Department for Energy Security & Net Zero

Smart Energy Savings Competition (SENS): Smart Local Energy Markets with Smart Meters

Trial Level Evaluation Report

June 2023

Acknowledgements

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Rationale for and objectives of the SENS Competition

Smart meters are replacing traditional gas and electricity meters in homes and small businesses across Great Britain as part of an important upgrade to the national energy infrastructure, underpinning the cost-effective delivery of Government's Net Zero commitment. They are a critical tool in the transition to a low carbon energy system, for example helping consumers to use energy when renewable generation is available. Prior to the Competition, BEIS found that smart meters would result in average reductions of 3% for electricity customers, 2.2% for gas credit customers, and 0.5% for gas pre-payment customers[1].

Early evaluation and research showed that such savings can be realised through access to near real time feedback (via In-Home Displays, IHDs), energy efficiency advice at the point of installation, and accurate bills[2]. The Smart Energy Savings Innovation (SENS) Competition was developed on the assumption that more sophisticated uses of energy consumption data can deliver additional savings to those already achieved by having a smart meter installed in the home.

The SENS Competition, led by the Department for Business, Energy and Industrial Strategy (BEIS), committed up to £6.25 million, to support the development, trialling and evaluation of innovative feedback products and services that use smart meter data to help domestic consumers reduce their energy consumption. SENS was launched February 2019, with trials concluding at the end of March 2022, (extended by one-year due to COVID-19 impacts).

The objectives of the Competition were to:

- Identify innovative products and services using smart meter data, that can deliver energy savings in homes in excess of those currently identified in the smart meter impact assessment, for either the Great Britain population or specific groups within it.
- Ensure that solutions are attractive and valued by consumers and are easily available (using existing technologies and delivery channels or cost-effective new hardware).
- Support the development of a domestic market for energy management products and services, securing investment from technology providers, energy suppliers, and third parties.

[1] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/831716/smart-meter-roll-out-cost-benefit-analysis-2019.pdf
[2] https://www.gov.uk/government/publications/smart-metering-early-learning-project-and-small-scale-behaviour-trials

Overview of the SENS product

The ‘Smart Local Energy with Smart Meters’ (Energy Local) project, was delivered by Energy Local Community Interest Company (CIC), in partnership with Repowering London, Connected Response Limited, TMA Data Management Limited, and their energy supplier partner Octopus Energy Limited.

Energy Local was an intervention that offered customers who signed up to the project, direct access to electricity from a local renewable energy generator supplemented with a Time of Use Tariff (TOUT) provided by Octopus Energy. This TOUT was fixed for one year for all SENS Energy Local trialists (meaning participants were not exposed to energy price increases that were happening at this time during trial period).

The project entailed the creation of Energy Local clubs – cooperatives of households who shared access to electricity from a local small-scale renewable generator and purchased this electricity at an agreed price. The aim of Energy Local clubs was to increase the use of locally-generated, low-carbon electricity, and manage overall electricity consumption. All SENS Energy Local members had access to a web-based dashboard which presented trialists’ smart meter electricity data, information about the renewable energy available, relevant tariffs, and forecasts of club level local renewable electricity generation and aggregate household power demand. The dashboard also provided tips on how to reduce energy bills, and daily information on electricity costs at different times of the day. This enabled members to schedule their use of home appliances to the cheapest times of day. The core SENS Energy Local intervention was also adapted to target hard-to-reach customers living in affordable housing (with the provision of tailored personal support).

Evaluation approach and methodology

The Competition appointed a separate Trial Design and Evaluation Lead (TDEL) team, led by Ipsos, in conjunction with Energy Saving Trust, the University of Edinburgh and Manchester Metropolitan University to conduct an independent evaluation of the Competition overall and a separate evaluation for each of the individual projects trialled through the Competition.

This trial-level evaluation sought to test whether Energy Local was successful in realising its primary objective of achieving electricity savings through being a member of a Energy Local club. Secondary objectives were also explored and included the level of local generation energy used, improved awareness of and actions to reduce overall levels of electricity use, bill savings and energy demand shifting (usage in peak and off-peak periods).

As Energy Local was a complex intervention where a conventional counterfactual was not feasible, Theory Based Evaluation was deemed most appropriate to understand impacts. This involved developing two Theories of Change (one overall and one aimed specifically at hard-to-reach consumers) which posited causal hypotheses about the motivations of potential members for joining Energy Local clubs, the aspects of Energy Local that would leverage these motivations, and the anticipated outcomes. The evaluation traced the assumed causal

pathways and used Realist Evaluation to develop context-mechanism-outcome (CMO) configurations that could be tested through the qualitative data collection and the survey of trialists.

Recruitment for the SENS Energy Local trial ended early October 2021. By the end of the trial (end March 2022), six Energy Local clubs were live and 121 members across the clubs had participated in the trial. Signing up to take part in a SENS trial was entirely voluntary, and consent could be withdrawn at any time without giving a reason.

The trial-level evaluation gathered evidence through a range of primary research activities. These included a quantitative telephone survey with trialists conducted before and after the intervention, 30 in-depth qualitative interviews with trialists, 28 qualitative interviews with other intervention stakeholders and analysis of pre- and during-trial electricity consumption data (available only for around half of all trialists due to many trialists not having a smart meter installed for a sufficiently long proportion of the analysis period). Two focus groups were also conducted with trialists forming part of the hard-to-reach group.

There were limitations to the data and evidence available for this evaluation. Due to delays progressing the rollout of smart meters to club members, resulting from social distancing measures around the COVID-19 pandemic and technical problems in establishing the clubs and billing, recruitment to the clubs and the SENS Energy Local trial was lower than initially expected. This meant that the sample from which evidence was drawn for this evaluation was relatively limited and may not reflect the experiences of all trialists. The relatively early stage of implementation also meant that some of the expected outcomes were not able to be evidenced in full during the lifecycle of the trial – particularly in rolling the Energy Local model out to hard-to-reach members of the community.

Outcomes for trialists

Participation in Energy Local clubs and the SENS trial was valued by club members. It generated or added to a sense of community, enabled members to feel like they were contributing to mitigating the effects of the global climate crisis, and facilitated members to switch from on-grid electricity supply to a higher proportion of locally-generated renewable electricity. Survey and interview data suggested that the majority of trialists were satisfied with the intervention and viewed it as a means of improving the resilience of their energy supply.

Indicative analysis of participant energy consumption data (comparative before-and-in-trial) and of survey data did not indicate that trialists reduced their energy consumption after participating in Energy Local, though some trialists participating in the qualitative research did report an increase in energy-efficient behaviours (e.g., reducing the temperature at which they washed clothes, reducing use of appliances such as irons). While they attributed this to participation in the trial, it was not possible to validate this with energy consumption data.

Some trialists reported that they used electricity in a less efficient way when they saw that there was surplus renewable electricity available from the local generator (because they

recognised that otherwise the energy would not be used by the club). Finally, several trialists reported that they were already using energy efficiently, so whilst their household electricity consumption was low, this was not due to the trial.

Energy Local also aimed to shift trialists' electricity use to lower carbon sources (when renewables were a greater proportion in the supply or at off-peak hours), to reduce the electricity bills of members, and to achieve satisfaction with Energy Local and aspects of the intervention. Several trialists were able to provide convincing evidence that their electricity bills had reduced over the time period of the intervention, which was traceable to (and which trialists attributed to) their participation in the SENS Energy Local trial. There was also clear evidence from the qualitative interviews, to demonstrate that Energy Local supported switching to lower carbon sources of electricity (i.e. at off-peak times when energy was cheaper or when the supply was via local renewable sources).

Energy Local appealed to individuals who wanted to reduce their impact on the environment, as well as those who wanted to participate in a community activity and feel that they were contributing to the local economy (by buying electricity from a local producer). There was some evidence that it appealed to those who wished to reduce their energy costs. However, the majority of those participating in the trial (including the hard-to-reach intervention) were not motivated (at the time of sign-up) to join by any concerns around energy bills (although recruitment was before increases in energy prices).

Conclusions

By providing access to a share of local renewable energy generation in combination with a time of use tariff, Energy Local was successful in helping consumers reduce the carbon intensity of the energy they used, while also reducing their energy costs. Although trialists shared a desire to save energy, either to reduce their negative impact on the environment, or to save money, the evaluation indicated no reduction in overall energy consumption amongst most trialists. This result was explained by the combination of lower prices for local generation and at off peak times via time of use tariffs which enabled participants to prioritise usage of lower carbon energy (and potentially higher overall usage when this was considered surplus), while still reducing their costs.

The intervention had the additional benefits for many participants, of providing a way to contribute to climate objectives and contributing to a sense of community. While SENS Energy Local was also trialled in a hard-to-reach community, where there was emerging evidence of the trial's success at attracting trialists, sustaining engagement and changing behaviours, the trial had only recently begun in that location and the evaluation was only able to gather very limited (and non-robust) data on effects.

SENS Energy Local was trialled with a limited number of clubs. A larger scale trial (with more clubs and club members), over a longer period of time, would be necessary to more robustly assess impacts on energy consumption, the durability of behaviour change, and the replicability of the Energy Local model.

1 Introduction

The Smart Energy Savings Innovation Competition (from here on referred to as 'SENS' or 'the Competition') led by the former Department for Business, Energy and Industrial Strategy (BEIS) committed up to £6.25 million to support the development, trialling and evaluation of innovative feedback products and services that use smart meter data to help domestic consumers reduce their energy consumption.

Following a competitive application process in 2019, eight projects were selected to receive Phase One Competition (matched) grant funding to support the development of their products and/or service. Following a stage-gate review, five projects were taken through to Phase Two to trial and evaluate their products and/or services in homes across Great Britain. The Competition was launched in February 2019, with trials concluding end of March 2022 (extended by one-year due to COVID-19 impacts).

Ipsos, in partnership with Energy Saving Trust, the University of Edinburgh and Manchester Metropolitan University were commissioned by BEIS as the Trial Design and Evaluation Lead (TDEL), to undertake a robust independent evaluation of the Competition, including separate trial evaluations for each of the individual projects, and to implement a wider package of research. Separately, BEIS awarded a grant to the Smart Energy Research Laboratory (SERL) based at University College London (UCL), for the collection and provision of secure access to energy consumption data from trial trialists (with customer consent) to the TDEL for their analyses. Separate to this contract, BEIS also appointed an independent project management lead, AECOM, to oversee Competition Partner's project delivery and grant funding milestones.

This report is part of a package of reports published for the Competition, including an overarching Competition-level evaluation report, a Technical Report and five separate trial-level evaluation reports (of which this is one report).

Purpose of this report

This report provides the evidence from the Smart Local Energy Markets with Smart Meters (from here on referred to 'SENS Energy Local') project that was taken through to Phase Two of the Competition and trialled by providing trialists access to local renewable electricity, supplemented by a time of use tariff (TOUT), via a local cooperative (Energy Local 'club'). This report presents the analysis of electricity consumption data and other primary and secondary data that were used to answer the primary research question of the SENS Energy Local trial:

> What is the added electricity saving achieved by Energy Local, over and above the baseline smart meter consumer proposition (i.e. a smart meter, an In-Home Display (IHD), and energy efficiency advice provided at install)?

Subsequent chapters of this report provide a summary of the Energy Local intervention and trial design (chapter two); a description of the trial evaluation methodology (chapter three); evidence of the primary outcome (chapter four); and evidence of secondary outcomes (chapter five). Chapter six presents the conclusions from the trial evaluation.

2 Summary of trial

This chapter provides a summary of the SENS Energy Local intervention, including its core functionality and mechanisms for change as presented through its Theory of Change. The core features of the trial design are also presented here.

2.1. The SENS Energy Local intervention

The Energy Local intervention was delivered by the Energy Local Limited Community Interest Company (CIC), in partnership with Repowering London, Connected Response Limited, TMA Data Management Limited, and their energy supplier partner Octopus Energy Limited. The purpose of the Energy Local intervention was to increase the uptake of locally-generated renewable electricity and encourage households to better manage their overall electricity consumption. This was to be achieved by providing trialists with the opportunity to join a local energy cooperative that offered them direct access to electricity from a local renewable energy generator supplemented with a fixed three-band (peak, standard and off-peak times) Time of Use Tariff (TOUT) provided to trialists for one year by Octopus Energy Limited.

Table 1: SENS Energy Local delivery partners and product description

Project Title	Competition delivery partner(s)		SENS product
	Lead	Partners	
Smart Local Energy Markets with Smart Meters (SENS Energy Local)	Energy Local Limited Community Interest Company (CIC)	Repowering London, Connected Response Limited, TMA Data Management Limited, Octopus Energy Limited	The project entailed the creation of 'Energy Local clubs' – cooperatives of households who shared access to a local small-scale renewable generator and purchased energy at an agreed price. The aim of Energy Local clubs was to increase the use of locally-generated, low-carbon energy and manage participating households' overall electricity consumption. All SENS Energy Local members had access to a web-based dashboard that brought together trialists' smart meter electricity data, information about the renewable energy available, and active tariffs, to show forecasts of the local renewable electricity generated and aggregate household power demand in the club. The dashboard also provided tips on how to reduce energy bills and daily information on electricity costs at different times of the day.

			This enabled members to schedule their use of home appliances to the cheapest times of day. The core SENS Energy Local intervention was also adapted to target hard-to-reach and customers living in affordable housing by providing them with tailored personal support in using the dashboard and different incentives.

2.1.1. Aims of the intervention and how it was expected to achieve these

Several primary and secondary outcomes were identified at the outset of the trial that have been explored in this report (see Table 2 below for details).

Table 2: Primary and secondary outcomes of the SENS Energy Local intervention

Primary/ Secondary	Outcome to be evaluated
Primary	Reduction in electricity consumption
Secondary	Shifting to use lower carbon electricity (off-peak when renewables are a greater proportion, or local renewable generation)
	Reduced electricity bills
	Satisfaction with Energy Local and aspects of the intervention

2.1.2 The core SENS Energy Local intervention

Membership of a SENS Energy Local club entailed purchasing locally-generated renewable electricity at a pre-agreed rate. Clubs made use of hydropower, wind or solar energy (see Table 3 for more details). There was no storage capacity for the locally-generated electricity, so supply was weather-dependent and had to be used when it was available. Additional energy demand was met from the licensed supplier and charged to trialists via a fixed for one year TOUT provided by Octopus Energy Limited.

The core functions of the Energy Local intervention were to provide participating households with:

- **Access to locally-generated electricity**: Members of the Local Energy club were entitled to an equal share of locally-generated electricity which they could access dependent upon demand and supply levels.

- **Access to a smart meter (where they did not already have one)**: SENS Energy Local's energy supplier partner (Octopus Energy Limited) installed smart meters for all households wanting to participate who did not already have a smart meter.
- **Access to a Time of Use Tariff (TOUT)**: All members were required to switch to SENS Octopus Energy Limited's supply if they were not with the supplier already and were given a simplified TOUT, fixed by the energy supplier for one year.
- **Access to household and club information**: Households were provided with real-time smart meter data on energy usage and information on available tariffs at the household and Energy Local club level via a web-based dashboard, which they were able to access as often or as little as they wished.
- **Access to tips**: Through the dashboard, energy reports and events, members could also access information on how to save energy.

2.1.3 Adaptations to the intervention for hard-to-reach communities

SENS Energy Local adapted its core intervention offering to meet the needs of a potentially hard-to-reach[3],[4] community – residents of Roupell Park in Brixton, London – where there was a higher proportion of vulnerable households likely to be in fuel poverty. These trialists were also less able (sometimes due to language difficulties) or less likely to access resources and information around energy bills savings and energy efficiency online or through their energy supplier. Energy Local wanted to adapt their offer, or approach, to tailor it to the needs of these groups (including to those on prepayment meters which couldn't be supported by the core approach at the time of the trial), to make it more accessible to them.

In Roupell Park, a pilot phase of the Energy Local intervention was delivered from October 2021 with the club being formally launched in February 2022.

The pilot was set up to assess the potential benefits and costs to each member prior to switching supplier and formally joining the Energy Local club; due to delivery of the full club being delayed by COVID-19 and because rising energy prices meant it was not a good time to switch suppliers for some potential trialists. During the pilot phase, trialists did not have access to the 'matched tariff arrangements' for local solar electricity (though they did receive a credit that was equivalent to savings that they would have received) or the Energy Local dashboard and several did not have smart meters. Here, data required to monitor trialist's electricity use was via an OWL[5] electricity monitor (attached to their meter) to then calculate how much they should have saved on their bills.

