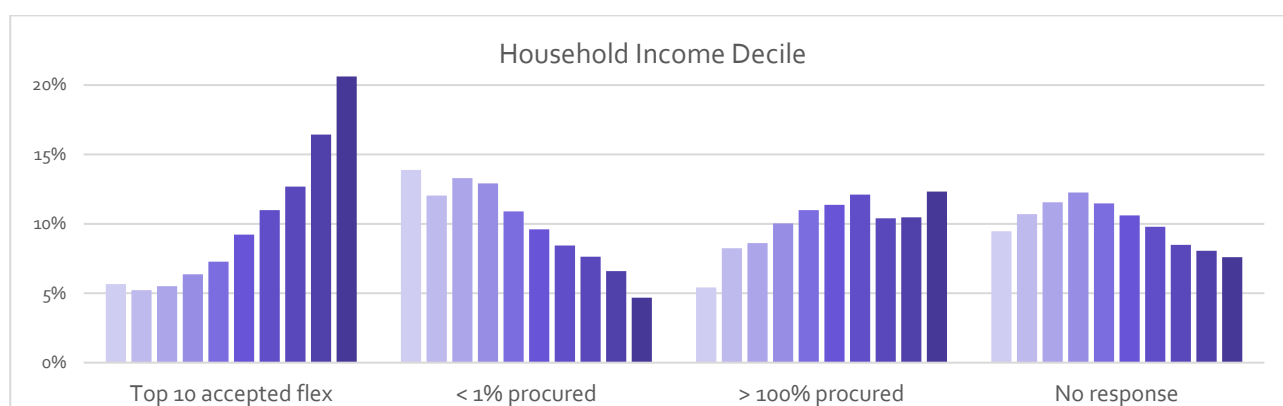


Figure 6: Percentage of households in different flexibility procurement result grouping of CMZs by household income decile. The darker the coloured bars the higher the income decile.

Similarly to income, but less strongly, there was an association between **IMD deciles** and the different procurement result CMZ groups (**Figure 7**). Households in the least deprived deciles (darker bars) tended to be more prevalent in CMZs that provided the highest amount of flexibility, and in the CMZs that provided more flexibility than was tendered for, and most deprived deciles were more represented in CMZs that provided less than 1% of the tendered flexibility.

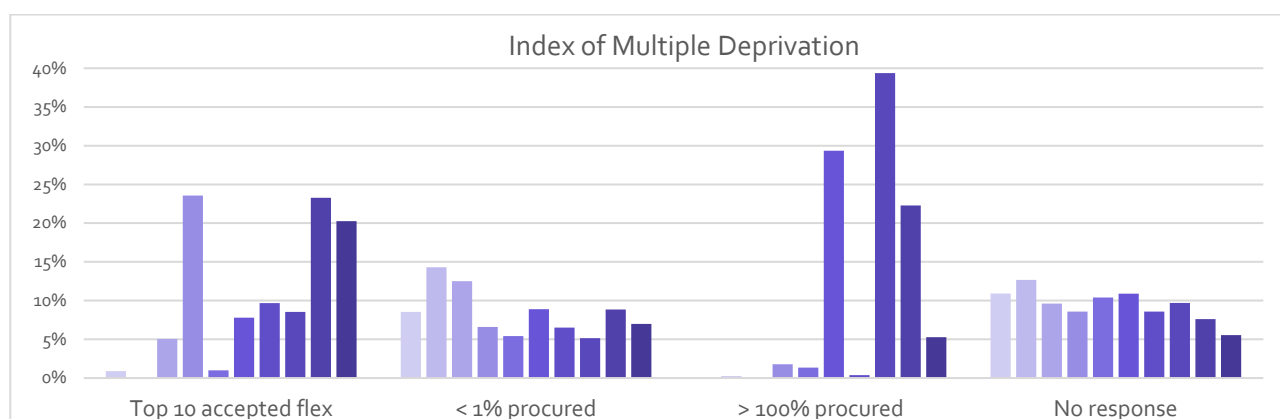


Figure 6: Percentage of households in different flexibility procurement result grouping of CMZs by Index of Multiple Deprivation decile. The darker the coloured bars the higher the IMD decile.

Likely related to the income of the household, the **type of building** also had different associations with procurement result groupings. For example, semi-detached and detached homes were the most prevalent in the CMZs that provided the most flexibility, while terraced houses were the most prevalent housing types in the CMZs that provided less than 1% of the tendered flexibility, and in CMZs that had no response to any tender (**Figure 8**). Of the four groups analysed, flats had the least representation in the >100% of tendered flexibility provided group.

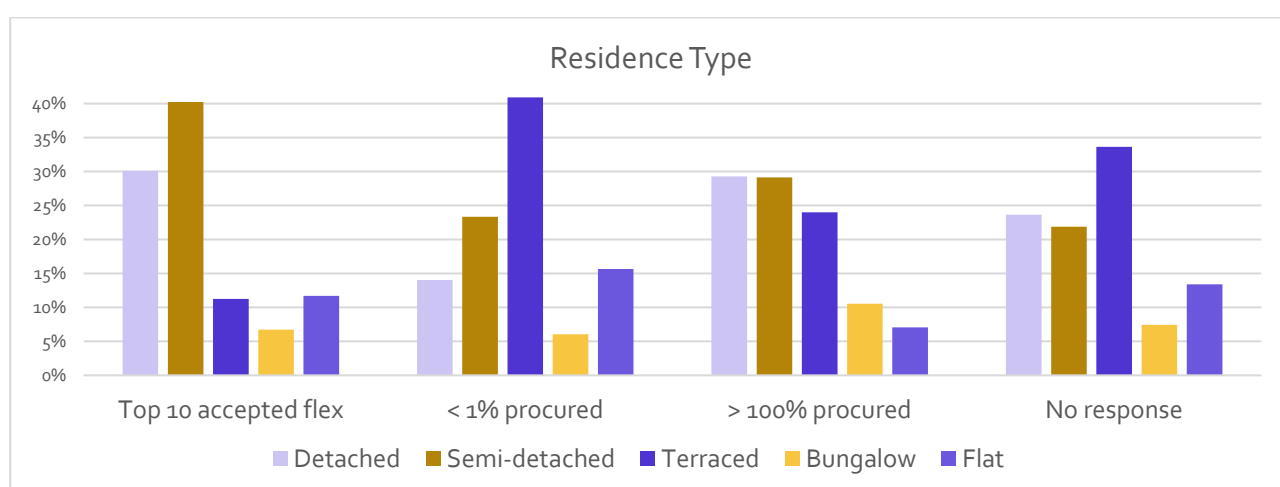


Figure 7: Percentage of households in different flexibility procurement result grouping of CMZs by building type.

These findings likely relate to the capabilities of different household types that allow them to participate in flex. For example, the highest asset type used for flexibility was **EV charging** points, but terraced homes and flats are unlikely to have off-street parking, therefore these households are less likely to have assets available for flexibility services. These capability barriers are also reflected in the **tenures** of households, where social rented housing was most likely to be in the <1% flexibility procured group, and least likely to be in the >100% flexibility procured group (**Figure 9**). In contrast, owner occupied households – who have the greatest capabilities to modify

their household energy systems – had highest representation in the top flexibility procurement groups, and the >100% flexibility procurement group.

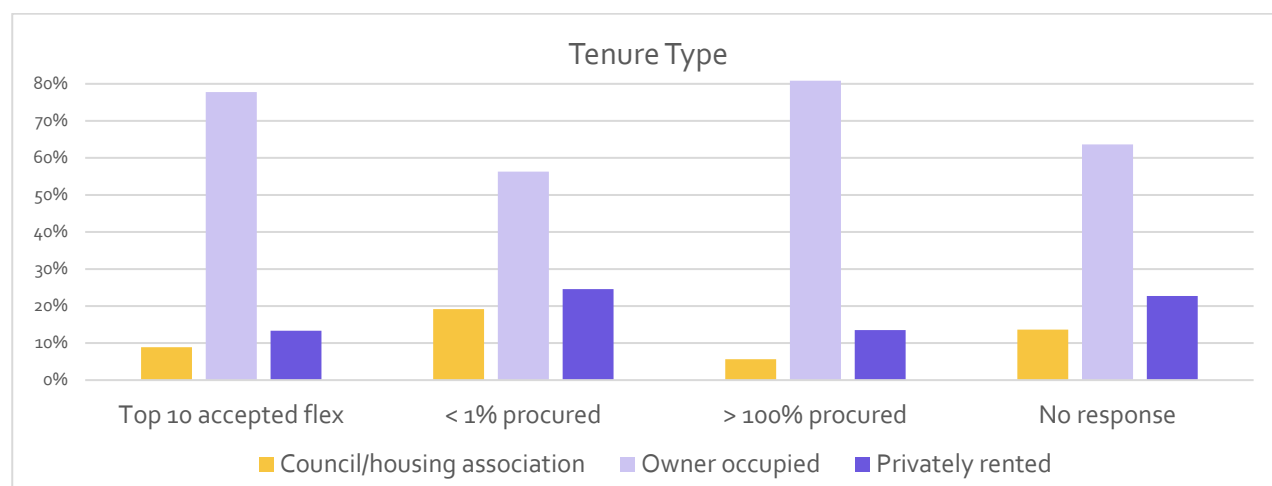


Figure 8: Percentage of households in different flexibility procurement result grouping of CMZs by household tenure type.

The distribution of household **heating systems** is not very different within CMZs in each procurement result group, with boiler and radiators (not shown in **Figure 10**) having the highest representation in each group, followed by storage heaters and room heaters (**Figure 10**). Communal heating systems were more prevalent in <1% flexibility procured group and in the no response group, but were not present in the other two groups.

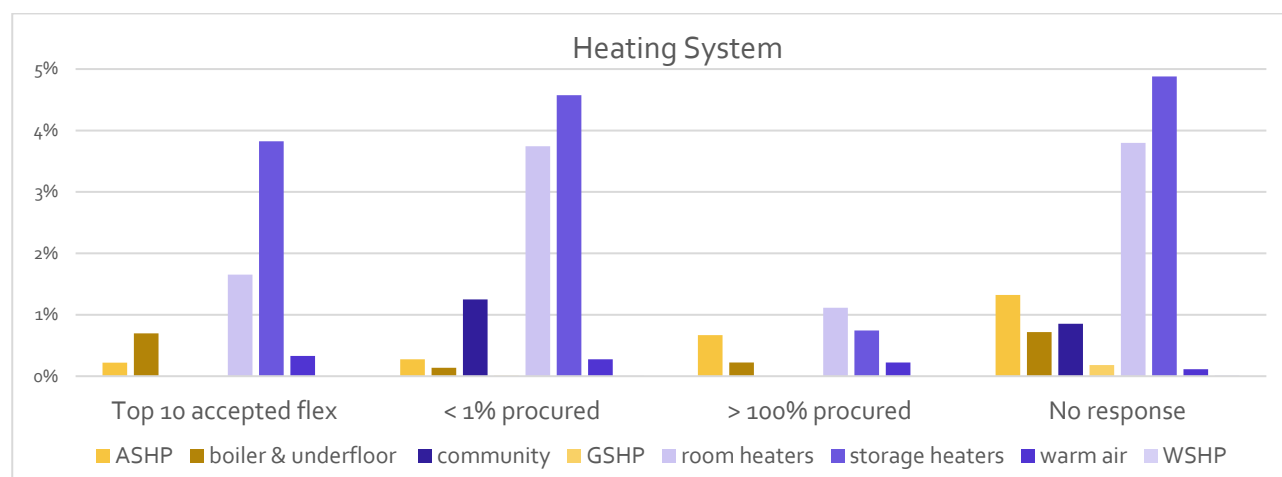


Figure 9: Percentage of households in different flexibility procurement result grouping of CMZs by household heating system. Boiler + radiators system was the most common heating system for all groups, but are not shown here for better visual representation of other heating types.

Rural households had their highest prevalence in CMZs that gave no response when flexibility tenders were released, and were least prevalent in CMZs that procured the most flexibility (**Figure 11**). This effect may be related to the relative sizing of CMZs, with rural CMZs containing, on

average, half the number of households as CMZs in urban areas (157 households compared to 337), meaning fewer connected assets and perhaps less likelihood of receiving a response to a flexibility tender. The opposing trend was found for urban households. There is no difference between the proportions of urban and rural households that fall within and outside of National Grid DSO's CMZs, so the difference in procurement results may suggest a lack of engagement with flexibility in rural areas by households or a lack of options for rural households.

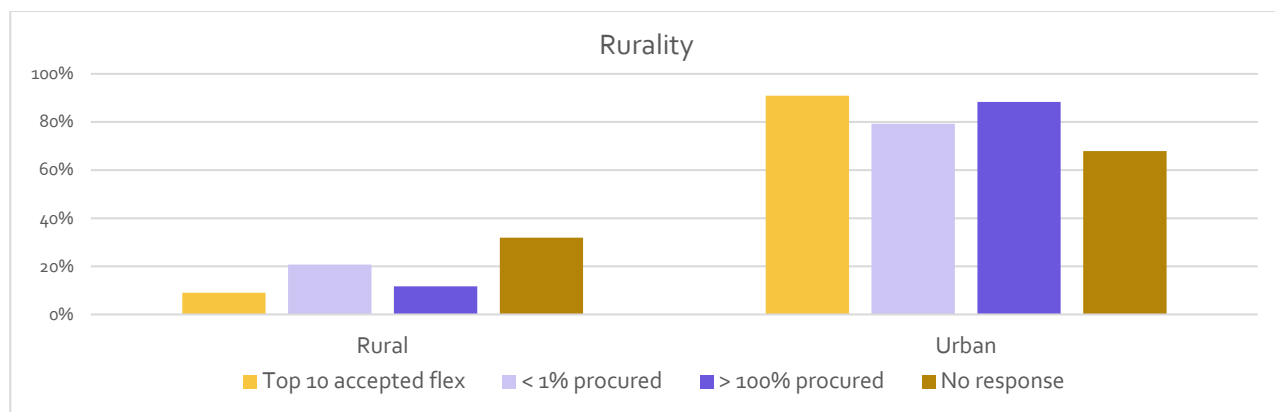


Figure 10: Percentage of households in different flexibility procurement result grouping of CMZs by rurality of households

Technology types and procurement

The following section looks at the characteristics of households in CMZs where the specific technology types were used to procure flexibility. This gives insight into types of households are typically linked with assets that were used to successfully provide flexibility to National Grid DSO.

