Local Energy Oxfordshire

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Residential Demand Side Response: An Aggregator's Report on Local Flexibility

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1. PROJECT LEO - OVERVIEW

Project Local Energy Oxfordshire (LEO) is an important and ambitious series of innovative trials aiming to accurately understand the potential of smart grids in both Oxfordshire and UK wide. Project LEO is critical in deepening the understanding of how flexible markets and residential Demand Side Response (rDSR) might work, and key to improving customer engagement through the establishment of critical insights.

Project LEO is part funded by the Industrial Strategy Challenge Fund (ISCF) who set up a £102.5m fund in 2018 for UK industry to research and develop systems that can support the drive toward renewable energy. The fund is called: *Prospering from the Energy Revolution (PfER)*.

The Project draws upon an exceptional group of Partner stakeholders, delivering upon a common goal in the establishment of a sustainable local energy system. This breadth of stakeholders seeks to represent the entire energy value chain, but through a consciously select, focused consortium.

The UK Government has committed to reducing carbon emissions and achieving Net Zero by 2050. However, meeting this objective will require a significant increase in decarbonisation, whilst also driving an acute uplift in the demand on the energy network. Traditionally, network reinforcement would be the leading response to an increase in energy demand, however the evolution in both energy balancing and digital technologies has enabled the emergence of new energy markets. These markets are characterised by the availability of smart, secure flexibility on the demand side, or in other terms, the flexibility of the traditional energy consumer to change their demand characteristics in real time.

These future energy markets are enabling the creation of a decentralised energy system, supporting local renewable energy sources, and establishing markets where everyone can participate and benefit from energy flexibility and residential Demand Side Response.

Project LEO will enhance our ability to unlock opportunities in the transition to a smarter, flexible electricity system and uncover how households, businesses and communities can realise the benefits. The rapid rise in the deployment of small-scale renewables and low-carbon technologies is driving forward consumer engagement energy, and their ability to sell electricity, store electricity, and use their electric vehicles (EVs) to alleviate the increasing demands on the electricity system.

The Project seeks to replicate the conditions of a future electricity system, helping to understand the evolving relationships within flexible energy markets, building a base of evidence to better inform the transition to a smarter electricity system. Project LEO will advise Distribution System Operators (DSOs) on how flexible markets may function and how the DSOs should support their evolution, invest intelligently and drive community engagement to deliver a smarter, more responsive and flexible electricity network.

2. ABOUT EQUIWATT

equiwatt is an energy management platform that helps households get money back off their energy bills by reducing energy usage at peak times.

Saving energy at the same time helps energy companies reduce the use of polluting power plants at peak times. Energy companies pay equiwatt for helping to reduce this expensive and dirty peak time energy usage. By joining the equiwatt community, households are collectively building the UK's first domestic Virtual Power Plant which enables them to get their share of payments for saving energy collectively when it matters most.

Users can join equiwatt by downloading and signing up to the free equiwatt app. To take part, users connect their smart meter and receive notifications to reduce their energy usage during peak times. Users can automate their participation by connecting compatible smart home devices including smart heaters, electric vehicles, and plugs.

equiwatt manages the reduction in energy usage and rewards users with points that can be exchanged for e-gift vouchers and a variety of rewards in the equiwatt app gift store. Users can also track their energy reduction or saving performance and participate in prize draws and leader boards to motivate their involvement.

Figure 2.1: Participating in an equivent.

3. SCOPE AND APPROACH

EQUIWATT'S INVOLVEMENT IN PROJECT LEO

equiwatt Ltd was invited by Project LEO (Local Energy Oxford) to deliver a 5-month (Nov 2022 to Mar 2023) research project funded by Innovate UK. The project demonstrates the concept of residential Demand Side Response (rDSR) in the Oxfordshire area and provides research insights and reliable evidence on how to unlock and engage residential participation in the local energy system.

OBJECTIVES

equiwatt's main goal of partnering with Project LEO was to validate equiwatt's rDSR model end-to-end with real market conditions and incentives, demonstrating all types of consumers can engage with and benefit from being paid to provide demand flexibility under the right user experience. This report focuses on the following specific areas:

- **Analysis of rDSR household energy reduction data**: energy saved, best performing appliances, user profiles and consumer feedback and behaviour change. The detail of this analysis is subject to the availability of data, which is impacted by the relatively late and short engagement of equiwatt in Project LEO. Where possible we use equiwatt data from Project LEO, and supplement this with data provided by equiwatt regarding its wider portfolio, or other sources. We identify and reference each of our sources used in the analysis.
- **Project learning and recommendations on recruiting and engaging households**: a critique with recommendations of our approach to recruitment in the area, including most successful channels and demographics within the Oxfordshire target areas. This utilises information provided by equiwatt regarding recruitment channels, results of a survey conducted and interviews held, literature review, and our own experience.
- **An assessment of the total flexibility potential of the Project LEO / Oxfordshire area**: using a variety of data sources, such as Future Energy Scenarios, Climate Change Committee Carbon Budgets, BEIS / DESNZ reports on roll-out of smart metering, demographic information regarding Oxfordshire, user recruitment information, and analysis of energy savings / shifting from the trials and other sources, we will estimate the total flexibility potential for the trial area / Oxfordshire.

INFORMATION SOURCES

As part of the project, equiwatt has shared the following data sources:

INFORMATION	DESCRIPTION
Analysis of February 2023 "equivents" from DFS & SSEN flexibility events	equiwatt provided information from "equivents" that took place in January and February 2023. This report is based on the analysis of the February events as this included more meaningful numbers of participating users (as the recruitment campaigns discussed in section 6 took effect). The analysis uses an industry-standard method of baselining usage and calculating demand reductions. The analysis considers three geographic regions with users who have connected smart meters and available half hourly data within each (noting

INFORMATION	DESCRIPTION
	that this is therefore not the same as the total number of users in each area): • SSEN / Project TRANSITION areas: 47 equiwatt users in the trial area (with connected smart meters and available half hourly data). In section 7, this is referred to as 'Whole SSEN Fleet'. Table 7.1 shows this group broken down by Bulk Supply Point. • All of Oxfordshire: 127 equiwatt users across Oxfordshire (with connected smart meters and available half hourly data). In section 7, this is referred to as 'Oxfordshire'. • All of UK: 1,234 equiwatt users across the United Kingdom (with connected Smart Meters and available half hourly data), as of February 2023. In section 7, this is referred to as 'All UK'.
Survey of Project LEO prosumers	A survey designed by Gemserv of equiwatt's Project LEO users, designed to gain a greater understanding of motivations, sentiment, experience, how they participated, motivations for further participation, and other insights.
Detailed interviews	Gemserv designed and conducted detailed interviews to gain further depth of insight on the topics covered in the survey.
equiwatt consumer insights report	Consumer insights report developed by Energy Systems Catapult in 2020 for equiwatt.
Oxfordshire campaign focus	Overview provided by equiwatt of the recruitment channels and campaigns established to onboard users for Project LEO

Table 3.1: Key information sources used for this report

We have also extensively referenced materials in the public domain. These are listed in section 11, with the detailed data sources also referenced in our modelling for the project.

APPROACH

In developing this report, we have developed consumer insights based on the recruitment channels used, the recruitment outcomes, conducted a survey of equiwatt users in the Project LEO area, and conducted in-depth interviews.

We have analysed data from equivents, assessing the extent of demand reduction during the equivents and considering any correlation between reduction and other factors, such as how users participate, different event types, and demographic factors. In addition to using data from the Project LEO area, we have also assessed data from equiwatt's wider portfolio. Throughout the report the analysis of demand reduction or shifting is undertaken using data from smart meters.

We have held validation sessions with equiwatt, reviewing modelling assumptions and enabling challenge of the results of modelling. Finally, the report and presentations have been made available to Project LEO partners.

We have identified user insights, analysed the flexibility response during the trial, and considered the wider potential for flexibility in Oxfordshire, establishing the key messages from this analysis.

4. FIVE KEY MESSAGES FOR NATIONAL POLICY

1. **Aggregators, such as equiwatt, are key to enabling residential flexibility.**
   equiwatt offers a simple and compelling proposition that enables households to participate in flexibility markets. Users can be shielded from the complexity of the energy markets, whilst being rewarded as they contribute to the development of a smarter, more energy-secure, electricity system.

2. **A collaborative effort between public and private enterprises is vital.**
   Partnerships involving local authorities, trusted organisations, local groups, and private enterprises are key to scaling up and giving confidence to users to participate in local flexibility schemes.

3. **Aggregators, such as equiwatt, can support participation regardless of a user's motivation.**
   Users participate in flexibility for a variety of reasons including environmental awareness, gaining reward for participation, and to reduce energy usage and cost. equiwatt enables users to participate regardless of their motivation. The most effective motivation, leading to the most satisfied users, appears to be environmental awareness.

4. **There is still significant flexibility potential still to be unlocked.**
   equiwatt has demonstrated that flexibility benefits can be delivered in a short period of time. A long-term partnership would enable greater recruitment success. Additionally, equiwatt has demonstrated that users without smart meters and who cannot participate in flexibility markets are still able to contribute to a flexible energy system. The extent of residential flexibility will increase significantly with the continuing uptake of Electric Vehicles (EVs) and associated smart charging, (smart) heat pumps, and other smart appliances.

5. **Further research into optimal engagement approaches is necessary.**
   Further research should be undertaken to determine whether the aggregate effect on consumption reduction is greatest when users are required to opt into an event (they have to actively confirm participation) or opt out of an event (they are presumed to opt in unless they actively confirm otherwise). We consider opt out to be effective when users agree to 'Connect and Forget' (participate automatically using remote control capability) – which is reinforced with high levels of user satisfaction, but do not have sufficient data to analyse the effectiveness of manual participation under each option.

5. FIVE KEY MESSAGES FOR PROJECT LEO

1. **A strategic, multi-faceted, recruitment approach is necessary for engagement success.**
   Engagement success is greatest when there are multiple, well-targeted, touch points with potential users. Engagement strategies should be wide-ranging, multi-faceted, and planned such that potential user awareness is gained, interest is piqued, desire is created, and action is taken. This is supported by partner touch points and making it easy for users to take action.

2. **Trusted partnerships are crucial for gaining traction and credibility.**
   Partnerships involving public and private sector organisations support the concept of multiple touch points, offer third-party validation, and provide user confidence when trusted partners are involved. Ideally an ecosystem of partners should be developed including organisations with products and services that allow users to benefit from rDSR services.

3. **There are potential downsides of hyper-localised campaigns.**
   Social media campaigns are an effective way of recruiting users, with the target being tech savvy and just one click away from downloading and using the app. However, a focus on small geographic areas means that audience volumes in that area are not sufficient to run an efficient campaign that achieves learning and recruitment targets. There is also risk of disenfranchising potential participants if they receive messages but cannot benefit if rewards are tied to specific areas – this could become an issue in the long run.