[3] The demographic profile of 'hard-to-reach' groups can be defined as BME communities, retired customers, those with a disability or vulnerability, those experiencing financial instability and those facing language barriers.
[4] https://natcen.ac.uk/our-research/research/maximising-the-benefits-of-smart-metering-for-consumers/
[5] An energy monitor that uses a current clamp attached to a meter tail to estimate consumption, sometimes used prior to receiving a smart meter.

Once the Roupell Park club was formally launched in February 2022, these members then had smart meters installed (if they did not have one already) and had access to the 'matched tariff' for local solar electricity and the Energy Local dashboard.

Energy Local partnered with an intermediary (Repowering London), already known and trusted within the local community, to provide direct support to potential members through a staff member who was able to meet on-site (either at participant's homes or at the local community centre). During the pilot, Repowering London, monitored trialists' electricity use (through an electricity monitor) and calculated how much they would have saved on their bills in this period if they had had access to the 'matched tariff arrangements' for local solar electricity. Participants were then given a credit to their energy bill, which matched the savings they would have made under the Energy Local model.

The Roupell Park offer during the SENS Energy Local trial also comprised:

- A bespoke flat rate tariff offered by Octopus Energy Limited, with the possibility of transitioning to a TOUT after the trial.
- Ongoing support from Repowering London to answer any questions via email/ phone access and drop-in sessions on the estate.
- Tailored support to help with navigating the online portal, the provision of information in alternative offline formats, and referrals for support with digital inclusion.
- One-to-one energy advice (provided by Repowering London) to promote behaviour change, shifting electricity use where possible to using renewable energy available.
- For those without internet access or who did not want to allow access to their own Wi-Fi network, they were also offered the option to have a 3G enabled broad band access point fitted to use the Consumer Access Device (CAD) and access the Energy Local portal.
- Monthly club newsletters updating progress, including total savings made, mitigated carbon as CO2 and as equivalent in trees saved.
- Risk-monitoring to check trialists would not pay more by joining the Energy Local club.
- An energy monitoring report with recommendations on the extent to which the Energy Local club was a sensible financial option for them.

The Theories of Change for both the core intervention and the potentially 'hard-to-reach' (i.e. Roupell Park) intervention are outlined in Annex B. Whilst this report considers findings for both intervention types, as the hard-to-reach intervention had only been in operation for four months before the writing of this report in its pilot form since October 2021, with the club formally and fully launched in February 2022, the findings for that particular intervention are limited.

2.1.4 The composition of Energy Local clubs

By the end of the trial (end March 2022), 10 clubs were live with a total of 290 club (237 active club) members. However, only six clubs (and 121 members) participated in the SENS Energy

Local trial and evaluation. (Households could be members of an Energy Local club without participating in the SENS Energy Local trial, so the number of club members differed from the number of SENS Energy Local trialists). Delays in launching the clubs and administrative delays around accessing smart data and how trialists would receive bills had knock-on effects for trial recruitment, as Energy Local staff wanted customers to have received at least one bill before they were contacted to be invited to interview as part of the SENS Energy Local trial.

Recruitment for the SENS Energy Local trial ended on 8th October 2021. The trial covered the 121 trialists whose Energy Local club had a minimum of 12 members when recruitment finished (meaning it was 'live' and trialists had access to the full Energy Local offer including the dashboard) where the member had consented to participate in the trial. Table 3 overleaf provides an overview of the Energy Local clubs included in the trial.

Club capacity (i.e. the maximum number of members for each club) was set to align with the club's renewable energy generation capacity, to ensure a balance between the generator getting enough increased generation and customers getting enough of a reduction in bills.

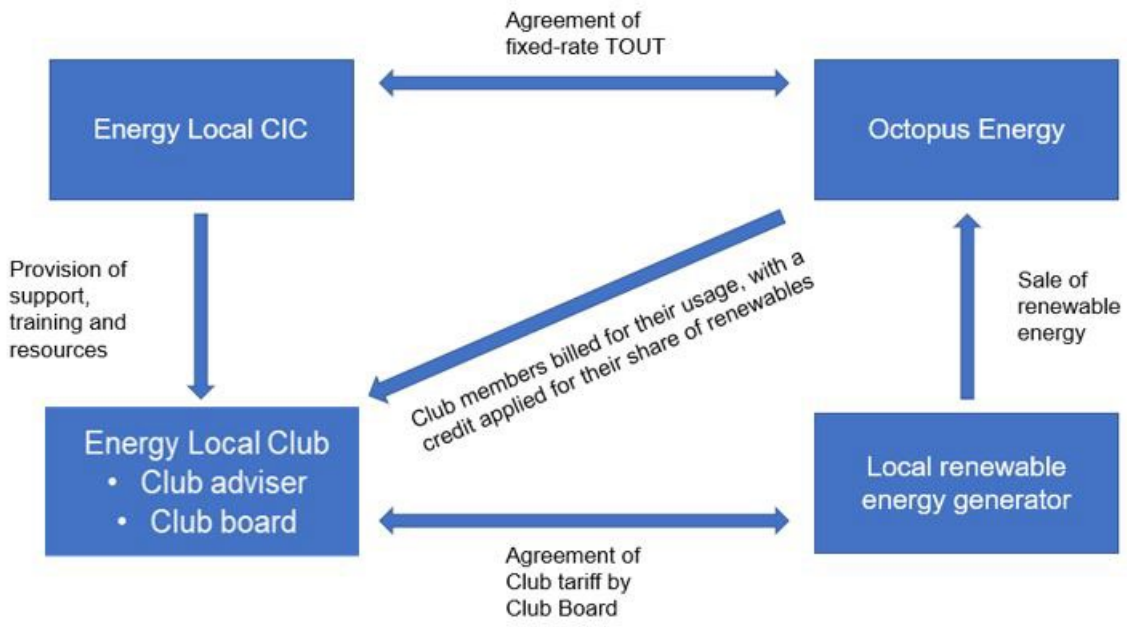
Table 3: Overview of the six SENS Energy Local clubs covered in the trial

Club name	Location	Energy type	Renewable energy generation capacity	Members in SENS Energy Local trial	Total Club members	Club Capacity	'Go live' date
Corwen	Denbigh-shire, Wales	Hydro	100 kW	15	46	60	1 February 2021
Crick-howell	Brecknock-shire, Wales	Hydro	50 kW	10	29	40	1 March 2021
Bethesda	Gwynned, Wales	Hydro and solar	200 kW/ 300 kW	63	120	250	28 June 2021
Bridport	Dorset, England	Wind	50 kW	12	32	50	17 September 2021
Machyn-lleth	Powys, Wales	Hydro	60 kW	13	52	80	8 October 2021
Roupell Park	London, England	Solar	27 kW	8	11	30	1 February 2022
TOTAL				**121**	**290**	**510**	

2.1.5 Components of the SENS Energy Local intervention

Figure 1 below provides an overview of the key stakeholders involved in the different elements of the Energy Local model as well as their roles and interactions.

Figure 1: Local model: stakeholders and their interactions



Each Energy Local club was supported by an advisor with governance overseen by a club board. While there was sometimes overlap between these roles (i.e. the club adviser could also be a member of the club and/ or on the club board), the roles themselves served distinct purposes as outlined in Table 4.

Table 4: Roles and responsibilities of club advisers and club boards

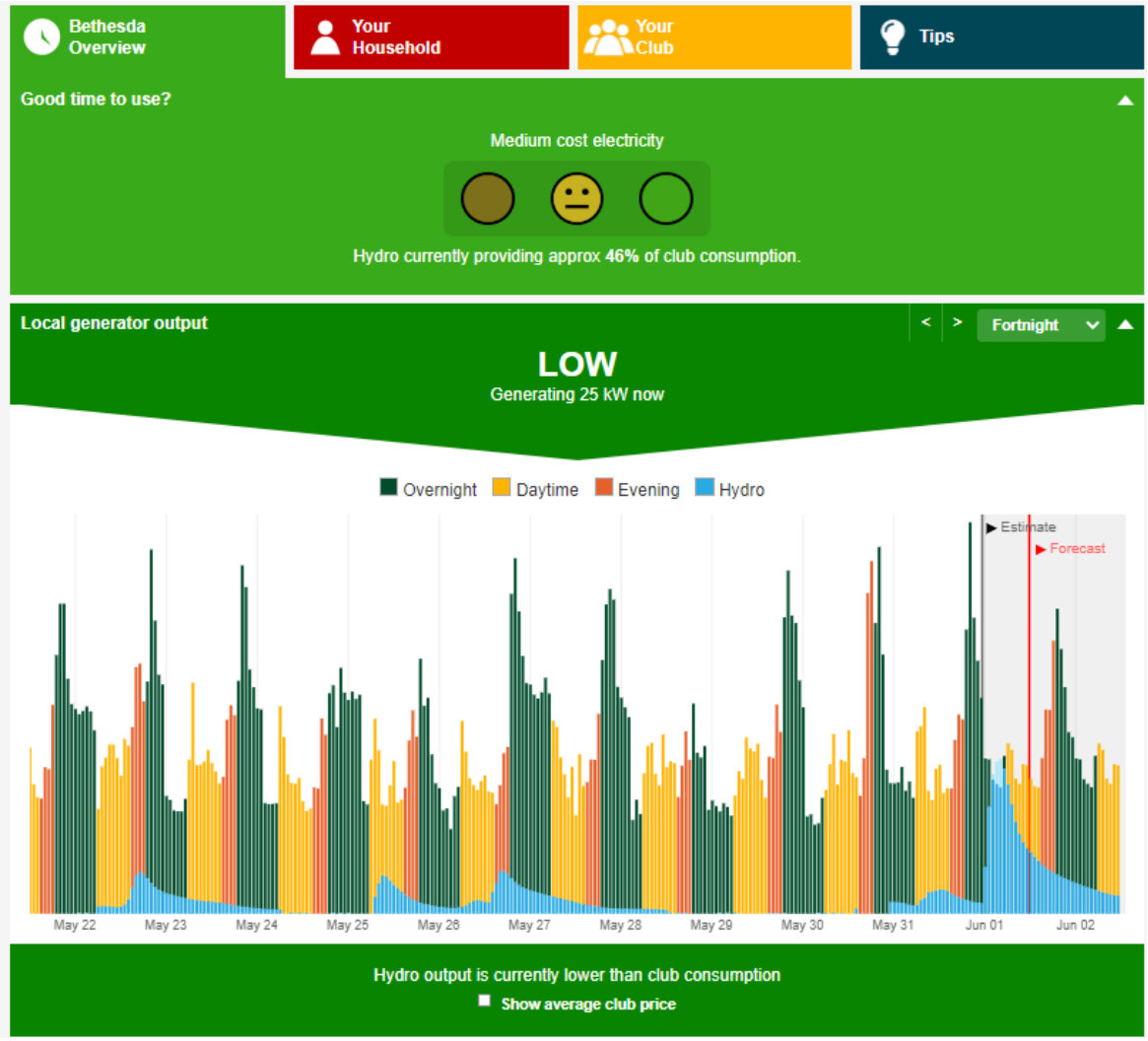
Position	Role and responsibilities
Club adviser	Advisers acted as a bridge between EL-CIC and EL club members. In practice, two worked for EL-CIC in a full or part-time capacity (one did not). After receiving training from Energy Local on their role and on club administration, they supported communities wishing to set up a club with the process of set-up and registration and how to use the Energy Local tool kit and portal.
Club board	Energy Local club boards were made up of club members plus the local energy generator. Some club members had shares in the generator. Once formed, the board made decisions and negotiated tariffs on behalf of all club members.

Energy Local clubs aimed to help their members to use electricity that was greener and cheaper and locally sourced from a renewable source (i.e. generated within the same area as the club). It was assumed that participation in a club would economically benefit a local energy generator, and that the intervention would also encourage and help members to use energy more efficiently (including less overall). It was anticipated that these benefits of the clubs (better for the environment, financial savings, and increased community cohesion) would:

- Motivate people with varying concerns and lifestyles to join Energy Local clubs;
- Motivate them to use the products and services offered through each club; and
- Enable them to adopt more energy efficient behaviour.

All trialists in the core intervention were given access to a web-based 'energy dashboard', with the option to check usage both at club and individual level. The dashboard used smart meter data collected via in-home CADs to provide information on individual and club level consumption. The snapshot in Figure 2 provides an example of how the estimate and forecast were displayed to trialists. The estimate was for the 24 hours prior to observation, for which smart meter data was not yet available. The forecast was the predicted usage for the next 24 hours.

Figure 2: Example of a SENS Energy Local club-level dashboard (Bethesda)

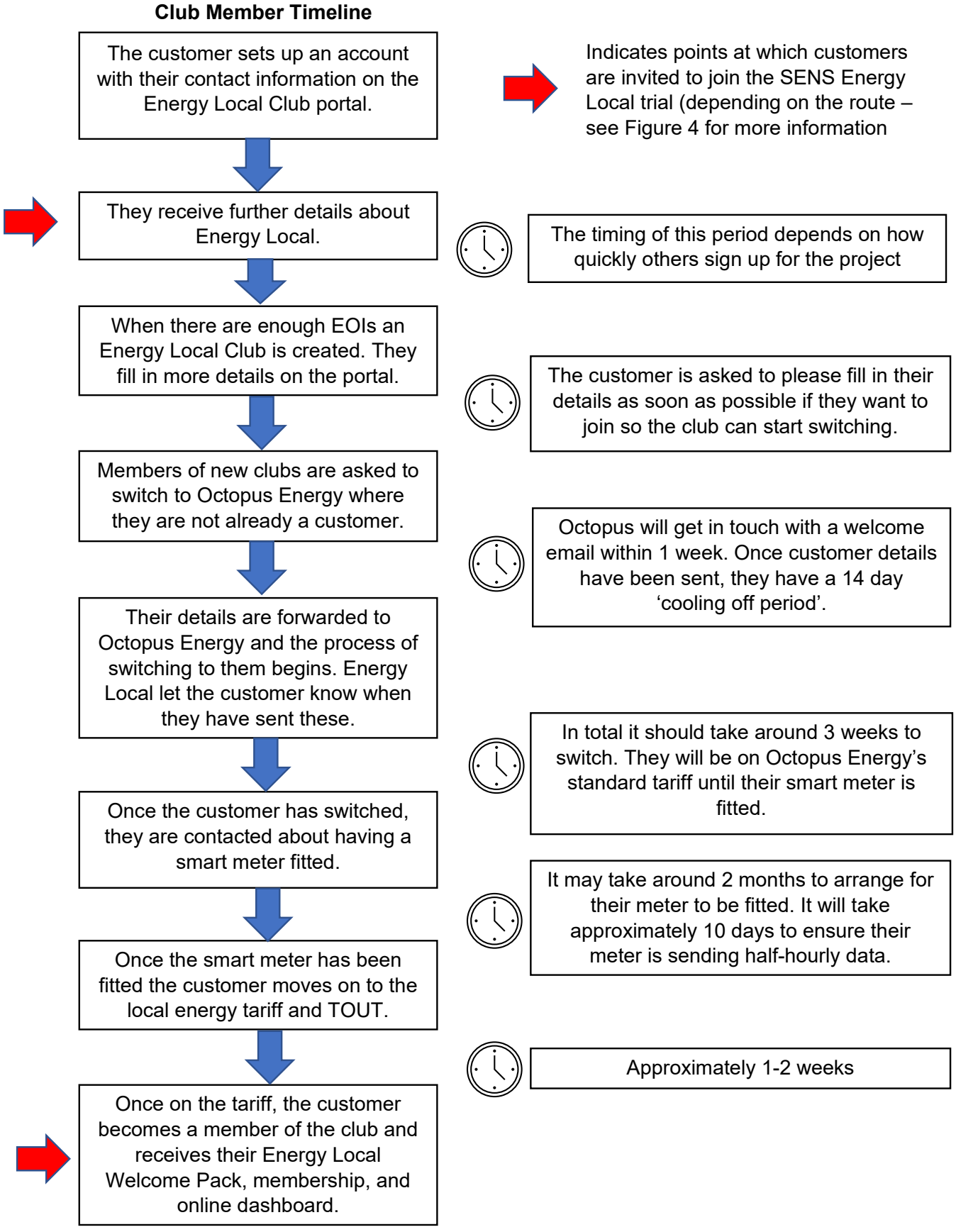


An extension of the energy dashboard, the **appliance scheduler** or **'home hub'**, allowed households to schedule their use of home appliances, such as dishwashers and tumble dryers, at the cheapest times of day. The user would input the length of time that the appliance needed to start and end (including whether it is interruptible). The home hub would then aggregate information on the supply forecast, the community's total demand and the TOUT available to indicate the best times to use power. The aim was to create a new demand shape that would reduce costs for the households and energy supplier.