The distribution of household income deciles in CMZs where **electric charge points** were used to provide flexibility were skewed towards higher incomes, as might be expected given the costs of an EV and the associated building requirements for having an EV charger (**Figure 12**). The pattern was also reflected in CMZs where air-source heat pumps (ASHPs) and batteries were used to provide flexibility. In contrast, household demand flexibility (defined as everything not captured in other technology types) was skewed towards lower incomes. This may mean that lower income households are manually shifting their demand by adjusting their domestic routines. Over 20% of households in CMZs where **hybrid heat pumps** (HHPs) were used to provide flexibility were in the lowest income decile, which could be due to their association with trials in low-income dwellings.

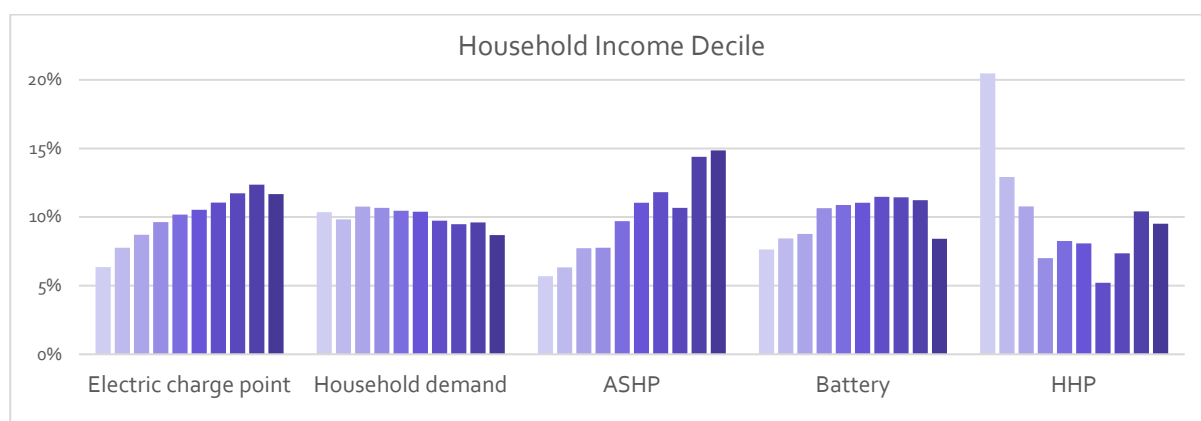


Figure 12: Percentage of households within CMZs, by household income decile, where different technologies were used to provide flexibility. Darker bars represent higher income deciles.

The IMD deciles showed the same distribution pattern as income deciles for CMZs that used electric vehicle charge points to provide flexibility (**Figure 13**). However, the distribution of IMD deciles for CMZs that used household demand flexibility did not show the same pattern as income, with less-deprived households being more prevalent than more-deprived households in using household demand to flex.

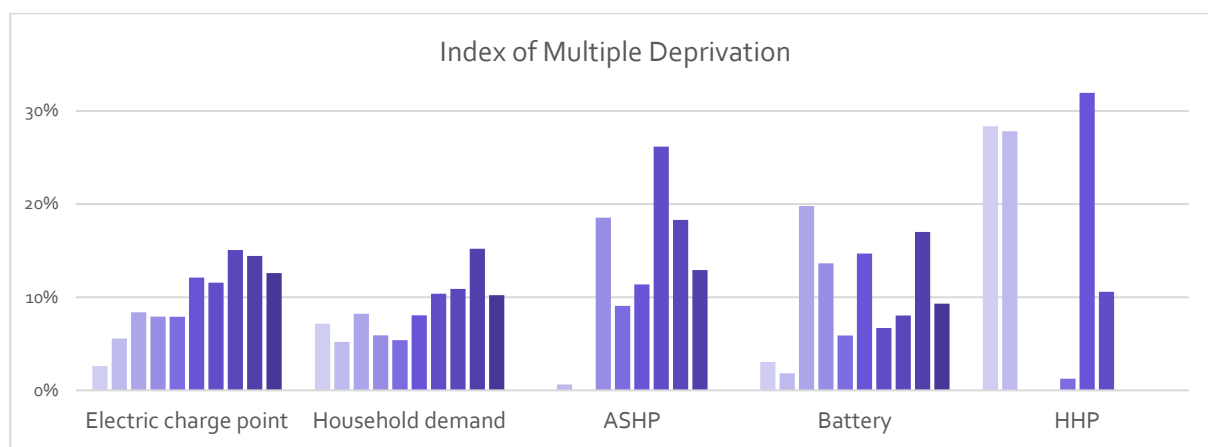


Figure 13: Percentage of households within CMZs, by IMD decile, where different technologies were used to provide flexibility. Darker bars represent less deprived deciles.

In CMZs that used **ASHPs** to flex, detached households were the most prevalent, and flats the least (**Figure 14a**). This again may relate to the capabilities surrounding household space and income for participating in flexibility services using these technologies. Social rented households had their highest representation in CMZs that used hybrid heat pumps (**Figure 14b**), potentially explaining the high percentage of households in the lowest income deciles for HHPs in **Figure 12**.

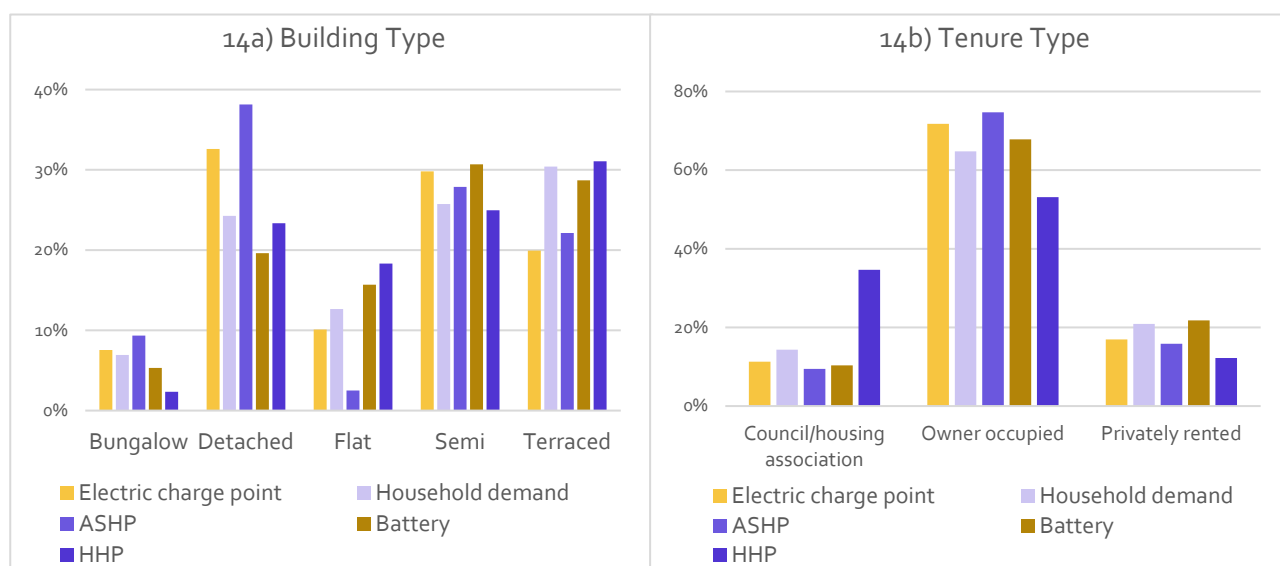


Figure 14: Percentage of households within CMZs, by (a) building type and (b) tenure type, where different technologies were used to provide flexibility.

Rural households were most prevalent in CMZs where ASHPs were used to provide flexibility, and least prevalent where HHPs were used to provide flexibility (**Figure 15**). The patterns were reversed in urban areas, where HHPs were used most frequently in urban areas for providing flexibility procurement.

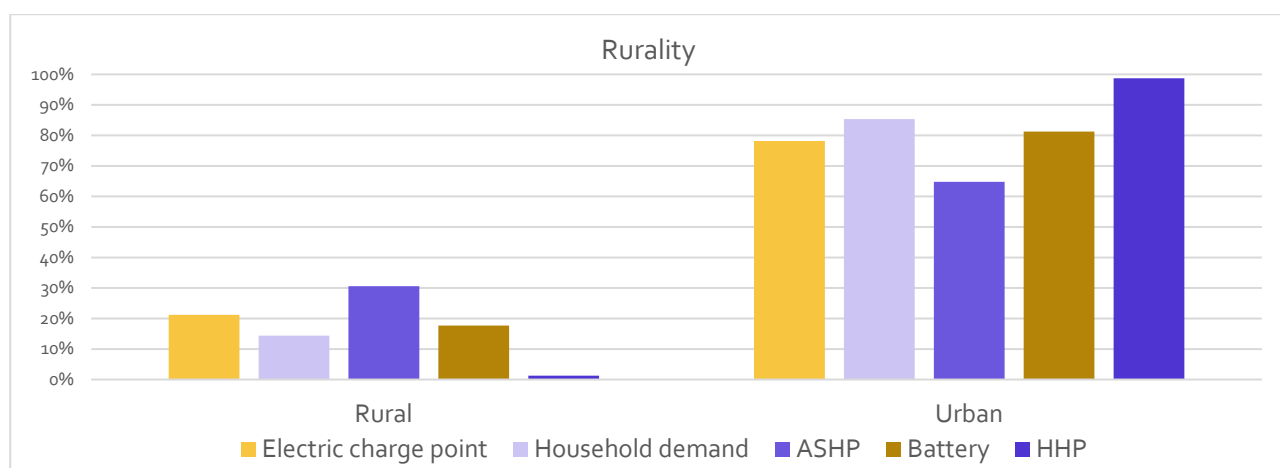


Figure 15: Percentage of households within CMZs, by rurality, where different technologies were used to provide flexibility

2.4. Summary

National Grid DSO will only procure flexibility in areas where it is needed, these Constraint Managed Zones (CMZs) are geographic regions where network requirements are met through the use of flexibility services. The available data cannot be used to determine the extent that income or a lack of deprivation drives constraints. Nor has the analysis been able to look at how DNO methods of predicting LV constraints may be contributing to the higher representation of low deprivation areas within CMZs⁵. However, the analysis does confirm that flexibility revenues are more likely to be available within the least deprived areas of National Grid's network and that wealthier households are accessing these value streams by providing flexibility, typically using EV charge points.

The data analysis shows that within CMZs there is a higher representation of least deprived areas (deciles 6 to 10) compared to the rest of the National Grid licence area. When looking at income there is only a slight difference when looking within and outside of the CMZs, with the lowest incomes underrepresented by only 2 and 1% in the 2 lowest income deciles. The differing patterns between income and IMD could indicate that non-financial deprivation factors affect asset adoption and engagement, if income is relatively normal inside a CMZ. Dwelling type is relevant. CMZs have a higher proportion of detached homes and lower proportion of flats. However, heating type is less of a factor. Homes that use electricity as their main heating fuel are slightly underrepresented in CMZs and electric heating systems such as room heaters and storage heaters are also underrepresented in CMZs.

Flexibility provision was highest in CMZs with high-income, least-deprived households, particularly in detached and semi-detached homes. EV charge points were the predominant technology for providing flexibility, with air source heat pumps (ASHPs) also significant in high-income areas. This is likely due to the assets owned by the high-income households and the space required e.g. off-street parking for an EV or garden space for a heat pump. In terms of household characteristics, detached and semi-detached households were key contributors to flexibility.

Where flexibility revenues are available in more deprived areas, households struggle to access them. The analysis showed the largest gaps between tendered and delivered flexibility was from low-income and deprived areas with terraced housing. This is likely due to a lack of assets used by these households, but also could be due to lower levels of smart energy capabilities. The data showed that a high proportion of lower-income households used household demand flexibility, indicating they were manually flexing their demand.

Owner occupied households, who have the greatest capabilities to modify their household energy systems, had highest representation in the top flexibility procurement groups, and the >100%

⁵ Recent research published by Regen looks at how network planning could change if assumptions about technology adoption changes for low-income households particularly and argues this could support a more equitable transition. Regen (2024) 'Just transition, Vulnerability and Future Energy Scenario' <https://www.ssen.co.uk/globalassets/about-us/dso/forecasting-future-needs/just-transition-and-the-dfes-report-v2.pdf>

flexibility procurement group. Social housing was the most likely tenure to fall in the less than 1% flexibility procured group. This may be due to a lack of engagement with tenants or ability to shift demand. Rural households appeared to be less successful in delivering flexibility compared to urban households. This may be due to smaller CMZs with less households in rural areas but could also show a lack of demand shifting options for rural households.

As might be expected, EV charging points, air source heat pumps and batteries were generally used in CMZs where there are a high proportion of high-income households, whereas manual household demand shifting was skewed towards CMZs with lower income households. This may mean that lower income households are manually shifting their demand by adjusting their domestic routines. However, the distribution of IMD deciles for CMZs that used household demand flexibility did not show the same pattern as income, with less-deprived households being more prevalent than more-deprived households in using household demand to flex. This suggests that low income is not necessarily a barrier to engage in flexibility using household demand, but that other aspects of deprivation that are considered in the IMD may present barriers in such instances.

Social tenure households had their highest representation in CMZs that used hybrid heat pumps. This is likely due to funding schemes such as the Social Housing Decarbonisation Fund (SHDF). Technology installation schemes such as SHDF can build the capabilities of social housing tenants and allow them to participate in flexibility services and benefit from them.