4. **A variety of motivations exist, and all can be unlocked.**
   The most effective motivation, leading to the most satisfied users, appears to be environmental awareness. Users motivated by environmental contribution were extremely satisfied with the service. Users were equally motivated by rewards and saving energy & cost, although their level of satisfaction was lower than those motivated by environmental considerations. LEO partners may wish to focus messaging on environmental awareness.

5. **There are common characteristics of active users and potential users.**
   Among active users, there were significantly more men than women, and more detached houses. There was a reasonable spread of households (dual, family, and single occupancy). EV ownership is relatively high in this group.
   Among potential users the gender and age range in this group was relatively balanced, the most notable commonality were dual occupants and family occupants making up the majority of this group. Two thirds of this group lived in either semi-detached or detached housing and most had a household income of over £50,000.

6. USER INSIGHTS

RECRUITMENT OVERVIEW

equiwatt used a selection of recruitment channels and tactics to acquire users for the Project LEO Flex Trial. Tactical activity was deployed by equiwatt in Oxfordshire prior to the official partnership as part of their existing UK wide marketing activities, whilst a more deliberate local campaign was implemented from Dec 2022. This enabled equiwatt to trial the effectiveness of local recruitment methods, whilst also strengthening relationships with various agencies, private sector, public sector, local communities, and individual ambassadors.

Pre-partnership activity

All recruitment activity by equiwatt prior to becoming an official partner was conducted without any reference to Project LEO or any partner organisations which may have impacted credibility and effectiveness.

Paid Social Media Campaign

equiwatt utilised paid social media campaigns via Meta promoting sign up and smart plug incentives to reach target households in the Oxfordshire area. Audience volumes in that area are not sufficient to run an efficient campaign that reaches learning goals, so Oxfordshire was targeted as part of a broader UK audience campaign for short periods.

Letterbox Flyer Campaign

10,000 A5 flyers were designed in house and delivered as part of a mixed distribution (with other marketing materials using a specialist leaflet distribution company) to OX postcodes within trial areas proposed by SSEN during pre-partnership discussions. Although this was a low-cost option, traction was also low, evident from the low rate of sign-ups. The August timing likely meant that summer weather and holiday season impacted outcomes.

Communities Campaign

equiwatt proactively began to build relationships with sustainability communities in the Oxfordshire area in order to reach environmentally minded households. Activity was implemented with two community groups in particular, Banbury Community Action Group and Thame Green Living, through which the equiwatt app was promoted. Communities were offered unique registration codes for their members to sign up and receive bonus points as a or smart plugs as reward for joining. This third-party validation demonstrated the importance of such relationships to gain credible traction with such communities.

Events

equiwatt were proactively invited to participate in a selection of Oxfordshire based events through the summer via relationships with communities and those involved in pre-partnership discussions. The Oxford Energy Fair provided a platform to remotely present the rDSR concept and what equiwatt can offer. Local homes involved in showcasing smart home and energy saving activities were also provided with smart plugs by equiwatt to aid their efforts. equiwatt also attended the Thame Green Living Community Group (TGLCG) 'Drive Electric' event in person to showcase equiwatt to EV drivers. Free smart plugs were offered as a prize draw to incentivise household sign-up and community relationships built to support future activity.

Post partnership activity

Media

equiwatt was approached by top media outlets reaching Oxfordshire audiences to promote the Project LEO and the National Grid DFS release. OX Magazine ran a detailed feature whilst both Sky News and BBC Oxford interviewed equiwatt's Founder/CEO. However, the timings of some media coverage limited audience reach (early morning weekend and bank holiday). More effective was coverage in national titles including the Daily Express about equiwatt's role in the National Grid DFS. This helped reach Oxfordshire residents as part of national coverage and 'evergreen' digital content like this is proven to provide high volumes of sign-ups. Dedicated consumer Oxfordshire media titles were reluctant to run Project LEO led stories due to the relative low awareness of the project at household level.

Brand Ambassador Campaign

equiwatt partnered with a third-party marketing agency to promote equiwatt in key Oxfordshire areas. Brand ambassadors hired by the marketing agency were present in a variety of locations to meet the public face to face and promote the equiwatt app. Ambassadors were equipped with branded clothing, flyers, stands, and tablets to demonstrate the app. A unique sign-up code, OXFO was provide to all users to use to enter a competition to win a smart plug. Locations included:

- On-street marketing in high shopping footfall areas - impact was very limited success due to weather (cold/wet), time of year (Christmas) and location (too many non-residents).
- County Library marketing - exhibited in several Oxfordshire County libraries which enabled better conditions to talk to the public. Conversations were engaging but low volume.
- Council building marketing - exhibited in County Hall (Oxfordshire County Council head office) and reached an engaged audience who were both invested in the project and local residents.

It was noted that while there was a good level of engagement, the ratio of sign-up volume to effort was low.

Figure 6.1: Library campaign

Figure 6.2: Council office campaign

Low Carbon Hub Campaign

As Low Carbon Hub (LCH) is a Project LEO partner, they were able to work jointly with equiwatt to promote the app and service to the 42 sustainability groups that are associated with LCH. A series of live webinars for group leads and a joint communication effort with LCH and Project LEO extended outreach. Pre-written material was produced for groups to use when introducing equiwatt, and the smart plug campaign was used as an incentive when signing up community members. Interest was high from those engaged although many had to prioritise support in context of the many other sustainability projects already supported by these volunteer/social enterprise groups.

Referral ambassadors

equiwatt developed close relationships with selected social media individuals with related values and agenda (such as climate, sustainability, money saving, EVs) and appointed them as social media brand ambassadors. These ambassadors would promote equiwatt through stories, posts and reels. While it takes time to build relationships and appoint ambassadors, sign-ups via this method were highly engaged.

Referral programme

An enhanced referral programme (increased rewards) was developed for residents of Oxfordshire and promoted to existing users in the area as well as through several of the channels above. This was accompanied by a leader board dedicated to those in the area to instigate a fun, yet competitive nature. This proved successful with a small proportion of existing users but has not yet had time exponentially scale.

RECRUITMENT OUTCOMES AND OBSERVATIONS

While equiwatt successfully launched as many recruitment campaigns as possible, the urgency of acquiring users for Project LEO meant that equiwatt did not have the opportunity to strategically plan the recruitment process, preventing them from optimising the advantages of each method. The key observations regarding the recruitment campaign are:

- The best outcome is achieved with a strategically planned approach, using coordinated marketing so that the target audience will encounter multiple touch points and reinforcements.
- Partnerships involving public and private sector organisations support the concept of multiple touch points, offer third-party validation, and provide user confidence when trusted partners are involved.
- Promotional events and media should be timed to coincide with peak times to address a large audience.
- The use of referral codes to specific recruitment methods is useful to understand the effectiveness of recruitment campaigns but the insights can be clouded (while 53 new registrations used the OXFO code, this was shared across multiple recruitment channels including the brand ambassador activity, Low Carbon Hub and online activity).

USER RESEARCH

equiwatt has been particularly active around obtaining feedback from users through ad hoc reviews on the app as well as by conducting surveys and interviews.

In February 2023, equiwatt launched a survey across more than 160 users in Oxfordshire to obtain insight on user profiles and users' experience of the service. In addition, an interview with 5 participants from the survey ranging from the ages of 25-50 was also conducted. The majority of these interviewees have been participating for under 2 months, and one person for under a year. All interviewees were connected via smart meter and have participated in at least 2 equivents.

INTERVIEWEE	RECRUITMENT METHOD
#1	Promotion on Ecotown housing app
#2	Myenergi email promotion for Project LEO
#3	Instagram influencer
#4	Low Carbon Hub email
#5	Gifted Kasaplug by friend

Table 6.1: Interviewees and their recruitment method

The findings from the survey and interviews are below.

Recruitment Observations

Survey respondents have noted how they came across equiwatt. As shown in the graph below, the majority of the participants were informed of equiwatt through social media, local event or promotion, or local sustainability group. Within the category 'Other' 6/11 respondents were directed to equiwatt through their EV charger manufacturer. There was particularly low traction through recommendations and referral schemes, and this is further explained in the 'Interview Findings' where interviewees explain what the barriers are preventing them from spreading awareness.

Figure 6.3: Recruitment methods of survey respondents

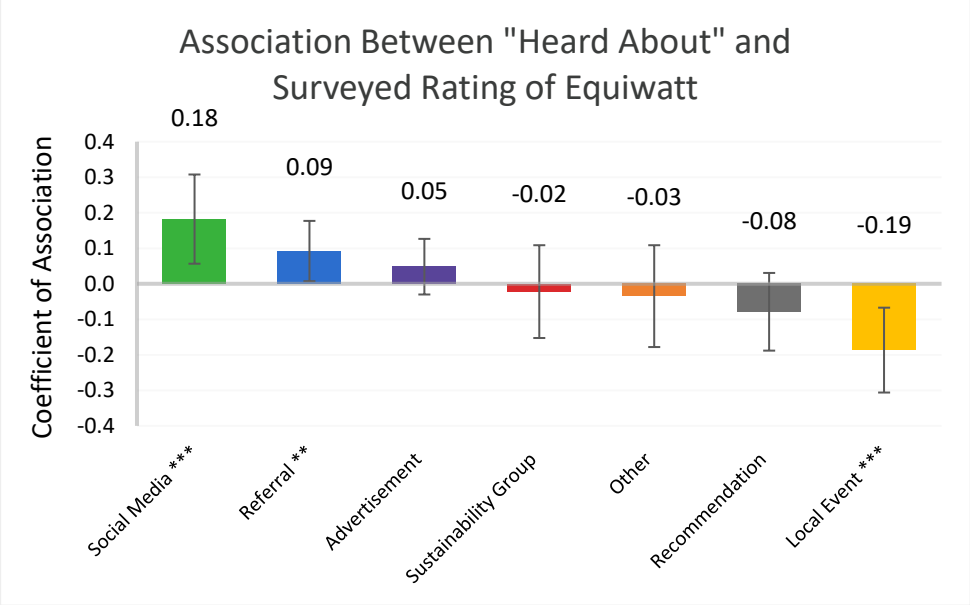

Figure 6.4: Association between how users become aware of equiwatt and surveyed rating.