The dashboard also provided tips on how to reduce energy bills. With the same aim, Energy Local CIC provided each member with a monthly energy report, and offered webinars, online resources, and the opportunity for clubs to share knowledge. Club members were encouraged to share information, tips, and experiences with each other on energy saving and use of Energy Local through informal social events and meetings organised by each club, though due to COVID-19 and associated restrictions these did not always take place as planned.

Potential club members interested in setting up a new club or joining an existing Energy Local club were required to submit an expression of interest. A minimum of twelve expressions of interest were required for a new club to be formed. Once sufficient expressions of interest were gathered, club members switched their energy supplier to Octopus Energy and had a smart meter installed. Following smart meter installation, club members moved across to the TOUT and were given access to local renewable energy at the price agreed by the club board. A more detailed overview of the steps and timings required to join a SENS Energy Local club is provided in Figure 3 overleaf. This shows that the membership process was quite complex and could be lengthy. It is perhaps one of the reasons why the club attracted people who were already keen to, and often already carrying out actions to, reduce their carbon emissions. The overall SENS customer journey is shown in Figure 4.

Figure 3: SENS Energy Local's customer journey and data flows



2.2 Design of the SENS Energy Local trial

2.2.1 Theory-based approach

Theory-based methods can be used to investigate net impacts by exploring the causal chains thought to bring about change by an intervention. They are suitable in situations, such as for SENS Energy Local trial, where determining the effect size can often be difficult (including because a control group is not available or feasible), but the intention is to understand whether an intervention had an effect in the desired direction. While theory-based approaches do not provide precise estimates of effect sizes they can provide information on the extent of the change and why the change occurs.[6]

Further to this, Realist Evaluation is a theory-based approach that requires evaluators to develop and test a set of hypotheses (or theories) about the factors or processes that explain why an intervention has had a particular result (called a mechanism), and the effect the context of an intervention has on these mechanisms. Mechanisms capture people's reasoning and their choices when faced with an intervention.[7] TDEL selected a Realist Evaluation approach, because Energy Local was developed on the hypothesis that, through its different features or characteristics (being a community-ran intervention, with advice on how save energy and bills), the intervention would appeal to different groups of people with different motivations. It was then expected to catalyse and facilitate behaviour change by leveraging one or more of these motivations:

- **Community motivation:** A desire to strengthen the local community, develop closer links with others in the community and achieve positive outcomes within the local area.
- **Environmental motivation:** A desire to contribute to broader environmental goals (e.g. by reducing energy consumption).
- **Financial motivation:** A desire to increase financial savings and/or provide financial benefits to others.

TDEL therefore selected Realist Evaluation to evaluate whether the intervention would appeal to these different groups and motivations and whether these different motivators would make different outcomes more or less likely to happen.

At the beginning of the intervention, TDEL worked closely with Energy Local CIC, Repowering London and BEIS to develop a detailed understanding of the intervention strategy (its Theory of Change – see section 2.2.2 and Annex B) to structure this around a series of 'context – mechanism – outcome' (CMO) statements (see section 2.2.2) that would then be measured in the evaluation (see Annex A for discussion and validation of these). The Theory of Change was developed iteratively over three workshops and subsequently adapted to create a separate version for the hard-to-reach intervention.

[6] Description of theory-based approaches based upon the HMT (2020) Magenta Book, p43.
[7] Definition of Realist Evaluation taken from HMT (2020) Magenta Book, p43.

2.2.2 The SENS Energy Local Theories of Change, and the CMO statements tested in the evaluation

The core Energy Local intervention was designed upon the assumption that households and communities have a desire to reduce their energy consumption (for the above-mentioned motivations), but they do not have sufficient knowledge of how to do this. Energy Local was intended to provide club members with an equal share of local generation, access to this (dependent on demand levels and overall supply), a household contract and fixed year TOUT with Octopus Energy, access to an Energy Local dashboard and (if the Home Hub was used) the ability to schedule appliances to work when electricity was cheaper.

For these outputs to lead to outcomes, it was assumed that households would join the club and access the dashboard regularly. During and immediately after the trial, Energy Local was then expected to increase members' understanding of the drivers of energy consumption and encourage them to change their energy use behaviour (to use an optimal mix of electricity from local generation or at cheaper times of the day). It was expected that such learning would happen both through the dashboard and through peer-to-peer learning between members.

Later, it was expected that post-trial the outcomes would lead to energy and bill savings for member households and also to financial benefits for local electricity generators, and cost-savings to the energy supplier. Longer term, it was expected that such benefits would contribute to national energy and carbon savings targets, to long-term financial savings for club members (should their membership be sustained), and to improved community outcomes through e.g., and increased investment in the local community.

The hard-to-reach intervention differed in its design and Theory of Change (see section 2.1.3 and Annex B), but also in terms of some of the underlying assumptions, its expected outcomes and impacts. The hard-to-reach community were assumed to have limited trust in energy suppliers and in external interventions (hence being considered 'hard-to-reach'), as well as limited or no internet access (and/ or language barriers) which prevented them from accessing online support and resources around energy bills. For the hard-to-reach community, the intervention was expected to reduce fuel poverty amongst trialists and, longer-term, to increase trialists' and the wider community's willingness to engage with and invest in community projects in the future.

Reflecting the design and causal assumptions of the Theories of Change, TDEL developed ten CMO statements to be tested through the evaluation. These are presented in Table 5 with a description of how these would lead to the impacts foreseen in the Theory of Change. The table is designed to be read left to right, where the 'context' represents the represents SENS Energy Local's design assumptions about motivations for members to join the club (community, environmental, financial), 'mechanism' describes the trialist's response to Energy Local (and the aspect of Energy Local that was expected to trigger the response), and 'outcome' describes the intended result of members' participation in this aspect of the club.

Table 5: CMO statements for SENS Energy Local clubs

Context	Mechanism	Outcome
Community pathway		
Electricity bill payers within households (i.e. potential trialists) have a strong desire to actively participate in their local community.	Energy Local creates an opportunity for local people to come together (through events and through co-membership to share knowledge on energy use) and households respond by joining and actively participating in the club.	Household members interact with the dashboard and share tips and knowledge with each other, resulting in peer-to-peer learning and sustained participation beyond the close of the trial.
Electricity bill payers within households (i.e. potential trialists) have a desire to support local initiatives/ businesses based in the community.	The club structure allows members to contribute a proportion of their annual electricity costs (typically 30-50% per household) to go directly to (a) community-owned renewable energy generator(s).	Increased sense of ownership of community energy supply and financial benefits to local generators.
In communities with a higher proportion of low-income households, external interventions can be viewed with suspicion and may need extra support.	Repowering London (an organisation already working in Roupell Park) takes responsibility for engagement and support.	Household members interact with the dashboard and share tips and knowledge with each other, resulting in peer-to-peer learning and sustained participation beyond the close of the trial.
Electricity bill payers in hard-to-reach communities lack trust in energy companies and cannot easily access information around energy bills, savings and efficiency measures.	Through Energy Local, electricity bill payers have a more direct line of communication to the energy supplier (through Repowering) and greater transparency around pricing (through a TOUT), which enables them to feel more in control of their energy use and costs.	Trialists in hard-to-reach intervention make informed decisions about their electricity use.

Historically, a lack of appropriate engagement within the local community (e.g. focus on online activities when many households lack consistent internet connection) leads to information not being disseminated appropriately.	The in-person support drop-in sessions and digital literacy training reduce obstacles to household participation and households respond by joining and actively participating in the club.	Household members interact with the dashboard and share tips and knowledge with each other, resulting in peer-to-peer learning and sustained participation beyond the close of the trial.
Financial pathway		
Households on lower incomes may be less able to pay for the electricity needed to make their homes comfortable particularly where they are using prepayment electricity meters, or tariffs that unnecessarily raise their energy costs.	Energy Local, through access to a smart meter, a TOUT and a fixed-price local tariff, could provide Roupell Park households with rates lower than their existing meter / tariff, the household responds by joining and actively participating in the club.	With the financial savings made through participation, trialists make choices which increase home comfort.
Electricity bill payers have a desire to save money on their energy bills, but they are unable to make informed decisions around how to reduce costs, due to a lack of understanding around different energy tariffs, how these are costed and how much energy is used by different household appliances.	Through the energy dashboard, TOUT, and fixed price local generation, trialists are better able to measure usage by appliance and to understand the costs of using energy at different times. This makes them better informed about the cost of their energy use at different times of the day.	Those trialists who are driven by a desire to save on energy costs make choices which minimise their energy cost (through time switching and/ or reduced consumption).
Environmental pathway		
Households are aware of the global climate crisis and wish to access local renewable technologies, but these are unaffordable or not feasible for	Energy Local clubs provide an alternative route to owning local renewable energy generation and households respond by	Households increase the proportion of locally-generated energy they use (turning households

many households (e.g. renters, residents of multi-occupancy buildings).	joining and actively participating in the club.	from consumers to 'prosumers').
Households are aware of the global climate crisis and wish to ensure that as much of their energy supply as possible comes from renewable sources (but there is uncertainty as to where electricity has come from when supplied through the grid).	Because the dashboard shows when renewable energy generation is operating, trialists are able to schedule their use of energy around these times.	Households increase the proportion of renewable electricity that they use overall.
Households are aware of the global climate crisis and wish to reduce their energy consumption.	Because the dashboard allows members to track energy consumption and the club events allow members to share tips on ways to reduce energy consumption, trialists become more energy-efficient in their behaviour.	Households decrease the amount of electricity that they use overall.

2.2.3 Eligible trialists

All households within the catchment areas of communities with locally available generators (hydro, solar or wind) who had a SMETS1-DCC[8] enabled or SMETS2 meter installed at the time of recruitment were eligible to participate in the SENS Energy Local trial. Potential trialists needed to be existing Octopus Energy Limited customers or to have signed up to switch to Octopus Energy Limited. A requirement for participation in the trial was also having a household internet connection. (However, Roupell Park trialists who did not have access or did not want to allow access to their own Wi-Fi network were also offered the possibility of having 3G enabled broad band access point fitted to use the CAD, enabling tenants to access the Energy Local dashboard once it was formally launched). They were also offered tailored support from Repowering London to help with navigating the online portal, provision of information in alternative offline formats, referrals for support with digital inclusion, and energy advice.

[8] SMETS1-DCC designates the first generation of smart meters having been migrated to the Wide Area Network (WAN) and communicating information to a Data Collection Company (DCC). SMETS stands for "Smart Meter Equipment Technical Specifications". More details can be found here: https://www.britishgas.co.uk/business/blog/smart-meters-explained/

2.2.4 Recruitment strategy

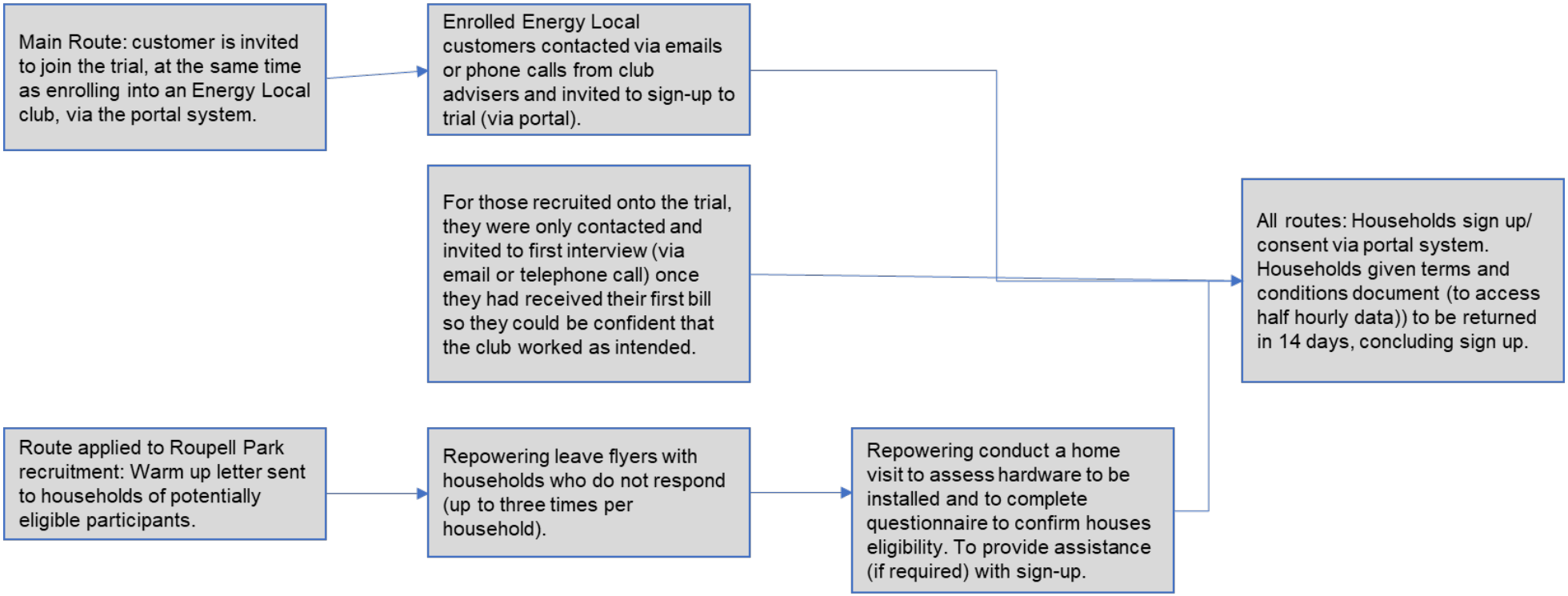
Recruitment was led by Energy Local CIC, with additional support from Repowering for recruitment support for the Roupell Park intervention. This entailed Energy Local CIC developing the recruitment materials and the format of the consent form (using standardised opt-in consent forms that were General Data Protection Regulation (GDPR) and Smart Energy Code (SEC) compliant, developed by UCL and TDEL). Once the materials were agreed and finalised, Energy Local CIC recruited potential club members and invited potential trialists to consent to the trial via the Energy Local on-line portal. The overall trialist customer journey is shown in Figure 4 overleaf. Signing up to take part in a SENS Energy Local trial was entirely voluntary, and consent could be withdrawn at any time without giving a reason.

To assess the primary aim of the evaluation, to ascertain if Energy Local helped trialists use less electricity, UCL SERL directly contacted (core group) trialists to seek their opt-in consent[9], to provide access to their smart meter data for the evaluation, using a virtual 'secure lab' analysis environment provided by UCL. This smart meter data was used by TDEL and UCL SERL solely for the evaluation. More information on the approach to obtaining customer consent is provided in the accompanying Technical Report.

Roupell Park trialists were not invited to provide access to their smart meter data for the evaluation via UCL SERL.

[9] There was a £5 voucher incentive offered to trialists to sign-up to SERL.

Figure 4: SENS Energy Local trialist recruitment customer journey



Recruitment targets were initially set by TDEL to achieve the sample sizes needed to detect (with quantitative analysis of energy consumption data) the expected impacts from Energy Local. In order to meet the minimum sample size of 1,000 participants in the treatment group and allowing for an anticipated churn rate of 18% (due to trialists switching suppliers, moving house or choosing to drop out of the trial), the trial targeted a recruitment sample of 1,180 for the treatment group.

Table 6 overleaf gives a summary of the recruitment target planned versus that which was achieved, including withdrawals during the trial. It also details the sample numbers used in the analysis in subsequent sections.

Table 6: Summary of recruitment and analysis sample sizes (target and achieved)

Trial	Trial design	Recruitment strategy to reach eligible customers	Initial recruitment target (set by TDEL)	Trialists signed up to participate in SENS Energy Local	Trialists for whom energy consumption data was accessed for evaluation
Energy Local	Theory-based evaluation	Potential trialists signed up on joining the SENS trial, or otherwise via targeted emails after receiving their first bill from Octopus Energy	1180 to retain 1000	121	83

Due to various challenges, including COVID-19 impacts (see SENS Evaluation Competition Report for more details), the SENS Energy Local trial did not achieve the number of recruited trialists as initially planned.

Separate to the challenges related to COVID-19, further recruitment and installation challenges included:

- **Delays establishing communication between Consumer Access Devices (CADs)[10] and smart meters** which led to further delays in bringing new club members online, as the dashboards needed to communicate with the smart meters via the CADs.
- **Technical complexities in how to apply the price reduction to billing** associated with the renewable energy meant that the billing of trialists was delayed. This affected user experience, which led Energy Local to delay engagement with the SENS Energy Local trial trialists until after they had successfully received their first bill.
- **Increases in energy prices in Great Britain in October 2021 and April 2022**, which meant that Energy Local had to exercise caution in terms of advising potential (Roupell Park) trialists to switch tariffs and where the household was on a low-rate fixed tariff if this could lead to cost increases to the household.