3. Smart energy capabilities analysis

This chapter provides key findings from the smart energy capabilities assessment carried out by CSE and National Grid DSO. The purpose of this activity was to use the CSE Offer Profiling Tool and Capabilities Lens as prompts to analyse whether DSO flexibility procurement products or rules create requirements that are passed on to consumers, and the extent these requirements might ultimately exclude certain consumers from DSO markets.

3.1. Background

Each household has a different capacity to engage with and benefit from a more flexible and greener energy system. CSE developed the concept of smart energy capabilities to describe and analyse these differences⁶. We look at five types of capability; dwelling and local area, energy technology and usage, financial situation, personal values and social connections, and confidence in digital technologies.

The Offer Profiling Tool is a beta tool developed by CSE which allows a user to assess the different 'essential' or 'desirable' requirements that different smart energy offers place on households. For example, to take part in flexibility services and earn incentives for reducing demand at specific peak times, it is essential that a user: has a smart meter (dwelling and local area), has a device that they can use to check for notifications (digital), and is okay with sharing their energy data with a third party like a system operator (personal/social). It is also desirable that a user: has a high electricity demand and can move their electricity usage to different times of day (both energy use).

Most features of smart offers result from commercial product design and consumer research. However, some may also result from the technical requirements or market rules used by system operators to procure flexibility services. For example, half hourly consumption data is typically required by a system operator from aggregators, and this means households without smart meters may be excluded from participating. A systematic understanding of the connection between consumer capabilities and DSO procurement rules has not been produced previously.

3.2. Methodology

CSE researchers designed a customised version of the Offer Profiling Tool for the activity. The changes made to were:

⁶ This concept and methodology is detailed in CSE's research report 'Working with the smart energy capabilities lens' available on our website [Working with the smart energy capabilities lens - Centre for Sustainable Energy](#)

- Added a selection of further potential smart energy capabilities that were not originally included in the tool.
- Added three example smart offers, profiled against each of the smart energy capabilities.
- Added two prompt questions to work through with National Grid DSO for each capability.

The final list of smart energy capabilities discussed with National Grid DSO is included in **Table 2**.

Table 2: Smart energy capabilities discussed with National Grid DSO

Energy	Space heating system	Digital	Computer device
	Water heating system		Digital confidence
	Heating usage level		Internet connection
	Electricity usage level	Personal	Ability to move energy usage
	Existing renewables		Willing to switch tariff
	Existing electricity storage		Okay with regular offer engagement
	Existing EV		Okay with automation
	Existing EV charger	Other potential factors	Dwelling location
	Existing TOUT		Indoor/outdoor space
	Meter		Rural/urban
Dwelling	Ability to make changes to dwelling		Good physical health
	EPC		Social capital
	Off-street parking		Mindset or values
	Long expected tenure		Credit score
Financial	Okay with fluctuating bills		Income level/reliability

After the spreadsheet and activity were designed, CSE ran an introductory session with National Grid DSO. This introduced the DSO to the different smart energy capabilities and how offer profiling could be used to analyse different smart offers. It also previewed the prompt questions and activity to be run in the next session.

After the DSO had an opportunity to review the spreadsheet, CSE hosted a second, longer session to work through the designed activity. This involved discussing the extended list of smart energy capabilities and for each asking two questions:

- 1) Is this requirement DSO related?
- 2) Is there any scope to mitigate any of the capability requirements?

This discussion was video recorded and lasted 90 minutes. Following the session, analysis using the recording and spreadsheet outputs was carried out in Microsoft Word.

3.3. Results

Discussion in the session highlighted some key relationships between DSO procurement rules and capability requirements, and some options for mitigating these requirements in future.

Which capabilities were related to DSO procurement?

As anticipated, discussion uncovered that DSO procurement products and rules have uneven impacts across the spectrum of smart energy capabilities.

National Grid DSO identified three capabilities that were directly related to DSO procurement requirements. Firstly, **dwelling location**. Network constraints drive DSO markets and the procurement of flexibility. In practice, if a household is not situated within a constrained part of the DNO network there is no reason for a DSO to procure flexibility from them. Axle Energy (an FSP and aggregator) estimates that roughly 20% of the UK population live within an area with some network constraints currently⁷. Network requirements will change, but dwelling location will impact the value of any flexibility that a household can provide to the network. This in turn will influence the services offered by FSPs to households. As mentioned in Chapter 2, it is unclear whether constrained zones occur primarily due to a concentration of existing energy assets, like EV chargers, typically owned by more affluent households or for other reasons such as new housing being connected. However, there is a risk that this is building injustice into the energy system. National Grid DSO also highlighted that they were unsure how constraints intersect with **rural and urban** profiles: data analysis in Chapter 2 shows there is no difference between the proportions of urban and rural households that fall within and outside of National Grid DSO's Constraint Managed Zones (CMZs).

Second, **ability to move energy usage** is also fundamental for DSOs. Once a CMZ has been identified and a flexibility tender produced, households will need to have some flexibility in their demand in relation to their assumed baseline usage to deliver value to a flexibility service provider and, in turn, a DSO.

Thirdly, this flexibility also needs to be measured using a specific **meter-type**. DSOs require measurement of flexibility in half-hourly periods by either a smart meter or some kind of asset-meter. Without either of these, a user would be unable demonstrate flexibility provided and therefore, unable to take part. Some flexibility products may also require more granular measurement. In allowing users to take part with just an asset meter (like for an EV charger), it should be noted that DSOs are more permissive than other procurers of flexibility. Nonetheless, in practice, having a smart meter is desirable for most consumers to be able to make use of other value streams. The requirement for prepayment meter users to switch to credit mode, a barrier to prepayment users adopting time of use tariffs, is not a result of DSO rules.

⁷ Axle Energy: <https://www.axle.energy/blog/analysis/local-flex>.

Aside from these three, some further capabilities were identified as not technically being required by DSOs, but in practice being highly desirable, especially in their relation to increasing a user's **ability to move energy usage**.

Many of these capabilities related to the energy theme. Having a large electrical asset, particularly an **EV charger, electric battery, or electric heating**, was identified as key both for increasing a user's flexible volume and providing options for automating usage in line with flexibility demands. More broadly, certain demand profiles were also identified as useful, particularly having **high electricity** or (electric) **heating demand**, or already being on a **time of use tariff**.

Similarly, all elements of the digital capability theme were also seen as essential for facilitating **ability to move energy usage**. Whilst in most cases it would not be impossible for a user without a **digital device, skill** or **internet connection** to take part in flexibility, practically, this would be difficult.

There was also discussion of some personal or social capabilities that are often desirable in enabling flexibility. Key capabilities highlighted were **being okay with automation**, to enable automated flexing. An example of this is when an FSP is controlling when an EV is charging. **Income reliability** and the **mindset or values** to want to take part are also desirable.

The remaining capabilities were viewed as the least relevant to DSO procurement rules. Some of these were contextual capabilities that might enable a user to take up or use a large electrical asset: having renewable generation, a good credit score, relevant social capital, good physical health, off-street parking, indoor or outdoor space, a higher EPC or being able to make changes to your dwelling.

Other capabilities were seen as more specific to how individual offers are designed by FSPs, specifically being: okay with fluctuating bills, willing to switch tariff and okay with regular offer engagement.

Mitigation options

Discussion covered a range of options for mitigating some of the requirements, either technical or practical, passed through from DSO to end user.

Baselining recurred throughout discussions as a crucial technical lever that DSOs had at their disposal in relation to access to flexibility. The calculation of assumed baseline usages of different consumer groups is central in determining the relative benefits that can be derived by these groups from flexing their demand.

Baselining methodologies vary between DSOs, as discussed in Chapter 4 and **Appendix 2**. Interestingly, the current National Grid DSO baselining approach, using average consumption profiles to derive fixed baselines for a portfolio, technically favours lower, rather than higher, electricity users for demand turn down services (although whether or how this is passed on to

specific end users by FSPs is unclear). Nonetheless, this is a quirk in National Grid DSO's baselining methodology and not a long-term mitigation of **high electricity usage** as a prohibitive capability for low users: ultimately, there is little system benefit to be gained from low users not changing their behaviour. Furthermore, the average baselining system also penalises low users in relation to demand turn-up opportunities.

As a result, discussion highlighted that more targeted baselining, potentially scaled by energy consumption estimates, may help National Grid DSO to distribute fairer and more accurate flexibility benefits both to low energy users and the broader network. Such targeting may also help to mitigate **heating type** as a capability. National Grid DSO reported that their current profiles for (non-heat pump) electric heating are relatively aggregated. Creating more granular versions of these could be a useful mitigating factor given that electric heating users tend to be more vulnerable than average⁸.

The workshop also covered the **timing of flexibility procurement** as another option open to National Grid DSO for mitigating some capability barriers. Procuring more flexibility through products that support longer timeframes – Scheduled Utilisation, as well as Peak Reduction, which National Grid DSO currently does not tender through at all, may open up energy efficiency improvements as a method for consumers in vulnerable circumstances, who may otherwise have limited **ability to move energy usage**. Moreover, the long-term nature of these products could also be combined with specific interventions (such as paper or telephone registration) to assist consumers who may have low **digital capabilities** to register. National Grid DSO also highlighted that longer procurement notice periods may encourage FSPs to use a wider range of notification methods (like text or email), that may be more amenable to users with limited digital capabilities.

There was also discussion around the role that National Grid DSO could play as a responsible flexibility procurer, driving standards through the flexibility supply chain. For example, in relation to **digital skills**, it was suggested that DSOs could set specific requirements for FSPs, such as needing to offer communication in a range of different methods. Nonetheless, there was concern about placing too many demands on FSPs. DSOs are generally wary of being too prescriptive to FSPs in relation to their communication methods, and this may add additional costs, which will ultimately reduce the benefits passed on to consumers.

Supporting existing initiatives such as HOMEflex⁹ was seen as a more realistic way of promoting best practice. Through building industry support for HOMEflex, or requiring FSPs to align with the HOMEflex Code of Conduct in service agreements, DSOs could encourage generally more inclusive practice in relation to different smart energy capabilities. For example, this would encourage FSPs to ensure a service is aligned with a user's **health** or **financial** circumstances.

⁸ OFGEM Insights paper on households with electric and other non-gas heating (2015): https://www.ofgem.gov.uk/sites/default/files/docs/insights_paper_on_households_with_electric_and_other_non-gas_heating_1.pdf

⁹ HOMEflex: <https://www.flexasure.org/homeflex>

There was also recognition that there was a more general need for improved communication across the sector about flexibility. This could include general awareness-raising or more specific guidance around what constitutes 'safe flexing' – for example, medical electrical equipment is not suitable for load shifting. This may help to address some softer capability barriers around **social capital** or **mindset and values**. However, there was also recognition that some of this communication may best come from organisations holding direct customer relationships (such as FSPs), rather than DSOs.

Finally, some suggestions were also made for mitigating specific capability barriers. For example, there was also a proposal that challenges for **prepayment meter users** using time of use tariffs might be mitigated through asset metering.

3.4. Summary

Overall, the capabilities assessment was a useful exercise for understanding more about some of the barriers and opportunities for DSOs like National Grid DSO around inclusive flexibility.

The findings underline some of the systemic challenges around procuring more flexibility from consumers in vulnerable circumstances. All three of the capabilities identified as essential from the DSO perspective have potentially regressive impacts. Due to the DSO's need to procure from CMZs, the less vulnerable groups who are overrepresented in these areas (see Chapter 2) are given more opportunities to participate in flexibility services. The requirement to have a smart or asset meter may exclude those consumers on lower incomes who are less likely to have a smart meter from participating at all¹⁰. And although the requirement to deliver load shifting is technically open to anyone, in practice, wealthier consumers are more likely to have the combination of capabilities relating to energy assets, property and personal habits that result in higher volumes of flexibility that can be used by DSOs and deliver rewards to households¹¹.

This evidence underscores a fundamental point that is increasingly recognised across the domestic flexibility sector: less vulnerable consumers are likely to benefit more from flexibility, whilst some more vulnerable groups may not be suitable for participating at all. This highlights a need for clear communication around the socialisation of the system benefits of flexibility. If we understand that some consumers may not be able to gain any direct benefits from flexibility service participation – we should be able to point to clear evidence that this group is being equally, if not better, served in the distribution of system benefits. Although the method of calculating this distribution is beyond the scope of this report, there may be an action for DSOs like National Grid DSO around ensuring that whatever system is used is communicated well to emphasise this point.

¹⁰ UK Parliament: Update on the rollout of smart meters 2023

<https://publications.parliament.uk/pa/cm5803/cmselect/cmpubacc/1332/report.html#:~:text=Its%20recent%20data%20show%20consumers,likely%20to%20have%20smart%20meters.>

¹¹ Powells, G. and Fell, M. (2019) 'Flexibility capital and flexibility justice in smart energy systems', *Energy Research and Social Science*, 54 (August), 56-59.

Nevertheless, discussion also elicited some options for National Grid DSO to consider that might mitigate capability barriers to ensure that vulnerable households who might stand to benefit from flexibility can participate without being unnecessarily excluded.

Baselining was a key lever identified here. More targeted baselining, scaled by consumption estimates, may help to deliver fairer and more accurate benefits to low electricity users, and help them benefit from appropriate opportunities, such as demand turn-up. Providing more granular baselines for storage heaters may also provide more flexibility benefits for storage heater users – especially important because, as demonstrated in the Chapter 2, this technology is linked to low income.

The timing of flexibility procurement was another interesting option raised. More use of long-term procurement (especially Peak Reduction and Scheduled Utilisation) may open up flexibility opportunities for consumers in vulnerable circumstances, who otherwise would not have the capability to move their energy use, via energy efficiency, and partnership with, for example, a social housing provider. Longer flexibility notice periods may also help FSPs enrol more digitally disadvantaged consumers in flexibility opportunities.

Finally, discussion also highlighted that promoting good practice is likely to be essential if DSOs such as National Grid DSO are serious about inclusive flexibility. Although this could be done unilaterally, in practice, supporting industry-wide schemes like HOMEflex, or improved communication campaigns may be more effective in driving high standards amongst FSPs and ensuring specific vulnerable groups (such as disabled people) are able to participate safely.