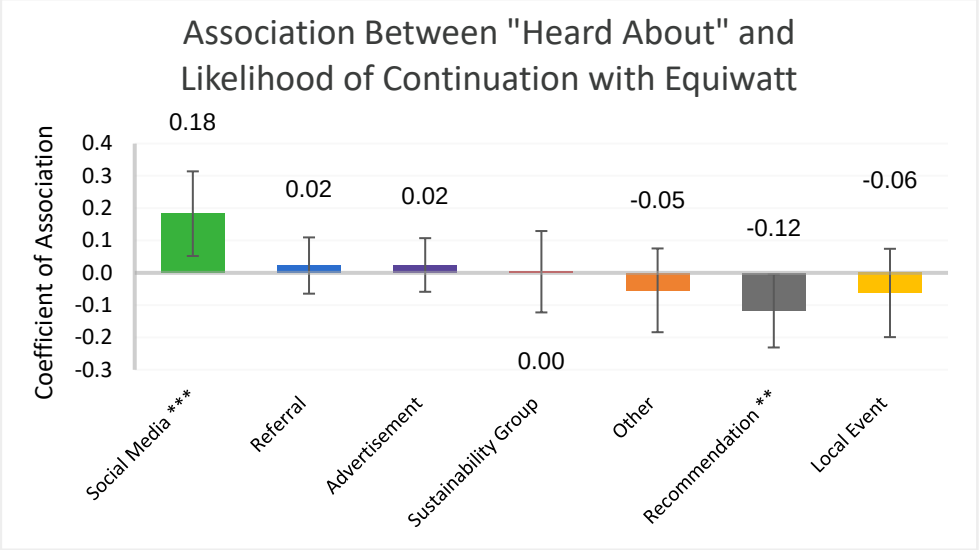

Figure 6.5: Association between how users become aware of equiwatt and likelihood of continuing use.

Social media was the most successful recruitment method with 92% of the respondents giving equiwatt a rating of 7 or more, 84% of which are currently connected, and all of whom intend to continue participating. One reason why social media was the most common recruitment pathway may have been because accessing the equiwatt app would have only been a click of a button since the users would have already been using a digital device in that moment. On the other hand, advertisements[1] may have been less common in comparison as receivers of a flyer would have to read the contents and make the decision to get their devices out specifically to download the app.

Local event or promotion/Local Sustainability Group were both common recruitment channels after social media[2]. The interviewees have explained that third-party endorsement was highly important especially when engaging with a young company.

USER DEMOGRAPHICS

As of 2022, Oxfordshire has a total population of 725,300[3] within which 288,000 were residential households with an average of 2.4 people per household on average and 31,000 people in communal establishments [4]. In 2021, an update breakdown of the typical household composition was conducted[5]. This showed that One-person households remained most common (18.4%) although a drop since 2011, and the single-family households, both with and without dependent children increased in 2011.

The median age of the population in Oxfordshire as of 2021 is 29-31[6] which our analysis has shown falls into the age categories that often engage in rDSR events. Similarly, despite a fall in homeownership since 2011, it remains relatively

[1] It must be caveated that although we define advertisement as a non-digital medium compared to social media, this distinction was not stated on the survey. However, looking at the responses, a respondent who has ticked social media refer to twitter and one respondent who ticked advertisement refers to a flyer. Therefore, we have continued the analysis with the assumption that the respondents have defined social media and advertisement this way.
[2] As half of the respondents who ticked 'Other' were referred by their EV charger company, we have looked at the next most common recruitment channel.
[3] The Office for National Statistics 2021 Census
[4] Households | Oxfordshire Insight
[5] How life has changed in Oxford: Census 2021 (ons.gov.uk)
[6] How life has changed in Oxford: Census 2021 (ons.gov.uk)

high making up 45.3% of Oxfordshire's housing tenure. [7] As of January 2023, almost half 49.88% of vehicles newly registered in Oxfordshire were electric.[8] These are all characteristics we have found in users to take part in equivents.

From the survey, we received responses from 65 users, of which 58 (89%)[9] users participated in at least one equivent, 46 (70%) intend to start and continue participating in equivents[10], 32 (49%) are currently regularly active users[11], and 7 (10%) have strongly detracted[12]. Below is a demographic profile of the three highlighted groups:

Opportunity Group - 46 respondents who are interested in starting or continuing to participate in equivents.
Although the gender and age range in this group was relatively balanced (20 Women, 26 Men), there were emerging common characteristics around housing type, occupancy, and household income. Out of these 46 respondents, the most notable commonality were the 18 dual occupants and 18 family occupants making up 78%. 31 out of 46 participants lived in either semi-detached or detached housing and 41 out of 46 participants noted that they have a household income of over £50,001.

Active Group - 32 respondents who are regularly active users.
The demography of the active group was slightly different to the previous category. While the age was relatively balanced, there were significantly more men than women (20 Men, 12 Women), and more detached houses (15) over semi-detached (8). There was a relative degree of balance of dual (12), family (11) and single occupancy (7). Just under half of these users (15) have energy supplied by Octopus and 17 users have opted in to equiwatt's control over their smart appliances. Although 10 users have EV chargers, only 6 have been able to connect.

Detractor Group - 7 respondents who do not intend to participate in equivents in the future.
Compared to the groups of respondents who are engaged in equiwatt, there was no typical demographic profile of those who have detracted from the service as the gender, age, housing type, occupancy and housing income were all entirely varied. The commonalities amongst these respondents were the recruitment channel and challenging circumstances that they faced. In contrast to the active group, who were often recruited through social media, local event or promotions, or local sustainability group, half of these respondents were recruited through recommendations or 'other' methods. They also commonly raised issues about the difficulty with signing up and connecting.

[7] How life has changed in Oxford: Census 2021 (ons.gov.uk)
[8] Phase two of Go Ultra Low Oxford to start this spring | Oxford City Council – DVLA data.
[9] This includes 3 respondents who are not sure if they have successfully connected to the smart meter.
[10] **Opportunity Group** - Participants who have scored 7+ on whether they intend to continue using equiwatt in the future. This does not take consideration of what the participants rated the service and whether they intend to also be interested in other providers. This can also include participants who have not yet participated in an equivents.
[11] **Active Group** - Participants who have their smart meter connected and participates in every equivent and intend to in the future.
[12] **Detractor Group** - Participants who don't intent participate in equivents (responding with 'none') in the future regardless of whether they have participated in one or never or participated very little but don't intend to continue.

USER EXPERIENCE

The 58 out of 65 respondents, 89% were generally content[13] with the service and are keen to participate in equivents in the future. 58/65 participated in at least one equivent[14] 41 out of this 58 were satisfied by the service, giving a score of 7 or above.

Strengths raised about the equiwatt service:

- **equiwatt gives access to those who cannot otherwise participate in DFS** - It was highlighted in the survey and interview that users who are particularly motivated to use equiwatt were those who were unable to participate in DFS through their energy provider whether it is because it is not offered or because they weren't able to sign up. They found that a third-party service like equiwatt was beneficial as it made DFS accessible to all with smart meters. In addition, out of 46 regularly engaged participants, 19 have energy supplied by Octopus Energy where they have access to an alternative route to participating in DFS. An interviewer stated that they like to use equiwatt as a way of participating in other rDSR events.
- **Convenience of passive participation** – 30/65 of respondents currently opt into automatic control. Of which 23/30 were highly satisfied. An interview with one of these respondents explained that once the smart meter and smart plugs have been connected, all they need to do is adjust their daily routine slightly to accommodate typical equivents and can completely forget about the connections, letting it switch things off when necessary. They noted that the equiwatt opt in option prevented any inconvenience of this to their lifestyle, making rDSR appealing.

Figure 6.6: app set-up

- **Reward satisfaction** – It was highlighted in the interviews that while participants don't find the rewards significant, they are relatively satisfied with it. The survey has shown that 15 of the regular users have scored rewards as 6 or below as they find that it takes a long time to notice a benefit. However, this has not prevented them from continuing. The interviewees explained that they believe that they should be rewarded something for participating but that it does not have to be a large prize.

There were three barriers commonly raised across the interviewees and surveys that prevented them from recommending equiwatt and/or referring their friends and family:

Difficulty setting up gave participants low confidence about the service – All interviewees found the first step of setting up particularly challenging. A few flagged that they struggled to find the right codes from the smart meter and that they were unsure whether they successfully connected until the first equivent. One interviewee stated that they believe the difficulty in connecting with the smart meter was the issue of the smart meter and not equiwatt. As majority of the interviewees identified themselves as the one amongst their family to be most familiar with smart technology, the fact that setting up was a challenge for them gave them low confidence that their family would be able

[13] Participants who said that they would like to participate in future events regardless of whether they have already and regardless of how they scored equiwatt.
[14] Participants have responded that they have participated in at least one equivents. This includes those who were unsure whether their smart meter and appliances have been connected. This is based on the assumption that they do participate but either were not the ones to set it up or haven't checked.

to set it up on their own. One participant stated that they would only like to share products and services that they are very confident that their friends would enjoy, and that the setting up process makes them feel less inclined to recommend.

Challenges in connecting with EVs and smart plugs were inconvenient for participants – A large majority of the survey respondents noted that they struggled with connecting to equiwatt because of the incompatibility of the devices however for many this did not prevent them from taking part by other methods. 3 out of 5 interviewees were unable to connect their EV or smart plugs due to interoperability issues (there are no industry-wide standards for connecting smart plugs and EVs[15]) and raised that it was also inconvenient that they can only purchase compatible smart plugs through equiwatt. One interviewee raised their struggle of connecting with their smart plug as it is in an area of low Wi-Fi coverage. equiwatt is addressing the industry-wide EV interoperability issue by working with manufacturers and adding more brands each year.

Challenges in understanding the results of each equivent - Interviewees found that they were unclear about the impact that the equivents have on them. 2 interviewees raised that they were unclear about the rewards and what the points mean. They flagged that they would specifically like more information after each equivents ends, including how much energy they saved in each respective equivent and what it directly correlates to in terms of points. One interviewee also highlighted that they have found inconsistent results in equivents where they have made more savings being at home compared to being outside. The interviewees commonly agreed that they would like more tailored advice and results to give them reassurance that their participation in equivents is measured accurately.

Other challenges identified:

- Limitation of geographical coverage - One interviewee also noted that they would like to make referrals but were under the impression that they were unable to as their friends and family do not live in areas that are covered by the Project LEO trial (where users were/are actually able to refer friends and then benefit from the general equiwatt referral scheme).
- The need for more familiarity - While most interviewees were open to referring their friends and family, one interviewee stated that they would like to use the service for longer to have more trust before recommending.

[15] PAS1878 should address interoperability of EVs, HVACs, battery storage and other 'Energy Smart Appliances' by mid- to late-'20s.