[10] A Consumer Access Device (CAD) is a cloud-connected secure smart meter gateway device that accesses real-time energy data from smart meters and sends that data to a designated cloud service.

3 Methodology

This section describes the methodological approach to implementing the theory-based evaluation including data collection methods, the overall analytical approach and analytical methods used to analyse the energy consumption data. More information is provided in the accompanying Technical Report published alongside this report.

3.1. Data collection

The following primary and secondary data sources were used to collect evidence to assess the success of the trial and evaluation.

3.1.1 Electricity consumption data

Electricity consumption data for evaluation purposes was collected (with consumer consent from trialists) to cover two periods:

- During the trial. For core group trialists, electricity consumption data was securely accessed by the TDEL via the Smart Energy Research Laboratory (responsible for managing the collection and provision of access to smart meter data from trialists to TDEL for the purposes of the evaluation) at 30-minute resolution for the trial period.
- Before the trial. For core group trialists, electricity consumption data was accessed for a period of up to 12 months before the start of the trial. The pre-trial time period and resolution of data available varied based on availability by home.

3.1.2 Quantitative telephone survey with trialists

All SENS trialists were invited to take part in a baseline and endline telephone survey. The baseline survey took place between June 2021 and December 2021, achieving 52 responses. The endline survey was conducted in March 2022 and surveyed 26 trialists (see Annex C). The survey questions covered attitudes towards energy, energy usage and management behaviours, uptake of energy efficiency measures, views of smart metering, and engagement and satisfaction with Energy Local. While most questions asked in the baseline survey were repeated in the endline survey to allow for comparisons, about a quarter of the questions were changed to investigate tool interaction. More details on the key topics explored by the telephone survey are included in the accompanying Technical Report.

One sample t-tests between baseline and endline survey percentages were conducted for the survey findings at the Competition level only (aggregated across all trialists) but not at individual trial level, to determine whether the change was statistically significant at conventional significance levels. Unless explicitly stated, any reported changes (baseline to endline) are indicative only and have either not undergone statistical significance testing or were not found to be statistically significant.

3.1.3 User in-depth interviews

TDEL also conducted qualitative in-depth interviews in February and March 2022 with 30 trialists across five of the live Energy Local clubs in SENS. Recruiters ensured the inclusion of a range of demographics and perspectives, to enable analysis across key quotas (more details can be found in the accompanying Technical Report). The interviews were semi-structured and typically lasted 45-60 minutes, and covered topics including how trialists interacted with the components of the intervention, their initial experiences and behaviour changes, and perceived longer-term impacts.

Additionally, four qualitative interviews were conducted with club advisors for Bethesda, Bridport, Crickhowell and Machynlleth, and three focus groups were conducted with club Board members for Bethesda, Bridport and Crickhowell to discuss the context and functioning of each individual club, as well as the experiences of interviewees.

Roupell Park did not have a club Board or Adviser and was instead administered by Repowering London. Repowering staff were not formally interviewed for this evaluation but did provide ongoing updates and information regarding the status of Energy Local Roupell Park.

3.1.4 Focus groups

Instead of interviews, TDEL carried out two focus groups (pre- and post- intervention) with potential and actual trialists of the Energy Local Roupell Park, moderated by Repowering staff members. Fifteen people were invited to the initial focus group and eight attended, and five were invited to the second group, with three attending. Both focus groups were held virtually (see Technical Report) and attendees were invited to explore their motivations behind signing up to the club and their experiences so far in participating.

3.1.5 Engagement data

Energy Local CIC shared Google analytics data with TDEL that indicated users' level of engagement with the Energy Local dashboard. There were some technical issues around the retrieval of the data from Google Analytics, which means that the amount of this data available was limited to January and February 2022.

3.2 Analytical approach

3.2.1 Realist evaluation

At the core of the realist approach is seeking an understanding of whether the intervention contributes to its intended outcomes, in terms of how, for whom and in what circumstances. In practice, this meant developing the CMO statements set out in chapter 2 to examine the context in which the intervention emerged (context), the role of SENS Energy Local's intervention in inducing behaviour change, increasing energy awareness and encouraging shifting of power to locally-generated supply or at optimal times of day (mechanism), and their role of achieving reduced overall energy consumption (as the primary outcome). These CMOs

were then used in the selection of households for qualitative interviews (ensuring this gathered evidence on SENS Energy Local's intervention in different contexts), and informed questions in the quantitative survey.

3.2.2 Energy consumption analysis

To test for the achievement of the primary objective, i.e. a reduction in energy consumption among core trialists, TDEL first conducted a descriptive analysis of trialist energy consumption data. In order to examine any changes in energy consumption using smart meter data, TDEL analysed data for months where this was available in 2022 (in-trial) and 2021 (pre-trial)[11]. Data was only used where trialists had at least 15 daily observations during each relevant month that could then be used to determine a monthly consumption average. March was chosen as the comparison month for the analysis. The reasons for this were threefold:

- All Energy Local clubs in scope of the Competition were live by the start of March 2022.
- This month provided the greatest amount of time to have elapsed since the start of the Competition, thereby maximising the likelihood that behaviour change had occurred.
- To make a like-for-like comparison between a pre- and in-trial month, the circumstances influencing household energy consumption needed to be as similar as possible. March had the most comparable restrictions on social distancing and home-working in 2020 and 2021, and therefore offered most potential to control for COVID-19 impacts.

Approximately half of the core SENS trialists who gave and maintained their consent for SERL to access and share their energy data, were missing pre-trial half-hourly consumption data (due to not having a smart meter installed during March 2021) and were therefore excluded from the analysis. The final number of trialists that had at least 15 daily observations over both analysis periods was 54.

3.2.3 Key caveats and limitations associated with this research

There were several caveats associated with interpreting the findings from the energy consumption analysis (including small sample sizes), however, due to the Theory Based Design, evaluation findings include a triangulation of evidence across all sources of evidence (including quantitative telephone surveys, in-depth interviews and focus groups). More details on these methods are provided in the accompanying Technical Report.

Moreover, there were limitations that should be borne in mind when interpreting the evaluation findings resulting from contextual factors (which could not be addressed given the lack of a counterfactual scenario), delivery challenges, and relating to the available sample size and data:

- From March 2021, the Government started to lift COVID-19 restrictions and began its roadmap to return to more 'normal' life. The resulting transition, and subsequent trends

[11] Due to the seasonality of energy consumption, pre-trial months should be compared with the same months during the in-trial period.

in COVID-19 infections are likely to have impacted household energy use. Winter 2021/22 was also believed by participants to be warmer than Winter 2020/21.

- Energy prices were starting to rise at the end of the trial period (March 2022), though SENS trialists were on a fixed one-year TOUT, which ensured their energy costs were constant throughout the trial. The trial did not achieve its ambition for recruitment, meaning there was a reduced sample of trialists available for analysis. In addition, trialists also had access to Energy Local for a limited period of time only. This placed constraints on the analysis that could be carried out, and the strength of conclusion that could be drawn from it.
- Local generation data was not available for the evaluation period, meaning the impacts of the timing and availability of club renewable energy cannot be isolated.

As a result of these, the analysis presented here is indicative only, and further research with a larger pilot group would be required to robustly identify impacts.

4 Analysis of primary outcomes

This section describes the extent to which the results of the trial provide evidence that the expected primary outcomes of Energy Local were achieved, i.e. that Energy Local *led to a reduction in electricity consumption amongst participating households. The principal sources of evidence analysed were energy consumption data for active Energy Local trialists, user interaction data, and reported behavioural data (from surveys, interviews and focus groups). First evidence of changes in energy consumption is discussed, followed by an analysis of the likely contribution of Energy Local to any changes in consumption.*

4.1. Key findings

Energy Local appealed to individuals who wanted to reduce their impact on the environment, as well as those who wanted to participate in a community activity and feel that they were contributing to the local economy (by buying electricity from a local producer). There was also some evidence that it appealed to those who wished to reduce their energy costs; however, the majority of those participating in the trial (including in the hard-to-reach intervention) were not motivated at the point of sign-up to join by any concerns around energy bills.

The evaluation showed that Energy Local was valued amongst its members. It generated or added to a sense of community, enabled members to feel like they were contributing to mitigating the effects of the global climate crisis, and encouraged members to switch from on-grid electricity supply to a higher proportion of locally-generated renewable electricity. Interview and survey data suggested that the majority of trialists (96%) were satisfied with the intervention and viewed it as an important approach to improving the resilience of their energy supply.

While some trialists participating in the qualitative research, particularly the Roupell Park club, reported energy-efficient behaviours which they attributed to participation in the trial, indicative energy consumption and survey data did not show that trialists had reduced their energy consumption. Several trialists reported they were already using energy efficiently, so whilst their electricity consumption was low, this was not due to the trial. Some qualitative research participants reported that they used electricity in a less efficient way when it was from the local generator because they considered that otherwise the energy would go to waste due to a lack of battery storage.

Despite this, trialists also reported lower electricity bills, which they attributed to their participation in Energy Local. The core intervention appeared to have encouraged trialists (and enabled them – through the dashboard) to switch to lower carbon (and cheaper) sources of electricity, for example at off-peak times or when the supply was via local renewable sources.

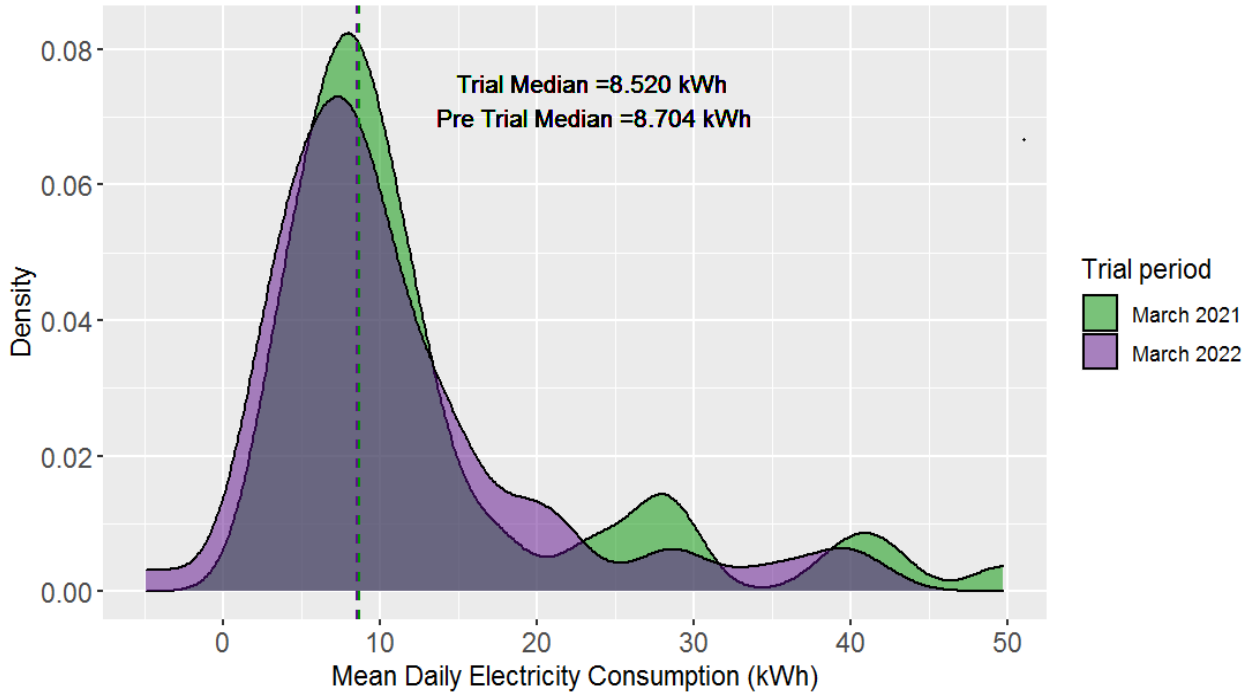
4.2 Evidence of reductions in energy consumption over the trial period

This sub-section discusses evidence collected from both energy consumption analysis, surveys, and interviews on changes in energy consumption over the trial period.

4.2.1 Energy consumption data analysis

Figure 5 shows the mean daily electricity consumption for one month during the pre-trial period (March 2021) and one month during in-trial period (March 2022) for 54 core trialists with complete daily records during the analysis period. Meanwhile, Figure 6 shows heating degree-day adjusted[12] mean daily electricity consumption during the pre-trial period (March 2021) and in-trial period (March 2022) for the same set of trialists. The purpose of heating degree day adjustments in this case were to account for seasonal temperature variations between the pre-trial and in-trial periods when comparing daily mean consumption averages.

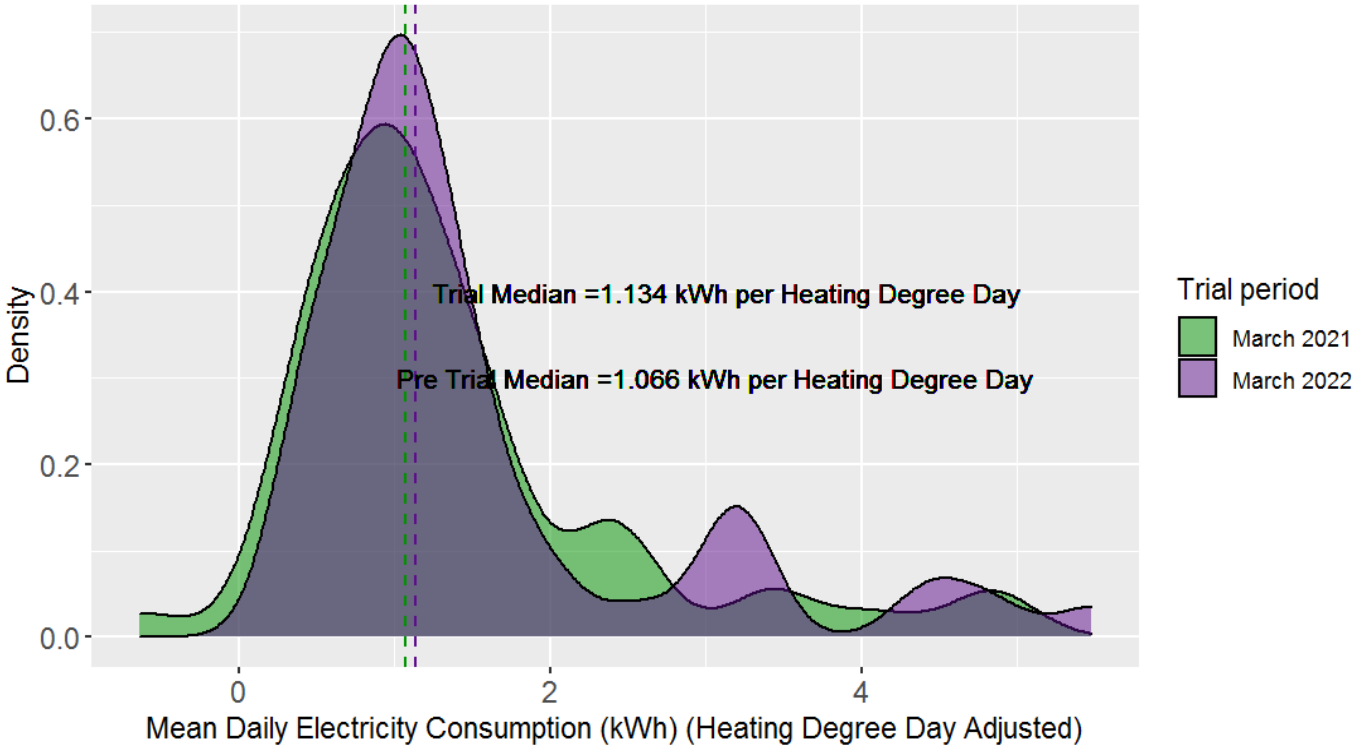
Figure 5: Mean daily electricity consumption amongst SENS Energy Local club members before (March 2021) and in-trial (March 2022) SENS intervention



N=54 trialists with complete daily records during the analysis period

[12] Heating degree day adjustments were made to all 54 trialists included in the initial analysis. This controlled for variations in external weather temperature that may have influenced electricity consumption. While it was acknowledged that those with electric heating would be most suited to heating degree day adjustment, this information was not available to the research team at the point of analysis. Hence, adjustments were made to the entire analysis population.