4. DSO activities review

This chapter provides a summary of key activities undertaken by GB DSOs in relation to increasing access to domestic flexibility. This review has two key objectives:

1. Providing National Grid DSO with a systematic overview of existing DSO work around accessible flexibility.
2. From this work, offer National Grid DSO insight into any further actions they could take to maximise their procurement of accessible flexibility in future.

4.1. Background

In RIIO-ED2, the price control framework for the electricity networks, DNOs have made a commitment to ensuring no consumer is left behind in the transition to the smarter future energy system¹². To this end, over the last few years, all DNOs have been engaging with the challenge of enabling more consumers in vulnerable circumstances to participate in energy flexibility. They have experimented with different service requirements to facilitate wider access. Many have also run innovation projects to test methods for including 'hard-to-reach' groups in flexibility initiatives or engage with broader dialogue and research across the industry on 'fair flexibility'. This chapter aims to provide a systematic review of these activities and draw out key insights for National Grid DSO in relation to opportunities for procuring more accessibility from consumers in vulnerable circumstances in the future.

4.2. Methodology

The review focusses on technical service requirements and innovation projects. For the technical arrangements review, a longlist of potentially relevant rules and requirements was first drawn up by CSE through desk research. This aimed to track which arrangements were most pertinent to accessible flexibility and what information was available across a broad cross-section of DSOs. Some reflections on challenges of finding some of this information, and its implications for inclusive flexibility, are included in the discussion below. Three key requirement areas emerged as most suitable for analysis: product availability and diversity, platforms used and baselining methodologies (more detailed baselining methodology is also found in **Appendix 2**).

¹² RIIO-ED2: <https://www.ofgem.gov.uk/energy-policy-and-regulation/policy-and-regulatory-programmes/network-price-controls-2021-2028-riio-2/network-price-controls-2021-2028-riio-2-electricity-distribution-price-control-2023-2028-riio-ed2>.

For the innovation review, a list of potential projects was compiled through a combination of desk research and existing awareness of relevant projects. Given the potential range of innovation projects, two criteria were used to longlist and shortlist the most relevant:

- 1) A clear focus on improving accessibility.
- 2) Clear innovation or activity on behalf of the DSO involved.

Longlisted projects were then sorted by some common categories, including date, type/level of DSO innovation and intervention theme (price signalling, technology, energy efficiency, other market innovation, community and standard setting). 44 projects were longlisted and of these, 25 shortlisted projects, which were seen as most important for this report, are discussed in the main report below. More details on all longlisted projects, and profiles for each shortlisted project, are available in **Appendices 3 and 4**.

4.3. DSO technical arrangements

The following discussion summarises findings in relation to the different technical arrangements used by GB DSOs when procuring domestic flexibility.

Product availability and diversity

All DSOs procure domestic flexibility through a range of different products. In 2023, the Energy Networks Association (ENA), in collaboration with industry bodies, completed a standardisation exercise to propose a new set of flexibility products, with improved alignment between DSOs. These new products superseded the former products: Sustain, Secure, Dynamic and Restore¹³. The new Market Facilitator (Elexon) will work with ENA to help ensure the right governance and institutions are in place as an essential part of establishing an efficient, fair and flexible energy system¹⁴.

Despite increasing standardisation within the products themselves, Table 3 shows that DSOs are currently delivering a variety of the new flexibility products. It is important to note that platform variety is reducing as DSO flexibility procurement matures.

¹³ Full technical specifications can be found in the ENA's product alignment report [https://www.energynetworks.org/assets/images/2023/Aug/on-flexibility-products-alignment-\(feb-2024\).pdf?1709039097](https://www.energynetworks.org/assets/images/2023/Aug/on-flexibility-products-alignment-(feb-2024).pdf?1709039097)

¹⁴ Market Facilitator role <https://www.ofgem.gov.uk/press-release/ofgem-lays-groundwork-consumer-friendly-flexible-energy-use>

Table 3: Summary of flexibility products tendered for by DSOs at time of writing, including relevant subtypes (if information available).

Product Name	Sub-Parameter	Network Company					
		NPg	SSEN	SPEN	NG DSO	UKPN	ENW
Peak Reduction (PR)	Any/ Not specified					X	X
Scheduled Utilisation (SU)	Any/ Not specified	X		X		X	
	Settlement Periods				X		
	Specific periods				X		
Operational Utilisation (OU)	Any/ Not specified		X	X			
	2 mins						
	15 mins				X		X
	Week ahead						
Operational Utilisation + Scheduled Availability (SAOU)	Any/ Not specified			X			
	2 mins						
	Day ahead		X		X	X	
Operational Utilisation + Variable Availability (VAOU)	Any/ Not specified		X	X			
	2 mins						
	15 mins						X
	Day ahead						
	Week ahead						

Product parameters and availability

The two products under which domestic flexibility is most typically procured are Peak Reduction, and Scheduled Utilisation. Below is a short discussion of the definitions of these products, variation in their procurement across DSOs, and any appropriate comments on the relation of

their procurement to domestic flexibility. It is unclear whether there is a key difference between these products in terms of accessibility.

Peak Reduction (PR)

This product seeks a reduction in peak power utilised over time. This response can manage peaks in demand and could be provided by long-term energy efficiency activities.

Energy Networks Association: Flexibility Products Review and Alignment

Only two DSOs procure flexibility under the Peak Reduction product: ENW and UK Power Networks. As it can be procured via energy efficiency activities, it could present a meaningful way for households without flexible assets to participate in flexibility markets.

Scheduled Utilisation (SU)

In this product, the time that flexibility is delivered has been pre-agreed in advance with the provider. This product will primarily benefit FSPs that cannot respond in real-time or near to real-time. This service can be used by the Network Companies to manage seasonal peak demands and defer network reinforcement, for example.

Energy Networks Association: Flexibility Products Review and Alignment

ENA's product definitions state that under SU, flexibility should be delivered "continuously" throughout the agreed window. Contrast with the definition for Peak Reduction, which requires "peak delivery": for flexibility service providers to "target the maximum response that can be delivered". SU appears to allow less room for variation around the agreed delivery; in the context of domestic flexibility, it is easier to imagine less-than-continuous flexibility being delivered by the aggregation of many households. Domestic FSPs might be able to predict average volume across their portfolio, but this is less reliable than large commercial distributed energy resources with specific and controllable energy use.

Platforms used

Table 4 below highlights the variation in platform dependency across the DSOs, broken down by the procurement stage each platform is relevant to.

Table 4: Platforms used by each DSO at each stage of the flexibility procurement process.

Network Company	Stage				
	Registration & pre-qualification	Asset registration	Bidding	Dispatch	Payment
ENW	PicloMax	PicloMax	Electron Connect	Unclear	
	Electron Connect	Electron Connect			
NG DSO	Market Gateway	Market Gateway	Flexible Power	Flexible Power	Flexible Power
	PicloMax	PicloMax			
NPg	Piclo Flex	Piclo Flex	Piclo Flex	Flexible Power	Flexible Power
SPEN	Piclo Flex	Piclo Flex	Piclo Flex	Piclo Flex	Piclo Flex
SSEN	Electron Connect - unclear	Electron Connect	Electron Connect	Flexible Power	Harmony
	Delta				
UKPN	Localflex	Localflex	Localflex	Unclear	

Only two DSOs, UK Power Networks and SPEN (and potentially ENW, although it is unclear what platform is used for dispatch and payment) use a single platform throughout the entire process. FSPs engaging with the remaining four may have to register for an additional platform. National Grid DSO and SSEN are notable for potentially relying on requiring usage of more than two platforms to engage in their respective flexibility markets. There is also a lack of consistency across DSOs. For an FSP providing flexibility in one DSO market, in almost all instances they would need to set up with an additional platform to engage in any other market.

For non-traditional FSPs, such as local authorities and housing associations, this diversity in platform use may provide additional barriers to participation, in turn slowing the inclusion of households managed by these entities into flexibility markets. However, it may be of limited concern, given that the additional costs associated with multiple platform use are lessened for housing providers with highly localised catchment areas. Organisations that can provide flexibility

across different DSO markets may be of a scale significant enough that the cost of multiple platforms is minimal.

It is possible that, for FSPs, some stages of the flexibility process may be more easily performed on new platforms. For example, registration and pre-qualification occur once (per DSO, although it is unclear in which instances this has to be repeated in markets with the same registration platform), whereas bidding, dispatch and payment may be engaged with more regularly, increasing training needs and complexifying the process.

Baselining methodologies

When flexibility is provided to a DSO, a methodology is needed to agree the value of electricity consumption to measure this flexibility against, these are referred to as baselining methodologies.

Baselining methods are important to discussions around accessibility for domestic consumers in flexibility markets. On one hand, complex baselining allows for more accurate prediction and better prices, which may make flexibility more financially viable for a wider range of households: beyond those with high-usage assets that have historically contributed most flexibility. However, with complex methods comes a need for more detailed consumption data and metering technology, which may exclude a subset of households: notably those without smart technology and asset-level metering. Complex methods may also create barriers for non-traditional FSPs, such as local authorities and housing associations.

Table 5: Baselining information by DSO. Yellow represents where information is available, lilac cells show where partial information is available, blank cells show missing information.

* : information only given for EV chargers.

** : baselining method described for both heat pumps and EV chargers, although the method is the same for both

DSO	Baselining information available	Calculation method explained	Baseline values given	Variation in baseline method across technologies	Variation in baseline values across technologies
ENW					
NG DSO					
NPg				*	*
SPEN					
SSEN					
UKPN				**	

Table 5 details the information available on different DSO's baselining methodologies. There is distinct variation in the level of detail given: National Grid DSO, UK Power Networks, and NPg all

provide specific baselining methods and baseline values for specific technologies; whereas SSEN¹⁵, ENW¹⁶ and SPEN¹⁷ simply refer to the ENA's baselining methods¹⁸ (or the ENA's baselining calculator¹⁹).

The ENA specifies a series of specific baseline calculation methods: most of which include taking a recent-historical average consumption profile and calculating a baseline value for a particular asset or portfolio of assets. However, some DSOs prefer to agree specific baseline values at a flat rate, according to a set of parameters; typically at least considering the type of technology and season, but in some instances varying by time of day (NPg²⁰, UK Power Networks²¹, and some National Grid DSO products²²), metering point (National Grid DSO), weekday-vs-weekend (NPg), or whether the asset is in a HV or LV zone (UK Power Networks).

Details of how each DSO's baselining methodology works can be found in **Appendix 2**.

4.4. Innovation projects

The longlist of all innovation projects considered in this review is included in **Appendix 3**. The following discussion summarises key findings in relation to accessible flexibility across the core intervention themes. This focusses on shortlisted projects - all of which are profiled in **Appendix 4**.

Price signalling trials

A number of innovation trials have focussed on demand flexibility. These have involved trialling different market arrangements to incentivise domestic residents to shift their energy usage away from peak times. A significant barrier to wider domestic participation in flexibility is the limited ownership of flexible assets, such as batteries, EV chargers and heat-pumps. These trials explore

¹⁵ SSEN Service Terms – Manual: page 19 <https://www.ssen.co.uk/globalassets/our-services/flexibility-services-document-library/slc31e-reports--statements/ssen-service-terms-aligned-to-fsa-manualv4.pdf>

(cont.) & SSEN Service Terms – Flexible Power, page 23 <https://www.ssen.co.uk/globalassets/our-services/flexibility-services-document-library/slc31e-reports--statements/ssen-service-terms-aligned-to-fsa-flexible-power-v4.pdf>

¹⁶ ENW Flexibility FAQs <https://www.enwl.co.uk/future-energy/flexibility-hub/flexibility-faqs/>

¹⁷ SPEN Participation Guidance 2024-25: page 4 <https://www.spenergynetworks.co.uk/userfiles/file/2024-25ParticipationGuidance.pdf>

¹⁸ ENW Flexibility FAQs <https://www.enwl.co.uk/future-energy/flexibility-hub/flexibility-faqs/>

¹⁹ ENA Baseline Calculator https://ena-baselining.herokuapp.com/baselining_app/

²⁰ NPg Northern Powergrid baselining methodology domestic EV chargers <https://www.flexiblepower.co.uk/downloads/1127> & NPg Northern Powergrid baselining domestic EV chargers V2 <https://www.flexiblepower.co.uk/downloads/1126>

²¹ UKPN Baseline Data <https://d1lf10z5vvdbr.cloudfront.net/app/uploads/2024/10/Baseline-data-for-electric-vehicles-heat-pumps-and-householdsBaselines.xlsx>

²² National Grid DSO Baseline Values <https://www.flexiblepower.co.uk/downloads/1122>

the ability for customers without such assets to participate in, and the extent to which they might benefit from, DSO flexibility markets.

Most trials of this nature have been considered successful in terms of achieving flexibility, but have on occasion raised important concerns about accessibility. NESO's **Demand Flexibility Service**²³ and **Crowdflex**²⁴ have both identified concerns about the minimal rewards achieved by low energy users under these trials, as well as reliability for procurers.

Trials such as **Energywise**²⁵ and **Warmworks**²⁶ have trialled novel time-of-use tariffs as a means of procuring domestic flexibility. The lower technological requirements of these tariffs (when compared to other flexibility-enabling solutions) may be a useful tool for expanding accessibility.

At present, innovation projects of this type have emphasised expanding accessibility over identifying ways to make flexibility more rewarding to consumers. This may prove troublesome if increased accessibility to flexibility does not translate into increased participation.

Technology trials

Many trials have focussed on technological solutions to expand access to flexibility in the domestic sector. These include projects that evaluated the potential of new technologies and those that investigated existing technologies applied or distributed in new ways.

Distributed Storage and Solar Study (DS3)²⁷, **Warmworks**, **Urban Energy Club**²⁸, **Home Response**²⁹ and **Balancer**³⁰ all explore the use of batteries as a means of providing flexibility. Batteries allow customers without domestic generation (or assets with substantial electrical demand, such as EVs) to participate in flexibility by storing energy from the grid when energy is cheap and discharging when expensive.