USER MOTIVATIONS

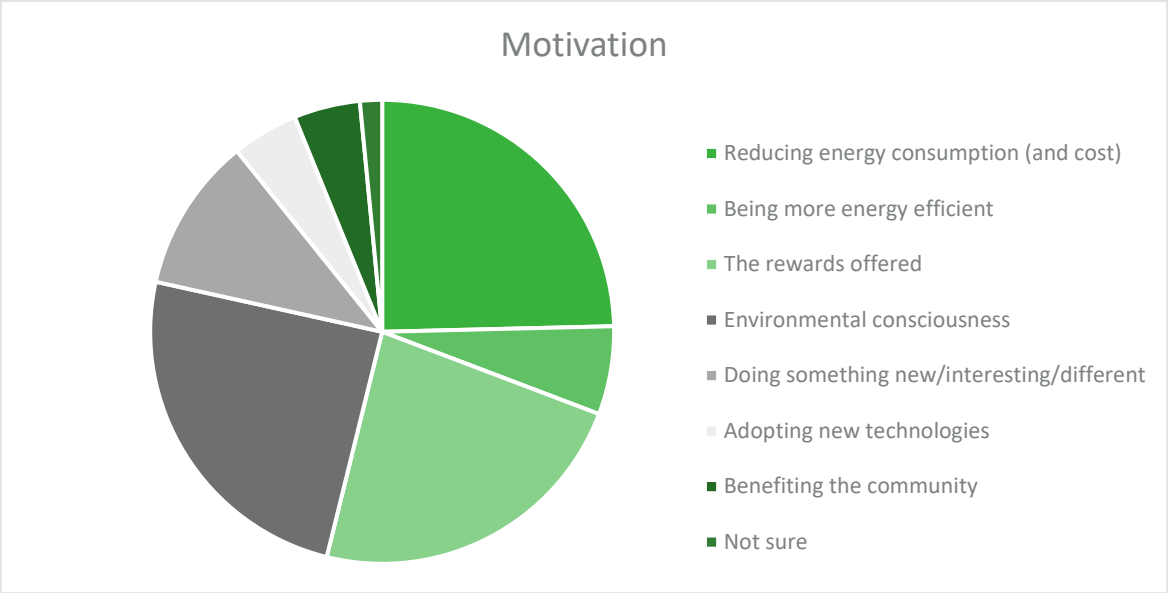

Figure 6.7: User motivation for participating in equivents.

The survey result has shown that participants are mostly motivated by three aspects of equiwatt:

- **Environmental Consciousness** – 25% of respondents noted that they are motivated by the sustainability quality of equiwatt. 81% of the respondents who joined equiwatt for this reason was highly satisfied [16], this is the highest proportion compared to the other motivations.
- **The Rewards Offered** – 23% of respondents said that they were motivated by the rewards offered. This includes both the reward of signing up and the reward of participating in equivents. Out of this group, 47% were highly satisfied. (Further details about the rewards in the next section on 'Incentives for Participation'.
- **Reducing Energy Consumption (and cost)** – 25% of respondents said that they were motivated by the prospective to reduce energy use both for the purpose of reducing bills but also for energy efficiency. Out of this group, 44% were highly satisfied.

It is important to note that Octopus Energy is the energy supplier for 44% of the total respondents. Although 1 interviewee mentioned that they try to take part in DFS through both Octopus Energy and equiwatt, a different interviewee stated that they take part in DFS through Octopus Energy and other events through equiwatt. Therefore, it cannot be assumed that 44% of the respondents are taking advantage of this possible loophole.

[16] Participants who have given equiwatt an overall rating of 7 and or above and who have given a score of 7 and or above on likelihood of using equiwatt in the future.

USER INCENTIVES

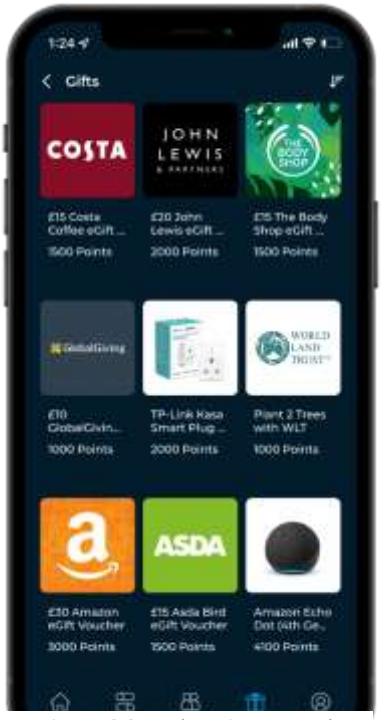

Figure 6.8: Redeeming rewards

Incentives for signing up: equiwatt has launched various campaigns in Oxfordshire to reward users for signing up to the app (smart plugs and points), participating in equivents (points), and referring participants (Cash reward, gamification, or smart plug). However, the survey has shown that only 44% of respondents have been motivated by rewards. None of survey respondents have specifically referred to cash rewards or smart plugs being a reason for signing up or referring. Interviewees have also commented that these rewards were not the main incentive to signing up.

Incentives for equivent participation: Of those who have participated in equivents[17], 59%[18] are aware of the points they have accumulated. Notes from the survey and the interview highlight that participants who have not connected their EV charger don't often track the points accumulated as they feel it will take a long time until the savings are sufficient. Cross checking interview results with the survey also show that those who track points don't necessarily also track energy savings on their bill. In fact, two regular users of equiwatt have said that they have not looked at whether participating in equivents have made a difference to their energy bill but that they have a feeling that it is making a difference.

Gamification: The insights about gamification from the survey was significantly contrasting to various literatures of other industry reports as well as how long-term users of equiwatt have been perceiving it. None of the survey respondents made comments about the leader board or community engagement as an incentive. Interviewees explained the gamification aspect has not necessarily been an incentive as they thought they have no chance in reaching the top and that unless they are already in the top 10. One interviewee also noted that it is particularly difficult to be motivated by the leader board if users are new to the app as they can see their competition. In addition, those at the top 10 are often users with EV chargers who can accumulate points faster than those who only connect smaller appliances. As 79% of the respondents either don't own an EV/Plug in Hybrid/EV Charger or cannot connect to it, this is a large proportion of users who might not be incentivised through the gamification campaign.

Figure 6.9: Gamification

In further consultation with equiwatt, we have noticed that some newer users may not have had a chance to appreciate that their leader board is regularly refreshed and therefore may introduce bias into their survey response.

[17] 58 respondents

[18] Participants who have participated in at least 1 equivent and have noted the points they have saved including those who have noted zero.

Prior to, and leading up to participation in Project LEO, equiwatt has been testing gamification techniques with consumers, gathering feedback on how various techniques can be used to influence consumer behaviours towards different goals. Strategies such as leader boards, spot prizes and how monthly prize draws help drive up the perceived value of points and persuade people to remain engaged have been trialled. This is complemented by evidence in equiwatt's wider user base that there is a growing community of equiwatt users who support each other, share strategies to maximise points and impact, etc.

In the gathering of user feedback ahead of ahead of Project LEO, equiwatt were able to see more tangible evidence in user positivity towards their gamification approach[19]:

- "The points system keeps me interested and participating. Easy set up and pleased to join the community. Having the energy usage of my appliance from the smart plug is an added bonus" RL
- "Loving the app so far, can't wait till I've got enough points to get my next plug" RM
- "This app is wonderful! It actively encourages saving energy by way of earning points which you can exchange for goodies! Really brilliant concept!" - AR
- "Great energy saving. Such a good app as it helps me save and monitor energy. It also gives me a chance to earn points to spend on what I want" - NC

It was apparent through feedback that gamification in the equiwatt app is not only seen by users as about competition/leader boards, but also in gamifying the saving of energy, making it easier to understand the importance of being energy wise and actually taking action throughout the user journey. The gamification element also lies in users feeling part of a community virtual power plant which they can see 'live' or in action in the app when there is an equivent.

Furthermore, some of equiwatt users have been participating in 'energy saving' events for more than 2 years, some for 3 years. From the average 70 active users equiwatt had at the end of 2020, 67 are still active, participating in events as of 9 of March 2023 and a few of them have been part of the top 3 positions in the leader board.

Whilst the leader board and other elements of equiwatt's gamification in the app was not fully grasped by the surveyed or interviewed users in Oxfordshire who joined in the later stages of the trial (users may have not been aware the leader board resets every month, there are also 3 random winners selected per month for the lucky Dip, etc.), or users commented on the unlikeliness of winning unless having a high usage (having an EV or heat pump), the fact they are aware gives confidence to equiwatt that users are aware and may be build interest.

Several international demand-side response platforms have seen significant benefits of gamification. One example is Bidgely, a Californian Energy Analytics company, who helped an Energy utility called United Energy in Melbourne to reduce the summer peak demand by 30% through gamification. They noted that customers were especially encouraged to respond to events consistently as they were provided rewards and the ability to keep score. They also highlighted that maintaining users' engagement over time is key and that tiered rewards helped smooth participation[20]. Similarly, it was found through Northern Powergrid's use of GenGame app that, since rewards are not sufficient to be a stand-alone incentive for participants, gamification offered a fun solution to consumers[21]. In addition, a rDSR programme in

[19] User feedback on gamification collated and provided to Gemserv by Equiwatt for this report.
[20] https://www.utilitydive.com/news/gamification-for-the-grid-inside-bidgelys-australian-demand-response-pilo/419230/
[2121] https://www.forbes.com/sites/feliciajackson/2018/07/12/is-gaming-the-future-of-consumer-demand-response/

Texas changed their entire name of the programme after noticing the benefits of the gamification aspect. The 'Save for Tomorrow Energy Plan' started off as a standard CSR programme called Behavioural Demand Response but changed the name to Power Player to better articulate the gamification angle to consumers. The consumers were incentivised to participate as they competed against their neighbours to improve their personal rankings[22].

Passive participation: It is important to highlight that two interviewees have also explained that although it would be dissatisfactory to not be rewarded for participating in equivents, they do not give much attention to the points accumulated. While an interviewee who opts-in to automatic control takes an entirely passive approach where they participate but don't take notice every time they do, those who haven't opted-in also find that they are relatively passive as they only act when they receive notification but do not track their participation.

CUSTOMER INSIGHT CONCLUSIONS

The key insights we draw from recruitment are:

- **Paid social media appears effective as a recruitment method** and leads to the most satisfied and engaged users, although it can be expensive, and a high degree of skill is required to ensure accuracy of targeting.
- **Local events / promotions and partnering** with local sustainability groups were both common recruitment channels.
- **Third-party endorsement was highly important** especially when engaging with a young company.
- **The most effective user motivation for participating is environmental awareness**. In addition to being the most common reason for users participating, the satisfaction rating of users joining for the reason was higher than for any other reason at around 80% highly satisfied.
- Users were equally **motivated by the rewards and by reducing energy use and cost** and around 50% of users who joined for this reason being highly satisfied.
- **Gamification seems to be an effective long-term participation tool**, with international studies and responses from long-term users showing benefits, although new users do not seem to be especially motivated unless they are EV owners.