Figure 6: Mean daily electricity consumption amongst SENS Energy Local club members before (March 2021) and in-trial (March 2022) SENS intervention – heating degree day adjusted



N=54 trialists with complete daily records during the analysis period

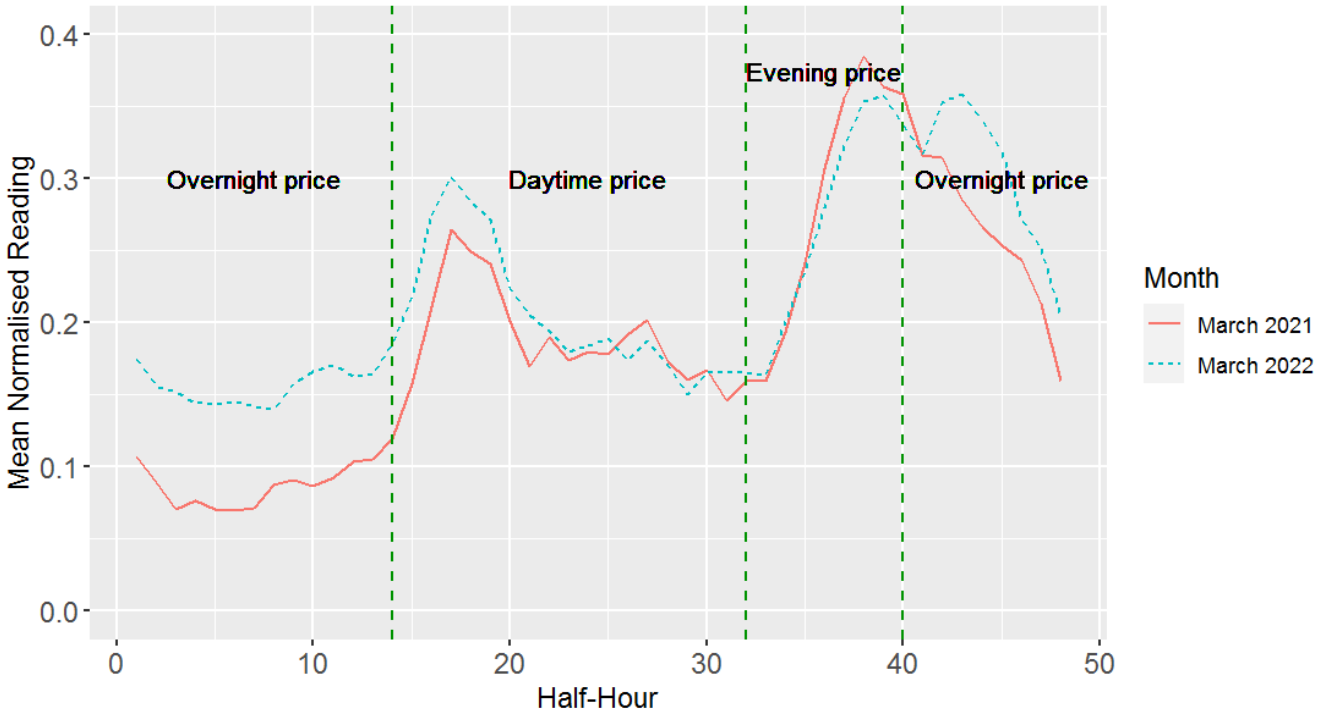
The main observations that can be drawn from the data are:

- In trial consumption was slightly lower than pre-trial consumption indicating some reduction in energy consumption among intervention group trialists (see Figure 5). Once seasonal variations were accounted for (i.e. heating degree day adjustments made), the opposite was true (see Figure 6). These findings were non-significant at conventional statistical levels.
- Mean daily consumption is positively skewed in both analysis periods, indicating a non-normal distribution with some individuals consuming larger than 'normal' amounts of electricity on a daily basis[13].

Further analysis was carried out on electricity use by time of day ('load profiles') of 31 participating core households with available data pre- and during-trial. Usage was compared to the TOUT pricing bands, however local generation data could not be overlayed (and will have had different profiles across the customers included) therefore this analysis does not include a significant potential driver of consumption patterns. Figure 6 shows the pre and in-trial load profile for weekdays, where there appears to be an increase in overnight (and off-peak day time) energy usage. Consumption during the evening peak appears slightly reduced.

[13] https://www.ofgem.gov.uk/publications/decision-typical-domestic-consumption-values-2021

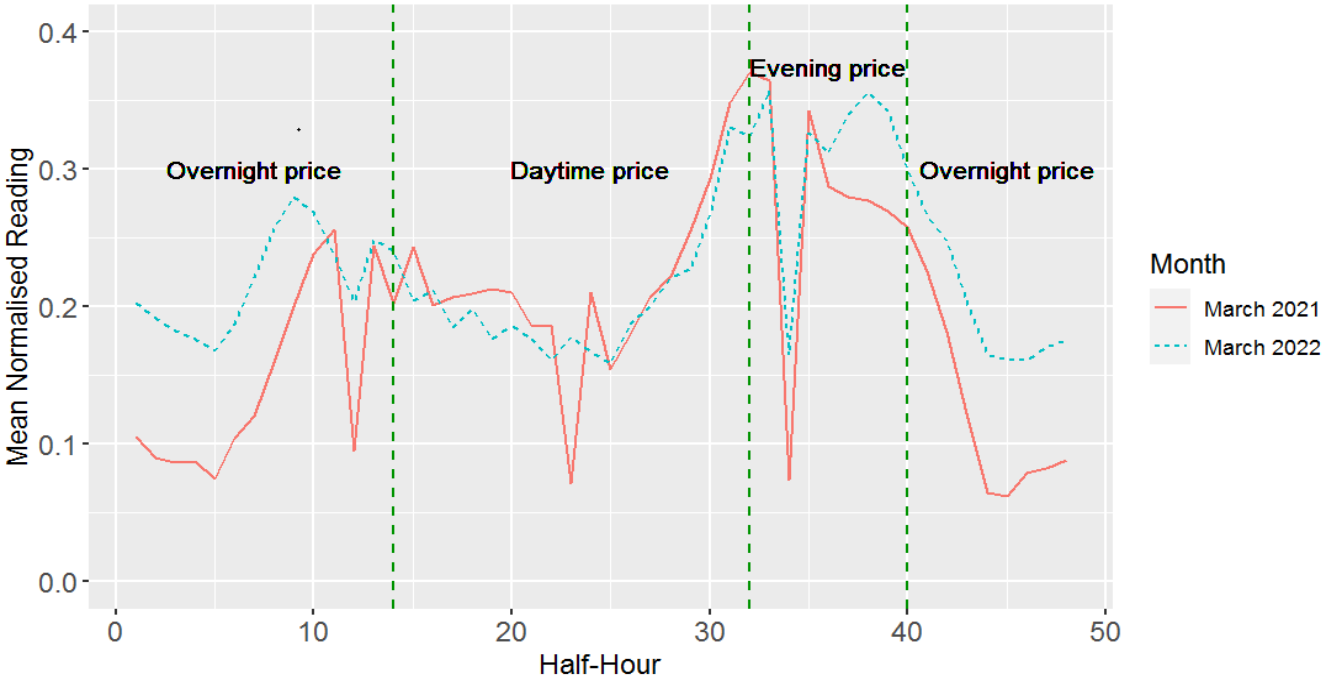
Figure 5: Mean normalised weekday load profile – pre-trial (March 2021) and in-trial (March 2022)



N=31 trialists with complete half-hourly records during the analysis period.

Similar effects can be seen during weekend days (see Figure 7 overleaf), with overnight (off-peak) usage higher, and evening (peak) usage unchanged, or slightly increased.

Figure 6: Mean normalised weekend load profile – pre-trial (March 2021) and in-trial (March 2022)



N=31 trialists with complete half-hourly records during the analysis period.

4.2.2 Reported energy savings (interviews and survey data)

Whilst the indicative pre-trial to in-trial energy consumption analysis did not conclude a reduction in energy consumption over the trial period at conventional statistical significance levels, intervention group trialists surveyed self-reported they had tried to reduce the amount of energy they use at the home. This had indicatively increased from 89% at baseline to 96% at endline.

Reducing electricity consumption was seen by some (but not all) trialists as a point of pride: one interviewee reported having reduced their usage to approximately 3,000 kWh per year, against an average consumption in Wales of approximately 4,500 kWh per year[14]. Others reported that they were driven to make behaviour changes by engaging with information from the dashboard.

> *"Yeah, I think I do look at the time, and think 'Oh.. I can't put [the heating] on yet because it's not the right time'. I think it sort of… You can get quite competitive with yourself to try and make it lower, can't you, when you have got that information. It's quite nice. You feel like you have a bit of control." [Energy Local club member, Crickhowell]*

[14] https://www.worlddata.info/europe/united-kingdom/energy-consumption.php#:~:text=of%20electric%20energy%20per%20year,of%20the%20country's%20own%20usage.

> *"Yes, I have used the Energy Local dashboard to track my energy usage. Not now as much as I did in the beginning, I was a bit obsessed in the beginning." [Energy Local club member, Corwen]*

For some, however, membership of the club had little perceived impact on their electricity use. This was either because they felt their consumption was already low or because they were not able to or not willing to change their usage patterns. Common reasons cited were working patterns, which precluded significant changes; safety fears, for example related to fire risk associated with running appliances overnight; lack of control over others energy usage; and convenience. In some cases, interviewees felt reassured that their consumption was already low and this alleviated pressure to further reduce consumption.

> *"It has informed us; we realise we don't use a huge amount – [we] tend not to have peaks and troughs…it's quite reassuring." [Energy Local club member, Machynlleth]*

> *"I spend what is necessary which fortunately is relatively little. So nothing could prompt me setting a budget. If I feel cold, I will burn the energy. Fortunately, I have sufficient resources with these pensions that I don't have to concern myself with it." [Energy Local club member, Bridport]*

> *"We're very fortunate, we have no worries about our bills at all." [Energy Local club member, Crickhowell]*

Some trialists interviewed reported knowingly continuing to do something they had discovered was consuming a lot of energy.

> *"If it's too much effort my husband won't do it. We won't carry on if it's not worth the saving. […] I know someone who turns the lights off every time they go out of a room but that's pointless if you've got a small house. We have a toddler so changes need to be things I can do one-handed." [Energy Local club member, Machynlleth]*

> *"Sometimes you just need something cleaned there and then and I don't like running big appliances after we go to bed for safety and noise reasons." [Energy Local club member, Bethesda]*

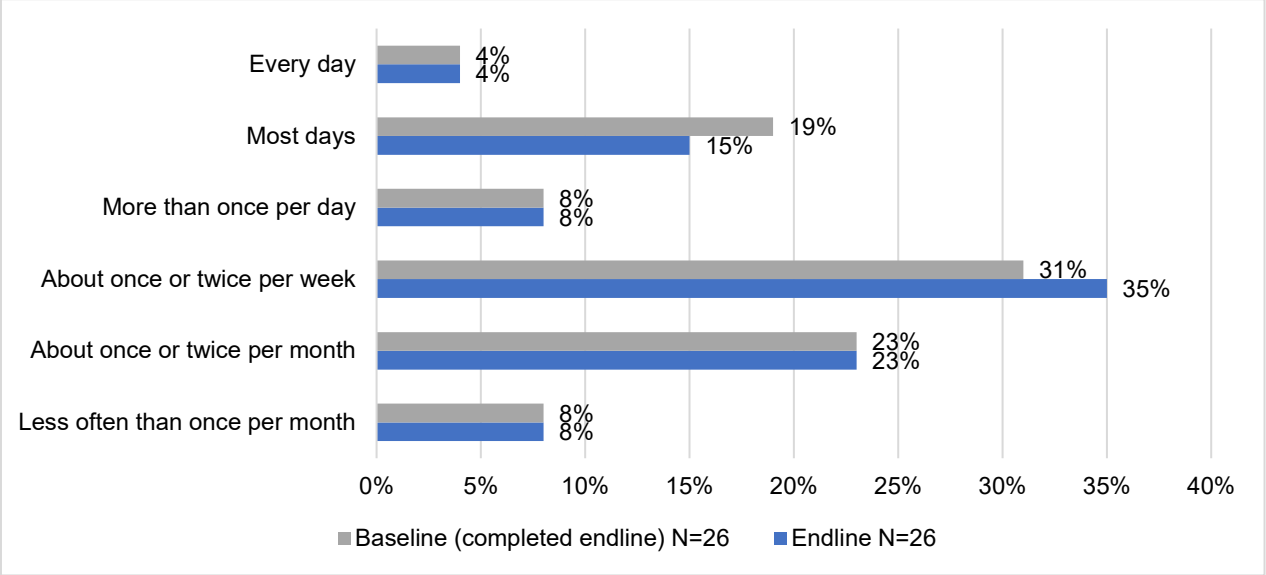
4.3 Whether Energy Local contributed to changes in energy use

4.3.1 User perceptions of a contribution of Energy Local to changes in energy use

Features of the SENS Energy Local intervention which members reported encouraged them to change their consumption patterns were the information provided to trialists (primarily through the Energy Local dashboard, but also through information sharing) and the implicit "peer pressure" of being part of a club. Most interviewees reported that they used the Energy Local dashboard and the baseline and endline surveys indicatively suggested the frequency of checking the dashboard did not change much from baseline to endline, except for a slight

indicative reduction of daily checks at baseline to a slight indicative increase in weekly checks at endline.

Figure 10: Reported frequency of dashboard use



Evidence from qualitative interviews with some trialists suggested that some club members felt Energy Local had contributed to their changing their energy use behaviours.

> *"It was the trigger for behaviour change, we started monitoring which appliances would use the most power – Energy Local prompted the purchase of a smart plug to monitor this." [Energy Local club member, Bethesda]*

In the focus groups for the Roupell Park club, club members also reported that they had started to use electricity more efficiently in the home (ironing less for example) and they attributed this change to their participation in the SENS Energy Local trial.[15]

> *"I was someone who used to use 90 degrees when washing whites, then I realised if I reduced temperature, stopped using plugs, I would save energy so yes [Energy Local] has helped me understand how to save energy more." [Energy Local club member, Roupell Park]*
>
> *"Similarly [Energy Local] has helped me understand to not use energy when I am not using it. It helps me be mindful of plugs when they don't need to be used." [Energy Local club member, Roupell Park]*

However, it has not been possible to determine whether Energy Local, and any associated changes in behaviour, led to an actual reduction in energy consumption[16]. It was also unclear from the qualitative data whether these perceived behaviour changes were due to the

[15] The quotes below come from the discussion in response to the focus group question "From your experience of energy local, have any of you noticed changes in how you use energy?"
[16] Quantitative analysis of Roupell Park participants' energy consumption data for the evaluation was not possible due to limited data coverage during the analysis periods selected for analysis.

intervention or not, as Roupell Park members also talked about using IHDs and smart meters provided by their energy supplier i.e. the baseline smart meter consumer proposition.

> *"The [IHD] has been amazing, really worthwhile knowing how much energy you used and when energy is cheaper, so I have enjoyed using it and think it's really useful. Very easy, simple, very much like my phone, weekly use, yearly use, pretty easy. I check it probably 10 times a day, its located very easy". [Energy Local club member, Roupell Park]*

Roupell Park trialists participating in the focus group spoke very positively of the support provided by Repowering London and considered that this support potentially drove them to reduce their electricity consumption.

> *"[Repowering London contact] is great. I've always found it very easy and quick to get support [from Repowering London]." [Energy Local club member, Roupell Park]*

> *"[Repowering] was helpful going over my bill, explaining how much I am saving, VAT." [Energy Local club member, Roupell Park]*

> *"[Repowering London contact] is always at the end of the phone if you need advice." [Energy Local club member, Roupell Park]*

> *"I was someone how used to use 90 degrees when washing whites, then I realised if I reduced temperature, I would save so yes its helped me understand how to save energy more." [Energy Local club member, Roupell Park]*

> *"I've been thinking about the ironing so I'm not doing that as much, changing family habits too so helping everyone to understand the environment, energy usage, bills, etc more." [Energy Local club member, Roupell Park]*

However, because Roupell Park received such a different intervention (especially during the pilot phase) it was not possible to say whether – with the full intervention – they would have acted in the same way as other club members (i.e. by shifting to lower carbon uses of electricity to match available generation, rather than reducing their energy consumption).