Warmworks and **Home Response** both identified significant financial gains to the consumer, as a result of flexibility unlocked by battery ownership, and that these gains were optimised under time-of-use-tariffs. Furthermore, **Home Response** found a benefit to the grid: notably that a household with a battery and a time-of-use-tariff could offset 2.5 households' worth of peak demand, but would have no impact if on a flat tariff instead.

²³ Demand Flexibility Service <https://www.neso.energy/industry-information/balancing-services/demand-flexibility-service-dfs>

²⁴ Crowdflex <https://www.neso.energy/about/our-projects/crowdflex>

²⁵ Energywise <https://innovation.ukpowernetworks.co.uk/projects/energywise-also-known-as-vulnerable-customers-and-energy-efficiency>

²⁶ Warmworks <https://www.warmworks.co.uk/wp-content/uploads/2022/08/Domestic-Battery-Storage-Report.pdf>

²⁷ Distributed Storage and Solar Study <https://www.northernpowergrid.com/sites/default/files/assets/5396.pdf>

²⁸ Urban Energy Club <https://innovation.ukpowernetworks.co.uk/projects/urban-energy-club>

²⁹ Home Response <https://innovation.ukpowernetworks.co.uk/projects/home-response>

³⁰ Balancer: SIF Round 3 Project Registration <https://smarter.energynetworks.org/view-pdf?projectId=41307>

Urban Energy Club installed a community battery and set up an informal peer-to-peer energy market. They found that whilst such a scheme could provide flexibility and financial value to the consumer, the report highlighted that regulatory barriers impact the viability of using communal batteries in this way.

DS3 installed batteries and tested a set of aggregator-controlled charging schemes, some which maximised value to consumer, and some that maximised flexibility. The project found that peak reductions could be achieved even under the consumer-focussed charging scheme, essentially providing a free benefit to the DSO.

Across the technology innovation projects considered here, all identified financial gains to either the consumer or to the grid operator. However, these gains were typically small when compared to the typically large price of domestic batteries, and very little emphasis was given to whether the two were economically viable as a potential DSO intervention.

Energy efficiency

Some trials explored innovative techniques to expand the use of energy efficiency measures as a means of supplying flexibility. Only some DSOs currently procure via energy efficiency measures, making these trials a vital source of knowledge for the future of procurement.

Future Flex³¹, **Flex Direct**³² and **Socially Green (Autumn trial)**³³ all explore using direct installation of energy efficiency measures in homes as a source of flexibility through demand reduction. This may offer DSOs an opportunity to engage a wider range of households in flexibility markets, especially those without existing flexible assets. Additionally, if a viable mechanism is found for installation, households may be able to receive free home improvements (and enjoy a warmer and cheaper-to-run home), while DSOs save money on reinforcement costs.

In **Future Flex**, although the workstream to install measures was not completed, research found that DSOs could save up to £1,000 per household in deferred or avoided reinforcement costs as a result of installing energy efficiency measures in constrained areas.

The **Socially Green (Autumn Trial)** did involve the installation of measures in some local authority housing. To date there is little evidence from this project in terms of network impact – perhaps because of its recency – but the project did find that targeted advice, in-home support, and the use of trusted intermediaries would all improve householders' understanding of flexibility and could increase participation.

Flex Direct builds on **Socially Green** by planning to roll out energy efficiency upgrades in social landlord housing, with a specific focus on different commercial models, with varying degrees of

³¹ Future Flex Progress Report <https://www.nationalgrid.co.uk/downloads-view-reciteme/598600>

³² Flex Direct <https://smarter.energynetworks.org/projects/10061348/>

³³ UKPN Network Innovation Allowance Annual Summary: pages 17-18
<https://smarter.energynetworks.org/media/nhhpocbs/uk-power-networks-annual-nia-summary-202324.pdf>

direct contracting between DSO and housing providers. This should produce some valuable evidence to take forward in future energy efficiency work.

Other projects have focused on calculating more accurate estimate of energy efficiency on absolute demand reduction. **Solent Achieving Value through Efficiency (SAVE)**³⁴ provided robust statistical evidence supporting the efficacy of energy efficiency interventions on demand reduction. **RetroMeter**³⁵, while still ongoing, identified that inaccurate baselining methodologies make procurement of flexibility via domestic energy efficiency less economical. **DEFENDER (Demand Forecasting Encapsulating Domestic Efficiency Retrofits)** created a tool for more accurately forecasting the impact of energy efficiency retrofits in relation to future network reinforcement.

As a follow-on to **DEFENDER**, **PIONEER (Proportional Investment of Networks in Energy Efficiency Retrofit)** is looking into other potential commercial models that DSOs could use to bring forward thermal efficiency measures. A key initial finding was that the cost of measures is high, but the value of DSOs is low, therefore it did not recommend that DSOs provide an alternative source of efficiency funding.

Other market innovation

Some innovation trials have proposed or tested novel flexibility market arrangements, institutions and projects. Of all aspects of flexibility markets discussed, DSOs have the most control over their own relationships with FSPs: things such as how contracts are agreed and the level and type of incentives set. By identifying ways in which the market can be made more amenable to domestic aggregator FSPs – or to encourage more engagement with vulnerable households – DSOs can directly influence market accessibility.

Project Transition³⁶ highlighted the importance of simplified contractual arrangements to minimise legal reviews for potential flexibility service providers. They proposed that this could be aided by use of a Neutral Market Facilitation system, which was explored by the **BiTraDER**³⁷ project, albeit with a focus on generation.

Project Fusion³⁸ noted that automation is attractive to flexibility service provides with large portfolios of smaller assets, which typically include domestic aggregators. **Intraflex**³⁹ also noted that domestic aggregators found “close-to-real-time” flexibility procurement was preferred by

³⁴ Solent Achieving Value through Efficiency <https://save-project.co.uk/>

³⁵ RetroMeter: <https://www.enwl.co.uk/future-energy/innovation/strategic-innovation-fund/retrometer/>

³⁶ Project Transition Project Close Down Report (2023) <https://ssen-transition.com/wp-content/uploads/2023/09/TRANSITION-Close-Down-Report-Webpage.pdf>

³⁷ BiTraDER: <https://www.enwl.co.uk/future-energy/innovation/key-projects/bitrader/what-is-bitrader/>

³⁸ FUSION: Close Down Report (2024)

https://www.spenergynetworks.co.uk/userfiles/file/FUSION_Close_Down_Report_CLEAN_020224.pdf

³⁹ IntraFlex Project Closedown Report (2021) <https://www.nationalgrid.co.uk/downloads-view-reciteme/603011>

some domestic aggregators, due to their limited confidence in providing baselines and nominating capacity at longer notices.

Socially Green produced a set of suggestions for FSPs to procure flexibility from consumers in vulnerable circumstances, a number of which could be actionable by DSOs. They proposed, amongst other things, that FSPs be mandated to procure a certain proportion of flexibility from hard-to-reach households, an incentive payment to FSPs to redistribute flexibility revenue to consumers in vulnerable circumstances, and to update the priority process to provide support to disadvantaged groups in accessing flexibility services.

One proposal was later actioned on in the **Socially Green (Summer trial)**⁴⁰: to pay FSPs a bonus per hard-to-reach household procured from. However, there is no evidence of impact.

Community and engagement

Several projects have explored opportunities for increasing access to flexibility through engaging with broader communities. Working to procure flexibility at the community level may help to unlock procurement from more vulnerable households. Equally, providing support and advice to community groups or direct to consumers in vulnerable circumstances can also help develop their smart energy capabilities to enable them to participate more equitably in flex.

The **Smart Energy Action Plan (SmEAP)**⁴¹ project has demonstrated that bespoke advice can help consumers improve their smart energy capabilities and offer more opportunities to engage with flexibility. The **Energy Choices Tool (ECT)** is pioneering a way of delivering similar advice through an online platform.

Socially Green (Autumn Trial)⁴² reported that when procuring flexibility from social housing, use of targeted advice, in-home support and the use of trusted intermediaries could all increase participation in flexibility services. Likewise, **Urban Energy Club** highlighted the need for trusted community members to act as intermediaries.

Drawing insights from **Urban Energy Club, Balancer**⁴³ explored community-owned batteries, with a focus on testing a new commercial model to enable new consumers to participate in flexibility. The project looked at the regulatory barriers to DSOs owning batteries with a system of co-owners and investors.

⁴⁰ UKPN Network Innovation Allowance Annual Summary: pages 17-18

<https://smarter.energynetworks.org/media/nhhpocbs/uk-power-networks-annual-nia-summary-202324.pdf>

⁴¹ CSE Smart Energy Action Plans: <https://www.cse.org.uk/my-home/advice-projects/smart-energy-action-plans-a-pilot/>

⁴² UKPN Network Innovation Allowance Annual Summary: pages 17-18

<https://smarter.energynetworks.org/media/nhhpocbs/uk-power-networks-annual-nia-summary-202324.pdf>

⁴³ Balancer: SIF Round 3 Project Registration <https://smarter.energynetworks.org/view-pdf?projectId=41307>

Less optimistically, **Social Constraint Management Zones (SCMZs)**⁴⁴ focused on developing a set of good practices for procuring flexibility from community groups. Despite a high level of support throughout the procurement process, they found that in most cases, the potential remuneration did not justify the cost of participating.

Setting standards

A final category of innovation projects focusses on investigating the challenge of inclusive flexibility and promoting better related standards of practice across the flexibility sector. Most of this work has not involved DSO innovation per se, but has been reliant on DSO funding, and has produced several key outputs to consider in relation to accessibility in flex.

As mentioned at the start of this report, **Smart & Fair** (National Grid, SSEN) has been run by CSE since 2019. The research programme focusses on building tools and developing insights to help embed fairness within the future energy system.

Insights from **Smart & Fair**, particularly around the emerging risks for consumers in vulnerable circumstances around flexibility, helped to develop the **HOMEflex**⁴⁵ project (SSEN). This has been running since 2022 with a focus on improving standards and trust in the domestic flexibility sector. **HOMEflex** built on insights from consumers to develop a Code of Conduct for FSPs providing services to domestic consumers in 2023. A second phase of research has recently published recommendations for a compliance scheme to support the Code. Although primarily focussed on the role of FSPs, the research has produced some pertinent recommendations for DSOs, particularly:

- Incorporating HOMEflex principles into their service agreements with FSPs,
- Contributing financially to the creation of a domestic flexibility compliance scheme,
- Providing advocacy for HOMEflex across the sector,
- Supporting a broader public communication campaign around energy flexibility.

4.5. Summary

Through a focus on flexibility technical arrangements and innovation projects, this chapter has summarised key activities undertaken by DSOs that may impact the accessibility of domestic flexibility services.

A key overarching finding from the technical arrangement review is the diversity of different practices across the GB DSOs in relation to domestic flexibility. Despite some recent efforts at standardisation, there remains a high level of variation in the flexibility products offered (and the makeup of these products), platforms used and baselining methodologies. From a practical

⁴⁴ SSEN: Social Constraint Management Zones <https://ssen-innovation.co.uk/wp-content/uploads/2021/06/NIA-0036-Closedown-Report-2.pdf>

⁴⁵ Homeflex: <https://www.flexassure.org/homeflex>

perspective, there is also little consistency in how and what information is presented online by different DSOs.

This situation could feasibly present a challenge for accessibility to flex. Different configurations between DSOs, and the inconsistencies in how this information is presented, is likely to increase the administrative burden for all FSPs, reducing their capacity to engage with accessibility issues. This may be particularly problematic for non-traditional FSPs, such as housing providers, who may engage with a higher proportion of consumers in vulnerable circumstances. Moreover, the variety in approaches and information also makes it harder to track consistent outcomes across the sector for consumers. The need to improve consistency across the flexibility market to drive fairness was also a key finding of several recent innovation projects led by DSOs. This evidence suggests that, at a high level, it would be valuable for National Grid DSO to continue supporting ongoing work on standardisation (for example of products, or platforms) across the sector. An accessibility review of National Grid DSO's online information relating to domestic flexibility may also be useful.

In relation to baselining, the diversity of different practices underlines that there is no simple solution in relation to accessibility: more granular or broad approaches both have potential challenges. As a result, if National Grid DSO do consider a more detailed approach, as suggested in the previous chapter, this should be considered in combination with more longer-term procurement options. Less onerous timing requirements may help to offer participation options to those consumers that may be challenged by more detailed baselining. For example, those without smart meters may be included via whole building metering options for energy efficiency procurement, as in the **Flex Direct** project. In this way, the recommendations around baselining and procurement timing flagged in the previous chapter work together well.

On the issue of timing, the review in this chapter found no clear evidence that suggested either Peak Reduction or Scheduled Utilisation had any clear advantages over each other in relation to accessibility. Nonetheless, as National Grid DSO do not currently procure through Peak Reduction, it may be worth exploring to understand if it can deliver different results. It should also be stressed that, as highlighted in the **Intraflex** project, more long-term procurement options won't be suitable for all domestic FSPs, so the general target here should be more, rather than exclusively, longer-term options.

As well as echoing the general call for greater market consistency, the review of innovation projects also highlights a range of different DSO intervention options for market accessibility. Technology and price signalling trials have to date had the largest practical impact in relation to the accessibility of flex, although each come with trade-offs. Installations of technology like batteries have delivered significant cost savings and flexibility volumes, and under a range of market conditions, but for a limited number of consumers, and at higher cost and complexity to the DSO. Demand turn-up or down projects are attractive as 'quick win' measures to reach lots of consumers in vulnerable circumstances, but deliver limited benefits for low-use consumers and may be unreliable for DSOs.

If National Grid DSO is interested in running similar trials in future, current evidence suggests that a large asset installation combined with a tariff mechanism would likely deliver the best balance of outcomes for consumers in vulnerable circumstances and broader network, although specific data on payback periods is limited. Community projects have also shown that a similar arrangement could also work at a communal-scale, but communication via trusted intermediaries in this case would be vital, as well as clear ownership models.