[22] https://www.global-energy-elites.com/2021-projects/gamification-of-demand-response

CONCLUSIONS & INSIGHTS AGAINSTS THE CUSTOMER JOURNEY

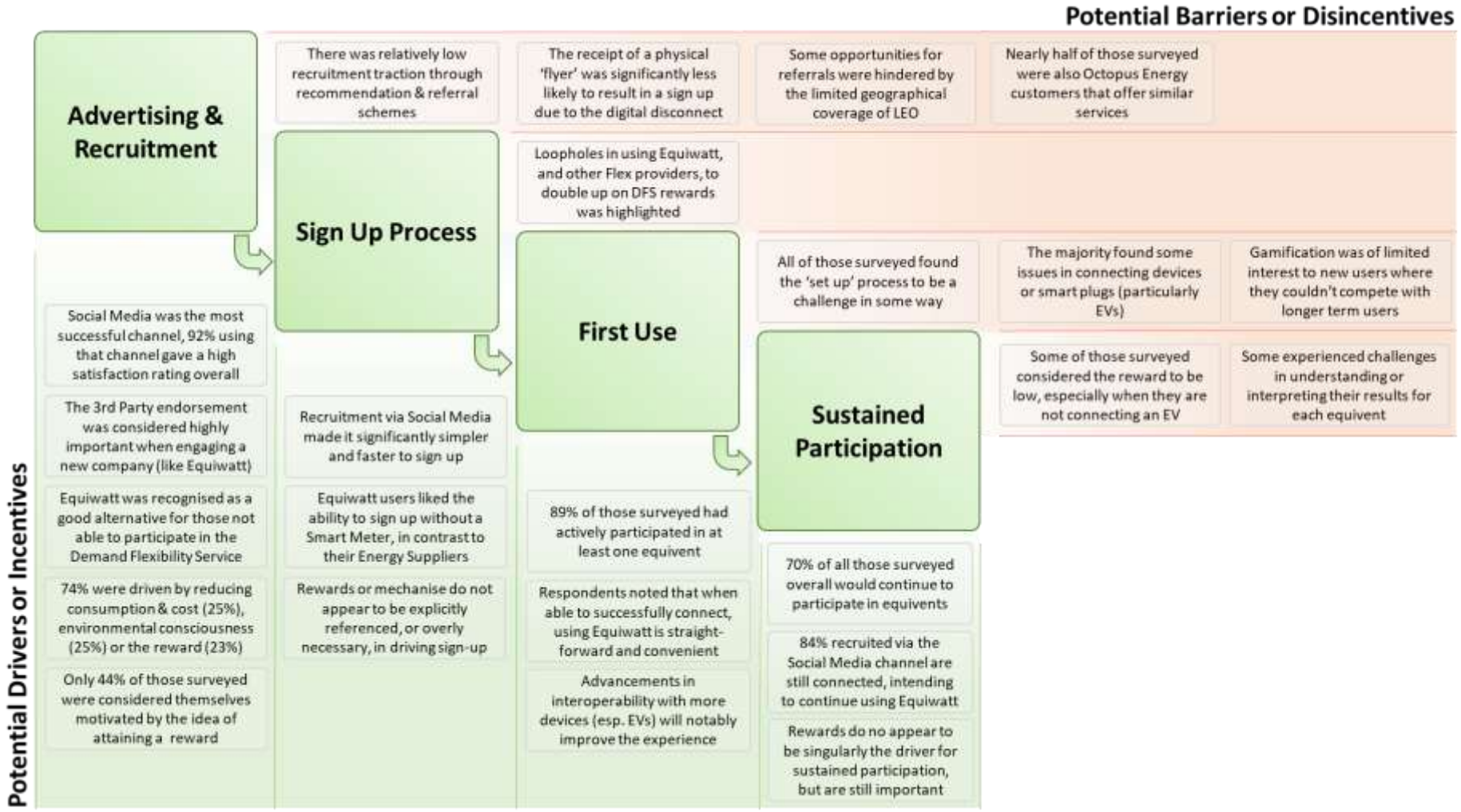

Figure 6.10: Customer journey insights

7. ANALYSIS OF FLEXIBILITY RESPONSE

OVERVIEW

The analysis performed in this section is primarily derived from data provided by equiwatt and the Project LEO rDSR trial, and in all cases using data from smart meters. Data was unfortunately impossible to connect to the findings of the survey (discussed in the prior section), due to GDPR regulations. As a result, saving results by more characteristic-based measurements (gender, motivation, income etc.) are not possible in this report. Whilst these limitations are unfortunate, there is a wealth of immediate statistics that can be brought to bear, shedding light on the flexibility that users can provide on events.

Figure 7.1: Connecting a smart meter.

DEMAND REDUCTION OVERVIEW

Once equiwatt has recruited and onboarded users, users participate in equivents reducing or shifting consumption either automatically (via equiwatt's 'Set and Forget' functionality that allows equiwatt to remotely control devices) or manually (with the user then turning off/down during the event). The reduction is then calculated using meter readings using an approved methodology that considers average consumption for the same time of day and day type (i.e., weekday or weekend) for ten preceding days not part of an equivent. The analysis below focuses the demand reduction or shifting resulting from:

- Users within the Project LEO trial areas that were able to participate in flexibility auctions.
- For comparison purposes, all equiwatt users in SSEN Fleet area, all equiwatt users in Oxfordshire, and all equiwatt users in Great Britain where they, in each case, connected to Smart Meters and have half hourly data available.

Demand Reduction in Project LEO / Project TRANSITION areas

Table 7.1 summarises the *per user* (based on smart meter data) demand reduction (or shifting) in the Project LEO / Project TRANSITION areas for the six equivents that took place from 1st to 17th February 2023 (the latest available data at the time of writing this report).

AREA (BSP)	PER USER MEAN REDUCTION (kWh)	PER USER MIN REDUCTION (kWh)	PER USER MAX REDUCTION (kWh)
Bicester North	-0.105	0.831	-0.899
Cowley	-0.178	3.141	-1.136
Drayton	-0.203	6.230	-1.176
Headington	-0.038	1.959	-1.169
Oxford	-0.163	3.037	-2.028
Yarnton	0.112	1.264	-0.837
ALL TRIAL AREAS	**-0.045**	**6.230**	**-2.208**

Table 7.1: Summary of demand deduction in Project LEO / Project TRANSITION area (per equivent)

Note: in these tables, negative values represent a reduction in imported energy whilst positive values represent an increase in import.

Demand Reduction Outside of Project LEO / Project TRANSITION Area

For context, similar analysis has been undertaken for equiwatt's whole SSEN fleet, all of Oxfordshire, and for all equiwatt users with connected Smart Meters in UK for the six equivents. This is shown in Table 7.2, below.

AREA (BSP)	PER USER MEAN REDUCTION (kWh)	PER USER MIN REDUCTION (kWh)	PER USER MAX REDUCTION (kWh)
Whole SSEN Fleet	-0.045	6.230	-2.028
Oxfordshire	-0.115	14.032	-4.128
All UK	-0.103	14.032	-4.166

Table 7.2: Summary of demand reduction outside of Project LEO / Project TRANSITION area

DEMAND REDUCTION INSIGHTS

Demand Reduction Overview

Based on the analysis above, the mean average demand reduction of users in the trial area is around **45Wh per registered user (regardless of whether they have elected to participate in any given event).** The equivalent reduction across Oxfordshire is 115Wh per registered used, and 103Wh fleet-wide.

Not all users participate in every equivent. Some users that may ordinarily elect to participate manually, and thus would usually turn down or turn off appliances during an equivent, may, on select occasions, choose not to do so. Even if they have elected to participate automatically through equiwatt's "Connect and Forget" functionality they can override instructions or the appliances (e.g., EVs) may not be in operation at the time, and therefore turn-down instructions would not have any demand reduction impact.

Figure 7.2: equivent usage forecast

More detailed analysis of participating users with connected Smart Meters and available half hourly data across the whole of equiwatt's UK portfolio shows a mean average demand reduction of around **360Wh per participating user.**

AREA (BSP)	PER USER MEAN REDUCTION (kWh)	PER PARTICIPATING USER MEAN REDUCTION (kWh)
All UK	-0.103	-0.360

Table 7.3: Comparison of demand reduction from all users and participating users

Demand Reduction Baselining Approach

Not all users have a smart meter (a recent update from the Data Communication Company[23] (DCC) indicates that half of all homes in Britain are connected to the smart meter network). This is a limiting factor for participating in flexibility markets that require Half-Hourly meter readings from smart meters. Effectively, this means that half of the total potential for demand flexibility is currently excluded from these markets.

Where users do have a smart meter and participate in National Grid ESO's Demand Flexibility Service (DFS) events, equiwatt uses the baselining approach required by National Grid.

However, equiwatt can also remotely control smart devices including certain smart plugs, Electric Vehicles (EVs), and EV Chargers. Even if the user does not have a smart meter installed equiwatt is still able to deliver benefit for the electricity system. Further effort is needed to understand how sub-metering could be used to add value where no smart meter exists.

Immediate observations from this analysis concludes:

- There is significant untapped flexibility potential arising from the high proportion of properties without smart meters and therefore excluded from flexibility markets.
- Further research and development effort is needed to understand how sub-metering can participate in flexibility markets.

Figure 7.3: Connecting an EV

ENERGY SAVINGS BY APPLIANCE TYPE

equiwatt can deliver flexibility savings across a variety of device types, either via direct integration with the end device, or via smart plugs which can be used to remotely control usage. The consumer would be able to manually override the remote control.

The savings are seen in aggregate in smart meter readings, although individual devices such as EVs or EV chargers and smart plugs can monitor and report usage, although they may not comply with Measuring Instruments Regulations[24] or be used for Settlement[25] purposes.