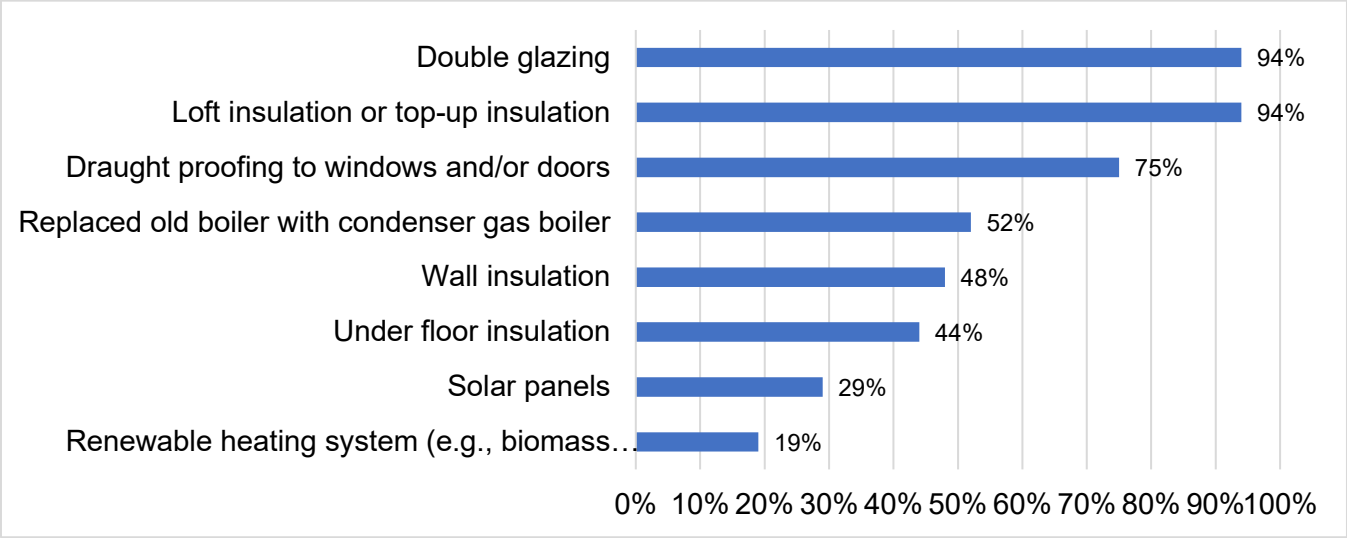
4.3.2 Factors preventing SENS Energy Local from enabling trialists to reduce their energy consumption over the trial period

Nearly all trialists consulted (from both the core and hard-to-reach groups) were already environmentally aware before joining a Energy Local club and there was good evidence to demonstrate that many were already actively using energy in a way that would reduce their negative impact on the environment. According to the baseline survey, almost all (96%) said that being environmentally friendly was an important part of their identity, and over nine in ten (92%) reported that they were prepared to greatly reduce their energy use in order to tackle climate change. As shown in the interview quotes directly below and in Figure 11 overleaf, amongst the 52 trialists in the pre-intervention ('baseline') survey, many already had energy efficiency measures – especially loft insulation (94%), double glazing (94%) and draught

proofing (75%) - installed in their homes. In addition, under a third (29%) had solar panels and one in five (19%)[17] also had their own renewable energy heating system[18].

> *"I may put the heating up for visitors but perfectly comfortable for me. I haven't had any uncomfortably cold days. It has been easier than last winter because of the thermal insulation." [Energy Local club member, Bridport]*

Figure 11: Energy efficiency improvements installed by trialists – Baseline Survey SENS Energy Local (%)



Many trialists interviewed from the core intervention group already had in place home improvements which made their home comfortable.

> *"The house is well insulated, so it keeps a good temperature. We also got a new boiler and a new hot water cylinder. We are able to turn the water temperature down on the boiler and still keep the house warm. There haven't been any days when the house has been uncomfortably cold." [Energy Local club member, Machynlleth]*

According to the baseline survey, over half (56%) of the households were equipped with an open fire or a wood stove. Firewood prices were largely independent from the energy market, and the interviews gave recurrent evidence that trialists using a wood burner were less severely impacted by any rises in energy prices and inflation.

Subsequently, core intervention trialists reported that their homes were generally already well insulated and were able to keep their home at a comfortable temperature before the intervention. This remained the case after joining the Energy Local Club.

[17] Survey data might not be representative of all those of the Energy Local club and/or figures could be high as they are self-reported

[18] A renewable energy heating system could include a biomass boiler, ground or air source heat pump or solar thermal system.

5 Analysis of secondary outcomes

This chapter reports the results of analyses of the SENS Energy Local surveys, qualitative interview data and two focus groups, relating to evaluation of the range of secondary outcomes listed in chapter two.

5.1 Shifting to use lower carbon electricity (off-peak or when renewables are a greater proportion)

Trialists interviewed as part of the qualitative research reported regularly checking their dashboard to understand whether or not renewable energy was currently available, what time of day was best to use electricity (based on their TOUT and costs data) and the extent to which different appliances (such as kettles and washing machines) were using electricity. Anecdotal evidence from the interviews suggested that the differentiated pricing (when renewable energy was available, and use was cheaper) was particularly useful in guiding trialists to shift their usage patterns to times when there was less pressure on the grid and that – where feasible – club members did change their usage patterns to respond to these lower price incentives (particularly at times when no renewable energy was available).

> *“The dashboard and smart meter together give you a better understanding, but I relate more to the dashboard [to] see on a day if I've used lots of energy and then you think what we were doing on that day, they definitely help you become more aware.” [Energy Local club member, Crickhowell]*
>
> *“I do now understand how the grid works a lot more and the pressure on peak times. And the fact that there is plenty of electricity around it's just getting it to us as it overloads the system at certain times." [Energy Local club member, Crickhowell]*

The interview data strongly suggested that trialists’ scheduling of appliances improved as a result of their subscribing to a TOUT and joining an Energy Local Club. The dashboard allowed trialists to compare energy prices between peak and off-peak times, and the interview data provided persistent evidence of trialists trying to avoid using energy intensive appliances during peak times.

> *“We get up early and decide whether to put the washing machine on before peak tariff. We work from home, so we cook before 4pm [to avoid the high tariff from 4 to 8pm].” [Energy Local club member, Bethesda]*
>
> *“[We] have changed [our] routine such that the bathroom heating and towel rail comes on before 7, and [we] don't use [the] electric heaters until 8pm. [We also] charge the electric car overnight.” [Energy Local club member, Bridport]*
>
> *"We bought a slow cooker so we can prepare meals earlier in the day and aren't using more powerful appliances during the evening meal preparation." [Energy Local club member, Bethesda]*

> *"I would recommend Energy Local, because I think it's encouraged us to tweak our energy use in a way that's better for the planet, by avoiding peak time use, because I would say that although we always tried to do things in an energy efficient way generally, we hadn't really considered the issue of avoiding peak times to avoid the load on power stations. [I am] sure we've also saved some money." [Energy Local club member, Bethesda]*

A small number of trialists in the Energy Local Bethesda club also invested in timer plugs or a washing machine and tumble dryer equipped with a timer to enable them to use energy at off-peak times. Participants also used the dashboard weather forecast to schedule when to use energy-intensive appliances, including electric vehicle charging.

> *Electricity from wind: "Charging my car [using the TOUT or when the weather is windy] is probably the only thing I do think about." [Energy Local club member, Bridport]*
>
> *Electricity from hydro: "If there is a heavy rain forecast, the pile of washing can wait. Energy Local is a planning tool for when to do certain activities." [Energy Local club member, Bethesda]*

Nevertheless, the qualitative data also evidenced some inconsistencies between some trialists lifestyles and the intervention. For example, one participant stressed that the TOUT did not combine well with his own use of the heat pump.

> *"If you've got a heat pump, this scheme is quite difficult [to implement as] peak time (4-8pm) is exactly the time you want the heat pump on." [Energy Local member, Machynlleth]*

A small number of other trialists in the Roupell Park Energy Local Club focus groups considered that it was not always practical to use appliances during the renewable generation periods, now that they were leaving their house more frequently post-COVID-19-related lockdowns.

A small number of other trialists considered that the times when renewables were available did not always match their needs. For example, renewable energy may not be produced when trialists needed it, or it might overlap with the off-peak tariff, providing no or limited additional benefit to switching the time they use household appliances.

> *"If we need to do our laundry on a certain day, we won't not do it just because it's not windy." [Energy Local club member, Bridport]*
>
> *"Overnight tariff from hydro is one penny cheaper than the tariff from the grid, therefore it doesn't matter to us whether hydro is running or not overnight." [Energy Local club member, Machynlleth]*

In terms of understanding when renewable energy production would be highest, clubs with access to hydro generation found the dashboard more useful than those relying on solar or wind generation. For trialists with access to generation from solar panels and wind turbines, observation was deemed sufficient to inform consumption patterns. Specific examples given included activities such as putting the washing machine on or batch cooking when it was sunny or windy. Members of clubs using wind-generated power generation reported that they would

like to supplement the supply from wind-energy with alternative, complementary sources of electricity to cover the gaps in wind (e.g. from solar or hydro).

5.2 Reduced energy bills for households

Energy prices sharply increased in April of 2022 due to an increase in Ofgem's energy price cap[19]. At the baseline survey (June to December 2021) and endline survey (March 2022), around half of the trialists said they worried about the cost of energy over the next few years and concern over future energy prices was also notable in the qualitative interviews (conducted in early 2022).

There was strong evidence from the qualitative depth interviews that Energy Local club members in SENS experienced a drop in their electricity bills compared to the pre-trial period, which they attributed to the intervention, specifically access to local generation at a fixed price, and TOUT price tariffs, which were guaranteed by Octopus Energy for one year.

> *"Our energy bill has increased over the last two years from £100 to £130, now to £150, but that is against the energy company prediction of £237. They are not factoring in the rebate of 27% of our bill, which is significant." [Energy Local club member, Bethesda]*
>
> *"Energy Local has buffered us against [increasing prices], especially buying from community hydro. We are as best prepared as we can be to make savings." [Energy Local club member, Bethesda]*
>
> *"Hydro made the bills much cheaper; we are surprised at how much we were able to save. In January we saved £90." [Energy Local club member, Corwen]*
>
> *"The bills are considerably less than they were before signing up to Energy Local. When we were with [other named energy supplier], we were paying nearly £300 per month and it was going up. With Octopus, we pay £178 per month and our latest bill was £262. However, we get back what we have saved with Energy Local, so getting credited £111 – it basically halves the bill." [Energy Local club member, Corwen]*
>
> *"It has been more difficult than last year because of [energy price] increases but Energy Local does help with the costs." [Energy Local club member, Bridport]*
>
> *"We are locked into a favourable tariff so coping well. Winter is coming to an end and we still have £100 credit, whereas we are normally negative in winter […] My electricity is extraordinarily cheap, and I feel slightly fraudulent about that." [Energy Local club member, Bridport]*

No one in the Roupell Park focus groups mentioned bill savings, but this may have been likely because they had not been participating in the trial for long enough to see a change at the time of the focus groups.

[19] The cap increase was announced on February 3rd, 2022 (https://www.ofgem.gov.uk/publications/price-cap-increase-ps693-april).

The ability to track the energy prices at different times via the dashboard was described by some in the core intervention as helpful in encouraging them to shift their usage to cheaper times. Within the hard-to-reach intervention at pilot stage, some trialists similarly found they were able to do this, prior to the installation of their smart meter, through the plug-in OWL energy monitors.

One core intervention interviewee talked positively about the tab on the dashboard with information at a group or community level, which showed information on how much energy the club had saved. Although not providing direct savings, this contributed into the overall pride in contributing to achieving benefits for the club as a whole.

Roupell Park trialists who participated in the pilot were able to access simulated savings, which were given to them as a credit on their energy bill. This temporary approach, however, prevented members from having a detailed understanding of how their bill had been calculated. This caused consternation for some members, whereas for others it was not viewed as a point of concern.

5.3 Satisfaction with Energy Local and aspects of the intervention

Overall, in the endline survey, the vast majority (96%) of trialists were satisfied with the Energy Local intervention and 69% were very satisfied. Further to this, 77% of trialists would definitely recommend Energy Local to a friend, colleague or relative.

Nine in ten (92%) of trialists also reported that they had engaged with the dashboard since becoming part of the Energy Local club and 62% had engaged with this at least once or twice per week during the trial.

By design, Energy Local was intended to enable trialists to view their electricity use and forecast when the cheapest energy would be available through the dashboard, but the qualitative research showed that trialists interaction with it was mixed and many trialists interviewed had a less-than-positive experience of the dashboard or did not find it useful. Participants who checked their dashboard most frequently were often those who wanted to optimise their energy bill by making the most of the TOUTs and/ or the renewable energy produced by their club. They found the forecasting function of the dashboard particularly useful.

> *“I check the dashboard most days, quite often to see if there’s a likelihood that we won’t get any hydro” [Energy Local Club, Machynlleth]*
>
> *“[We] log in every day – especially if there’s a dry spell, [as we] need to know when [we] can use it.” [Energy Local Club, Corwen]*
>
> *“[I check the dashboard] once a day on average, when using the oven or washing machine […]. I use [the dashboard] more to find out the best times to use energy. I have*

6 different rates and look the dashboard to see when 'smiley faces' come up" [Energy Local Club, Bethesda]

Where trialists wanted access to real-time information about whether the local generator was producing energy at that time or not, there was frustration amongst a small number of trialists that this information was not provided[20].

"There is a delay of information. For example, [we were] in the middle of storm Eunice with rain for three days and [we were] being told [that we would not] be on the hydro." [Energy Local Club, Corwen]

"Hydro data [gets] lost or [is] not showing. There seems to be a gap between app and real generator down time." [Energy Local Club, Machynlleth]

[20] There is currently no system set up via Data Controller to access real time generation data (instead with a time lag of approximately one day).

6 Conclusions

Given the complexity of the SENS Energy Local intervention and the specificities of individual clubs, a Theory-Based Evaluation design was used for this study.

Energy Local appealed to individuals who wanted to reduce their impact on the environment, as well as those who wanted to participate in a community activity and feel that they were contributing to the local economy (by buying electricity from a local producer). There was also some evidence that it appealed to those who wished to reduce their energy costs; however, the majority of those participating in the trial (including in the hard-to-reach intervention) were not motivated to join by any concerns around energy bills (at the time of sign-up).

Participating in the Energy Local clubs and the trial was valued amongst its members. It generated or added to a sense of community, enabled members to feel like they were contributing to mitigating the effects of the global climate crisis, and encouraged members to switch from on-grid electricity supply to a higher proportion of locally-generated renewable electricity. Interview and survey data suggested that the majority of trialists were satisfied with the intervention and viewed it as an important approach to improving the resilience of their energy supply.

However, indicative analysis of energy consumption data (comparative before-and-in-trial) and of survey data found that Energy Local did not lower overall electricity use during the SENS Energy Local trial. Within the hard-to-reach intervention, there was some evidence from qualitative research that trialists switched to more electricity saving behaviours, which they attributed to their participation in Energy Local, but the trial had only recently begun in that location and the evaluation was only able to gather very limited (and non-robust) data on effects[21].

For the core intervention group, some trialists interviewed in the qualitative research reported more energy-efficient behaviours (e.g. reducing the temperature at which they washed clothes, reducing use of irons), which they attributed to participation in the trial, but (as with the hard-to-reach group) it was not possible to validate any resultant changes in energy consumption from this. Secondly, some core intervention trialists reported that they used electricity in a less efficient way when it was from the local generator (because they considered that otherwise the energy would go to waste due to the lack of battery storage). Finally, several core intervention trialists reported they were already using energy efficiently, so whilst their electricity consumption was low, this was not due to the trial.

Several trialists were able to provide convincing evidence that their electricity bills had reduced over the time period of the intervention, which was clearly traceable to (and which trialists attributed to) their participation in SENS Energy Local trial. This was likely due to their fixed TOUT with Octopus Energy which was guaranteed for one year during the trial (and protected

[21] Quantitative analysis of Roupell Park participants' energy consumption data for the evaluation was not possible due to limited data coverage during the analysis periods selected for analysis.

trialists from wider energy price increases). There was also clear evidence from the qualitative interviews, that Energy Local enabled trialists in the core intervention to switch to lower carbon sources of electricity (i.e. at off-peak times and when the supply was via local renewable sources).

All trialists shared a desire to save energy, either to reduce their negative impact on the environment, or to save money. However, the trial did not indicate a reduction in overall energy consumption which was likely because the electricity supply was generally surplus to demand, so the intervention did not generate an incentive for trialists to reduce their energy consumption overall. It would be necessary to trial Energy Local at a larger scale (i.e. where electricity demand outweighed supply) to assess whether the dashboard and energy saving tips features are effective in enabling trialists to reduce their energy consumption where there is a real (environmental or financial) need to do so.