Previous energy efficiency projects may also offer a way forward, especially in relation to previous points made around more longer-term procurement for National Grid DSO. There is not yet robust evidence that these projects will deliver significant value for the network in relation to investment costs. However, ongoing projects may offer more evidence around more viable commercial models that National Grid DSO should look out for. Potential network savings also need to be factored together with co-benefits for vulnerable households and housing providers when calculating value.

Other projects have highlighted different market mechanisms that National Grid DSO could use to encourage more accessible flexibility procurement. **Project Transition** and **SCMZ** suggested that simplified contractual arrangements could enable participation for a wider group of FSPs. The **Socially Green** and **Urban Energy Club** projects have also proposed and tested some more radical network options for procuring more hard-to-reach flexibility, including using incentive payments for FSPs, mandating social and environmental value benefits, or setting procurement quotas. Again, evidence from these projects is patchy, but may offer some ideas for National Grid DSO to consider.

Finally, some projects have also produced some broader insights around how DSOs can support flexibility market accessibility. Although focussed on FSPs, **HOMEflex** carves out a clear role for DSOs in incorporating standards across the flexibility supply chain. It also suggests DSOs will be key in supporting a broader public communication campaign on flexibility. Indeed, many of the projects cited here, and especially those working at a community level, underline the importance of deeper engagement with consumers in vulnerable circumstances around the opportunities and risks of flexibility. This was a key capability identified in Chapter 3, and it is unlikely that any type of consumer proposition would work without it. On this point, National Grid has been pioneering in supporting smart energy advice through the **Smart Energy Action Plans** and **Energy Choices Tool** projects, and this example should be replicated by other DSOs.

5. Findings and recommendations

This research has presented evidence from data analysis, workshops, and a desk-based review in order to:

- Analyse the households that fall within National Grid DSO's flexibility procurement zones, and their respective contributions towards flexibility provision.
- Assess the barriers consumers may face in accessing flexibility services in the National Grid region, and particularly which of these may be under the control of National Grid DSO.
- Summarise potential options for National Grid DSO in mitigating these barriers in future.

The following sections detail key findings in relation to these three objectives, with an explanation of their accompanying recommendations for National Grid DSO, followed by a summary of recommendations.

5.1 Disparities across procurement zones and in the provision of flexibility

The key finding of this research is that, as suspected, low-income households are participating less in flexibility markets. Analysis in Chapter 2 comparing households in Constraint Managed Zones to those outside, found that the least deprived areas have a slightly higher representation in National Grid DSO CMZs compared to the rest of National Grid licence areas, although income levels were evenly distributed. Analysis of how flexibility was being provided in response to tenders found that provision was highest in CMZs with high-income, least-deprived households, particularly in detached and semi-detached homes. Most flexibility was provided by EV charge points with ASHPs also contributing significantly within high-income areas. Where lower income households did provide flexibility, this was typically through manual demand shifting.

In general, procuring flexibility within low-income and deprived areas is harder. The analysis showed CMZs in these areas faced the largest gaps between tendered and delivered flexibility. Rural areas are noticeable in delivering little flexibility.

Key finding: Flexibility revenues are more likely to be available within the least deprived areas of National Grid's licence areas and wealthier households are accessing these value streams. Where flexibility revenues are available in lower income or more deprived areas, households struggle to access them and DNOs struggle to procure the needed flexibility.

Analysis from the capabilities assessment in Chapter 3 identified three key capabilities required from consumers in order to take up DSO flexibility services that stem directly from National Grid

DSO requirements. Crucially, all three of these capabilities - location in a CMZ, having a smart or asset meter and being able to move energy usage - have potentially negative impacts on consumers in vulnerable circumstances as they are currently less likely to have them.

Combined with the analysis from Chapter 2, the research shows a need for further, more consistent analysis to understand uptake of flexibility services amongst vulnerable households. Therefore, similar studies to this should be commissioned both across other DSOs and over time as the market develops. Access to more detailed data such as MPAN level will add value. For example, an MPAN assessment to reveal how many households on the priority services register (PSR) have been involved in flexibility services.

Recommendation 1: Undertake further work to assess uptake of flexibility services amongst households in vulnerable circumstances.

Moreover, especially if evidence continues to suggest that less vulnerable consumers are likely to benefit more from flexibility, whilst some more vulnerable groups may not be suitable for participating at all, there needs to be clear evidence that the system benefits of flexibility are being suitably redistributed. Given the current paucity of this information across the domestic flexibility sector, and the requirement on DNOs to support a fair transition, a focus should be on making this information publicly accessible.

Recommendation 2: Undertake work to quantify how system benefits are distributed, and make findings publicly accessible and traceable over time.

Interestingly, the analysis in Chapter 2 also found some indications that targeted policy interventions like the Social Housing Decarbonisation Fund have built the smart energy capabilities of social housing tenants and allowed them to participate in flexibility services. This suggests there could be value in National Grid DSO targeting support at low income and vulnerable households that are currently not providing as much flexibility in CMZs. One option for support would be the Smart Energy Action Plans and Energy Choices Tool projects highlighted in Chapter 4. National Grid is already pioneering these projects that help improve smart energy capabilities and outcomes for vulnerable consumers. Further targeting of these offerings – perhaps in partnership with non-standard FSPs like housing providers, could add value to both DSO and consumers.

Recommendation 3: Leverage from learnings developed through existing National Grid projects, like Smart Energy Action Plans, to provide more targeted support for consumers in CMZs in low income or deprived areas to improve their smart energy capabilities and boost their provision of flexibility.

5.2 Options for DSO to mitigate barriers

Analysis across all three chapters also suggested other barriers that might be limiting flexibility take-up from households in vulnerable circumstances more generally, and how National Grid DSO may help to mitigate this.

Key Finding: Heating type is a key capability impacting ability to move energy use, direct electric heating is not currently recorded as an asset for flexibility by National Grid DSO or other DSOs. The inclusion of direct electric heating such as storage heaters as assets will improve the inclusion of homes without energy technologies such as EV chargers, heat pumps or solar panels, which currently predominate in terms of National Grid DSO flexibility service provision. This will also allow for greater accuracy of data on the value of electric heating as an asset, which is currently unknown.

This addition will need to be proposed to the ENA Open Networks and the Market Facilitator as it will be relevant to all DSOs as part of standardisation and alignment. The need for standardisation and alignment was a finding from the review of DSO technical arrangements, as there was a vast diversity of different practices across DSOs in relation to domestic flexibility. This is shown in the variation of flexibility products offered (and the makeup of these products), platforms used, baselining methodologies, and information presented online by DSOs. This situation could feasibly present a challenge for flexibility accessibility through raising administrative burdens for non-traditional FSPs, such as housing providers, who may engage with a higher proportion of consumers in vulnerable circumstances. Moreover, the variety in approaches and information also makes it harder to track consistent outcomes across the sector for consumers in vulnerable circumstances, which relates to the first recommendation. The need to improve consistency across the flexibility market to drive fairness was also a key finding of several recent innovation projects led by DSOs. It is positive that there is ongoing work on standardisation across the sector by ENA Open Networks and the Market Facilitator.

Recommendation 4: Present the case to ENA Open Networks and Market Facilitator to include non-heat pump electric heating as a specific flexible asset.

More generally, baselining was a key focus for discussion in Chapter 3, especially in relation to low energy users. These consumers, who are more likely to be vulnerable, can often be excluded from flexibility opportunities as high electricity usage is a key capability impacting ability to move energy usage. National Grid DSO highlighted that their current baselining approach, using average consumption profiles, may further ingrain this disadvantage by penalising low users in relation to demand turn-up opportunities. As a result, a key **recommendation** for National Grid DSO is to consider how more targeted baselining, potentially scaled by energy consumption estimates, may help the DSO to distribute fairer and more accurate flexibility benefits, both to low energy users and the broader network.

Recommendation 5: Review baselining approaches for domestic flexibility, with a view to ensuring fair outcomes for low energy users.

Nonetheless, as evidence from Chapter 4 showed regarding the diversity of different DNO practices, there is no simple baselining solution in relation to accessibility: more granular or more broad approaches both have potential challenges. As a result, if National Grid DSO do adopt a more detailed baselining approach, another **recommendation** is that this should be considered in combination with more longer-term procurement options. Less onerous timing requirements could help to offer participation options to those consumers that may be challenged by more detailed baselining. For example, those without smart meters may be included via whole building metering options for delivering energy efficiency flexibility services, as in the Flex Direct project. Evidence from Chapter 4 found no clear evidence favouring either Peak Reduction or Scheduled Utilisation as the best longer-term product for delivering accessibility, but evidence from the review of innovation projects does offer some useful suggestions for implementation. For example, Socially Green and Urban Energy Club both highlighted the importance of communicating via trusted community members to maximise participation. Flex Direct may also provide some useful learnings around viable commercial models for energy efficiency procurement in the near future. Nonetheless, as highlighted in the Intraflex project, more long-term procurement options won't be suitable for all domestic FSPs, so the general target relating to this recommendation here should be *more*, rather than *exclusively*, longer-term options.

Key finding: Longer-term procurement offers (such as week ahead or month ahead) opportunities to mitigate other capability barriers – such as offering long notice periods for digitally disadvantaged consumers, or options to take part in flexibility via energy efficiency for those without significant energy assets or demand.

Recommendation 6: Offer more longer-term domestic flexibility options – both in terms of procurement and notice period - incorporating relevant learnings from ongoing innovation trials about potential commercial models and community engagement best practice for including energy efficiency in flexibility services.

The review of innovation projects also highlighted some other actions for National Grid DSO that may help to improve access to flexibility for vulnerable consumers. Evidence from price signalling or technology trials suggested some valuable potential models for National Grid DSO if they were interested in mitigating particular capability requirements – especially those relating to asset ownership. More pertinently, however, projects such as Socially Green also raised some potential changes to procurement options that National Grid DSO could use to encourage inclusion – such as incentivising FSPs to capture more flexibility from vulnerable households. Although most of these solutions are untested, there is a **recommendation** that National Grid DSO consider the feasibility of these as potential levers at their control. This process will be aided by more work, as in the first recommendation, to understand how many vulnerable consumers are currently involved in National Grid DSO flexibility procurement. For example, an MPAN assessment will reveal how many households with a PSR flag have been included by FSPs in tenders.

Recommendation 7: Consider the feasibility of more speculative options raised in innovation projects for improving flexibility accessibility, such as incentivising FSPs to capture more flexibility from households in vulnerable circumstances.

Related to this, analysis in both Chapters 3 and 4 suggested that promoting good practice is a crucial, if more indirect, way in which DSOs like National Grid DSO can encourage inclusive flexibility. The most recent report from the HOMEflex project here carves out some specific actions that DSOs can take, including incorporating HOMEflex principles into service agreements with FSPs, contributing financially to the creation of a domestic flexibility compliance scheme and providing advocacy for HOMEflex across the sector. We **recommend** that supporting the rollout of HOMEflex in this way can help to ensure that all vulnerable consumers are able to participate in flexibility services with confidence.

Recommendation 8: Engage with and support the rollout of HOMEflex to build consumer trust across the domestic flexibility space through:

- Incorporating HOMEflex principles into service agreements with FSPs.
- Contributing financially to the creation of a domestic flexibility compliance scheme.
- Providing advocacy for HOMEflex across the sector.

5.3 Industry-wide action and collaboration

Chapters 3 and 4 also both underlined the importance of improved communication about energy flexibility. As highlighted above, this is likely to be essential for helping consumers in vulnerable circumstances to take part in procurement options such as energy efficiency. For this reason, an accessibility review of National Grid DSO's online information relating to domestic flexibility may be useful.

More generally, workshop discussion also raised that a consistent national campaign could be valuable in raising general awareness, as well as flagging specific guidance around what constitutes 'safe flexing'. This could help to mitigate softer capability barriers around social capital or mindset, ensuring more consumers in vulnerable circumstances are aware of the opportunities around flexibility, as well as ensuring specific vulnerable groups can take part safely and fairly. This is especially important in light of the evidence from Chapter 2 which suggests that consumers in vulnerable circumstances in National Grid DSO CMZs are more likely to use manual demand shifting when delivering flexibility. This may expose them to the risk of making significant sacrifices for little reward, or worse, endangering themselves by switching off essential appliances⁴⁶. The communications campaign may also advocate for the rollout of smart meters to be prioritised (and for broken smart meters to be fixed), given that meter type was identified as one of the key capabilities required to participate.

National Grid DSO felt that DSOs may not be best placed to lead such a national campaign, as consistency would be key (a body such as Smart Energy GB may be better placed), but their support would be vital. We therefore **recommend** that National Grid DSO collaborate with other

⁴⁶ As found in the evaluation of the Demand Flexibility Service (winter 2022/23).

actors on a national communications campaign to increase public awareness of flexibility and its benefits and challenges.

Recommendation 9: Advocate for a national communications campaign to provide trusted information and increase public awareness of flexibility and its benefits and challenges.

5.4 Summary of recommendations

The findings of this report suggest the following recommendations to support access to flexibility services and fairness based on the desk-based review, workshop and data analysis.

1. Repeat work to assess uptake of flexibility services amongst households in vulnerable circumstances in future to track changes over time.
2. Share information about how system benefits are calculated and distributed by National Grid DSO publicly.
3. Leverage from learnings developed through existing National Grid projects, like Smart Energy Action Plans, to provide more targeted support for consumers in CMZs in low income or deprived areas to improve their smart energy capabilities and boost their provision of flexibility.
4. Present the case to ENA Open Networks and Market Facilitator to include non-heat pump electric heating as a specific flexible asset.
5. Review baselining approaches for domestic flexibility, with a view to increasing granularity and ensuring fair outcomes for low energy users.
6. Offer more longer-term domestic flexibility options – both in terms of procurement and notice period - incorporating relevant learnings from ongoing innovation trials about potential commercial models and community engagement best practice for including energy efficiency in flexibility procurement.
7. Consider the feasibility of more speculative options raised in innovation projects for improving flexibility accessibility, such as incentivising FSPs to capture more flexibility from vulnerable households.
8. Engage with and support the rollout of HOMEflex to build consumer trust across the domestic flexibility space through:
 - a. Incorporating HOMEflex principles into service agreements with FSPs.
 - b. Contributing financially to the creation of a domestic flexibility compliance scheme.
 - c. Providing advocacy for HOMEflex across the sector.
9. Advocate for a national communications campaign to provide trusted information and increase public awareness of flexibility and its benefits and challenges.