The table below shows the flexibility potential of several appliances, either through use of smart plugs or via industry developments to increase interoperability of flexible assets, such as PAS1878[26]:

[23] DCC (2023) Half of homes connected to the smart meter network
[24] Measuring Instruments Regulations 2016
[25] ELEXON Codes of Practice
[26] BSI PAS1878

APPLIANCE	POWER (kW) AND SOURCE [27, 28, 29]	CHANCE OF AUTOMATED RDSR CONTROL	RDSR CONTRIBUTION (ASSUMING EVENING PEAK EVENTS)
Electric Showers	7 – 10.5	Low	Low: behavioural change needed to achieve benefit, more suited to ToU tariffs.
EV Chargers	7	High	Medium: high usage, but normal charging behaviour will be overnight
Heat Pumps	1.2 – 5	High	High: potential to automate, likely to be operating during winter events, potential to modulate usage and use thermal stores
Immersion Heaters	3	High	High: potential to automate, high power demands, likely to be operating during winter events
Dishwashers	1.2 – 2.4	Moderate	Low: some potential to automate, although some concerns expressed and relatively low usage
Supplementary Heaters	1 – 3	Moderate	Low: significant behavioural change to moderate usage of supplementary heaters
Tumble Dryers	1.5 – 2.5	Moderate	Medium: some potential to automate, although concerns expressed
Vacuum Cleaners	0.6 – 0.9	Low	Low: low power demand and low usage

Table 7.4: Power usage by appliance and potential contribution to rDSR

EV Developments for Oxfordshire

Phase two of Go Ultra Low Oxford (scheduled to start Spring 2023)[30]

Although Oxfordshire has the highest EV uptake in the UK, 46% of Oxford households don't have access to off street parking. With the narrow streets in Oxfordshire, this can be a challenge for those needing to charge their cars. Phase 1 of the Go Ultra Low Oxford started in July 2017 to June 2019. In this phase, over 40 charging points were rolled out. Phase two (2023-24) looks to install charging facilities for 1600 people through chargers and cable gullies. This will be a mix of on-street locations and residential charging hubs in car parks.

Implications: Oxfordshire has the highest uptake of EV across the UK, and it is likely that the ease of charging EVs will incentivise residents to switch to EVs. However, further research needs to be conducted to understand whether the Go Ultra Low Oxford is likely to reduce the number of residents who charge their EV at home.

DEMAND REDUCTION OVER TIME

Another important aspect in flexibility response is how the results are affected by time. In particular, the data collected allows us to compare the response by day of the week. Analysis by hour/minute of an event is not particularly useful, given all events take place in close proximity (5:00pm to 7:00pm). This analysis focuses on February, as this period

[27] RAC (2023). Electric car charging – how it works and how much it costs.
[28] Home Heating Guide (2023). Air Source Heat Pumps: A Sizing Guide.
[29] NEA (2022). Electricity Consumption Around the Home.
[30] Phase two of Go Ultra Low Oxford to start this spring | Oxford City Council

provides data on a wider sample of user events. Where days have not been included (Wednesday, Saturday & Sunday), no events had taken place:

AREA	DAY OF THE WEEK	MEAN REDUCTION PER USER (kWh)	MIN. REDUCTION PER USER (kWh)	MAX. REDUCTION PER USER (kWh)
All UK	Monday	-0.198	2.528	-4.166
	Tuesday	-0.060	9.857	-3.123
	Thursday	-0.130	8.914	-3.363
	Friday	-0.086	14.032	-3.959

Table 7.5: Demand reduction by day of week

As set out above, not all users participate in every equivent. Table 7.6, below, shows the daily view of mean reduction for all users, compared with all *participating* users.

AREA	DAY OF THE WEEK	MEAN REDUCTION PER USER (kWh)	MEAN REDUCTION PER PARTICIPATING USER (kWh)
All UK	Monday	-0.198	-0.429
	Tuesday	-0.060	-0.335
	Thursday	-0.130	-0.369
	Friday	-0.086	-0.343

Table 7.6: Comparison of demand reduction from all users and participating users, by day of week

FLEXIBILITY RESPONSE CONCLUSIONS

- As highlighted in Table 7.2, there are instances where **non-participating consumers increase their consumption**. To achieve more accurate data in the future, it may prove useful to explore whether a link can be made by a customer who 'confirms' their participation (such as via an in-app process), and the eventual collected data.
- Table 7.3 shows that the mean average reduction of 360Wh for users participating in an event (i.e., removing any user that increases consumption) versus 103Wh when non-participating users are included. Although it is unrealistic to achieve an increase of 250% in response, it does point to there being **considerable potential to increase the overall response magnitude by managing user participation more actively**.
- **Opting in vs opting out**: Further research should be undertaken to determine whether the aggregate effect on consumption reduction is greatest when users are required to opt into event (they have to actively confirm participation) or opt out (they are presumed to opt in unless they actively confirm otherwise). We consider opt out to be effective when users agree to 'Connect and Forget' (participate automatically using remote control capability), but do not have sufficient data to analyse the effectiveness of manual participation under each option.
- Our analysis indicates that mean reductions in demand (by event) vary from 39Wh to 365Wh. Average household hourly demand (at the national level) for this period is around 1,320Wh. **These events therefore**

have reduced demand at the household level by between 3% and 28%. Although there is a relatively small sample size from this project, it appears as though Mondays represent the best time for demand reduction, with Tuesday performing the worst (See Table 7.5).

- **Information failure, specifically around the actual types of devices that can be included in demand-side response measures, may limit demand response**. Table 7.4 highlights the wide range of potential appliances which could be considered for rDSR contributions – some of these may not have been considered by consumers when signing up to Equiwatt services, for example, electric showers and immersion heaters. Improving clarity around potentially includable devices may improve the average response that can be achieved.

8. POTENTIAL FLEXIBILITY RESPONSE FOR OXFORDSHIRE

Given increased electrification, the need to understand how potential flexibility changes over time becomes far greater. The analysis below aims to model the total flexibility that might be possible in the Oxfordshire area, both for equiwatt, and regardless of flexibility provider. The uptake of low carbon technologies, such as electric vehicles, and hydronic heat pumps, will drive the bulk of increased flexibility:

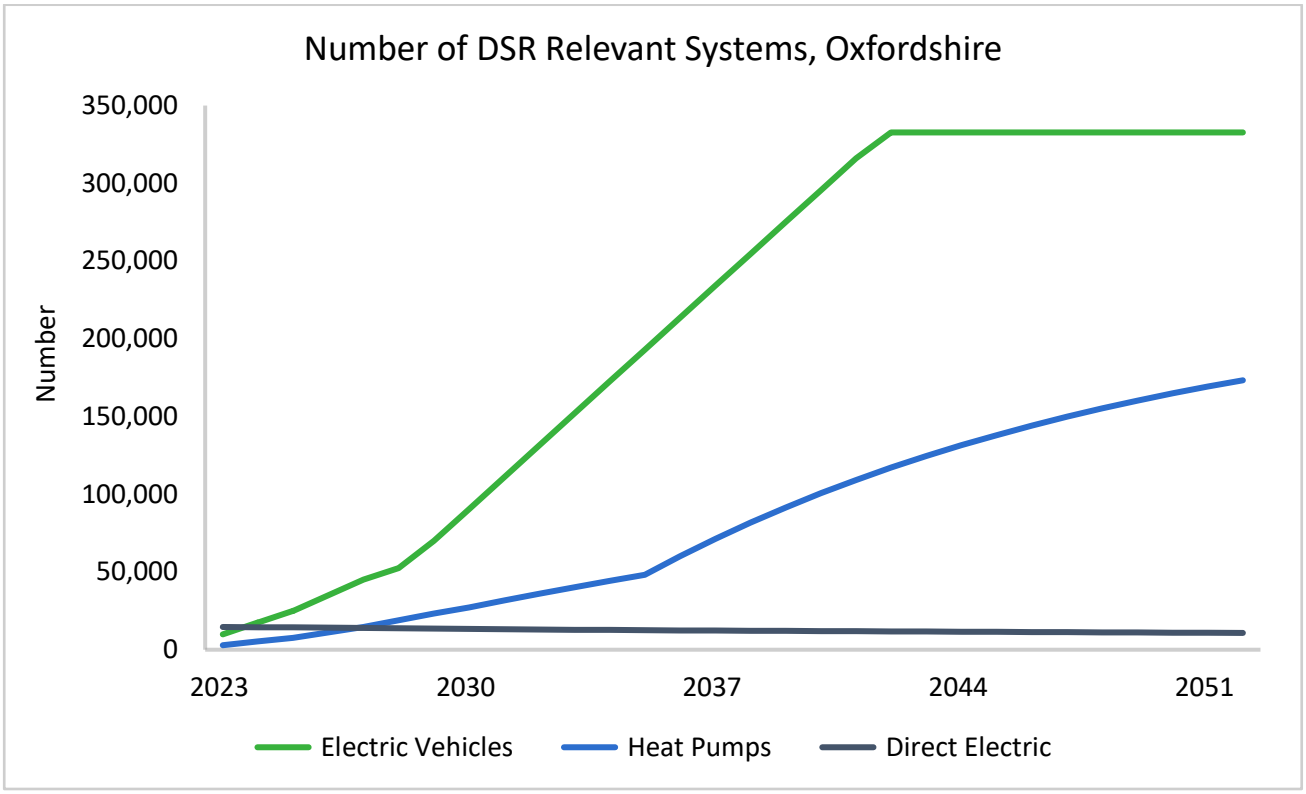

Figure 8.1: Predicted Number of rDSR-Relevant Systems[31].

As per the National Grid:

"Flexibility from appliances presents a smaller but still significant opportunity. Smart appliances automatically responding to price signals from smart tariffs could shift electricity demand away from peak periods for appliances such as washing machines, dishwashers and, even for short periods of time, refrigerators or freezers. Up to 1.4 GW of peak demand could be shifted away from peak times in this way. We expect the move to flexible EV charging to act as a trigger point for consumers to begin to engage in this type of demand shifting as elements such as time varying EV tariffs are already available in the current market." [32]

To consider how the potential flexibility across Oxfordshire will change over time, let us first begin by estimating how it currently looks in 2023:

Using data discussed in the prior section, households using smart meters deliver mean savings of 0.115 kWh per event. Given each event is an hour long, we can also state that there is approximately **0.115 kW** of flex per household. We then make the assumption that these households are not fully capturing the added flexibility potential of EV chargers, and

[31] These numbers are estimated using a wide range of Government targets, characteristics of the UK housing stock, and market estimations. These are then expected to scale proportionally down to Oxfordshire.
[32] National Grid (2022). Future Energy Scenarios

heat pump units – due to the small incidence of ownership of either of those systems, and the relatively small sample size of the population of Oxfordshire.