Overall, whilst Energy Local did not lower overall electricity consumption of trialists, it was effective in reducing the amount of on-grid (and therefore potentially non-renewable) electricity used and in reducing energy bills in some cases (although this behaviour change may have been driven by the TOUT). It did, however, shift trialists' self-reported behaviours to use energy when locally-produced renewable electricity was available i.e. lower carbon electricity consumption, thus making their energy use more sustainable overall. As an intervention for increasing local energy security (and reducing demand on the grid from that locality), Energy Local worked where the supply of locally-produced energy was greater or equal to the level of demand.

Energy Local was trialled with a limited number of clubs. A larger scale trial (with more clubs and club members), over a longer period of time, would be necessary to more robustly assess impacts on energy consumption, the durability of behaviour change, and the replicability of the Energy Local model in different contexts.

Glossary

ANCOVA	Analysis of Covariance
AQ	Annual Quantity (gas)
ATE	Average Treatment Effect
BAU	Business as Usual
BEAMA	British Electrotechnical and Allied Manufacturers' Association
BEIS	Department for Business, Energy and Industrial Strategy
BIT	Behavioural Insights Team
BST	British Summer Time
CA	Contribution Analysis
CAD	Consumer Access Device
CHP	Combined heat and power
CIC	Community Interest Company
CMO	Context-Mechanism-Outcome
CO2e	Carbon dioxide equivalent
COVID-19	Coronavirus Pandemic
CP	Competition Partner
CRL	Commercial Readiness Level
DCC	Data Communications Company
EAC	Estimated Annual (energy) Consumption
ECA	Energy Consumption Analysis
EL	Energy Local
ELC	Energy Local Club
EPC	Energy Performance Certificate

GDPR	General Data Protection Regulation
GEO	Green Energy Options Ltd.
HAN	Home Area Network
HDD	Heating Degree Day
ICE	Igloo Customer Engine
IDEAS	Intelligent Digital Energy Advisory (SENS project)
IHD	In-Home Display
IMD	Index of Multiple Deprivation
ITT	Intention to Treat
KW	Kilowatts
kWh	Kilowatt-hour
M&MH	Me & My Home profile
MDE	Minimum Detectable Effect
MEETS	More Effective and Efficient Thermal comfort with Smart meter data (SENS project)
MI	Monitoring Information
MOP	Meter Operator
MPAN	Meter Point Administration Number
OLS	Ordinary Least Squares
OWL	An energy monitor that uses a current clamp attached to a meter tail to estimate consumption, sometimes used prior to receiving a smart meter.
PSM	Propensity Score Matching
RCT	Randomised Controlled Trial
SEC	Smart Energy Code
SECAS	Smart Energy Code Administrator and Secretariat

SENS	Smart Energy Savings Competition
SENS GenGame	SENS GenGame Energy Saver app (SENS project)
SEN-ST	Smart Energy-Smart Thermostat (SENS project)
SERL	Smart Energy Research Laboratory, based at University College London
SM	Smart Meter
SMETER	Smart Meter Enabled Thermal Energy Ratings
SMETS	Smart Metering Equipment Technical Specifications
SMETS1	Smart Metering Equipment Technical Specifications - First Generation
SMETS2	Smart Metering Equipment Technical Specifications - Second Generation
SMS	Smart Energy Services
SoLR	Supplier of Last Resort
TDEL	Trial Design and Evaluation Lead
TOT	Treatment on the Treated
TOU	Time of use
TOUT	Time of Use Tariff
TP	Trial Protocol
TRL	Technology Readiness Level
UCL	University College London
WAN	Wide Area Network

Annex A: Analysis of the causal pathways to outcomes

*This annex provides an analysis of the validity of the causal assumptions (presented as the Context-Mechanism-Outcome, CMO statements) underpinning the Theory of Change. The CMO statements were originally set out in Table 5. This discussion presents whether the evidence support*ed *or refute*d *the statements, the strength of the evidence and the implications for understanding the effects and potential outcomes of the Energy Local trial.*

Community pathway

The community pathway hypothesis was comprised of five Context-Mechanism-Outcome (CMO) statements. These CMOs assumed that electricity bill payers within households (i.e. potential trialists) have a strong desire to actively participate in their local community, particularly in hard-to-reach communities where bill payers lack trust in their energy suppliers and in external interventions (context), and that potential trialists would be attracted to the community aspects of SENS Energy Local and would respond by joining and actively participating in the club. The pathway is also based on an assumption that participation in a community energy scheme with locally-generated electricity would help trialists to feel more in control of their energy use and costs. The community aspects of the trial were expected to lead to trialists interacting with the club, the dashboard (and other tools) and each other to share tips and knowledge with each other, resulting in peer-to-peer learning and sustained participation beyond the close of the trial.

Context

The evaluation found good evidence that SENS Energy Local trialists (in both the core and hard-to-reach groups) were motivated to learn about, join, and sustain their interest in the trial because they wanted to be part of a community endeavour and to support a local initiative.

> *"I joined because I want to support anything that redistributes power and gives more voice to the people who are using services." [Energy Local club member, Roupell Park (focus group 1)]*
>
> *"Usually on council estates it's difficult to know your neighbours, so it is great to be involved in community projects and meet familiar faces." [Energy Local club member, Roupell Park (focus group 1)]*
>
> *"The Energy Club seemed to tick all of the boxes. It uses renewable energy and we can see the turbine. That really appealed - having something local. […] It also costs less and eases the environmental guilt you feel, and the money goes back into the local community." [Energy Local club member, Machynlleth]*

> *"We liked the idea of putting money into micro-hydro to begin with the idea of directly benefitting from that. I am anti-nuclear energy. Building big power stations are not the way to go. Lots of local initiatives; I think that's the way to go - local solar, wind etc." [Energy Local club member, Crickhowell]*

The evaluation also found evidence that trialists in the hard-to-reach intervention lacked trust in energy companies prior to the trial, describing their experience with suppliers as 'frustrating', 'time consuming' and constantly 'delayed'.

> *"Big energy companies are impersonal, local is more appealing, you feel part of the community which is important." [Energy Local club member, Roupell Park (focus group 2)]*

The evaluation did not find any evidence of hard-to-reach communities lacking trust in external interventions such as Energy Local, though it did find that some of the trialists in the intervention lacked access to Wi-Fi in the home, which restricted their access to smart meter data and energy monitoring tools (and thus access to energy information).

Mechanism and outcomes

In the qualitative research, trialists indicated that participation in the trial gave them a sense of ownership of a community resource and sense of greater control over their energy supply. There are also strong indications from the research that the community aspect of Energy Local trial made trialists feel committed to the intervention (mechanism), which likely accounted for trialists continuing to participate in the scheme (outcome), even whilst there were waiting times in getting clubs and some technology-driven delays (see sections 2.1.3 and 2.1.4) amongst trialists. There were also strong indications that the community aspect contributed to a higher likelihood of long-term commitment to the intervention (outcome).

> *"Yes I am planning to stay on [with Energy Local after the SENS trial ends]. It is very practical, and you and everyone else benefits, and that will mean more savings and so it makes sense to stay on". [Energy Local club member, Roupell Park (focus group 2)]*

In most cases it was the Energy Local model itself which generated the sense of community and commitment to the intervention, rather than any Energy Local events or other features of the trial. The Energy Local events were not critical to club members feeling part of a community, or that they were contributing to a community endeavour. Indeed, trialists amongst the core intervention had mixed levels of involvement in events. This was likely due to differences in the ways that individual clubs were ran and the extent to which the community was already tight-knit or not, as well as individual circumstances:

> *"[I] didn't feel well enough informed about what was going on, not sure if there is underfunding or if it's the management style in the organisation." [Energy Local club member, Bethesda].*

> *"[I wasn't] aware there [were] any. [I] doubt [that I] would [attend], I can't think of any [activity] that would be appealing." [Energy Local club member, Bethesda]*

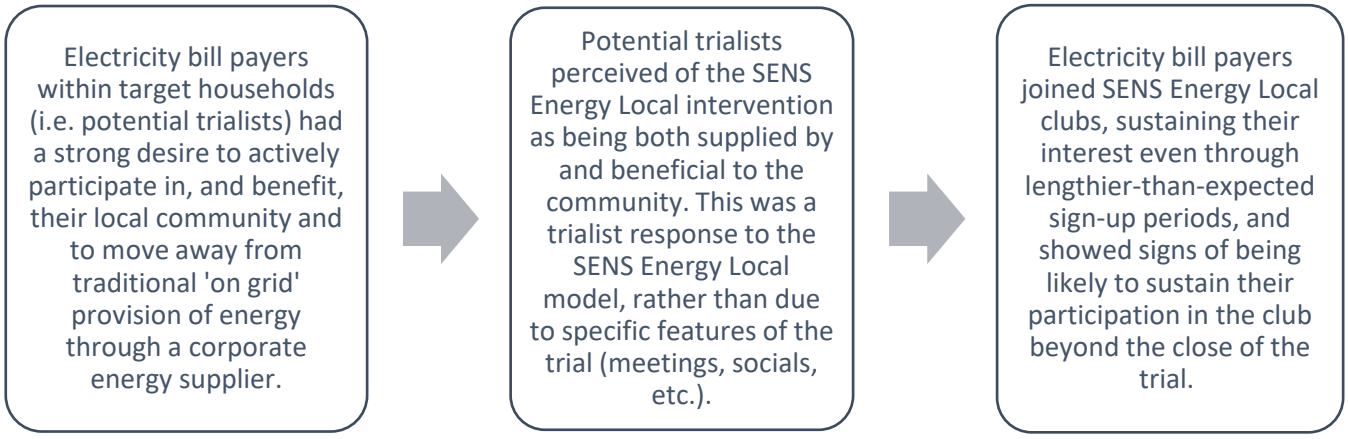
> *"I think I would emphasise the community nature of it. Our energy is linked to a physical sub-main and that defines another community, so I am linked with people I am not normally linked with because of being on the same physical sub-main" […] We have had socials in the past and are planning one fairly soon." [Energy Local club member, Bridport]*

There is little evidence, from the research that the community aspect of the intervention enabled trialists to exchange tips and knowledge with each other resulting in peer-to-peer learning. This is perhaps largely because, due to the social distancing measures in place during the trial period (October 2021 to March 2022), there were limited opportunities for in-person meetings or socialising between club members.

Resulting community pathway

Figure D.1 sets out how the community pathway worked within the SENS Energy Local trial. It was written as a CMO statement about what worked for whom in the trial's context.

Figure D.1: Community pathway CMO statement based on the evidence of the evaluation



Financial pathway

The financial pathway comprised two CMO statements. They reflected the Energy Local design assumptions that electricity bill payers have a desire to save money on their energy bills, but they are unable to make informed decisions around how to reduce costs. They also reflected the assumption that households on lower incomes may be less able to pay for the electricity needed to make their homes comfortable particularly where they are using prepayment electricity meters, or tariffs that unnecessarily raise their energy costs.

Context

The evaluation found evidence of both contexts amongst SENS Energy Local trialists. Several trialists reported that participation in Energy Local improved their knowledge and understanding of the costs of electricity in their homes, though other trialists were already actively monitoring this through their smart meters (where they had these in place). In Roupell Park, whilst some trialists did report that they were on pre-pay meters prior to joining Energy

Local, and some did not have access to Wi-Fi in the home, pre-trial energy costs were not raised as problematic. Indeed, some Roupell Park trialists considered that they did not use much electricity in their home anyway, because they were out working during the day.

Mechanism

There were high levels of interest and satisfaction amongst hard-to-reach trialists consulted where monitoring showed that it would be financially beneficial for them. Additionally, as anticipated in the Theory of Change and CMO statements, trialists who were driven by a desire to save on energy costs responded to the information provided by SENS Energy Local by minimising their use of more expensive electricity (through shifting to use renewable energy when it was available or by reducing their energy consumption in the case of Roupell Park). This was also achieved through the TOUT which prompted trialists to use energy more at off-peak times when it was cheaper.

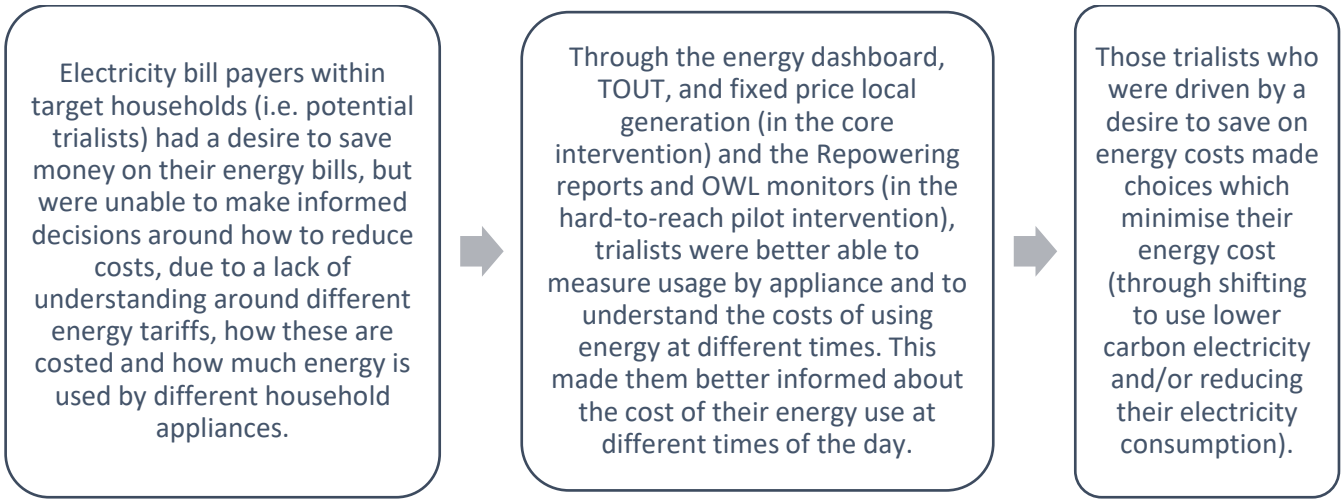
Outcomes

Financial motivations were a key consideration for almost half of survey respondents when joining their Energy Local club. Evidence from the in-depth interviews suggests, however, that in most cases this was secondary to environmental or community-based considerations. Nonetheless, trialists valued the information that Energy Local provided on electricity costs by time of day or appliance and used this to inform their energy use behaviour. As there were some delays to the rollout of the hard-to-reach intervention, it was not possible, within the scope of the evaluation to assess whether any financial savings made through participation contributed to improving the home comfort of these trialists.

Resulting financial pathway

Figure D.2 sets out how the financial pathway worked within the SENS Energy Local trial. It is written as a CMO statement about what worked for whom in the trial's context.

Figure D.2: Financial pathway CMO statement based on the evidence of the evaluation



Environmental pathway

The environmental pathway comprised three CMO statements. They reflect the SENS Energy Local design assumptions that people were aware of the global climate crisis and wished to contribute in a tangible way to reducing environmental impacts, but private development and ownership of local renewable technologies was unaffordable or not feasible for many households (e.g. renters, residents of multi-occupancy buildings). This pathway assumed that households wanted to both switch to renewable sources of energy and reduce their energy consumption overall to benefit the environment. It assumed that, by participating in Energy Local, but – in particular – by using the dashboard, trialists would increase the proportion of locally-generated and renewable energy that they used and would decrease the amount of electricity they used overall.

Context

The majority of SENS Energy Local club members consulted for the evaluation were motivated to join a club because of an awareness and wish to mitigate the global climate crisis. Survey and interview data showed a strong understanding of the global climate crisis matched by a personal desire amongst respondents to contribute to solving this. A significant proportion of SENS Energy Local members already owned renewable technologies prior to joining the scheme. Some trialists had installed insulation and draught-proofing, as well as heat pumps and solar panels prior to joining the scheme. Interviewees who had not been able to install or invest in renewable technologies previously clearly appreciated the opportunities presented by Energy Local to directly participate in a local renewable energy project. This suggested that, as the model is rolled out beyond those who are already highly engaged, the weight of evidence to support this CMO statement may increase.

Mechanism

The fact that Energy Local provided a route to ‘using’ local renewable energy generation was clearly a key motivator for trialists to join. In the baseline survey, 24 out of 52 respondents stated that they joined because it was based on renewable energy and 21 stated that the ‘community initiative’ factor motivated them to join, whilst only 13 responded that reducing energy use had been a motivating factor.

By design, Energy Local was intended to enable trialists to view their electricity use and forecast when the cheapest energy would be available through the dashboard, but the qualitative research showed that trialists interaction with it was mixed and many trialists had a less-than-positive experience of the dashboard or didn’t find it useful.