Appendices

Appendix 1 - Procurement pricing

The following analysis was carried out as part of the data analysis shown in Chapter 2. The boxplot chart below shows a caveat of the assessment approach, as the correlation between household characteristics and procurement don't imply direct causation, and that other factors such as the tendered price for flexibility impact the procurement outcome.

Of the 4,086 tenders that were put out, only around a quarter successfully procured flexibility. Further analysis revealed that the tendered ceiling price for sustain procurement had a small but significant effect on whether a flexibility tender successfully procured flexibility, or whether there was no response from suppliers (**Figure A1a**). On average, an increase in the sustain price of 20p/kWh for a tender was more likely to result in an 'accepted' trade outcome than a 'no response received' outcome (analysis of variance; $p < 0.001$). In addition, the average tendered sustain price was 21p/kWh and 31p/kWh greater for OVO Energy and Octopus Energy, respectively, compared to Axle Energy for tenders that resulted in successful flexibility procurement (analysis of variance: $p < 0.001$; **Figure A1b**).

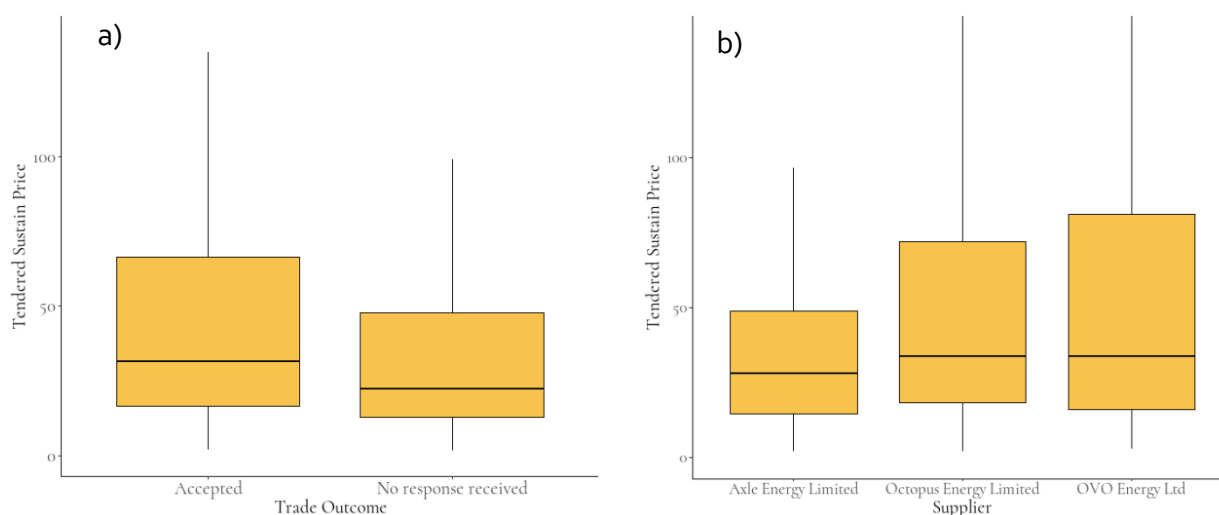


Figure A1: Boxplot of the sustain price (p/kWh) for flexibility procurement tenders when (a) the outcome of the tender was accepted and no response received, and (b) for the different suppliers when the trade outcome was accepted

Appendix 2 – Baseline methodologies

The section below details the methodologies used by each DSO to calculate baselines for flexibility.

Electricity North West

ENW, in their “Flexibility FAQs” webpage⁴⁷, refer to the set of standardised baselining methodologies, and provide a link to the ENA’s explainer and online calculator⁴⁸. Alongside this, ENW provide useful explanations of the different baselining methods available. ENW do not specify how a method is selected from amongst them, just that it will be agreed with the provider after a contract is awarded and prior to the provision of any flexibility services. As a result, there is little information on how baselining may vary across technologies, although they do specify that energy-efficiency based flexibility services are baselined using historical data. There is a brief mention of future plans to “develop more sophisticated methods” for baselining energy-efficiency based flexibility, under their **RetroMeter** project.

National Grid DSO

National Grid DSO provide highly detailed tables with the values used in baselining calculations⁴⁹, for different domestic technologies (heat pumps, domestic EV chargers, ‘flexible site demand’, energy storage and energy generation), under each flexibility product, by season, and by metering type. Of the DSOs that provide specific baselining values (National Grid DSO, NPg and UK Power Networks), National Grid DSO provides the widest breadth of baseline-modifying variables, but is also the only DSO not to vary baseline values by time-of-day (although, an AM and PM distinction is made for the Scheduled Utilisation – Specific Periods product). In most instances, baselines are given as static values, but on some occasions, ENA standardised methods are referenced instead, although only for energy generation in the domestic market⁵⁰. In their “Guidance for Electricity Distribution Flexibility Service Providers” document, National Grid DSO give a description of how these baselining values are used in measuring flexibility provided and gives a simple example of a baseline values table and how it might be used to calculate a real baseline⁵¹.

⁴⁷ ENW Flexibility FAQs <https://www.enwl.co.uk/future-energy/flexibility-hub/flexibility-faqs/>

⁴⁸ ENA Baseline Calculator https://ena-baselining.herokuapp.com/baselining_app/

⁴⁹ National Grid DSO Baseline Values <https://www.flexiblepower.co.uk/downloads/1122>

⁵⁰ National Grid DSO Baseline Values <https://www.flexiblepower.co.uk/downloads/1122>

⁵¹ National Grid DSO Guidance for Electricity Distribution Flexibility Service Providers: Appendix 1, page 27-29 <https://www.flexiblepower.co.uk/downloads/1121>

Northern Powergrid

NPg, on their Flexible Power webpage, also provide specific baselining values, but only for domestic EV chargers⁵². These values are varied across time-of-day (by 30-minute intervals), type-of-day (weekdays/weekend) and season (including a fifth school holiday season). The spreadsheet provides baselining values for each possible hour-day combination across an almost 2-year period (>35,000 individual baseline values) despite daily baseline profiles being identical between days of the same type. A separate tab provides the exact figures by each type of day without repetition, but labels these as “average profiles” despite there being no variance within each profile. Baselining methods for other technologies are not publicly available, although they may be present on NPg’s Piclo Flex profile, which is only accessible to FSPs. Separately, NPg provide an explanation of how baseline values are used to calculate maximum potential flexibility and flexibility delivered⁵³.

ScottishPower Energy Networks

SPEN make a brief reference to using the standardised ENA baselining methods in their “Participation Guidance” document, but do not provide an explanation of what these are⁵⁴. There appears to have been an attempt to give a hyperlink to further information (potentially the same link given by ENW⁵⁵), but this cannot be verified due to the link being faulty.

Scottish and Southern Electricity Networks

SSEN describe two potential baselining methods: either “nominated” or “historical”⁵⁶. “Nominated” baselines can take the form of a fixed value, or a week-long half-hourly profile, whereas “historical” baselines are calculated from an average over time. SSEN describe “historical” baselining differently in their “Manual” service terms and “Flexible Power” service terms (the distinction being that Operational Utilisation & Scheduled Availability is contracted under the “Flexible Power” service terms). Under the “Flexible Power” service terms, “historical” baselines use power readings taken between 3pm and 8pm on weekdays, over the first three weeks of the previous month⁵⁷. The “Manual” service terms just state that an “averaged historical baseline value will be used”.

⁵² NPg Northern Powergrid baselining domestic EV chargers V2 <https://www.flexiblepower.co.uk/downloads/1126>

⁵³ NPg Northern Powergrid baselining methodology domestic EV chargers <https://www.flexiblepower.co.uk/downloads/1127>

⁵⁴ SPEN Participation Guidance 2024-25: page 4 <https://www.spenergynetworks.co.uk/userfiles/file/2024-25ParticipationGuidance.pdf>

⁵⁵ ENA Baselining Calculator https://ena-baselining.herokuapp.com/baselining_app/

⁵⁶ SSEN Service Terms – Manual: page 19 <https://www.ssen.co.uk/globalassets/our-services/flexibility-services-document-library/slc31e-reports--statements/ssen-service-terms-aligned-to-fsa-manualv4.pdf>

⁵⁷ SSEN Service Terms – Flexible Power, page 23 <https://www.ssen.co.uk/globalassets/our-services/flexibility-services-document-library/slc31e-reports--statements/ssen-service-terms-aligned-to-fsa-flexible-power-v4.pdf>

UK Power Networks

UK Power Networks provide baseline values for domestic EV chargers, heat pumps and non-LCT domestic demand⁵⁸. These are further broken down by season (for heat pumps and non-LCT demand) or zone voltage (LV vs HV/EHV, for domestic EV chargers), and given in half-hourly profiles. In their “Participation Guidance” document⁵⁹, UK Power Networks also provide clear information on how baseline values are used to estimate maximum potential flexibility and delivered flexibility, according to the type of technology.

Appendix 3 – Longlist of projects

Table A1 below gives a summary of longlisted projects showing name, the DSO (or other organisation) who led the project, timeframes, intervention theme, the particular group they were targeting, and more detail on the kind of innovation they involved. Shortlisted projects discussed in the main body of the text are highlighted in lilac. Individual profiles for these projects are included in the following appendix.

Table A1: Summary of longlisted DSO innovation projects

Project	DSO / other lead	When	Theme	Target group	Innovation type	
Balancer	UKPN	2024	Technology / Other / Community	Disadvantaged households	Technological assessment: batteries	Commercial model
BiTraDER	ENW	2021-present	Other	Households and businesses with energy generation	Peer-to-peer trading	
Bethesda Home Hubs	SPEN	2019-2022	Price signalling	Households	Domestic flexibility trial	
Core4Grid	UKPN	2019-2021	Technology	Households with existing low carbon technology	Technological trial: controller	
CrowdFlex	NESO	2021-present	Price signalling	Households	Domestic flexibility trial	
DEFENDER	NG	2022-2023	Energy efficiency	Households	Technological assessment: energy	Demand reduction

⁵⁸ UKPN Baseline Data <https://d1lf1oz5vvdgbgr.cloudfront.net/app/uploads/2024/10/Baseline-data-for-electric-vehicles-heat-pumps-and-householdsBaselines.xlsx>

⁵⁹ UKPN Participation Guidance (2024) <https://d1lf1oz5vvdgbgr.cloudfront.net/app/uploads/2024/10/Participation-Guidance-Oct-2024-v1.1.pdf>

					efficiency measures	
DFS	NESO	2022-present	Price signalling	Households	Domestic flexibility trial	
DS3	NPg	2020	Technology	Households. Mostly PV owners.	Technological assessment: batteries	Technology distributed: batteries
Electric Nation	WPD	2022	Technology	EV owners	Technological assessment: Vehicle-to-grid charging	
ECT	NG & NPg	2022-present	Community		Direct smart energy advice	
ECAS	Regen	2018	Community	Households and community organisations	Flexibility aggregation platform	
Energywise	UKPN	2018	Price signalling	Social housing & EPC ≤ C	Price signalling: free energy windows	Technology distributed: meters
Equinox	NG	2022-present	Price signalling	Heat pump owners	Domestic flexibility trial	
EV-Up	SPEN	2019-2020	Technology	N/a	Technological simulation: EV adoption	
Flex Assure	ADE	2019	Standards	FSPs: commercial aggregators	Code of conduct for flexibility procurement	
Flex Direct	UKPN	2024	Energy efficiency / Other	Households in local authority or social housing	Commercial model	Technology distributed: Energy efficiency measures
Flex Heat Networks	UKPN	2023-2025	Technology	Heat networks	Technological trial	
Fusion	SPEN	2018-2022	Other	Households	Commercial model	
Future Flex	WPD	2019-2021	Energy efficiency	Households	Domestic flexibility trial	Demand reduction
HOMEflex	SSEN	2019	Standards	FSPs: domestic aggregators	Code of conduct for flexibility procurement	
Home Response	UKPN	2021	Technology	PV owners	Technological assessment: batteries	Technology distributed: batteries
Intraflex	NG	2019-2021	Other	Households	Commercial model	
KnowMyFlex	UKPN	2024	Standards	Non-domestic	Standards setting: flexibility certificates	
Max Flex	SSEN	2024-present	Standards	Non-domestic	Standards setting: flexibility certificates	
My Electric Avenue	SSEN	2015	Technology	N/a	Technological simulation: EV adoption	

NeatHeat	UKPN	2022-2024	Technology	Households	Technological trial: smart boiler	
PIONEER	NG	2023	Energy efficiency	Households	Technological assessment: energy efficiency measures	Commercial model
Power Saver Challenge	ENW	2013-2015	Price signalling	Households	Demand reduction	Technology distributed: Energy efficiency measures
Power to Participate	Regen	2019	Community	Community organisations & FSPs	Guidelines for engaging with community organisations	
Project Shield	UKPN & ENWL	2023-2024	Technology	Households	Technological trial: controller	
Project Transition	SSEN	2018-2023	Other	Households	Commercial model	
Power Ups	Octopus Energy	2023-present	Price signalling	Households	Price signalling: free energy windows	
Project Shift	UKPN	2019-present	Price signalling	Households with existing low carbon technologies	Domestic flexibility trial	
ReFLEX Orkney	EMEC	2021-present	Other	Local society as whole	Flexibility institution	Commercial model
RetroMeter	ENW	2023-present	Energy efficiency	Households	Technical assessment: smart meter baselining	
Smart & Fair	SSEN & CSE	2019-present	Standards	Households, vulnerable households	Research programme	
SmEAP	NGED	2022-present	Other	Vulnerable households	Direct smart energy advice	
SCMZ	SSEN	2019	Community	Community groups	Guidelines for engaging with community organisations	Technology distributed: Energy efficiency measures
Socially Green – Autumn	UKPN	2020-2023	Energy efficiency	Households in social housing	Technology distributed: Energy efficiency measures	Community engagement
Socially Green - Summer	UKPN	2020-2023	Other	Hard-to-reach households	Incentive structure	

SAVE	SSEN	2014-2021	Energy efficiency	Households	Technological assessment: energy efficiency measures	Demand reduction
The Big Dirty Turn Down	Octopus Energy	2022	Price signalling	Households	Domestic flexibility trial	
Urban Energy Club	UKPN	2019-2021	Technology / Other / Community	Households residing in tower block.	Technological assessment: communal battery	Flexibility platform
Warmworks	SPEN	2021	Price signalling / technology	Households not on gas grid	Time of use tariff	Technology distributed: batteries

Appendix 4 – Shortlisted project profiles

The following profiles give more detail on all the shortlisted projects discussed in the main report.