To build up a picture of theoretical flexibility, it is first worth beginning with EVs. Analysis demonstrates the varying changes expected in EV usage and resultant charging behaviour over time:

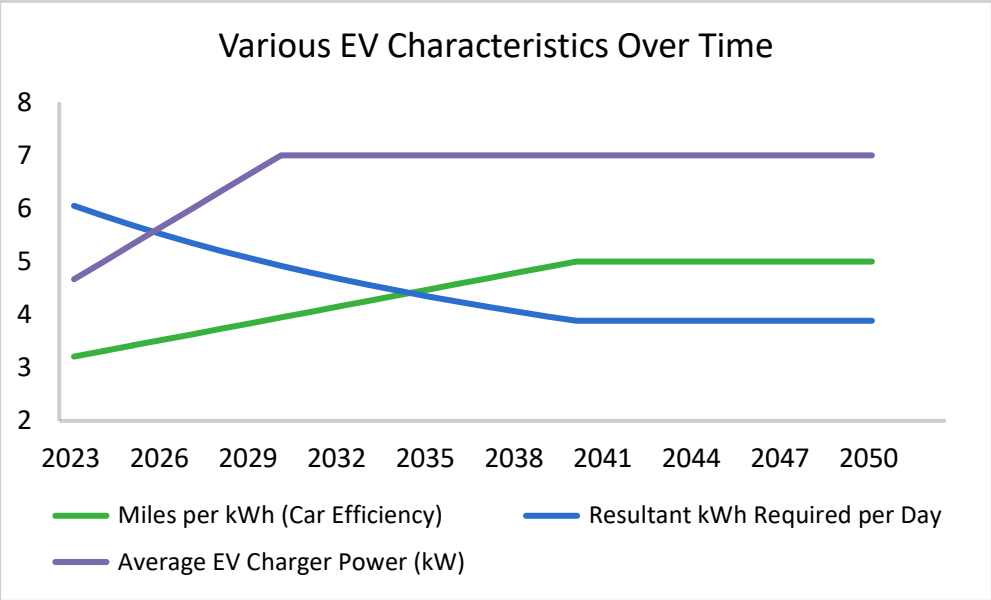

Figure 8.2: EV characteristics over time

Given an average EV charger rating of 7kW (by 2030), and the resultant kWh required per day (derived in part by the average miles driven across the UK, and the efficiency of EV cars in miles per kWh), we can calculate an average time to charge in minutes. This figure comes to around an hour – perfect for the hour-long flexibility events we are currently considering. Ultimately, this means **around 7kW of flexibility** should be available for each household with an EV, given that either the hour of charging can be moved, or the charger can be controlled to run at a lower charging rate.

With regards to heat pumps, one important issue to consider is the high coefficients of performance (COP) that they operate at. An efficient 12 kW heat pump, operating at a COP of 4.0, will only be drawing 3 kW of electricity (the maximum amount of flexibility that it can deliver). However, because of the inherent thermal inertia in a building (particularly so for those with better insulation properties), heating systems can "overheat" the property (whilst remaining in comfortable levels), prior to reduction. This is particularly useful from a demand-side response perspective. Our modelling indicates that a heat pump can, on an average given day, deliver **around 2.95 kW of flexibility**, whilst keeping the home comfortably warm.

These assumptions, allow us to build up a picture of the maximum *theoretical* flexibility across Oxfordshire in 2023, and over time:

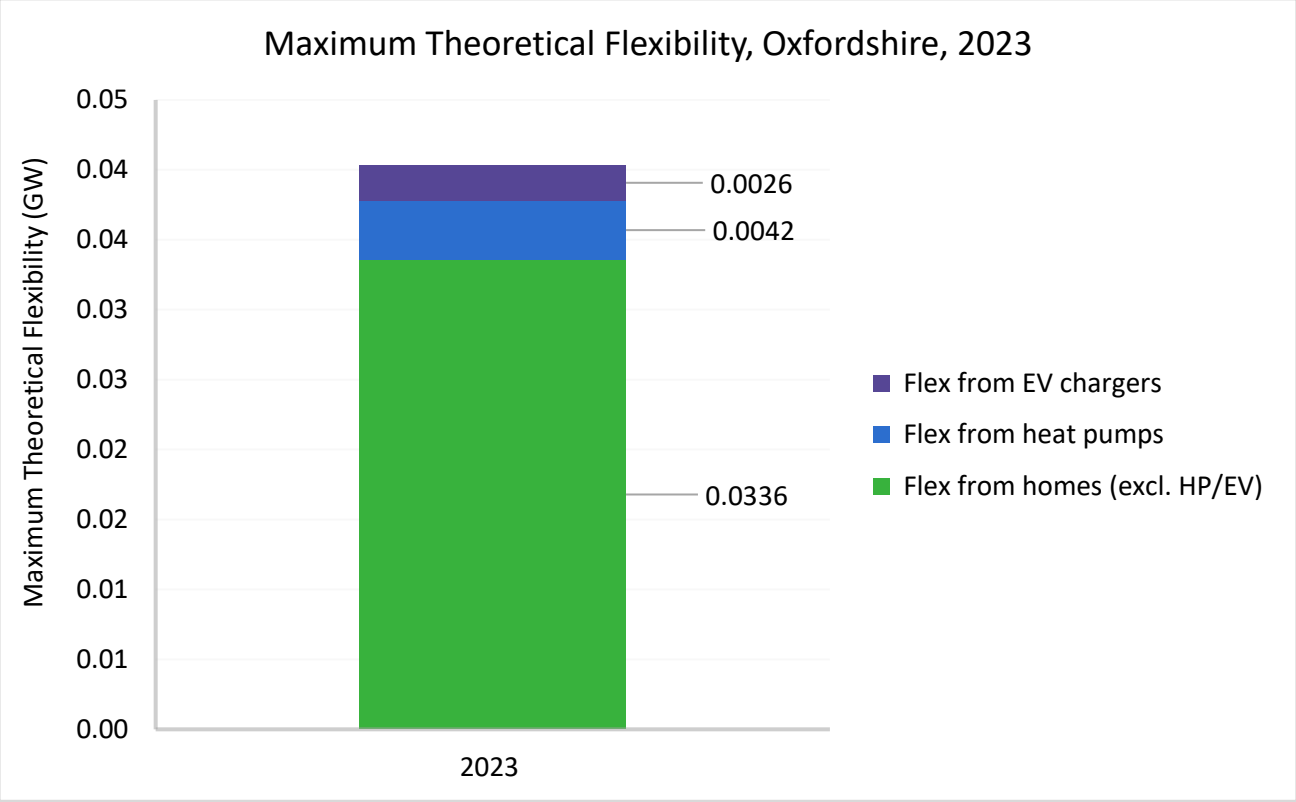

Figure 8.3: Modelled Maximum Theoretical Flexibility across Oxfordshire, 2023

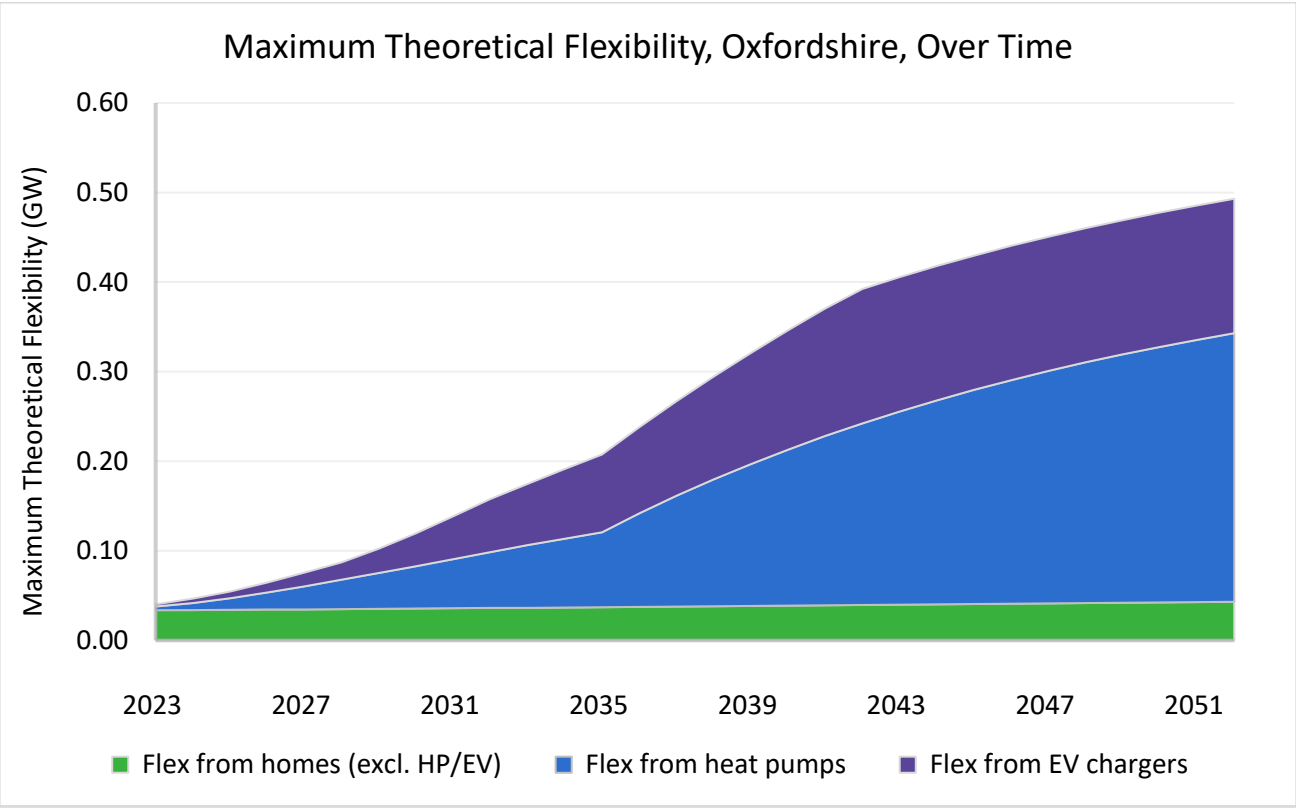

Figure 8.4: Total Theoretical Flexibility Across Oxfordshire, Over Time.