> *“It's not always online and it's not always up to date.” [Energy Local Club, Bethesda]*

> *“Not that accessible so don’t use it that often as have to open the app on a laptop and take the time to use it.” [Energy Local Club, Bethesda]*

Participants who checked their dashboard most frequently were often those who wanted to optimise their energy bill by making the most of the TOUTs and/ or the renewable energy

produced by their club. They found the forecasting function of the dashboard particularly useful.

> *"I check the dashboard most days, quite often to see if there's a likelihood that we won't get any hydro" [Energy Local Club, Machynlleth]*
>
> *"[We] log in every day – especially if there's a dry spell, [as we] need to know when [we] can use it." [Energy Local Club, Corwen]*
>
> *"[I check the dashboard] once a day on average, when using the oven or washing machine […]. I use [the dashboard] more to find out the best times to use energy. I have 6 different rates and look the dashboard to see when 'smiley faces' come up" [Energy Local Club, Bethesda]*

Where trialists wanted access to real-time information about whether the local generator was producing energy at that time or not, there was frustration amongst a small number of trialists that this information was not provided[22].

> *"There is a delay of information. For example, [we were] in the middle of storm Eunice with rain for three days and [we were] being told [that we would not] be on the hydro" [Energy Local Club, Corwen]*
>
> *"Hydro data [gets] lost or [is] not showing. There seems to be a gap between app and real generator down time." [Energy Local Club, Machynlleth]*

Some participants used the dashboard as a background tool, checking it out of curiosity or for long term monitoring rather than to optimise their energy use, several participants progressively checked their dashboard less and less regularly as novelty wore off.

> *"[We check it] monthly, maybe a bit more but not much. We're happy with the prices so we don't feel the need to check regularly. […] There is a pie chart showing the proportion of hydro and the different price ranges. It's interesting to see how it alters according to rainfall. We don't use it to look at renewable generation though." [Energy Local Club, Bethesda]*
>
> *"[We] check it less now, because [our] usage doesn't change too much. [We] will probably check more in future. [Energy Local Club, Crickhowell]*
>
> *"[I used it] more at the beginning as I was intrigued, but now it's more of a comfortable background tool. I don't need mine too much now." [Energy Local Club, Bridport]*

Some considered the dashboard's interface and data presented overly complicated. One of the participants who did not use the dashboard at all stressed that he/ she would have liked to have a face-to-face session to learn how it worked, which did not happen because of COVID-19, and another club member referred to an idea they were hoping to trial to have 'tech buddies' explain to less technologically literate trialists.

Outcomes

[22] There was currently no system set up via Data Controller to access real time generation data (instead with a time lag of approximately one day).

As set out in chapters 4 and 5, there was convincing evidence from the qualitative research that the core intervention contributed to trialists shifting to user lower carbon electricity and, through this, to energy bill savings. There was weaker evidence that the hard-to-reach intervention contributed to Roupell Park trialists shifting to more energy efficient behaviours that might be expected to lead to a reduction in electricity consumption.

Resulting environmental pathways

Figures D.3 and D.4 set out how the environmental pathway worked within the SENS Energy Local trial for the core and hard-to-reach interventions respectively.

Figure D. 3: Environmental pathway CMO statement 1 – core intervention

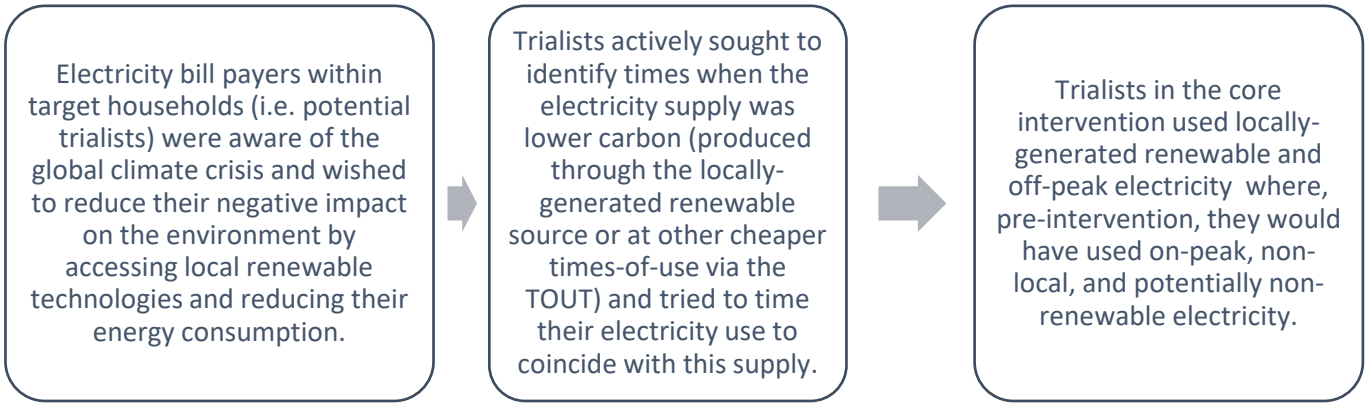
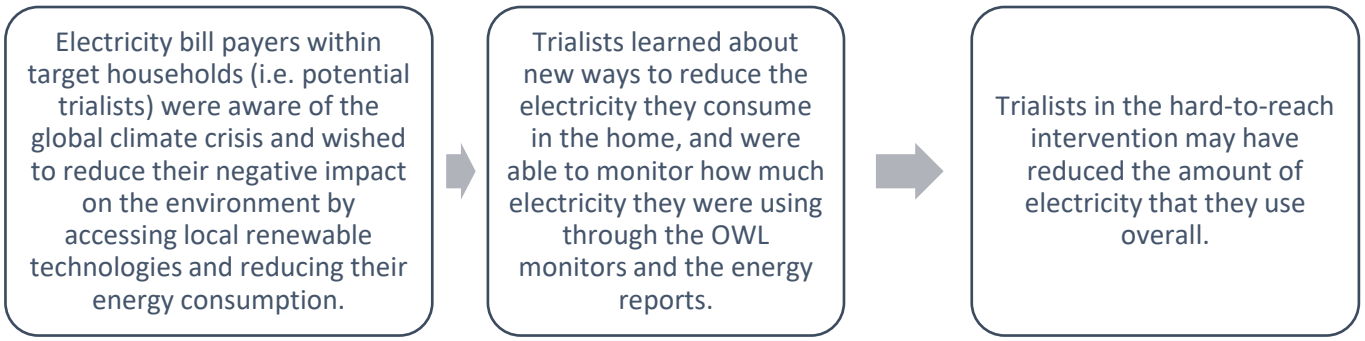


Figure D.4: Environmental pathway CMO statement 2 – hard-to-reach intervention

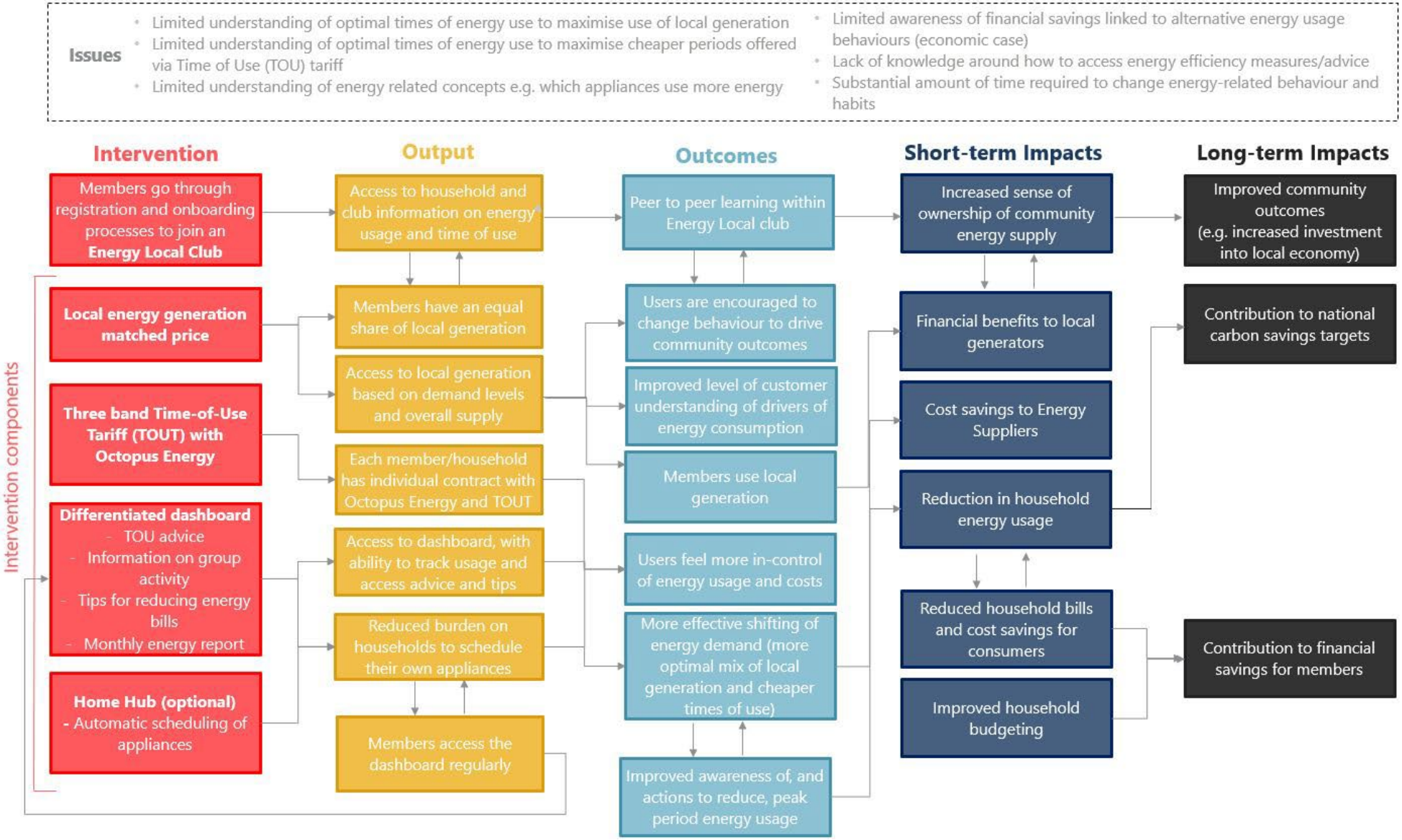


Annex B: Theory of Change

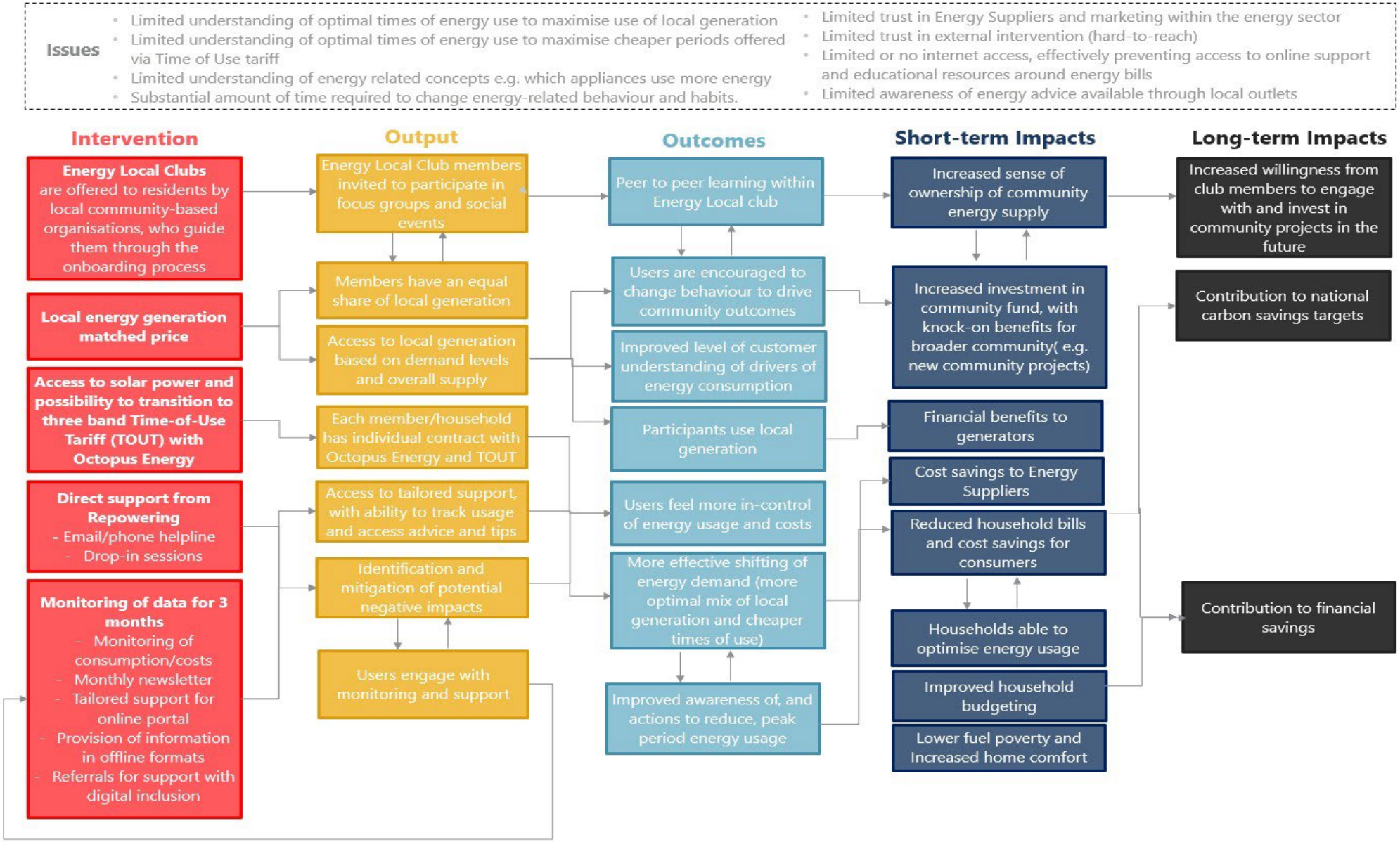
This section presents the Energy Local Theory of Change. which sets out the issues the intervention was trying to address, the core components of the intervention itself, the outputs it was expected to deliver, the outcomes to achieve, and ultimately, the impacts of the intervention.

For the Energy Local intervention, two slightly different Theories of Change exist – one for the core intervention and one for the hard-to-reach intervention.

Core intervention



Hard-to-reach intervention



Annex C: Trial sample development

This section presents information on the number of trialists included in the trial at different stages and for different aspects of the evaluation (energy consumption analysis, survey and qualitative data collection).

Table C.1: SENS Energy Local trial sample overview and development

Milestone / stage / sample		Number / Count (specify unit)	Date (where applicable, and including start and end date as needed)
Number of households / customers contacted to participate in trial (total)		205	January 2020 - November 2021
Number of households / customers that agreed to participate in SENS Energy Local Trial	Treatment	121	January 2020 - November 2021
	Control	N/A	
Number of households / customers providing consents to be contacted for TDEL research	Treatment	120	January 2020 – November 2021
	Control	N/A	
Number of withdrawals	Change of tenancy	2	March 2022

	Withdrawal of consent	0	
	On hold	7	
Final achieved sample (sample at the end of the trial period, accounting for churn of trialists)	Treatment	112	N/A
	Control	N/A	N/A
Number of households / customers providing consent for collection/ provision of energy consumption data via SERL	Treatment	92	January 2020 - November 2021
	Control	N/A	
Final achieved sample (retained in SERL)	Treatment	83	N/A
	Control	N/A	N/A
Number of households excluded and reasons	Missing data (did not have at least 50% of readings during the analysis months)	29	N/A
	Treatment	54	N/A

Final achieved sample for quantitative energy consumption analysis (i.e. less records excluded for e.g. missing data)	Control	N/A	N/A
Baseline survey issued / response rate	No. of contacts available to be contacted	88	June 2021 – December 2021
	No. of completed interviews	52	
	Completion rate	59%	
Endline survey issued / response rate	No. of contacts available to be contacted	49	March 2022
	No. of completed interviews	26	
	Completion rate	53%	
Number of qualitative interviews with trialists completed		30	December 2021 – March 2022

Number of focus group participants reached (with Roupell Park trialists)	8 [across 2 focus groups]	September 2021 – March 2022
Number of qualitative interviews with club advisors completed	4	December 2021 – March 2022
Number of focus groups conducted with club boards	3	December 2021 – March 2022

This publication is available from: www.gov.uk/government/publications/smart-energy-savings-sens-competition-evaluation

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