Balancer
UK Power Networks, 2024
Balancer looked at new commercial models, whereby community owned batteries enable consumers to participate in, and benefit financially from, DSO flexibility markets in a way that they otherwise would not be able to. The project innovated around the regulatory barriers to DSOs' ability to own batteries, by developing a proposal whereby a system of co-owners and investors could maintain the economic viability of the project while adhering to Ofgem's free market principles. <i>More information:</i> https://smarter.energynetworks.org/view-pdf?projectId=41307
BiTraDER
ENW, 2021-present
This project aims to investigate, design, build and trial – live on the network – options for the introduction of a bilateral trading market through which large connected customers can trade their contracted curtailment obligation. Significantly, the project also trials a Neutral Market Facilitator, which may have relevance to flexibility accessibility. <i>More information:</i> https://www.enwl.co.uk/future-energy/innovation/key-projects/bitrader/
Crowdflex
NESO, 2021-present
A large-scale project, including several domestic flexibility trials, to produce a deterministic model of domestic demand and flexibility. Across these flexibility trials, CrowdFlex also aims to evaluate the efficacy of different incentive structures and consumer interventions. By trialling domestic flexibility across a large sample of households, CrowdFlex hopes to develop a statistically confident understanding of the motivating factors behind participation in domestic flexibility. These findings may be of use for expanding accessibility in the future. <i>More information:</i> https://www.neso.energy/about/our-projects/crowdflex
DEFENDER (Demand Forecasting Encapsulating Domestic Efficiency Retrofits)
NGED, 2022-2023

Project that aimed to create a tool and methodology for better understanding the electricity demand profile of UK domestic building stock pre- and post-retrofits to building fabric. This will help to assess the potential savings on network reinforcement and flexibility from accounting for energy efficiency in demand forecasting.

The project was successful in creating a tool for better understanding demand profiles to assist in network planning. It recommended further exploration of the value of energy efficiency, to be taken up in part by the PIONEER project.

More information: <https://www.nationalgrid.co.uk/innovation/projects/demand-forecasting-encapsulating-domestic-efficiency-retrofits-defender>

Demand Flexibility Service (DFS)

NESO, 2022-present

The DFS comprised of a series of domestic flexibility trials, with FSPs offering the service to their customers, resulting in large number of participating households and businesses. FSPs offered a variety of incentive mechanisms.

Evaluation by CSE used a smart energy capabilities lens to investigate the factors that may have shaped engagement with the DFS. This evaluation found that most households would participate again, and many were considering changing their energy use behaviour beyond the trial.

However, some households found it more difficult and less rewarding to participate, namely, those struggling financially, those suffering from long-term health conditions, or those with lower energy usage.

In 2024, NESO announced that the DFS could end its trial status and become an in-merit margin service in line with the normal electricity market.

More information: <https://www.neso.energy/industry-information/balancing-services/demand-flexibility-service-dfs>

Distributed Storage and Solar Study (DS3)

Northern Powergrid, 2020

DS3 investigated the potential impact on peak load of installing batteries that used aggregator-controlled charging schemes. Three charging schemes were tested: two were 'customer-focussed', designed to minimise disruption to the customer, and one 'maximum impact', designed to discharge at peak-load times.

Peak reductions were delivered even under the customer-focussed charging scheme, essentially providing a free benefit to the DSO (without considering installation costs). **DS3** estimated a DSO could pay consumers £7 – £240 per kW (battery capacity) per year, depending on the charging scheme used.

More information: <https://www.northernpowergrid.com/sites/default/files/assets/5396.pdf>

Energy Choices Tool (ECT)

National Grid Electricity Distribution and Northern Powergrid, 2022-present

NGED and NPg have funded CSE to build an online self-service smart energy advice tool for consumers and energy advisors. The tool uses the capability-informed smart energy advice process pioneered by the SmEAP project to deliver advice via a digital platform and recommend suitable smart energy offers.

More information: <https://www.cse.org.uk/smart-and-fair-energy-transition/about-the-smart-and-fair-programme/>

Energywise

UK Power Networks, 2018

Energywise trialled a time of use tariff for low income households and a critical peak rebate scheme for prepayment meter users who otherwise wouldn't be able to use time of use tariffs.

More information: <https://innovation.ukpowernetworks.co.uk/projects/energywise-also-known-as-vulnerable-customers-and-energy-efficiency>

Flex Direct

UK Power Networks, 2024-present

Flex Direct aims to trial a variety of new commercial models to enable local authorities and social housing providers to become flexibility aggregators, contracting directly with the DSO.

Three potential commercial models have been shortlisted, ahead of trials to take place in the future.

1. Minor adjustments made to 'Sustain' product
2. Direct contracting between DSO and local authorities
3. Direct contracting between the wider supply chain and DSO.

More information: <https://smarter.energynetworks.org/projects/10061348/>

Fusion
SPEN, 2018-2022
Trialled a market-based approach to demand-side flexibility, based on the principles outlined in the Universal Smart Energy Framework (USEF). FSPs with large portfolios of smaller assets found it easier to manage these under the more automated processes under USEF. These types of FSPs are more likely to be domestic aggregators. "Free bids" (requests for flexibility outside of contracted time windows / capacity values) were found to encourage non-firm asset participation, which often included domestic assets managed by aggregators.
<i>More information:</i> https://www.spenergynetworks.co.uk/userfiles/file/FUSION_Close_Down_Report_CLEAN_020224.pdf

Future Flex
National Grid Electricity Distribution, 2019-2021
A widely scoped project with several activities and objectives. 1. Stakeholder engagement, to identify potential innovations 2. Deliver interventions to make homes "DSO-ready" 3. Domestic flexibility trial, based on a demand reduction service, Sustain-H Desktop research commissioned by NGED did discover that the installation of energy-efficiency measures in areas with severe network constraints could deliver value to the DNO of up to £1000 per home. The workstream aiming to make homes "DSO-ready" was not delivered, due to insufficient data, and dissuasive industry feedback. Results of industry roundtable suggested that making homes "DSO-ready" was too complex a task for DSO-led interventions alone.
<i>More information:</i> https://www.nationalgrid.co.uk/downloads-view-reciteme/598600

HOMEflex
SSEN (with ADE and CSE), 2021
HOMEflex built on insights from Smart and Fair – as well as engagement with consumers – developed a Code of Conduct for FSPs providing services to domestic consumers. A second phase of research has recently published recommendations for a compliance scheme to support the Code. Although primarily focussed on the role of FSPs, the research has produced some pertinent recommendations for DSOs, particularly:

- Incorporating HOMEflex principles into their service agreements with FSPs,
- Contributing financially to the creation of a domestic flexibility compliance scheme,
- Providing advocacy for HOMEflex across the sector,
- Supporting a broader public communication campaign around energy flexibility.

More information: <https://www.flexassure.org/homeflex>

Home Response

UK Power Networks, 2021

Home Response, carried out (in part) by UK Power Networks for the Greater London Authority, also installed batteries in homes, but limited to households with existing solar PV systems.

The project estimated a return to the consumer of £117/year as a result of installing a battery, and an additional £120-190 when combined with a time-of-use or export tariff; additionally, they estimated a £270/year value to households via participation in flexibility markets. Home Response noted that of the households with batteries installed, those with flat tariffs would not impact peak demand, whereas those on dynamic time-of-use tariffs would offset 2.5 households.

More information: <https://innovation.ukpowernetworks.co.uk/projects/home-response>

Intraflex

National Grid Electricity Distribution, 2019-2021

Developed a short-term flexibility market, with 'close to real time' products made available. Carried out operational trials, with the aim of establishing whether products can limit exposure to 'imbalance costs'.

Found that domestic aggregators might only be able to provide baselines and confidently offer capacity within shorter timeframes, enabling wider participation under 'close to real time' flexibility products.

More information: <https://www.nationalgrid.co.uk/downloads-view-reciteme/603011>

PIONEER (Proportional Investment of Networks in Energy Efficiency Retrofit)

National Grid Electricity Distribution, 2023

Project looking into potential commercial models that DSOs could use to bring forward thermal efficiency measures. A key initial finding was that the cost of measures is high, but the value of DSOs is low, therefore it did not recommend that DSOs provide an alternative source of efficiency funding. This was a SIF Discovery project – it is not clear if it is progressing to Alpha.

More information: <https://www.nationalgrid.co.uk/innovation/projects/pioneer-proportional-investment-of-networks-in-energy-efficiency-retrofit>

Project Transition

SSEN, 2018-2023

Project TRANSITION aimed to inform the design of DSO systems, and the DSO flexibility markets facilitated by them. To do so, TRANSITION developed a variety of roles, responsibilities and rules for a potential marketplace, which they tested via market trials.

Found that simplified contractual arrangements could enable wider participation, particularly for FSPs (and potential FSPs) who cannot afford a formal legal review. Also, that Neutral Market Facilitation, with a central platform, may lower set-up costs and simplify training needs.

More information: <https://ssen-transition.com/wp-content/uploads/2023/09/TRANSITION-Close-Down-Report-Webpage.pdf>

RetroMeter

ENW, 2023-present

For flexibility to be procured from energy efficiency, a “counterfactual” demand is needed in order to produce a baseline: i.e., how much energy a household would have been consuming if the measure had not been installed. This cannot be observed, as it does not exist.

To overcome this barrier, RetroMeter aims to create a new algorithm using smart meter data to create accurate baselines at the household level, making this form of flexibility procurement more economical.

More information: <https://www.enwl.co.uk/future-energy/innovation/strategic-innovation-fund/retrometer/>

Smart & Fair

SSEN, NGED & CSE, 2019-present

Smart & Fair is a research programme exploring the changes to the UK’s energy system as it transitions to zero-carbon. Amongst other things, it has produced an analytical framework used to analyse the accessibility of certain aspects of the energy transition: known as the “capabilities lens”. From this, the Offer Profiling Tool was developed to examine the capabilities needed for different smart energy offers.

More information: <https://www.cse.org.uk/resource/smart-fair/>

Smart Energy Action Plans (SmEAP)
NGED, 2022-present
Smart Energy Action Plans is a project supported by NGED that provides bespoke advice to households about their energy usage, and how they can improve their smart energy capabilities and engage in flexibility.
<i>More information:</i> https://www.cse.org.uk/my-home/advice-projects/smart-energy-action-plans-a-pilot/

Social Constraint Management Zones (SCMZ)
SSEN, 2019
SCMZs aimed to provide support for community groups to submit tender responses, and in doing so, develop documentation to allow for the process to be replicated.
The project found that overall, organisations were engaged with the process, and eager to participate. However, most participants were deterred from submitting full proposals when potential remuneration and effort costs were examined. Community groups needed more time for the procurement process than originally planned. Feedback from events highlighted a level of assumed knowledge that could have been rectified with 'pre-event' material.
<i>More information:</i> https://ssen-innovation.co.uk/wp-content/uploads/2021/06/NIA-0036-Closedown-Report-2.pdf

Socially Green (Summer and Autumn Trial)
UK Power Networks, 2020-2023
Summer Trial: Trialled a 'Hard-to-Reach Flexibility Top-Up' per qualified Meter Point Administration Number (MPAN), paid to flexibility service providers as compensation for engaging a wider range of households. Results have not been published from this trial.
Autumn Trial: Explored how energy efficiency measures installed by social housing providers could provide energy flexibility. Found that active engagement with residents is necessary for energy efficiency measures to be effective. Targeted advice, such as FAQ documents and in-home support were found to improve understanding. Trusted intermediaries were important for increasing participation and allaying concerns.

More information: <https://smarter.energynetworks.org/media/nhhpocbs/uk-power-networks-annual-nia-summary-202324.pdf> (pages 17-18)

Solent Achieving Value through Efficiency (SAVE)

SSEN, 2014-2021

Solent Achieving Value through Efficiency (SAVE) assessed the impact of energy efficiency measures (alongside different engagement methods and dynamic pricing) on consumption. The trial provided robust statistical evidence for the effectiveness of energy efficiency interventions as a means of demand reduction.

More information: <https://save-project.co.uk/>

Urban Energy Club

UK Power Networks, 2019-2021

Urban Energy Club, led by UK Power Networks with EDF, Repowering London & UCL, installed a battery in a block of flats and allowed residents to trade battery capacity through a peer-to-peer energy market and receive rewards from collective self-consumption and flexibility rewards (estimated at 15-20% of energy bills).

It provided evidence that community storage can be a mechanism for households to access flexibility revenues even when they lack smart energy capabilities (e.g. low income, renters, low digital confidence, limited space at home) and removes the need for households to manually shift demand. However, the final report outlined the regulatory barriers affecting peer to peer energy markets, and communal use of shared solar and storage assets.

More information: <https://innovation.ukpowernetworks.co.uk/projects/urban-energy-club>

Warmworks

SPEN, 2021

Warmworks, enables participation in a way that explicitly seeks to include more customers in vulnerable circumstances in DSO flexibility markets. The project installed batteries in off-gas social housing in Dumfries and Galloway and arranged time-of-use-tariffs for the householders. The project found that the isolated effect of installing a battery on energy tariffs (on UK average houses) would be £290/year, and a further £388/year by then switching to a time-of-use-tariff.

More information: <https://www.warmworks.co.uk/wp-content/uploads/2022/08/Domestic-Battery-Storage-Report.pdf>