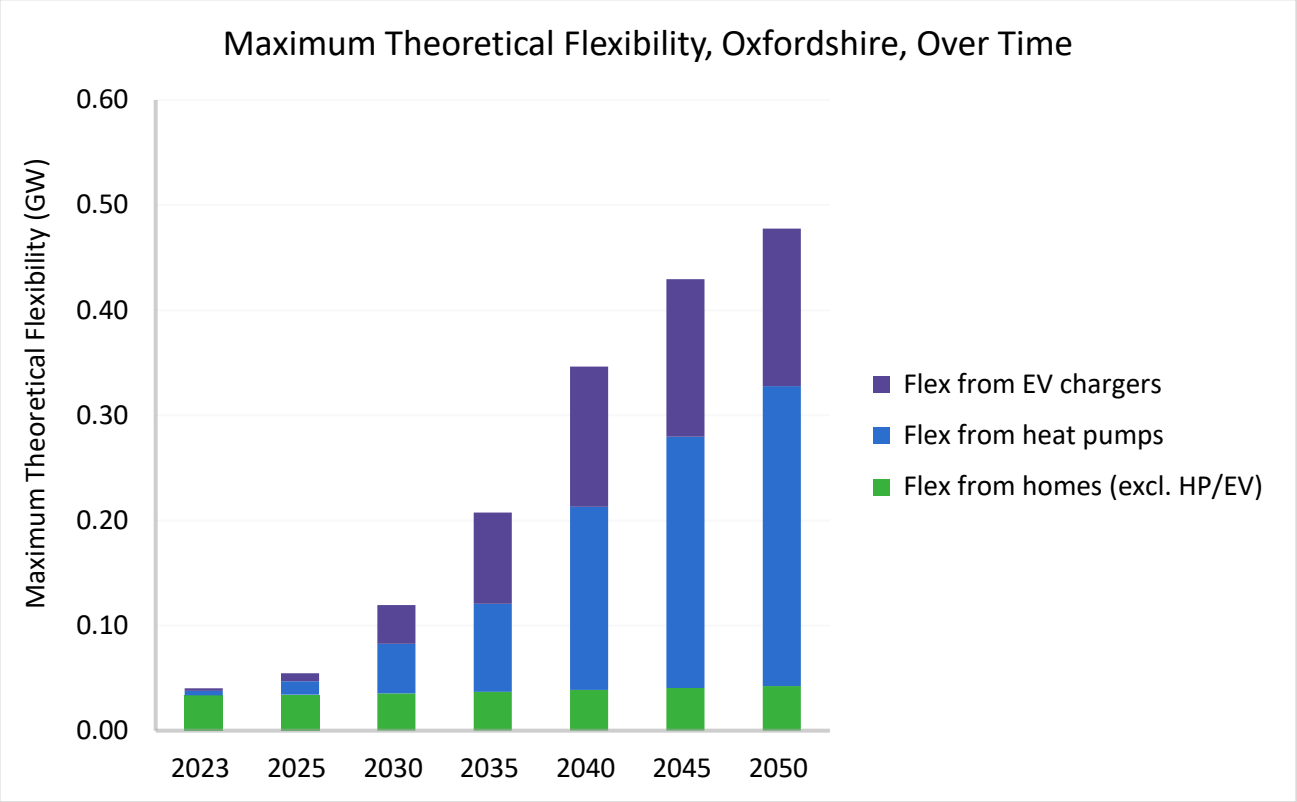

Figure 8.5: Maximum Theoretical Flexibility Across Oxfordshire, Over Time, Selected Years

It is important to reiterate that this is not expected total flexibility, but rather, a map of the maximum hypothetical flexibility that could be achieved across Oxfordshire.

CONCLUSIONS REGARDING THE POTENTIAL FLEXIBILITY RESPONSE FOR OXFORDSHIRE

- One of the key conclusions from this section is the increasing potential flexibility response over time in Oxfordshire. This is best illustrated by the combination of Figure 8.1 and Table 7.4. These demonstrate not only the likelihood of increased prevalence over time (as EV uptake and heat pump rollouts both start to become a reality), but also their relatively high-power usage.
- For EVs, one of the most important considerations will be the prominence in which price-dependent smart charging is used. If consumers predominantly allow their EVs to charge at times of lower cost (per unit of electricity), then that flexibility cannot be counted on in times of event – as the car will already have charged. One consideration for this may be on the financial side – if the reward from rDSR providers (such as equiwatt) is sufficiently high, consumers may prefer to avoid smart charging, and wait for the rewards on offer. Further, the mass adoption of V2G technology will enable the best of both worlds to be delivered, arbitraging between periods of excess supply of green electricity and shortfall.
- In terms of the overall theoretical flexibility in Oxfordshire, there is a clear upward trajectory, particularly from 2035 onwards. This is understandable, given that early indications are that the Government will stop the reinstall of natural gas boilers in this year, by which point heat pumps will be one of the few options households have by way of replacement. This, along with the mass rollout and uptake of EVs, gives a total flexibility for Oxfordshire of nearly half a Gigawatt by 2050. Of this, 0.29 GW will be provided by heat pump technologies, 0.15 from EV charging, with the rest coming from standard household appliances.

9. CONCLUSIONS

Aggregators, such as equiwatt, are key to enabling residential flexibility. equiwatt offers a simple and compelling proposition that enables households to participate in flexibility markets. Users can be shielded from the complexity of the energy markets, whilst being rewarded as they contribute to the development of a smarter, more energy-secure, solution.

The mean average **demand reduction is around 103Wh per registered user across the UK** (regardless of whether they have elected to participate in any given event), when excluding non-participants, this average rises to 360Wh.

Innovators, such as equiwatt, give access to those who cannot otherwise participate in DFS. Not all electricity suppliers enable their customers to participate in flexibility services and reward them for their participation. Aggregators are a valuable addition to the electricity market.

A collaborative effort between public and private enterprises is vital. Partnerships involving local authorities, trusted organisations, local groups, and private enterprises are key to scaling up and giving confidence to users to participate in local flexibility schemes. equiwatt has developed several mutually beneficial partnerships during their relatively short participation in Project LEO and continues to develop partnerships.

A strategic, multi-faceted, recruitment approach is necessary for engagement success. Engagement success is greatest when there are multiple, well-targeted, touch points with potential users. Engagement strategies should be wide-ranging, multi-faceted, and planned such that potential user awareness is gained, interest is piqued, desire is created, and action is taken.

Aggregators, such as equiwatt, can support participation regardless of a user's motivation. Users participate in flexibility for a variety of reasons including environmental awareness, gaining reward for participation, and to reduce energy usage and cost. equiwatt enables users to participate regardless of their motivation.

The most effective motivation, leading to the most satisfied users, appears to be environmental awareness. Users motivated by environmental contribution were extremely satisfied with the service. Users were equally motivated by rewards and saving energy & cost, although their level of satisfaction was lower than those motivated by environmental considerations.

Simplicity is key - Recruitment. Although resource intensive and requiring data science skills to ensure effective targeting, paid-for social media appears to be a highly successful recruitment method, leading to highly satisfied users. We consider this to be partly a result of the simplicity of moving from awareness to action, with the app being one click away.

Simplicity is key – Sign-up. Interoperability of Low Carbon Technologies is still developing. Users are most satisfied when they find it simple to link their EVs, appliances and smart plugs to the system. Frustration is encountered where users have appliances that cannot be linked.

Simplicity is key – Participation. Allowing users to optout (i.e., by default they will participate in events, but can elect to out out) of events simplifies participation. Similarly, users who sign up for automatic control of appliances during

events welcome the simplicity - all they need to do is adjust their daily routine slightly to accommodate typical equivents and do not have to concern themselves with turning off appliances.

Long-term, wide-ranging strategies are key to unlocking flexibility. equiwatt has demonstrated that flexibility benefits can be delivered in a short period of time. A long-term partnership would enable greater recruitment success. Geographic constraints can be limiting and may be counterproductive in the long term; consideration needs to be given to disengaging potential users if incentives are offered to users on geographic boundaries that are invisible to the user.

The extent of residential flexibility will increase significantly. We are still very early on the journey of electrification of transport and heat. The benefits of flexibility will grow exponentially with the uptake of electric vehicles, heat pumps, and other electric space & water heating types.

The regulatory environment will help the development of flexibility. Several developments will encourage the uptake of electric vehicles, heat pumps and other smart appliances; they will encourage the interoperability of these appliances, thus helping resolve current areas of frustration; and enable rDSR to be monetised.

Smart meters currently a limiting factor in monetising flexibility. Although users without smart meters can contribute to a smarter electricity system, markets require data from approved metering. The roll-out of smart meters is currently around 50% complete, meaning not all potential contributors can be effectively incentivised.

There are common characteristics of active users. While the age was relatively balanced, there were significantly more men than women, and more detached houses. There was a reasonable spread of households (dual, family, and single occupancy). EV ownership is relatively high in this group.

There are common characteristics of potential users. Although the gender and age range in this group was relatively balanced, there were emerging common characteristics around housing type, occupancy, and household income. The most notable commonality were dual occupants and family occupants making up the majority of this group. Two thirds of this group lived in either semi-detached or detached housing and most had a household income of over £50,001.

Gamification seems to be an effective long-term participation tool, with international studies and responses from long-term users showing benefits, although new users do not seem to be especially motivated unless they are EV owners**.**

10. REGULATORY ENVIRONMENT

The regulatory environment is changing such that the need for flexible resources, and the potential for flexibility, will increase dramatically over the next decade. Progression of these developments will significantly contribute to increasing flexibility. We list some of the key developments below:

For Electric Vehicles:

- Phase-out date for the sale of new petrol and diesel cars and vans from 2030.
- All new cars and vans be fully zero emission at the tailpipe from 2035.
- EV charge points sold in GB for private (domestic & workplace) use are required to be smart from June 2022.
- Publicly Available Specification (PAS) 1878 defining functionality and architecture of an Energy Smart Appliance (flexible asset) to allow it to be secure and interoperable. Applicable for EVs.
- Smart and Secure Electricity System consultation, setting out proposals to mandate interoperability based on PAS1878 by mid- to late-2020s.

For Heat Pumps:

- Phase-out of gas boilers, starting with a ban on newly built homes by 2025 and complete phase-out in early- to mid- 2030s, with related uptick in heat pump sales.
- Government target to achieve 600,000 heat pump installs per year by 2028.
- Boiler Upgrade Scheme providing grants to retrofit heat pumps as a part of stimulating the market.
- Publicly Available Specification (PAS) 1878 defining functionality and architecture of an Energy Smart Appliance (flexible asset) to allow it to be secure and interoperable. Applicable for heat pumps.
- Smart and Secure Electricity System consultation, setting out proposals to mandate:
    - that heat pumps (and other appliances) must be smart by mid-2020s.
    - interoperability based on PAS1878 by mid- to late-2020s.

For other appliances:

- Smart and Secure Electricity System consultation, setting out proposals to mandate that other devices with high flexibility potential, such as storage heaters and heat batteries, must be:
    - smart by mid-2020s
    - interoperability based on PAS1878 by mid- to late-2020s.

To develop flexibility markets:

- Review of Electricity Market Arrangements
- Developments by NG ESO (such as Demand Flexibility Service and revision of Balancing Services)
- Developments by Distribution Network Operators to support transition to Distribution System Operators (such as development of Distribution Flexibility Services Procurement)
- Amendments to Balancing and Settlement Code to facilitate the access to markets of flexibility providers, such as the introduction of Virtual Lead Parties.

11.CONTEXTUAL INFORMATION & REFERENCES

In developing this report, in additional to using data from equiwatt's portfolio of users we have referred to:

- National Grid Electricity System Operator (NGESO) Future Energy Scenarios: provides useful information regarding the uptake of low carbon technologies and the overall contribution to flexibility.
- NGESO Demand Flexibility Service (DFS): provides useful information regarding the flexibility achieved during DFS events over winter 2022/23.
- Climate Change Committee Carbon Budgets: similarly provides useful information regarding the uptake of low carbon technologies.
- Proprietary knowledge derived from our own knowledge and analysis of EVs and Heat Pumps.

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